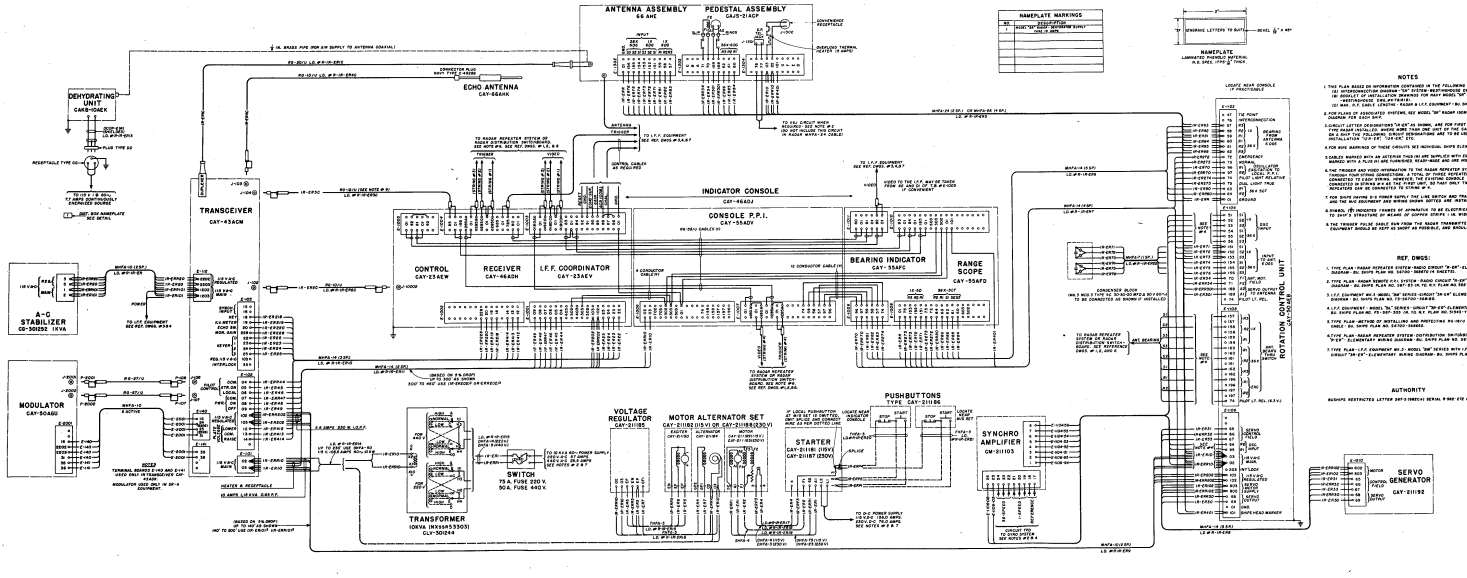
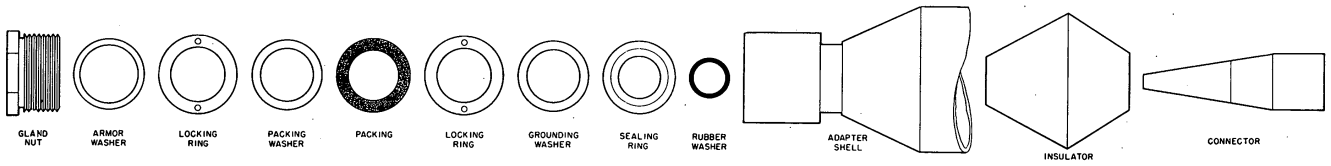
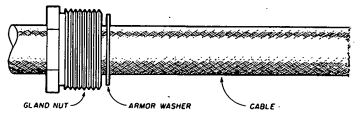


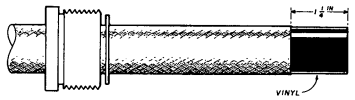
Figure 3-25. Master Interconnection Diagram

Figure 3-25. Master Interconnection Diagram

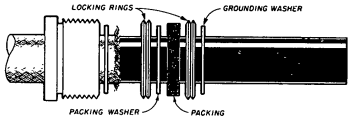




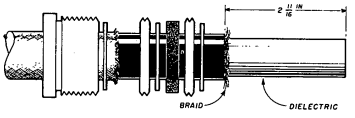
① PLACE GLAND NUT AND ARMOR WASHER ON CABLE.



② CUT OFF ARMOR APPROXIMATELY 1 1/4 INCHES AS SHOWN.



③ PUSH ARMOR, GLAND NUT, ARMOR WASHER BACK OUT OF WAY. PLACE LOCKING RING, PACKING WASHER, PACKING, ANOTHER LOCKING RING AND GROUNDING WASHER ON VINYL.



④ CUT VINYL INSULATION BACK 2 11/16 INCHES AS SHOWN, AND FAN BACK BRAID, EXPOSING DIELECTRIC.

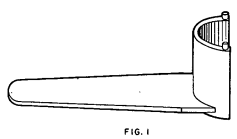
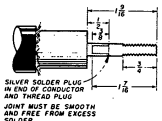
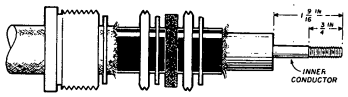


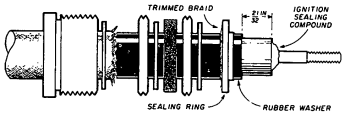
FIG. 1
DWG. 7416391

5g REFER TO FIG. 5
IF INNER CONDUCTOR IS HOLLOW, ALTER AS FOLLOWS TO ALLOW INNER CONDUCTOR TO BE THREADED.

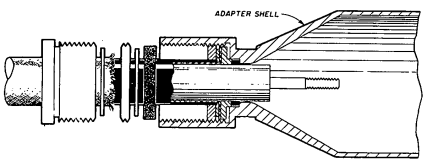




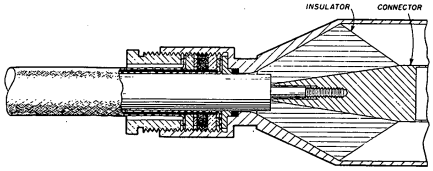
⑤ CUT THRU DIELECTRIC TO INNER CONDUCTOR 1 5/16 INCHES FROM END. USING 1/4 - 20 DIE, THREAD INNER CONDUCTOR FOR LENGTH OF 3/4 INCH AS SHOWN. CLEAN THREADED END THOROUGHLY.
SEE FIG. 5g FOR HOLLOW INNER CONDUCTOR



⑥ PLACE SEALING RING, AND STRETCH RUBBER WASHER OVER DIELECTRIC TO DIMENSION SHOWN, THEN TRIM BRAID TO DIAMETER OF SEALING RING. APPLY DOW CORNING IGNITION SEALING COMPOUND TO END OF DIELECTRIC.



⑦ INSERT END OF CABLE INTO REDUCER ADAPTER. PLACE GROUNDING WASHER NEXT TO BRAID, THEN SCREW LOCKING RING AGAINST WASHER, BUT NOT TIGHT. APPLY SEALING COMPOUND TO INNER SURFACE OF INSULATOR AND S-ROUND PORTION OF CONNECTOR WHICH FITS INTO INSULATOR.



⑧ BUTT THE POLYETHYLENE INSULATOR OVER THE END OF THE DIELECTRIC, AND SCREW CONNECTOR ONTO THE THREADED END OF INNER CONDUCTOR UNTIL TIGHT. TIGHTEN LOCKING RING FOR THE BRAID, USING SPANNER WRENCH SHOWN IN FIG. 1. PUSH IN PACKING AND HEAT WASHER DOWN THRU THREADED PART OF ADAPTER. DRAW UP NEXT LOCKING RING SO AS TO SPREAD THE PACKING. FLARE OUT ARMOR AGAINST LOCKING RING. SLIDE LAST WASHER AGAINST FLARED ARMOR, AND SECURE BY TIGHTENING GLAND NUT.

Figure 3-26. R.F. Cable, Type RG-20/U, Assembly Diagram

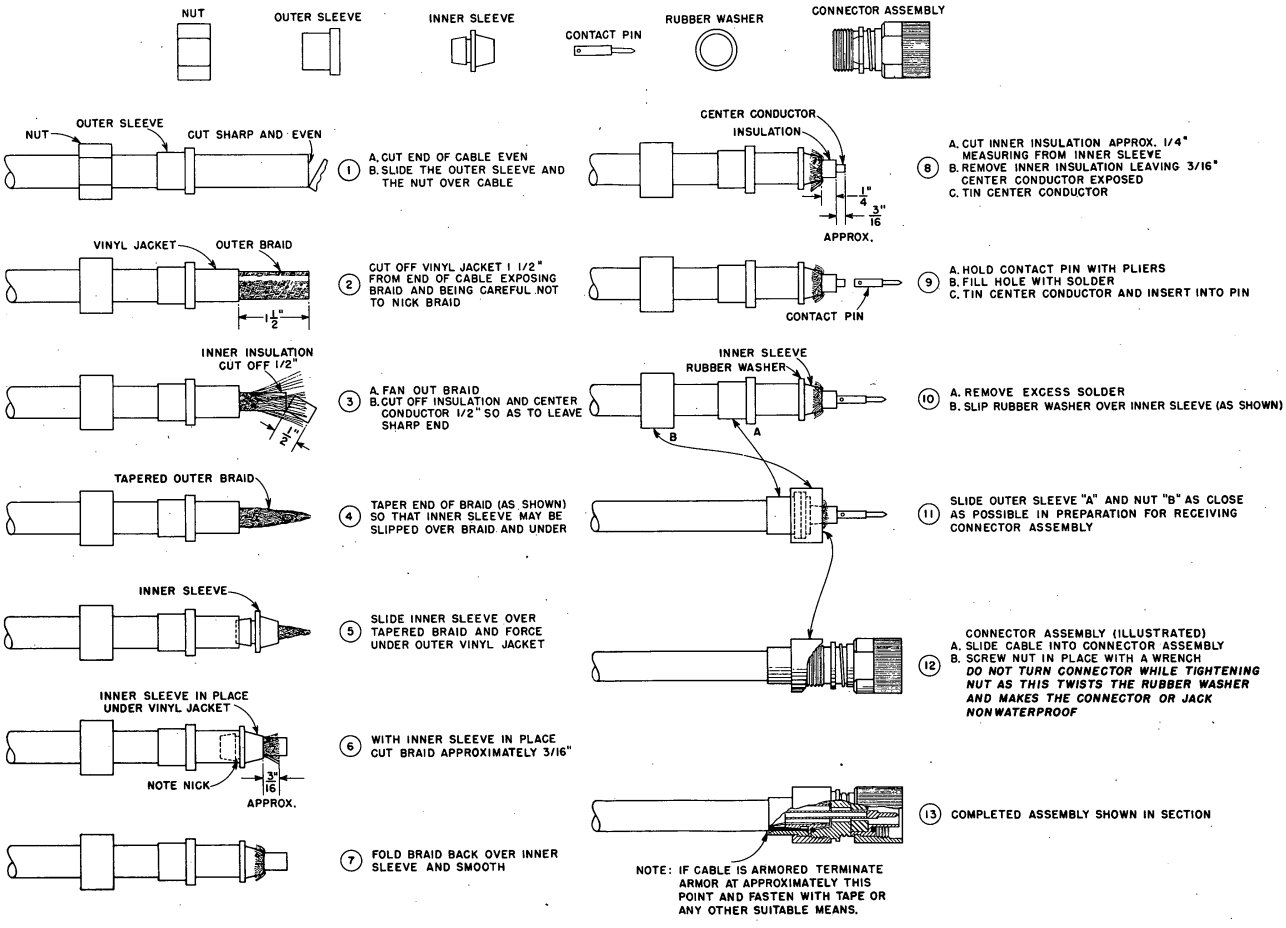


Figure 3-27. R.F. Connector, Type UG-21/U Assembly to R.F. Cable, Type RG-10/U or RG-12/U

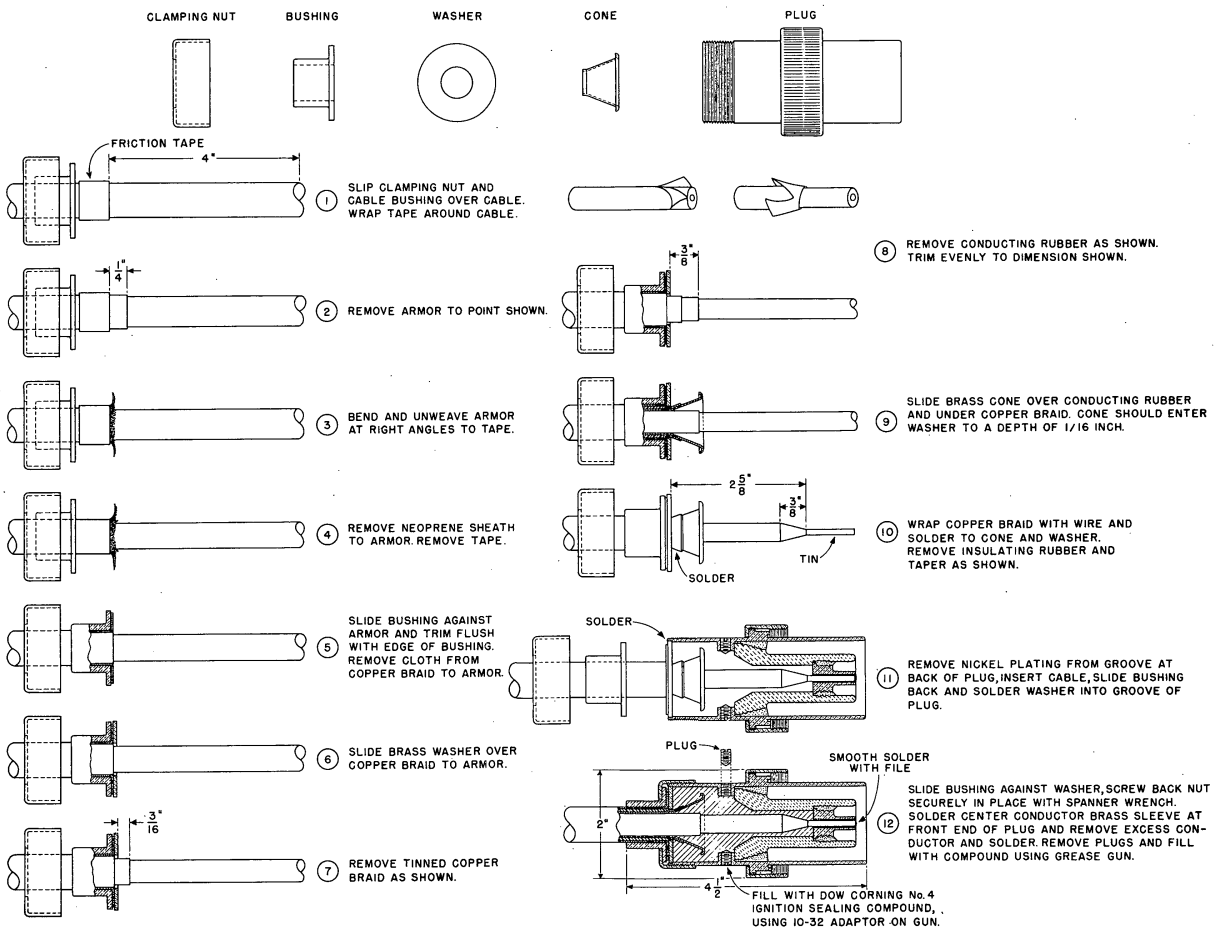


Figure 3-28. R.F. Connector, Type UG-36/U Assembly to R.F. Cable, Type RG-27/U

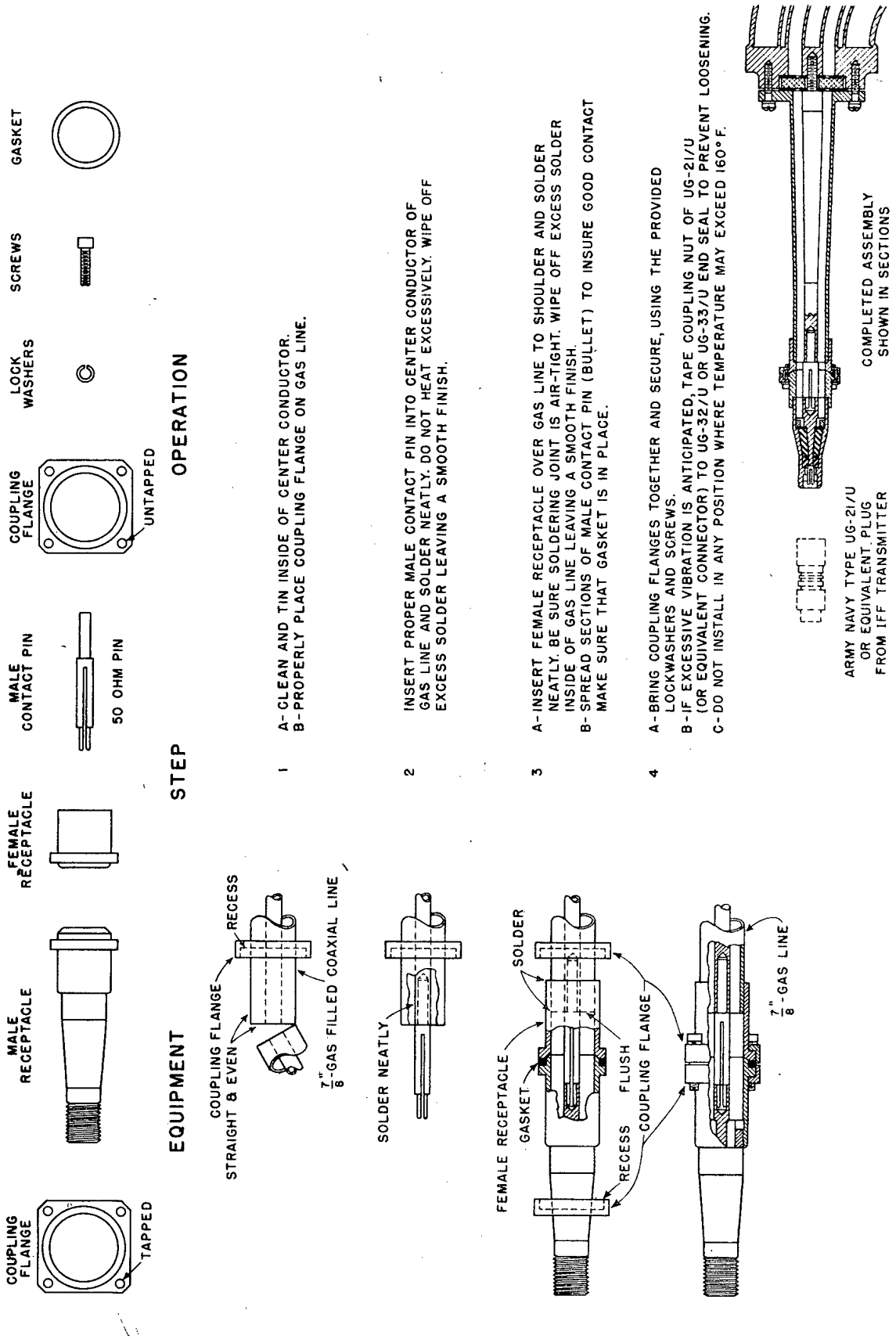


Figure 3-29. R.F. Connector, Type UG-32/U Assembly to IFF Transmission Line

Figure 3-29. R.F. Connector, Type UG-32/U Assembly to IFF Transmission Line

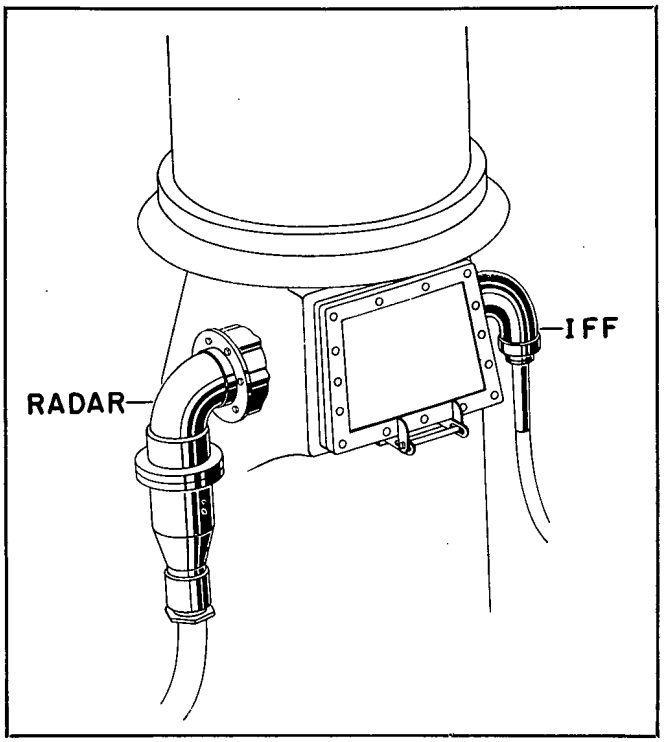


Figure 3-30. Pedestal Connection of IFF and Radar Transmission Cables

(2) Three low power r-f cables connect to the Transceiver. They are used to conduct i-f energy from the Monitor Receiver to the Console Receiver; to conduct r-f energy from the Echo Box Antenna to the Echo Box; and to conduct the Sync pulse from the Transceiver to the Indicator Console. These cables connect to three type UG-22/U jacks located on a panel behind the door in the lower left-hand corner of the Unit. These cables are brought into the terminal compartment of the Transceiver through an access hole provided in the floor of the unit, adjacent to the terminal area. The method of connecting the UG-21/U connectors to the type RG-10/U or RG-12/U coaxial cables is shown in Fig. 3-27.

(3) Several a-c cables are brought into the Transceiver. They provide power to the Transceiver, and also operate circuits in the other units which are controlled from the Transceiver. See Fig. 3-25. The wires of these cables are connected to the terminal blocks in the compartment behind the door in the lower left-hand corner of the unit. The cables are brought into the Transceiver through the same access hole as in the case of the lower power r-f cables. Soldering lugs should be fastened to each wire of the cables.

(4) If the Keyer unit is being used with the SR Transceiver, the foregoing three paragraphs have considered all the connections to the Transceiver. If, the equipment has been modified into the SR-a by the addition of the Modulator, it will be necessary to make three additional connections to the Transceiver. These connections consist of two high-voltage pulse cables and one low-voltage a-c cable. The pulse cables are each made of type RG-27/U armored coaxial cable. The two ends of each cable are terminated in type UG-36/U connectors. The connectors on the pulse lines are fastened to the connectors on the terminal panel located in what was originally the Keyer compartment of the Transceiver. This terminal panel was installed when the equipment was converted from the SR to the SR-a, as was described in previous paragraphs of this section. Access to the terminal panel is gained through a rectangular opening cut in the right-hand shield of the Transceiver, adjacent to the keyer compartment. In order to install the Modulator a-c cable to the terminal panel in the Transceiver, it is necessary to drill a hole in the vertical side member of the terminal panel, of the proper diameter to hold a stuffing tube, through which the cable should be inserted. The stuffing tube, when tightened, will prevent a strain being placed upon the terminals. The pulse cables, a-c cable, and stuffing tube are shown in Fig. 3-1. The method of connecting the type UG-36/U connectors to the type RG-27/U armored cable is shown in Fig. 3-28. Soldering lugs should be placed on all low voltage a-c wires.

c. MODULATOR.

(1) The Transceiver end of the connections between the Transceiver and the Modulator have been discussed in the previous paragraph. The junction box of the Modulator is installed on the upper left end of the unit. It may be installed with the connectors facing either up or down, as may be desired when running the interconnection cables. The connectors are to be installed on the cable as described in the previous paragraph. To fasten them to the connectors in the junction box of the Modulator it is only necessary to place the two together and tighten the retaining nut. It is necessary to drill a hole in the junction box and install a stuffing tube through which the a-c cable may enter the Modulator. The location of this stuffing tube may be any place in the junction box on the opposite side of the red line from the armored high voltage leads.

d. INDICATOR CONSOLE.

(1) The cables from the Transmitter and Rotation Control Unit as well as the a-c line and the connections to the other components of the radar equipment, may be brought into the Indicator Console in a number of different ways. Junction boxes are provided which may be mounted on the back of the equipment or on the sides. Five separate positions are provided for the junction boxes. They may be on either side of the Console, or on the back of either of the three cabinets. Three junction boxes are provided, and six cover plates are supplied to close up the holes not being used in the event the three units are installed separately. The Console is delivered with

the three junction boxes mounted in the rear, a cover plate on each side and the other four cover plates packed separately.

(2) Locate the junction boxes at points most convenient for the particular installation. These locations depend upon the location of the cables from the radar equipment. Also, the installation crew should take into consideration that the cables must be installed so as to allow a loop to permit freedom of movement on the rubber shockmounts. Drill or punch the holes in the junction boxes for the stuffing tubes which bring in the armored cables. Loop the armored cables up to the junction box if at all possible. This loop is provided to prevent the cable from breaking under vibration and shock. Bring the cable only as far as the junction box. Then feed the free ends of the wires into the top of the cases through the oval-shaped slots. Connect the wires according to the connection diagram in Fig. 3-25. Cut off the wire ends to appropriate lengths. Solder terminals on the wires and connect them to their respective points on the terminal boards. Since the Indicator Console is supplied as a unit by the manufacturer, the diagrams showing interconnection between the three units of the Console are not necessary in the installation of the Console.

(3) It is necessary to terminate both the video and the trigger lines in a resistance of 68 ohms. When only the Console PPI Indicator is used, the method of accomplishing the proper termination will be as described in this paragraph. If remote indicators are used in addition to the Console PPI, they should be connected as described in Par. 16r of this section. If no remote indicators are used, connect terminals 285D and 285C to 01, on terminal board E-1004 in the top of the lefthand frame above the Console Receiver. Place switch S-1008, in its TERMINATE position. This switch is located in the top of the center frame above the PPI Indicator. This connection will terminate both the video and trigger lines in the proper impedance.

e. ANTENNA AND ANTENNA PEDESTAL.

(1) Three types of connections are made to the Antenna Pedestal. They are the cable from the radar Transmitter, the cable from the IFF Transmitter; and the connections for controlling rotation of the Antenna. The connector on the Antenna end of the cable from the Transceiver is equipped with the same type of connector used on the Transceiver end of the cable. The Pedestal connector into which the cable connector fits is the same type as the one on the duplexer of the Transceiver. The connection at the Pedestal end of the cable is made in the way described for the duplexer in the Transceiver. Push the cable connector into the Pedestal connector, and secure it by means of two machine screws, which fit into tapped holes in the Pedestal connector.

(2) The connection of the type RG-10/U transmission line from the IFF transmitter to the IFF coaxial line of the Antenna Pedestal is made through the use of a type UG-32/U connector. Fasten the connector to the IFF coaxial line in the Pedestal as shown in Fig. 3-29. After the type UG-32/U connector has been fastened to the coaxial line, it is necessary to screw the plug on the end of the IFF Transmission line to the threaded jack on the end of the UG-32/U connector. The plug on the end of the IFF transmission line will be a type UG-21/U or its equivalent.

(3) The circuits which control the rotation of the Antenna are brought into the Pedestal through the power inlet entrance adjacent to the radar cable elbow connector. Install a stuffing tube in the opening shown. Some of the Pedestals were tapped at the factory to accommodate the stuffing tube. If the Pedestal being installed is not tapped, it will be necessary to do so before the stuffing tube can be installed. Fasten soldering lugs on the wires of the cable and connect to the appropriate terminals of the terminal panel, located behind the terminal panel access door. These terminals are shown in Fig. 3-25.

f. ECHO BOX ANTENNA.

(1) A type RG-10/U coaxial cable is used as the transmission line between the Echo Box Antenna and the Transceiver. The same type of connector is used at both ends of the cable. This connector is a type UG-21/U, and it should be fastened to the cable as directed in Fig. 3-27. The transmission cable should be firmly clamped to some rigid support at frequent intervals in order to prevent damage to the cable.

g. SYNCHRO AMPLIFIER.

(1) The method of interconnection between the two units of the Synchro Amplifier is shown in Fig. 3-25. Connections are made to the Synchro Unit through five stuffing tubes which are located on the walls of the terminal compartment at the top of the unit, as it is mounted on the bulkhead. Connections to the Electronic Unit are made through one stuffing tube, which may be located on either of three sides of the amplifier case. The unused openings on the two sides not used for the stuffing tube are closed with plates provided for that purpose.

(2) Three connections are made to the Synchro Unit. One of these brings information to the unit from the ship's gyro-compass. The second interconnects the Electronic Unit with the Synchro Unit, and the third conducts relayed compass data from the Synchro Amplifier to the components of the SR system. Bring the cables into the most convenient of the five available stuffing tubes of the Synchro Unit. In order to gain access to the terminal boards, loosen the screws holding the cover of the terminal compartment and swing the cover back. Remove the armor from the connecting cables and make connections as

required to the terminals. Use soldering lugs on the wires of the cables for connection to the terminals. To gain access to the terminals of the Electronic Unit, remove the screws holding the cover of the unit, and swing open the hinged door. The terminal strip is located on the wall of the unit adjacent to the cover hinge. Remove the armor of the cable and make connections as in the case of the Electronic Unit.

(3) Care should be taken during installation not to expose the mechanism of the Synchro Unit to dust or dirt. A tray is provided in the bottom of the terminal compartment to prevent insulation chips from the cables from falling into the mechanism. Remove these chips after the cable connections have been completed.

NOTE

DO NOT CONNECT TO THE SYNCHRO AMPLIFIER EITHER SYNCHRO DIFFERENTIALS OR CONTROL TRANSFORMERS UNLESS THEY HAVE BEEN COMPENSATED WITH THE PROPER VALUE OF CAPACITORS. NEGLECT OF THIS PRECAUTION MAY CAUSE INACCURACY IN THE SYNCHRO AMPLIFIER.

h. ROTATION CONTROL UNIT.

(1) Connections are brought into the Rotation Control Unit through a junction box of the same type as the ones used on the Indicator Console. This box may be located on the back of the case or on either side, depending upon which is the most convenient. Plates are provided for covering the entrance holes in the case on the two sides not used for the junction box. The armored cable may be brought into the junction box from the top, bottom, or either side. Select the proper location for the entering cables, and drill holes for stuffing tubes. Remove the armor from the cables at the junction box and allow three feet of wire for connection to the terminal boards on the top of the case. Use soldering lugs on the ends of all wires. When installing, leave sufficient slack in the cables to permit the unit to move on its shockmount. The connections to the terminal boards are shown in Fig. 3-25.

i. SERVO GENERATOR.

(1) Connections to the Servo Generator are made on a terminal board located on the right side of the unit, facing the motor. The terminal board is protected by a metal cover retained by six screws. This cover may be removed to permit access to the terminals. Install a stuffing tube in the tapped hole in the end of the casting which supports the protective cover. Bring the cable into the compartment through the stuffing tube, remove the armor, and connect the wires to the terminals by means of soldering lugs. See Fig. 3-25.

j. VOLTAGE STABILIZER.

(1) Access to the terminals of the Voltage Stabilizer is gained through a removable plate screwed to the top of the case. Two knockout openings are provided in the end of the case adjacent to the terminals. Select either of these holes, depending upon which is most conveniently located to the cable which must be brought to the terminals. Install a stuffing tube and bring the cable into the case. Remove the armor, and connect the wires to the terminals, using soldering lugs. The connections are shown in Fig. 3-25.

k. MOTOR GENERATOR.

(1) Conduit boxes are provided on the motor, generator, and exciter for connection to the SR system. The boxes on the exciter and generator are provided with knockout openings for the entrance of the cables. Holes for stuffing tubes on the box on the motor must be drilled by the customer. Connection to the centrifugal switch on the shaft of the motor is made through holes in its case. Select the proper holes in each case, and install stuffing tubes. Make all connections by soldering terminals of sufficient current-carrying capacity to the wires of the cables. See Fig. 3-25.

l. VOLTAGE REGULATOR.

(1) To bring the connecting cables into the Voltage Regulator, drill holes and install stuffing tubes in the removable plate covering the opening in the top of the case. Bring the cables into the unit, and connect the wires to the terminal board adjacent to the opening in the top. The connections are shown in Fig. 3-25.

m. MAGNETIC CONTROLLER.

(1) Connections are made to the Magnetic Controller through metal plates covering openings in both the top and bottom of the case. Drill holes in the plates and install stuffing tubes as required. When making connections, be certain that terminals with sufficient current-carrying capacity are soldered to the wires. See Fig. 3-25 for the necessary wiring information.

n. PUSHBUTTON STATION.

(1) Remove the front cover plate of this unit to expose the terminals, and install a stuffing tube in the hole on each end of the unit. Bring the cables into each end of the unit, and connect as required, using soldering lugs on the wires of the cables. See Fig. 3-25.

o. CONTROLLER DISCONNECT LINE SWITCH.

(1) Install stuffing tubes in the top and bottom of this unit as required, and bring the cables inside the case. Connect the wires of the cables to the terminals, making certain that terminals of sufficient current-carrying capacity are used on the wires of the cables.

p. CONNECTIONS TO IFF SYSTEM.

(1) The connections to the IFF equipment associated with the SR system are made to terminal boards located in the top of the left-hand case of the Indicator Console. Cables for the control circuits are connected

to terminal board E-1003; that for the trigger pulse to the IFF transmitter is connected to E-1004. The type of cables to be used is as specified in the installation instructions of the particular IFF equipment.

q. IFF VIDEO TO REMOTE PPI INDICATORS.

(1) The Indicator Console is interconnected before delivery so that IFF indications will appear on the Range Scope only. The diagrams show this type of connection. Should IFF video responses be desired on the PPI indicators, place a jumper across both terminals 82 on terminal board E-1005.

r. CONNECTION OF REMOTE PPI INDICATORS.

(1) Provisions are made in the Indicator Console for supplying a trigger pulse and video signals to four chains of remotely located PPI units. These two signals are supplied to the remote indicators from the terminal boards in the top of the left hand case in the Console. Synchro data and synchro excitation voltage for the synchro system in the remote units are supplied directly from the Rotation Control Unit. The PPI Scope in the Console is connected similarly to the remote indicators. However, its synchro data does not go through the remote disconnect switch on the Rotation Control Unit. As a result, the PPI Scope in the Console will not be cut off from the synchro line when the synchro circuit to the remote PPI indicators is opened by the remote disconnect switch.

(2) The primary source of the 1-speed synchro data signal is at terminals 57, 58 and 59. These terminals are connected to similarly numbered terminals on the PPI Scope. Terminals 96 and 97 carry O.S.C. excitation. Wire 74 conveys the relative bearing indicator light information. All of these wires are connected from the Rotation Control Unit to the PPI Scope through the Bearing Indicator.

(3) Inside the Rotation Control Unit, the wires to 57, 58, 59, 96 and 97 are connected through the remote disconnect switch to become 157, 158, 159, 196 and 197. When the disconnect switch is closed, the information becomes the same on both sets of terminals. When the switch is open, no voltage exists on terminals 157, 158, 159, 196 and 197. Adjacent sets of terminals bear the same number in the Rotation Control Unit. They are connected in parallel inside the unit. There will be two 157's, two 158's, etc. By connecting two wires to each of the two similar terminals, it will be possible to connect four lines to the terminals for supplying four groups of remote PPI indicators. It is permissible to connect three remote PPI units to each of these four lines, making a total of twelve remote units in all. The PPI Indicator in the Console must be included in the total of 12 PPI units.

(4) A similar set of 36-speed synchro data terminals are provided. These are 160, 161, and 162 for the data voltages and 196 and 197 for the O.S.C. excitation. These wires have also passed through the remote disconnect switch. By doubling up on these terminals, four lines may be connected to them also, with a limitation of three indicators per line. Accordingly, it is possible to supply voltages for twelve indicators requiring 1-speed data, twelve indicators requiring 36-speed data, or twelve indicators requiring a combination of both. This includes the requirements of the PPI Indicator in the Console.

(5) Four channels are provided for the video signals. Each of these is supplied by one of the cathode followers in the Console Receiver. These outputs appear on the 180 series of terminals in the left-hand Console Unit. Terminal 180A is the output of the first cathode follower and it is connected directly to the video input to the PPI Indicator in the Console Receiver. The equipment is designed to handle three remote PPI units on each of the four outputs, 180A, 180B, 180C and 180D. It must be remembered that one of these outputs is already in use by the PPI Indicator in the Console. When using this output only two additional units may be placed on this line. Convenient parallel terminations on the PPI scope are included to make these connections possible.

(6) In a similar manner, 285A is the terminal on the PPI frame from which the trigger pulse is obtained for the first chain of indicators. The PPI Indicator in the Console is connected to it. From there, two additional remote units may be coupled in parallel with the Console PPI. Three or less units in parallel may also be connected to each of the terminals 285B, 285C, and 285D.

(7) To summarize, a total of eleven remote indicators in addition to the Console PPI Indicator, may be connected to the SR system. The video signal for each of these indicators is obtained from the 180 series of terminals; the trigger signal is obtained from the 285 series of terminals. A total of three indicators may be connected in parallel to the "A" branch of trigger and video lines; three to the "B" branch, three to the "C" branch, and three to the "D" branch.

(8) In order to properly terminate the video and trigger lines, two procedures are necessary. These involve the BRIDGE-TERMINATE switches on the remote indicators, and the connections to terminal board E-1003 in the Indicator Console Case. First, make the connections required at terminal board E-1003 as shown in Fig. 3-31. Two additional indicators may be connected to the same branch of trigger and video circuits with the PPI Indicator in the Console. To properly terminate the lines under this condition, change the BRIDGE-TERMINATE switch on the Console PPI from the TERMINATE position to the BRIDGE position. If a second branch of trigger and video circuits is used; that is, if from four to six indicators in all are connected, connections will be

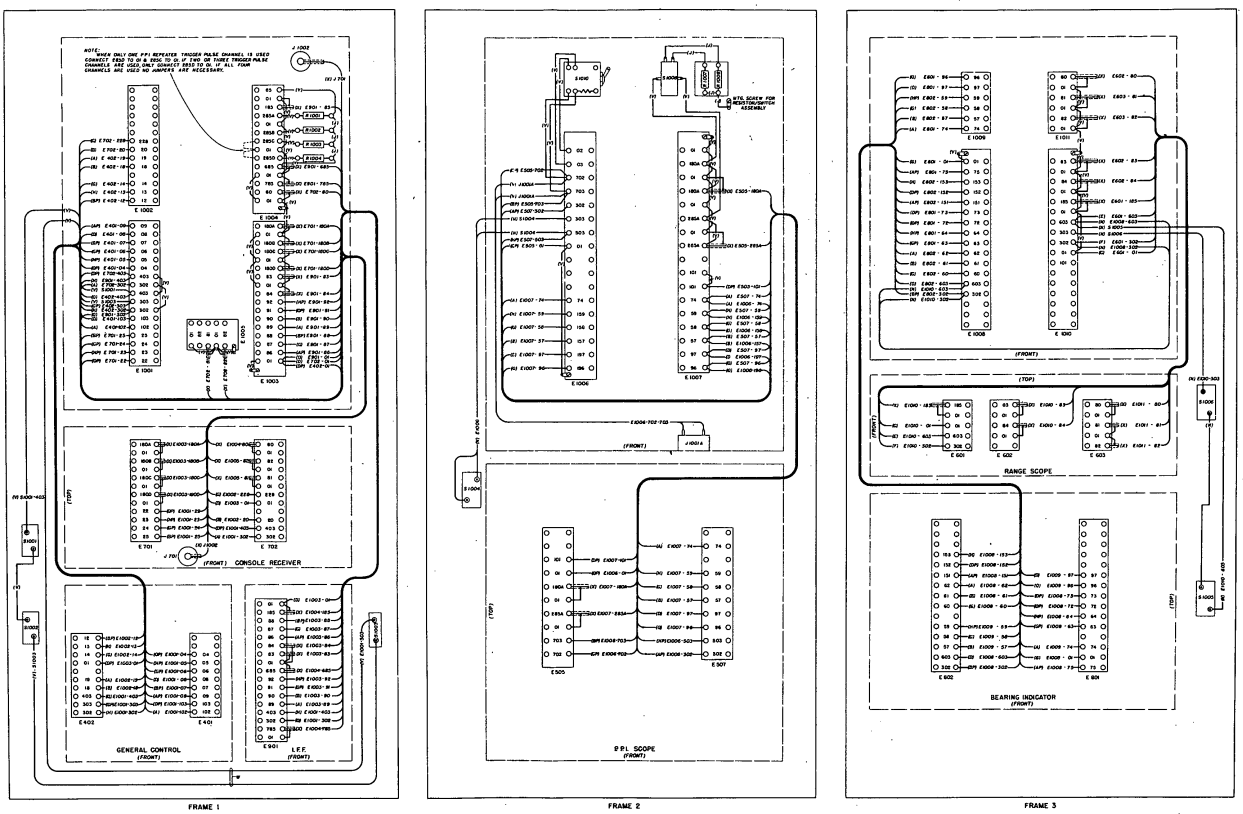


Figure 3-31. Indicator Console, Frame Wiring Diagram

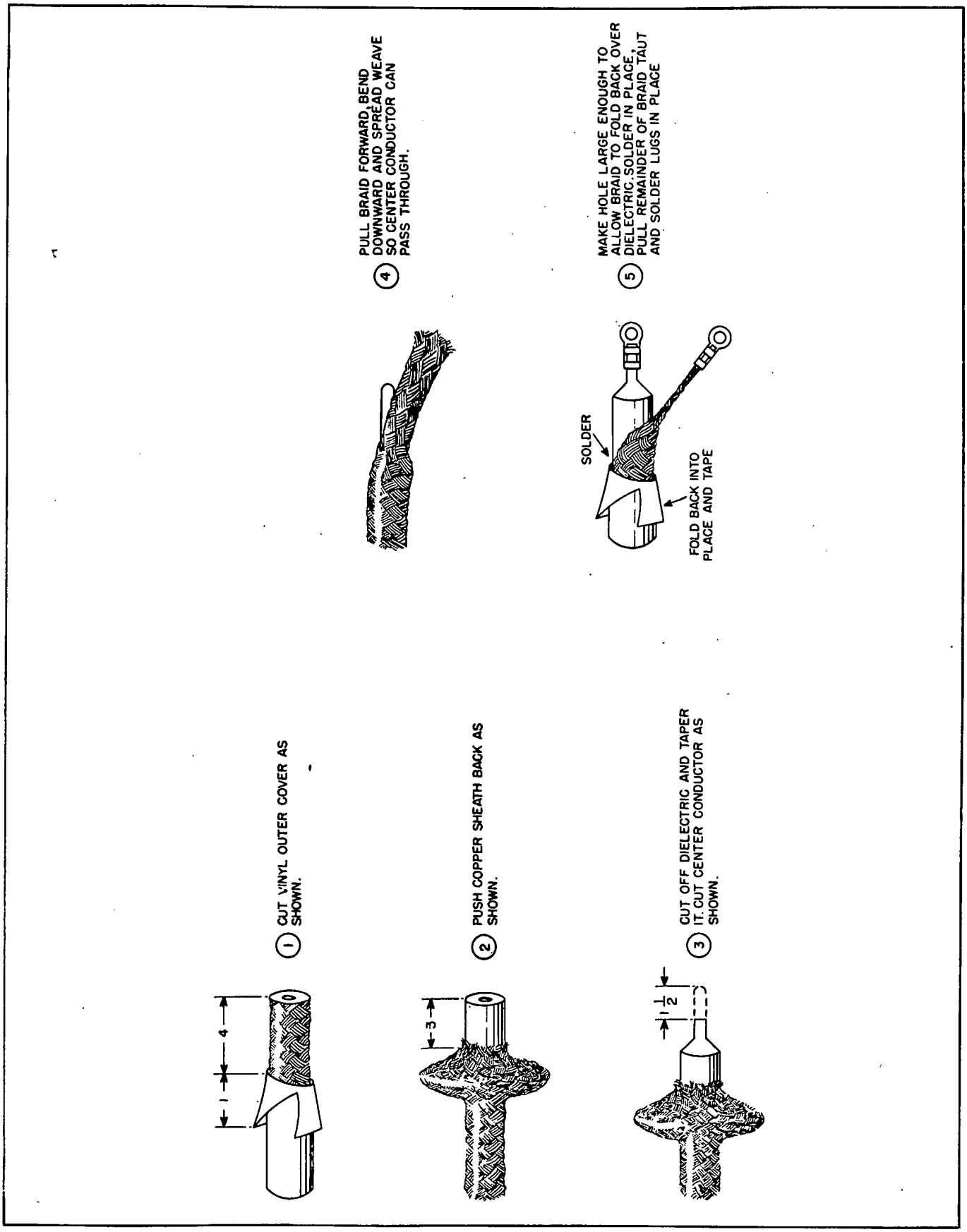


Figure 3-32. RG-12/U Coaxial Cable, Assembly of Connecting Lugs

to the "B" series of lines. In this case, it will be necessary to connect the 285D terminal of terminal board E-1003 to the 01 terminal. If a third, or "C" series of lines is used, it will be necessary to connect terminal 285C to 285D. If the fourth, or "D" series of lines be used, connecting from ten to twelve indicators, no jumpers are necessary on terminal board E-1003. The second procedure necessary to terminate the indicators is to throw the BRIDGE-TERMINATE switch on the *last unit* on each line to the TERMINATE position. The switches *on all other units* on that line should be in the BRIDGE position.

(9) The cables carrying the trigger and video signals are of the RG-12/U type. This is a coaxial cable, which must be connected to the terminal boards on the cases of the Indicator Console and the remote indicators. Connection is made by fastening soldering lugs on both the ground braid and the center conductor of the cable. Instructions for soldering these lugs are given in Fig. 3-32.

s. WIRE NUMBER DESIGNATIONS.

(1) Table 3-1 indicates the designations of the various terminals of the SR system. These designations are useful for connecting the equipment. They are also helpful when testing or trouble-shooting the equipment. The terminal numbering system is arranged so that all terminals of one unit are connected to similarly numbered terminals on another unit. In addition, all terminals having similar functions have the last two numbers. For example, the 115 volt a-c lines have the last two numbers 02 and 03. Terminals 102 and 103 are the a-c connections to the Transceiver, terminals 302 and 303 are the a-c terminals of the Console, etc. All terminals ending in 02 and 03 will carry a-c primary power. This will be noted in the complete listing of terminals which follows.

TABLE 3-1

WIRE NUMBER DESIGNATIONS

TERMINAL	FUNCTION
01	GROUND
	SHIP'S HEAD MARKER GROUND
02-03	115 V. A-C MAINS AND HEATER INPUT
102-103	115 V.A.C. TRANSCEIVER OUTPUT
203	INTERLOCK (ROTATION CONTROL UNIT)
302-303	115 V.A.C. THROUGH CONSOLE SWITCH
403	INTERLOCK (CONSOLE RECEIVER GENERAL CONTROL—IFF COORDINATOR)
503	INTERLOCK (PPI)
603	INTERLOCK BEARING INDICATOR —RANGE SCOPE
702-703	TO HEATER AND PLUGS THROUGH CIRCUIT BREAKER
802-803	MOTOR DRIVE ON SERVO GENERATOR SET
1202-1203	115 V.A.C.—OUTPUT FROM VOLTAGE STABILIZER
2202-2203	115 V.A.C. INPUT TO VOLTAGE STABILIZER
04	COMMON LINE FOR CONTROL INDICATOR LAMP VOLTAGES
05	"TRANSMITTER ON"—PILOT LIGHT
06	"LOCAL CONTROL"—PILOT LIGHT
07	POWER COMMON
08	POWER—ON
09	POWER—OFF
12	PLATE VOLTS—LOWER
13	PLATE VOLTS—COMMON
14	PLATE VOLTS—RAISE
15-16	SYNCHRONIZING TRIGGER PULSE INPUT
18	TRANSMITTER KEY
19	KV METER LEAD
20	ECHO BOX REMOTE SWITCH (COMMON)
120	ECHO BOX REMOTE SWITCH (REMOTE)
22	REMOTE KEYER CONTROL—COMMON
23	REMOTE KEYER CONTROL—SHARP
24	REMOTE KEYER CONTROL—MEDIUM
25	REMOTE KEYER CONTROL—BROAD
26	KEYER (INTERNAL)
28	MONITOR GAIN—COMMON (BEFORE SWITCH)
128	MONITOR GAIN—LOCAL (AFTER SWITCH)
228	MONITOR GAIN—REMOTE (AFTER SWITCH)
30	KEYER TRIGGER
31	KEYER TRIGGER
32	KEYER GRID RETURN
35-36	INTERLOCK (KEYER)
47	TIE POINT RCU (INTERNAL)
48	115 V. FOR O.S.C. EXCITATION CONTACTS (INTERNAL—R.C.U.)
49	115 V. FOR O.S.C. EXCITATION CONTACTS (INTERNAL—R.C.U.)
50	115 V. FOR O.S.C. EXCITATION CONTACTS (INTERNAL—R.C.U.)
51-52-53	1 X RELAYED O.S.C. SIGNAL
151-152-153	1 X RELAYED O.S.C. OR REFERENCE A.C. THROUGH TRUE-RELATIVE SWITCH
54-55-56	36 X RELAYED O.S.C. SIGNAL

154-155-156	36 X RELAYED O.S.C. OR REFERENCE A.C. THROUGH TRUE-RELATIVE SWITCH
57-58-59	1 X SIGNAL DATA (TRUE OR RELATIVE) FROM 6DG
157-158-159	1 X SIGNAL DATA (TRUE OR RELATIVE) THROUGH REMOTE DISCONNECT SWITCH
60-61-62	36 X SIGNAL DATA (TRUE OR RELATIVE) FROM 6DG
160-161-162	36 X SIGNAL DATA (TRUE OR RELATIVE) THROUGH REMOTE DISCONNECT SWITCH
64-63	5CT 36 X SIGNAL TO SERVO AMPLIFIER FROM BEARING INDICATOR
65-66-67	EXCITER FIELD—SERVO GENERATOR
68-69	ARMATURE OF SERVO GENERATOR
168-169	ARMATURE OF ANTENNA DRIVE MOTOR
70-71	FIELD SUPPLY OF ANTENNA DRIVE MOTOR
72	EMERGENCY ANTENNA ROTATION
73	NORMAL ANTENNA ROTATION
	NOTE: These functions are reversed by Navy Field Change No. 28.
74	PILOT LIGHT (RELATIVE)
75	DIAL LIGHT (TRUE)
76	INTERCONNECTION (R.C.U.)
77-78	TELEPHONE WIRES (ANTENNA PEDESTAL)
80	RADAR VIDEO TO RANGE SCOPE FROM RECEIVER
180A	PPI VIDEO OUTPUT (CONSOLE) AND TWO REMOTE PPI'S
180B	PPI VIDEO OUTPUT TO 4 REMOTE PPI'S
180C	PPI VIDEO OUTPUT TO 4 REMOTE PPI'S
180D	PPI VIDEO OUTPUT TO 4 REMOTE PPI'S
81	PPI MARKERS OUTPUT (RANGE SCOPE TO RECEIVER)
82	IFF VIDEO INPUT FROM IFF SYSTEM
83	RADAR BLOCK FROM IFF COORDINATOR TO RANGE SCOPE
84	IFF BLOCK FROM IFF COORDINATOR TO RANGE SCOPE
85	TRIGGER FROM RADAR TRANSMITTER
185	TRIGGER TO RANGE SCOPE
285A	TRIGGER TO CONSOLE PPI
285B	TRIGGER TO REMOTE PPI'S
285C	TRIGGER TO REMOTE PPI'S
285D	TRIGGER TO REMOTE PPI'S
685	TRIGGER TO IFF COORDINATOR
785	TRIGGER TO IFF TRANSMITTER
86-87-88-92	IFF TRANSMITTER CONTROL CIRCUITS
89-90-91	TO IFF RECEIVER
94-95	O.S.C. EXC. FROM O.S.C. AMPLIFIER
96-97	O.S.C. EXC. OR REFERENCE A-C TO CONSOLE PPI
196-197	O.S.C. EXC. OR REFERENCE A-C THROUGH REMOTE DISCONNECT SWITCH
802	A.C. TO SERVO GENERATOR
803	A.C. TO SERVO GENERATOR

17. INITIAL ADJUSTMENTS.

a. GENERAL.

(1) After the equipment has been installed, adjustments are required in nearly all of the components before the system may be considered to be in proper operating condition. These adjustments involve tuning the Transmitter, aligning the Antenna positioning system, and aligning the components of the Indicator Console. The paragraphs immediately following describe the procedure required to place the equipment in operation and the adjustments required by each component. The procedure to be followed in turning the equipment on depends upon the type of Modulation used. The SR Transmitter, using the Keyer Unit, requires more careful initial adjustment than the SR-a Transmitter, using the plate Modulator. It is presumed in this discussion that the SR Transmitter being turned on is equipped with a jack for viewing the grid pulse of voltage. This jack has been incorporated in the manufacture of all SR equipments above Serial No. 69 and consists of a voltage divider connected between the oscillator grid and ground with a test jack mounted on the front panel of the Transceiver and connected to the low voltage point of the divider. This connection provides approximately 5% of the total plate voltage for application to the vertical plates of the test oscilloscope. The addition of this jack has been provided for equipments of serial numbers less than 69 by Navy Field Change No. 8.

b. ADJUSTMENT OF MOTOR-GENERATOR VOLTAGE.

(1) Place all switches in their OFF positions.

(2) Place the Controller Disconnect Line Switch in its ON position.

(3) Push the START button of the Pushbutton Station. This switch energizes the relays in the Magnetic Controller, starting a sequence of relay operations that causes the Motor-Generator to start and apply a-c power to the input terminals on the Transceiver.

(4) Place switch S-1461 on the Voltage Regulator in its AUTO position.

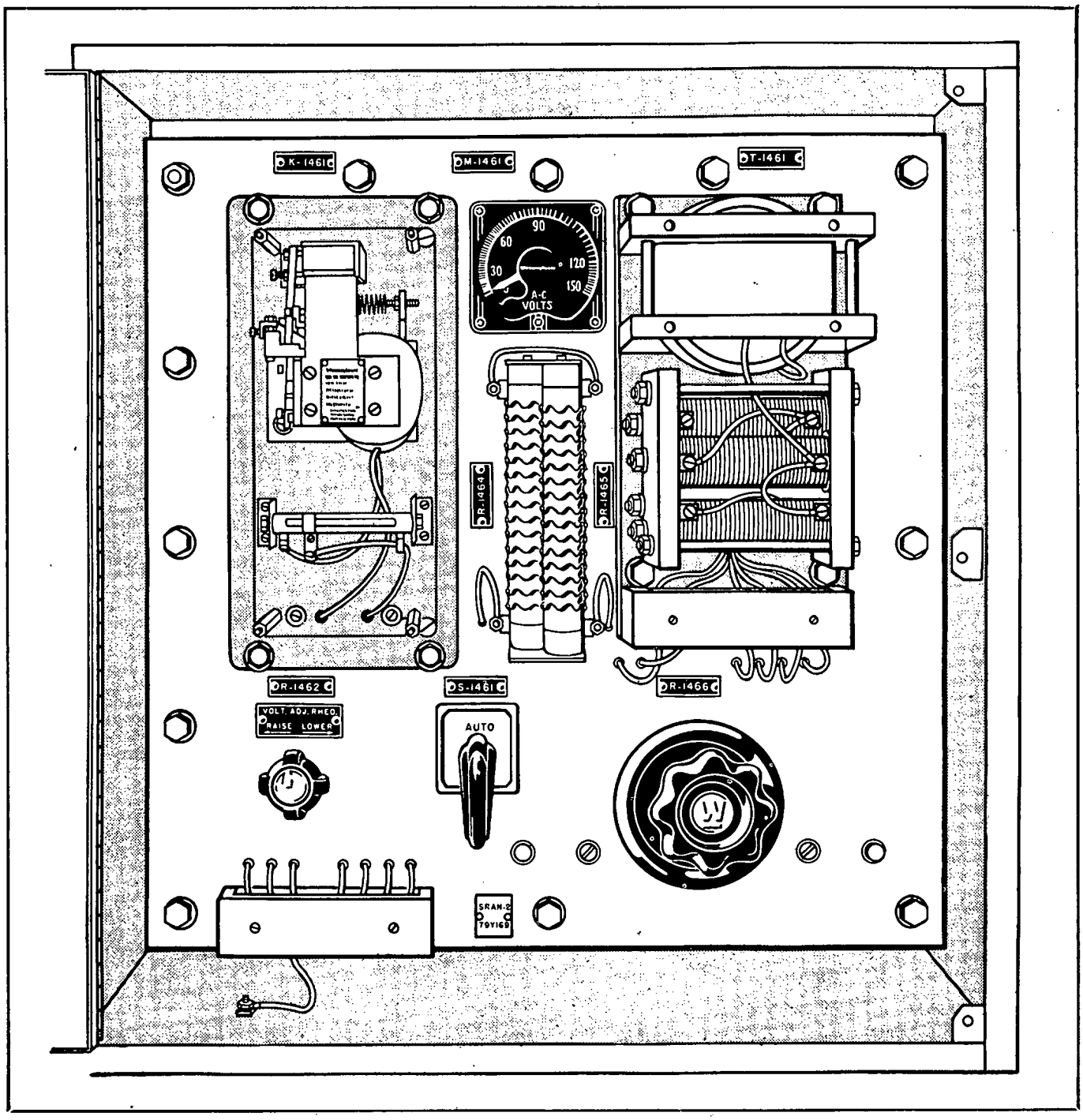


Figure 3-33. Voltage Regulator, Operating Controls

(5) Place the VOLT. ADJ. RHEO. control R-1462 in the center of its range.

(6) Remove the cover from the Silver Stat and adjust the tapped resistor R-1461 until the meter M-1461 indicates approximately 120 volts. Final adjustment is made with the VOLT ADJ. RHEO control. These adjustments are shown in Fig. 3-33.

(7) If switch S-1461 is in its MAN position, the voltage is adjusted with the large control for rheostat R-1466.

c. TRANSCEIVER ADJUSTMENTS FOR THE SR SYSTEM.

(1) Connect the grid straps to the type 527 oscillator tubes according to the frequency range of the Antenna in use. If operation is desired in the *blue* or highest frequency band, both grid straps must be used. Connect one of these between the top grid prongs, taking care not to damage the tubes in the process. Connect the other grid strap between the lower grid terminals. If operation is desired in the

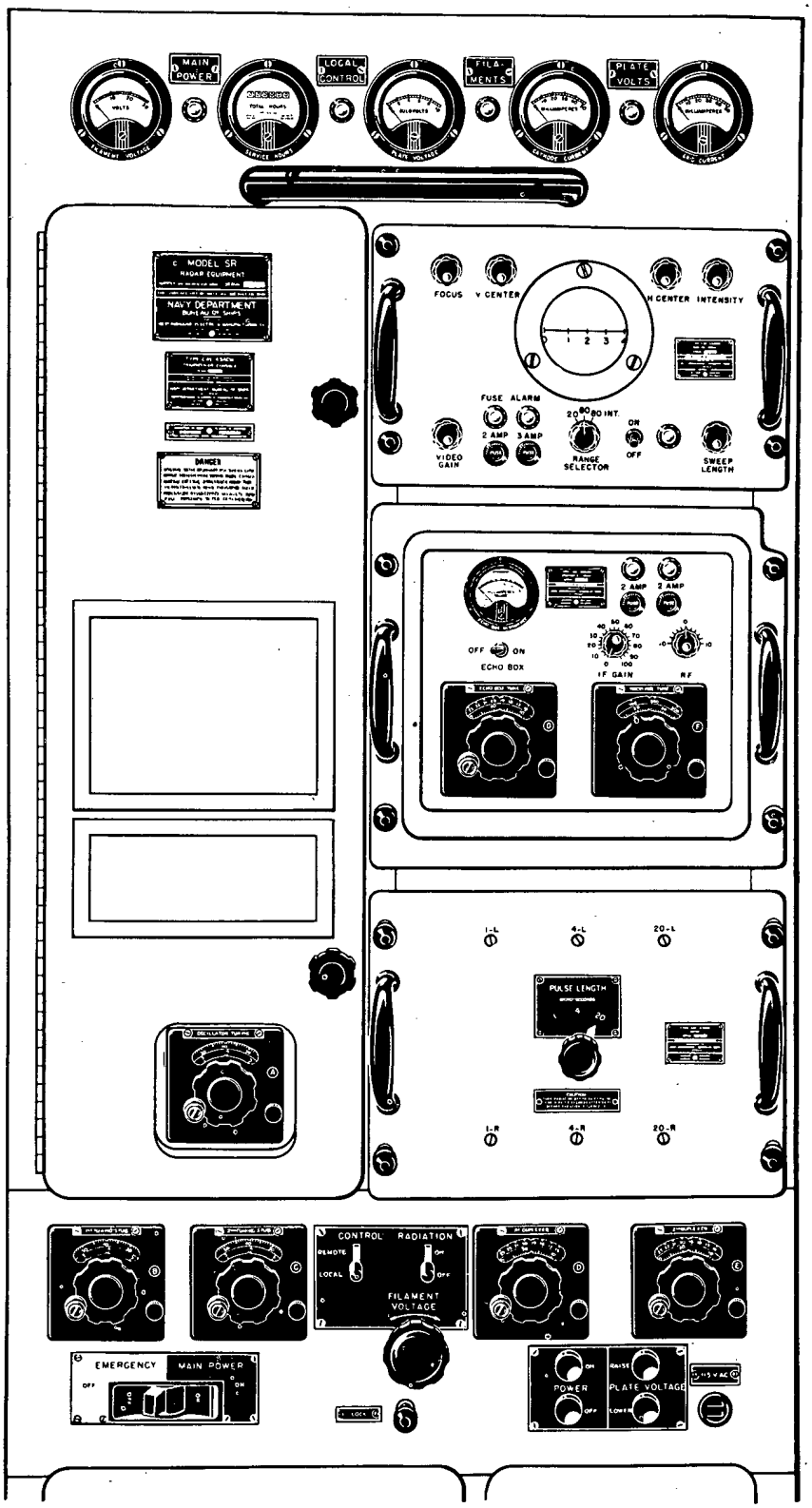


Figure 3-34. Transceiver, Operating Controls

yellow-green, or lower frequency band, place one shorting strap across the *lower* grid terminals of the tubes. Place corona balls on the two upper grid terminals. When installing grid straps be sure that the center lock screw is loose. Tighten the knurled nuts at the grids first and then tighten the center screw.

(2) Check the duplexer length. When operating on the blue band, adjust the duplexer length so that the distance between the lower edge of the flange of the upper U-shaped casting connecting the two duplexers and the center of the spark gap adjustment knob is 9⅞ inches. For the yellow-green band, the distance should be approximately 11⅝ inches. This adjustment is available when the back cover of the Transceiver is removed.

(3) Check the setting of the duplexer spark gaps. They should be open between 1/32 and 1/16 of an inch or roughly one turn of the adjustment knob. These gaps may be observed through openings in the duplexer when the Monitor Receiver is removed from the Transceiver, or when it is slipped forward and the right side shield of the Transceiver is removed.

(4) Place the CONTROL switch S-107 in its LOCAL position. See Fig. 3-34.

(5) From the calibration chart on the front of the oscillator door of the Transceiver, determine the approximate setting of the controls A, B, and C. Place these controls in their approximate positions. Control A is the OSCILLATOR TUNING control, while B and C are the 1st TUNING STUB and the 2nd TUNING STUB controls, respectively. The proper setting of these controls is critical for operation at maximum efficiency. Final adjustment is made after other operations have been completed.

(6) Place the PULSE LENGTH switch S-158 on the panel of the keyer compartment in its 20 microsecond position. This switch is shown in Fig. 3-34.

(7) Place the EMERGENCY-MAIN POWER switch S-101 in its ON position. After five seconds the time delay relay in the Transceiver will operate to permit d-c voltage to be applied to the plates of the oscillator tubes.

(8) Set the filament voltage to 10 volts on the FILAMENT VOLTAGE meter by adjustment of the FILAMENT VOLTAGE control T-106. See Fig. 3-34 for the location of this control.

(9) Press the POWER ON button S-103. The PLATE VOLTAGE meter should indicate 500 volts. If it does not, adjust it to 500 volts with the RAISE and LOWER switches. Then turn off the equipment and adjust the cam controlling microswitch S-109 so that this switch is open for all plate voltages below 500 volts. The cam is fastened by setscrews to the shaft of the variable low-voltage transformer. The location of this cam and those controlling microswitches S-110, S-111, and S-119 is shown in Fig. 3-35.

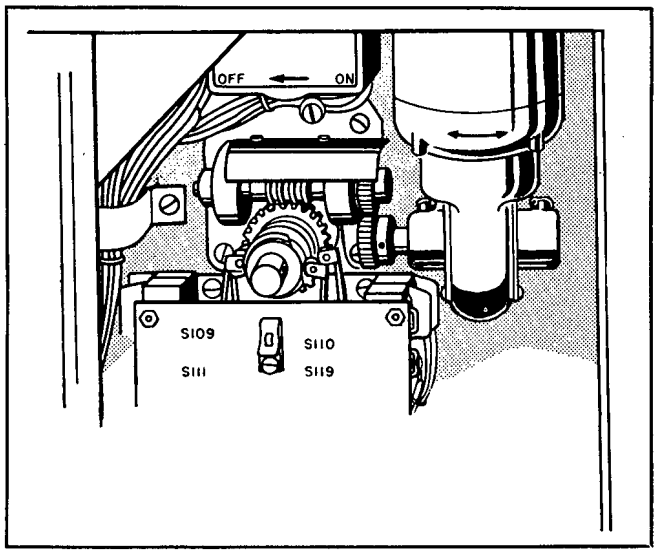


Figure 3-35. Limit Switch and Cam Assembly in Transceiver

(10) Adjust the cam controlling microswitch S-111 using the above procedure, so that this switch is open for plate voltages above 700 volts.

(11) Connect an oscilloscope to the grid pulse jack, J-106, on the Transceiver panel. Use the internal horizontal sweep frequency of the oscilloscope and adjust it to approximately the repetition rate of the transmitter which is 60 cps. Make final adjustments of the oscilloscope repetition rate after the signal is applied. Rotate the Antenna until it faces the Echo Box Antenna.

(12) Raise the plate voltage by pushing the RAISE switch S-105 until the PLATE VOLTAGE meter indicates 8 kv with the RADIATION switch in its OFF position.

(13) Place the RADIATION switch ON momentarily and observe the shape of the Keyer wave form on the test oscilloscope. It should be as shown in Figs. 3-36 and 3-37. The plate voltage should increase to 11 kv when the RADIATION switch is operated.

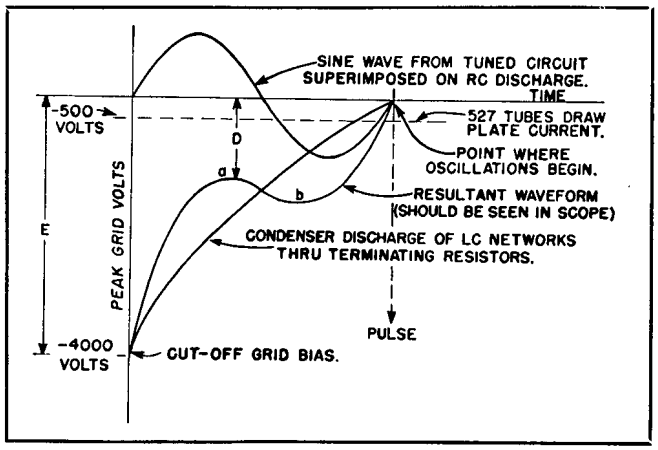


Figure 3-36. Keyer Pulse Waveform Development

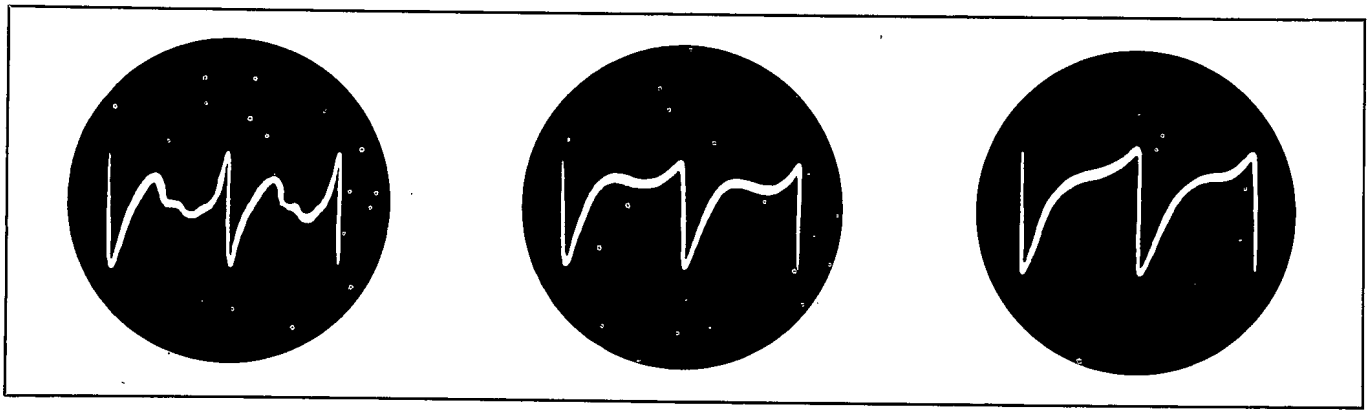


Figure A
Good 20 Microsecond Grid Pulse Shape

Figure B
Good 4 Microsecond Grid Pulse Shape

Figure C
Good 1 Microsecond Grid Pulse Shape

Figures A, B and C illustrate proper shapes of grid pulse patterns; the first hump is sufficiently high to insure a steep rise at the point of oscillation, thus keeping the time of plate current flow just before oscillation to a minimum. The hump itself is well below the level at which it would cause the tube to draw plate current.

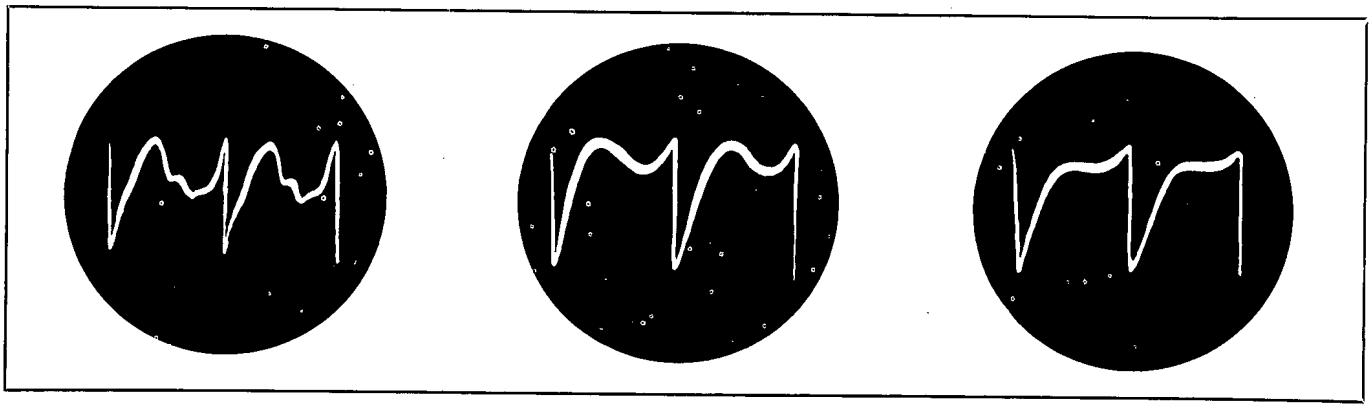


Figure D
Poor 20 Microsecond Grid Pulse Shape

Figure E
Poor 4 Microsecond Grid Pulse Shape

Figure F
Poor 1 Microsecond Grid Pulse Shape

Figures D, E and F illustrate grid pulse shapes in which the hump is too high and is causing plate current to flow at the top. If the hump were to go still higher, it would rise above the level at which the tube oscillates resulting in "multiple pulsing" and erratic patterns on both the grid pulse viewing scope and the indicator scopes.

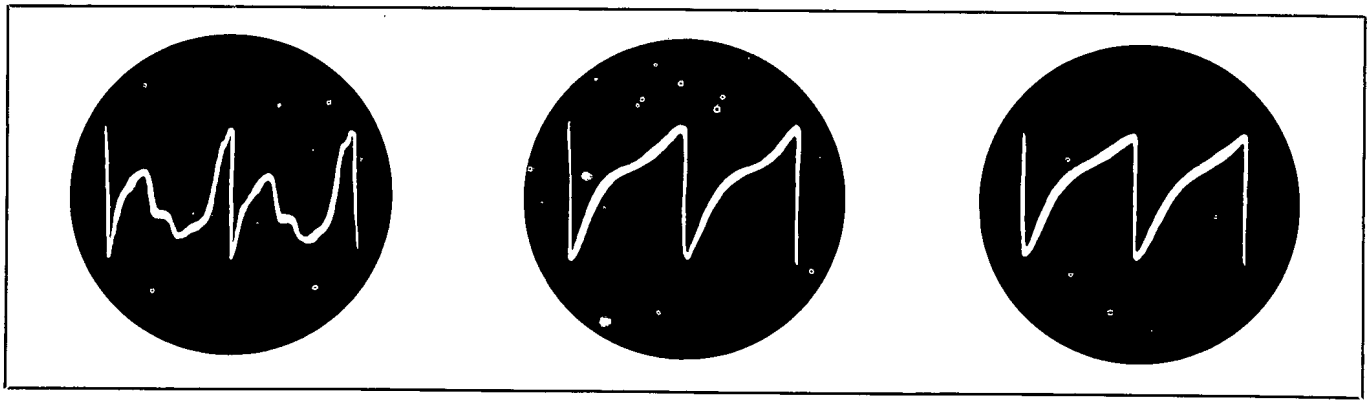


Figure G
Poor 20 Microsecond Grid Pulse Shape

Figure H
Poor 4 Microsecond Grid Pulse Shape

Figure I
Poor 1 Microsecond Grid Pulse Shape

Figures G, H and I illustrate grid pulse shapes in which the hump is too low, causing the rise at the firing level to be too flat, thus resulting in plate current flow for some time before oscillation begins.

Figure 3-37. Keyer Pulse Waveforms

CAUTION

IF THE TUBES ARE ALLOWED TO REMAIN OSCILLATING IN AN IMPROPER OPERATING CONDITION FOR MORE THAN A FEW SECONDS, PERMANENT DAMAGE MAY BE DONE TO THEM.

(14) If the waveform is not correct, adjust the 20-R controls a step at a time and repeat (13) after each adjustment. The 20-L control is a Vernier between steps on the 20-R control. If the overload relay trips back the 20-R control off one step, find the correct operating point with the 20-L control. See Fig. 3-34 for the location of these controls. The result of proper Keyer adjustments is an increase in the life of the oscillator tubes and an increase in the overall operating efficiency of the Transmitter. Ideal conditions exist when the discharge period of the RC network is equal to the natural period of the synchronizing voltage as is shown in Fig. 3-36. The positive peak of the resultant waveform should always be at least 15% of the overall waveform amplitude, or excessive oscillator tube heating will occur. Adjust the R and L tap switches until the conditions shown in Fig. 3-36 are satisfied. Distance *D* should never be less than 15 per cent of the total waveform E. The top portion of the waveform should be steep and should not round off where oscillation begins. If R is properly adjusted, it should be possible to vary the L tap switch over three or four positions without causing unstable operation. If the waveform seen when operating on the 20 microsecond pulse has several humps between *a* and *b*, it is not an indication of an abnormal condition. These humps are caused by the 60 cycle external synchronizing voltage used only on the 20 microsecond position. It may be found that changing the operating frequency of the Transmitter from one portion of the band to another may cause a change in the Keyer grid pulse waveform. For this reason, a test oscilloscope should be used for observing the grid pulse waveform whenever Transmitter tuning or Keyer adjustments are made. Fig. 3-37 shows actual photographs of typical oscilloscope patterns of the grid pulse waveforms.

(15) Place the Echo Box switch in its ON position. Tune the Echo Box, using the G dial on the Monitor Receiver panel, until a dip in the ECHO BOX RESONANCE meter indication occurs. This presumes that the Echo Box has been changed as described in Navy Field Change No. 30. If the change has not been made, tune the Echo Box to a peak in the meter reading. Check the G dial (ECHO BOX TUNE) reading against the calibration chart. The frequency should be within the frequency range of the Antenna plus or minus 3 megacycles of the center of the band. If the deviation is too great, correct by tuning the A dial. If it is necessary to retune the A dial, repeat the check on the Keyer grid pulse shape and of the plate and grid currents, as described previously. As a rule, tuning the A dial to higher numbers lowers the frequency and vice versa. Adjust dial A until the peak obtained is the largest that lies in the frequency band of the Antenna.

(16) Adjust the 1st TUNING STUB (B) dial and the ECHO BOX TUNE (G) dial alternately for maximum deflection on the ECHO BOX RESONANCE meter. If the waveform changes during this adjustment, readjust the L and R controls on the Keyer and then continue the adjustment of the B and G dials.

(17) Repeat step (16) using the 2nd TUNING STUB (C) dial and the G dial used in step (16).

(18) Repeat steps (16) and (17).

(19) Place the RADIATION switch in its OFF position and place the PULSE LENGTH switch in its 4 position. Place the RADIATION switch in its MOMENTARY position for a brief period of time and observe the shape of the grid pulse. Compare its shape with the ideal shapes shown in Figs. 3-36 and 3-37.

(20) Adjust the 4-R and 4-L controls shown in Fig. 3-34 using the technique described in step (14). Do not disturb the setting of any other controls during this procedure.

(21) Repeat steps (19) and (20) using the 1-R and 1-L controls and the 1 position of the PULSE LENGTH switch. See Fig. 3-34. Check the waveforms against the 1-us waveforms in Fig. 3-37.

(22) Place the ON-OFF switch on the Monitor Scope in its ON position. See Fig. 3-34.

(23) Adjust the V CENTER control (R-324) until the sweep trace coincides with the etched line on the face of the tube.

(24) Adjust the H CENTER control (R-322) until the start of the sweep trace coincides with the 0 position etched on the face of the tube.

(25) Place the FOCUS control (R-331) in approximately the center of its range of rotation. For the location of this control see Fig. 3-34.

(26) Adjust the FOCUS BALANCING control (R-335) to obtain maximum definition and uniformity of the sweep trace. This control is located on the top rear center of the chassis, and is shown in Fig. 3-38. If necessary, re-adjust the FOCUS BALANCING control after a video signal has been applied to the Monitor Scope in subsequent procedures. After the final re-adjustment, the FOCUS BALANCING control should be in the proper operating position and should require no further attention as the equipment is used. Lock the control.

(27) Adjust the RANGE SELECTOR switch S-301 to the 20 position. Adjust SWEEP LENGTH control R-313 until end of sweep coincides with 4 on the scale.

(28) Place the PULSE LENGTH switch in its

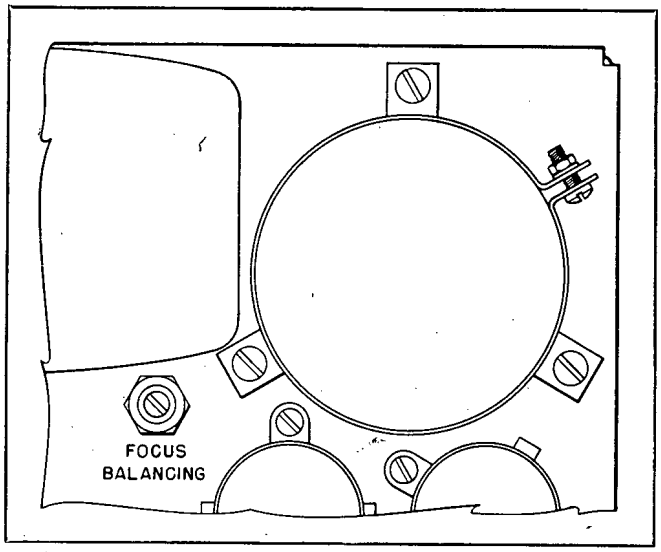


Figure 3-38. Monitor Scope, Focus Balancing Control

20 position and then place the RADIATION switch in its ON position.

(29) Set the RF control on the Monitor Receiver at 0, and set the IF GAIN control at 100. See Fig. 3-34.

(30) Adjust the RECEIVER TUNE (F) dial until target echoes appear on the Monitor Scope. Reduce the setting of the IF GAIN control through the remainder of this procedure as necessary.

(31) Adjust the 2nd DUPLEXER (E) dial for maximum echo amplitude and then adjust the 1st DUPLEXER (D) dial for maximum echo amplitude.

(32) Adjust the RF control for maximum echo amplitude.

(33) Adjust the knurled knobs that control the spark gap spacing until the amplitude on the Monitor Scope is maximum and the spark is clean and blue. See Fig. 3-39. The outer conductors of the r-f lines in the Transceiver are at ground potential and may be handled with safety. DO NOT TOUCH ANYTHING ELSE.

(34) Carefully trim the adjustment of the following controls for maximum echo amplitude in the order given:

2nd TUNING STUB (C)
RECEIVER TUNE (F)
2nd DUPLEXER (E)
1st DUPLEXER (D)
RF control

(35) Measure the frequency again with the Echo Box. If it has shifted during the tuning procedure, readjust the OSCILLATOR TUNING (A) dial and repeat the tuning process. Continue these operations until the frequency is correct at the end of the tuning procedure.

(36) Make a final check to make certain that the Transceiver operates properly on all three pulse lengths. Turn the RADIATION SWITCH to its OFF position while switching from one pulse length to another. The voltages which may be expected on the meters of the Transceiver during normal operation are as follows:

PULSE LENGTH (Micro-seconds)	20	4	1
PLATE VOLTS (kv.)	11	11	11
CATHODE CURRENT (ma.)	35-55	30-40	15-25
GRID CURRENT (ma.)	10-13	6- 9	2- 4

Record the readings actually obtained.

d. SR-a TRANSCEIVER ADJUSTMENTS.

(1) Connect both grid straps for the blue antenna. Use only the lower grid strap and the corona balls for the yellow-green antenna. See step (1) of Par. 17*c*.

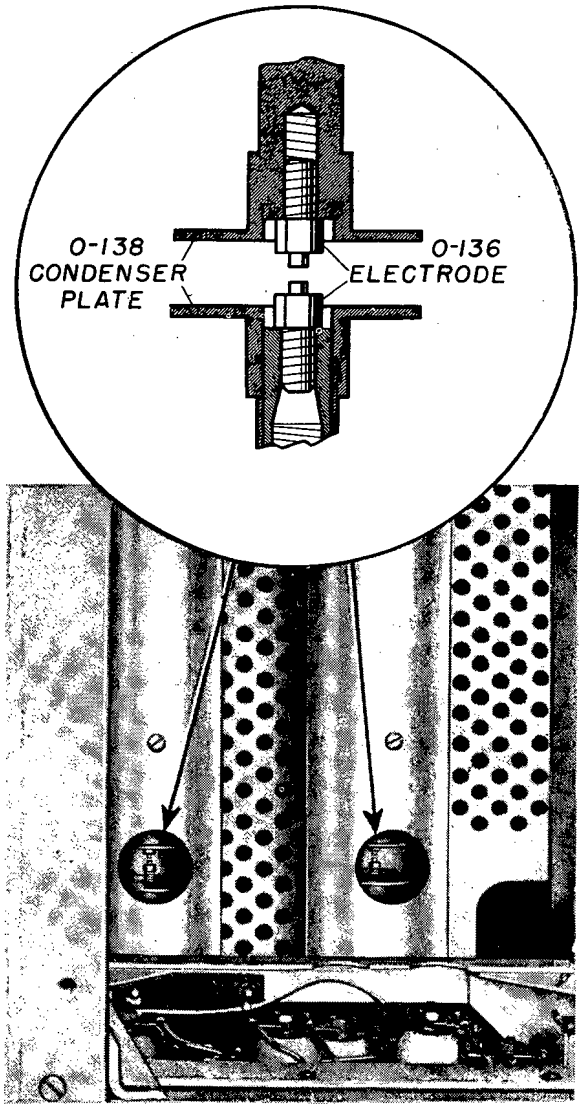


Figure 3-39. Duplexer Spark Gap Adjustments

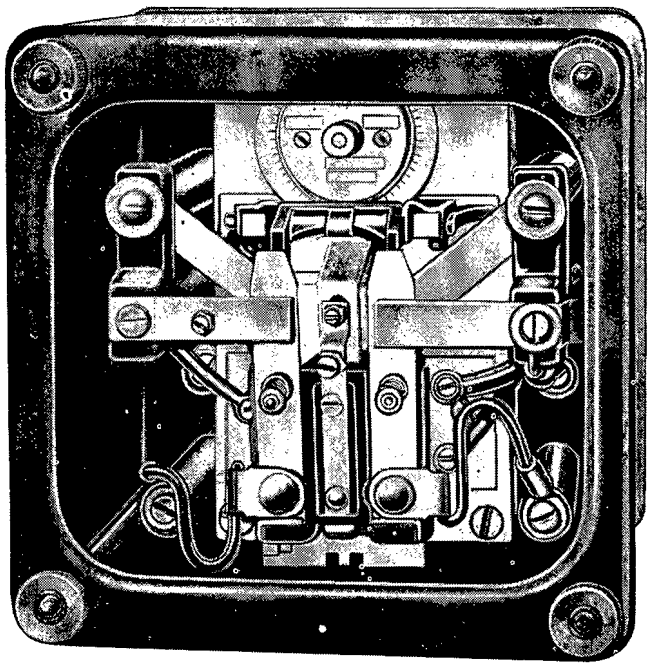


Figure 3-40. Time Delay Relay SR-a Modulator

(2) Check the duplexer length as directed in step (2) of Par. 17*c* of this section.

(3) Check the duplexer spark gaps as directed in step (3) of Par. 17*c* of this section.

(4) Place the CONTROL switch (S-107) in its LOCAL position.

(5) Adjust the Transmitter A, B, and C controls as described in step (5) of Par. 17*c* of this section.

(6) Remove the dust cover from time delay relay K-2002 in the Modulator. See Fig. 3-40. When the equipment is received, the metal clappers will have supports to protect them during shipment. These supports must be removed before the equipment can be placed in operation. Check the sliding gear to see that it is set on the 5-minute scale. If it is not, move the sliding gear until the large gear is opposite the 5-minute index. Loosen the thumbnut on the discs and rotate them until their index pins are opposite the 5-minute mark. Then tighten the thumbnut and replace the dust cover.

(7) Place the EMERGENCY-MAIN POWER switch S-101, in its ON position. After five seconds, the time delay relay in the Transceiver will operate to permit d-c voltage to be applied to the Modulator permitting the Modulator time delay relay to start its cycle. Five minutes must elapse before the POWER ON switch can be operated.

(8) Set the filament voltage to 10 volts on the FILAMENT VOLTAGE meter by adjustment of the FILAMENT VOLTAGE control T-106.

(9) Press the POWER ON button S-103. After five minutes the time delay relay in the Modulator unit will close. This will be indicated at the Transceiver by the lighting of the PLATE VOLTS indicator.

(10) Place the RADIATION switch in the ON position.

(11) Press the RAISE switch, holding it in until the PLATE VOLTAGE METER indicates approximately 3.5 kv.

(12) Perform steps (13) to (36) inclusive of Par. 17*c* of this section.

(13) Increase the plate voltage until the PLATE VOLTAGE meter indicates 5 kv. If arcing occurs in the oscillator compartment, retune to a different frequency with dial A, and adjust the other controls for optimum operation.

(14) Typical indications for the Transceiver meters in normal operation are as follows:

FILAMENT VOLTAGE	10 volts
PLATE VOLTAGE	5 kv.
PLATE CURRENT	20-30 ma.
GRID CURRENT	4- 8 ma.

Record the actual readings obtained.

(15) Adjust the repetition rate of the Modulator to 120 cps. by means of the REPETITION RATE control (R-2001) located on the panel in the lower center of the front of the unit. This control is shown in Fig. 3-41. The rate should not be set higher than 120 cps. even though slightly better definition may be obtained, because the faster repetition rate will tend to overload the high voltage rectifier in the Transceiver. Connect the 60-cps line voltage across one set of the plates of an oscilloscope and connect the

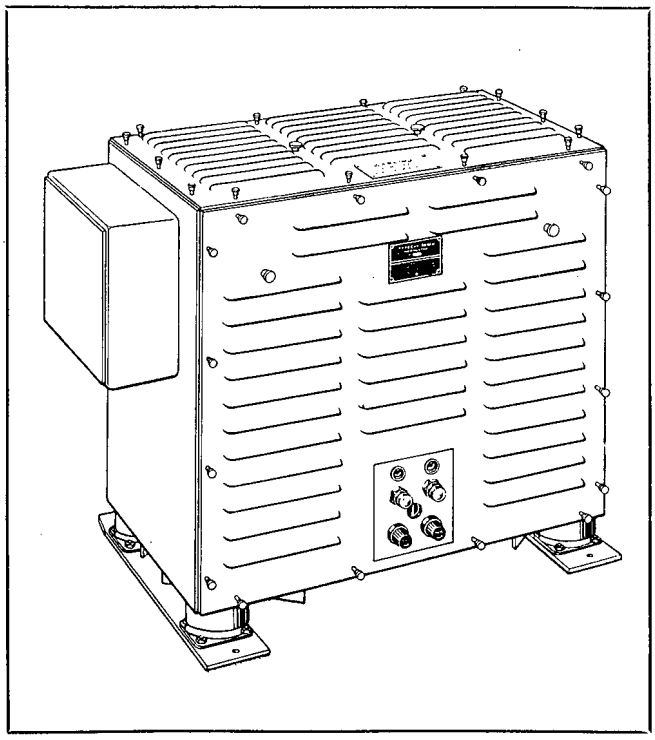


Figure 3-41. Modulator, Front View

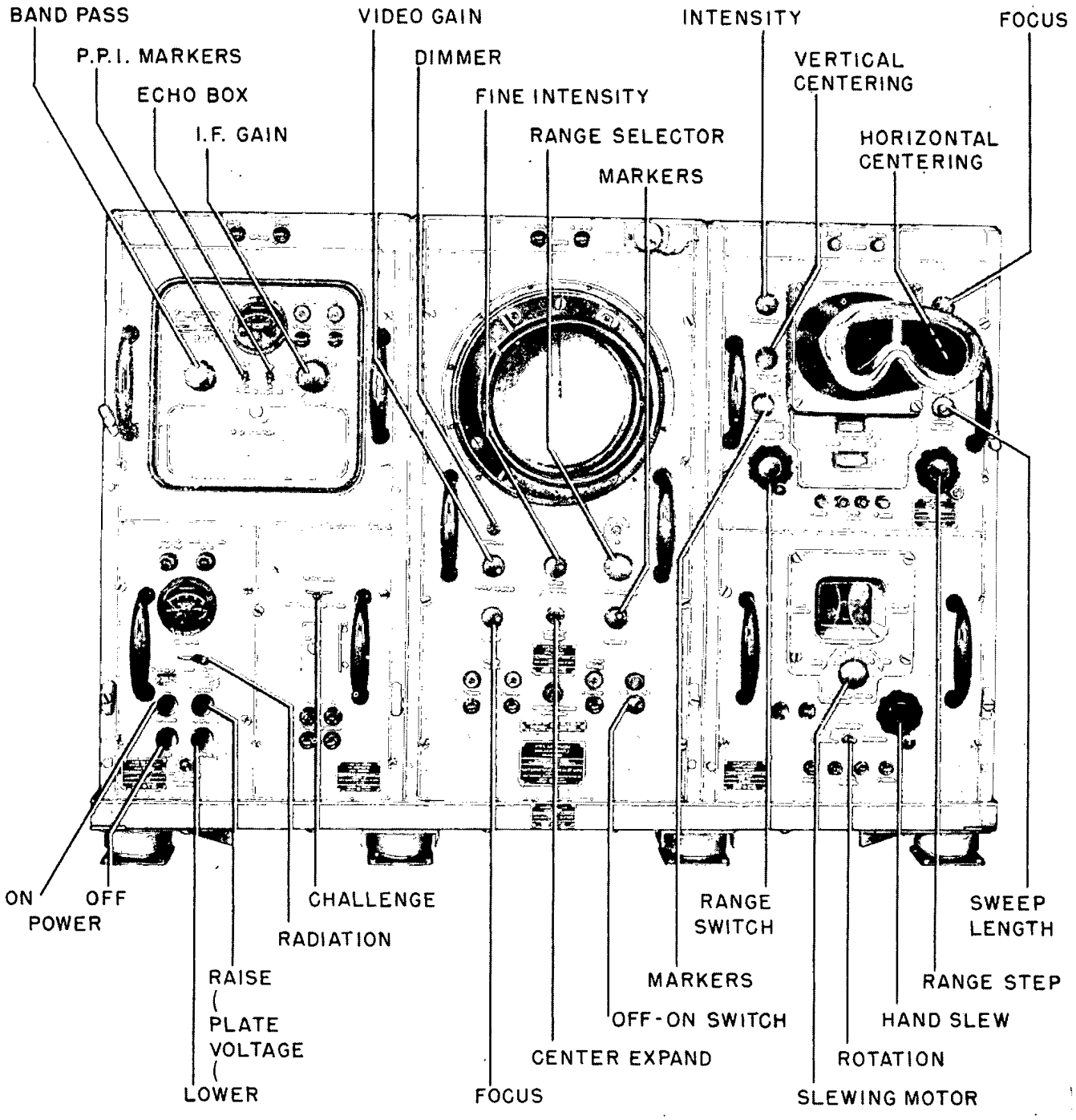


Figure 3-42. Operating Controls on Indicator Console

output between test jack J-2004 and ground to the other set of plates. Adjust the repetition rate control, R-2001 until a two-lobed Lissajous figure is visible on the screen of the test oscilloscope. The repetition rate will then be twice the line frequency, or 120 cycles ± the line frequency variation. Another check on the repetition frequency is to observe targets on the Monitor Scope. The targets jitter at all repetition frequencies except 120 cps.

e. THE ANTENNA POSITIONING SYSTEM ADJUSTMENTS.

(1) Remove the disconnect plug P-1301 in the Pedestal base. Then remove the plug from the rear end of the drive motor and insert the handcrank, making certain that the tongue on the crankshaft engages the groove in the motor shaft.

(2) Loosen the captive fillister head screws in the edge of the synchro inspection door shown in Fig. 3-43.

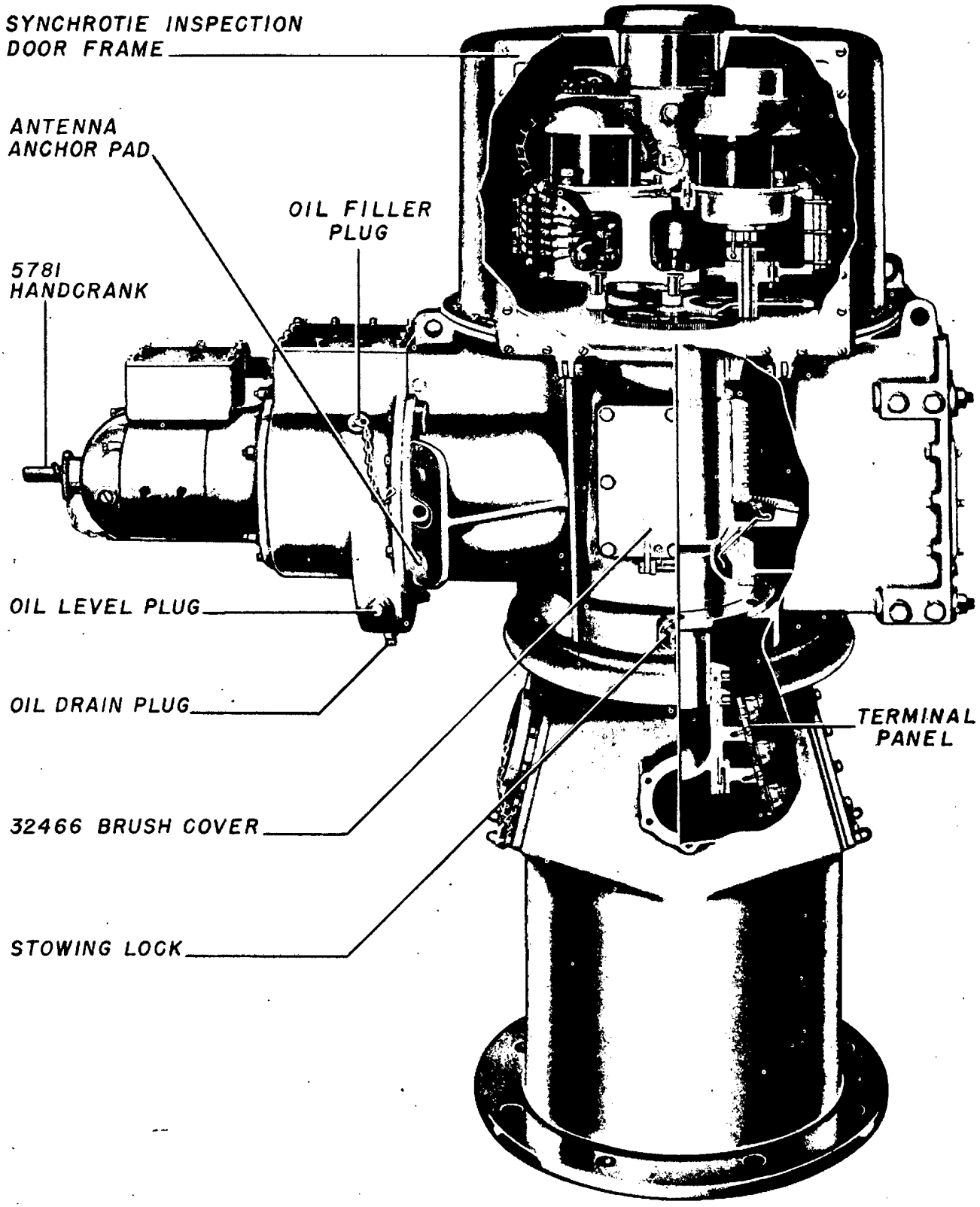


Figure 3-43. Antenna Pedestal, Showing Synchro Inspection Door

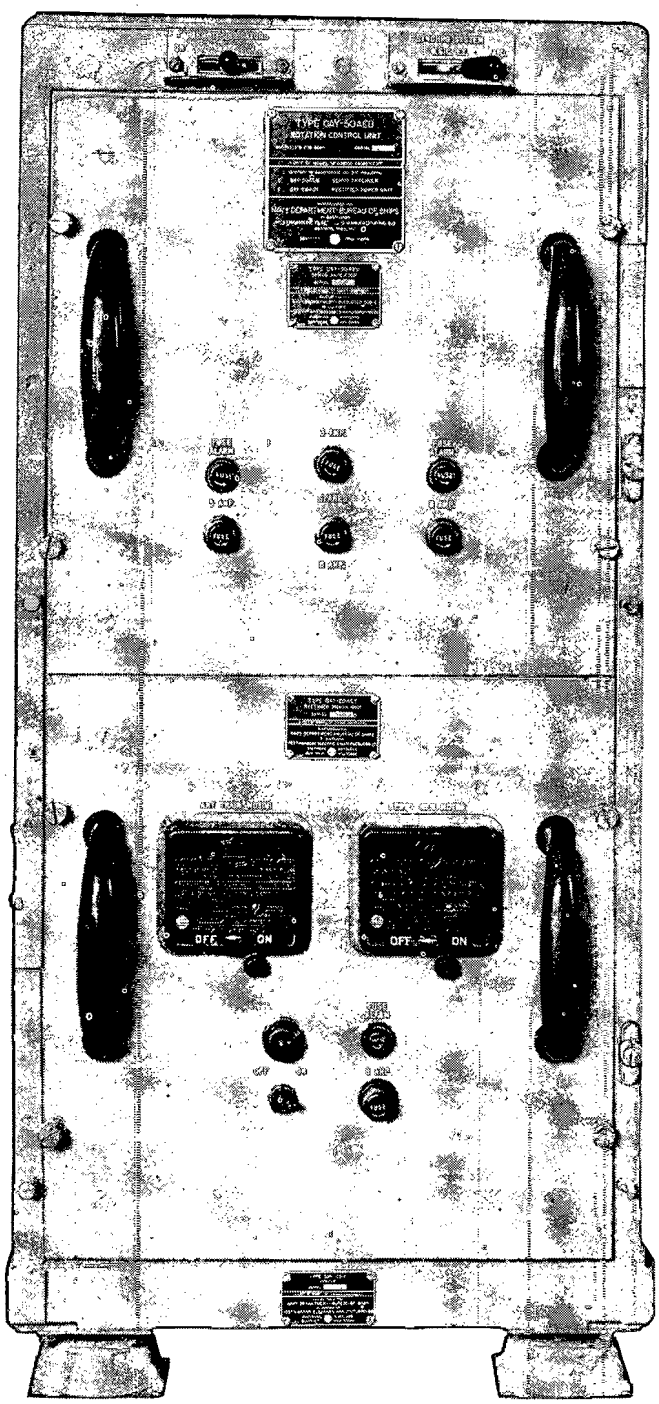


Figure 3-44. Rotation Control Unit, Front Panel

Pull the door away from the housing until all screws are clear and lower the door on its hinges.

(3) Rotate the Antenna with the hand crank until the Antenna is facing directly forward and engage the stowing lock. This lock is shown in Fig. 3-43.

(4) Place the SYNCHRO SYSTEM switch S-1105 on the Rotation Control Unit in its A.C. position. See Fig. 3-44.

(5) Disconnect leads 60, 61, and 62 from the terminal block E-1302 shown in Fig. 3-25 and located on the panel shown in Fig. 3-43.

(6) Tie the disconnected 61 lead to terminal 155.

(7) Connect one lead of an a-c voltmeter to terminal 154 and connect the other lead of the voltmeter to the disconnected 60 lead. The voltmeter should be operated on the 250 volt range.

(8) Loosen the three screws which hold the synchro clamp ring in place.

(9) Place the ON-OFF switch on the panel of the Rotation Control Unit in its ON position. See Fig. 3-44.

(10) Carefully rotate the stator of the synchro until a minimum reading is obtained on the voltmeter.

(11) Remove the voltmeter, and remove lead 61 from terminal 155.

(12) Connect one lead from a voltmeter to the disconnected 60 lead.

(13) Connect the other voltmeter lead to the disconnected 62 lead. This voltmeter should be capable of indicating 0.1 volt. It should have a maximum range of approximately 50 volts, and should be operated on that range for initial indications.

(14) Obtain a zero indication on the meter by adjusting the position of the stator of the synchro. Use the high meter scales for the initial indication, and as a zero indication is approached, switch to the 0.1 scale. If a zero indication is not possible, approach it as nearly as possible. Clamp the stator of the synchro in the zero voltage position. Be certain that the zero indication does not change as the clamp is tightened.

(15) Place the ON-OFF switch in its OFF position and replace leads 60, 61, and 62 on their terminal strip. The 36 speed synchro is now in its electrical zero position.

(16) Disconnect leads 57, 58, and 59 from their terminal strip E-1305 adjacent to the 1 speed synchro. Tie the disconnected 58 lead to terminal 152.

(17) Connect one lead of an a-c voltmeter to terminal 59 and the other lead to terminal 151. This meter should have a range of from 0-250 volts.

(18) Loosen the clamp ring of the one-speed synchro unit as in the case of the 36 speed unit.

(19) Place the ON-OFF SWITCH on the Rotation Control Unit in its ON position and rotate the stator until minimum voltage is indicated on the meter.

(20) Turn off the power, disconnect the voltmeter, and remove lead 58 from terminal 152.

(21) Connect one lead from a voltmeter to the disconnected 59 lead, and connect the other voltmeter lead to the disconnected 57 lead. This should be the same as was used in aligning the 36 speed unit.

(22) Obtain a zero indication on the meter and clamp the stator of the synchro as was done in aligning the 36 speed unit.

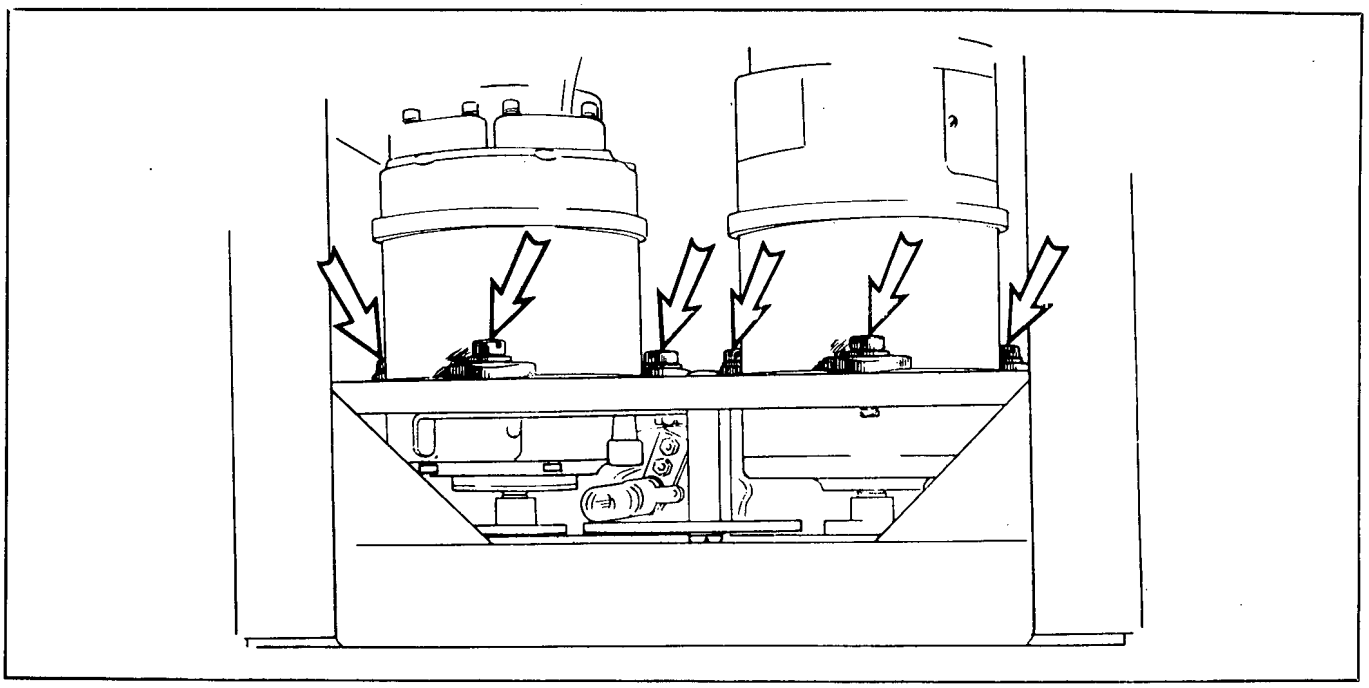


Figure 3-45. Mounting of Synchros in Bearing Indicator

(23) Clamp the stator of the synchro in the zero voltage position. Be certain that the voltage does not change as the clamp is tightened.

(24) Remove power from the unit and replace leads 57, 58, and 59 on their terminal strip.

(25) Replace the cover for the synchro access door in the Pedestal. Do not release the stowing lock.

(26) Apply power to the system by placing the power switch of the Rotation Control Unit in its ON position.

(27) Loosen the mounting screws holding each unit to the frame of the bearing indicator, as shown in Fig. 3-45.

(28) Rotate the stator of each unit until the zero position of the dial of the unit coincides with the index on the frame of the Bearing Indicator. Clamp the stators in this position.

(29) Release the stowing lock in the Antenna Pedestal and replace the disconnect plug in the Pedestal base.

(30) Place the SYNCHRO AMPLIFIER POWER switch on the terminal box of the Synchro Unit of the Synchro Amplifier in its ON position. As soon as the tubes of the Electronic Unit heat, the Synchro Amplifier will synchronize itself with the compass heading. If instead it settles at a point 180 degrees off, the trouble will be found in the reversal of connections in the ship's wiring and not in the unit itself, as the units are tested and operated under standard conditions at the time of Navy inspection at the factory. Once the Synchro Amplifier has been put into satisfactory operation its performance will be automatic. No attention during operation will be required. No adjustment should be necessary at the time of installation. The electrical zero for the synchro units of the Synchro Amplifier and for the commutator transmitter brushes has been set at the factory, after which the gear train was pinned so as to maintain the relative position between the 1-speed and the 36-speed control transformers and commutator brushes. If the alignment is found to be in error as evidenced by an error in the indication of the true bearing dial of the Bearing Indicator as compared with the known bearing of the ship, adjust the unit as described in Section 7 of this instruction book.

NOTE

STEPS (31) TO (40) APPLY ONLY TO UNMODIFIED SR ANTENNA SYSTEMS. IF THE SYSTEM HAS BEEN MODIFIED, PROCEED WITH STEP (41).

(31) Place the ROTATION SWITCH S-804 on the panel of the Bearing Indicator in its NORMAL position. This switch is shown in Fig. 3-42.

(32) Place the SLEWING MOTOR switch S-801 in its OFF position. This switch is located on the panel of the Bearing Indicator and is shown in Fig. 3-42.

(33) Loosen the panel screws on the Servo Amplifier shown in Fig. 3-44, and pull the chassis forward until it locks. Turn the interlock bars so that the interlock switches are closed.

(34) Place the ON-OFF switch of the Rotation Control Unit in its ON position.

(35) Turn the INPUT GAIN control R-113 counter-clockwise. This control is shown in Fig. 3-46. If the Antenna hunts, connect an a-c voltmeter with a

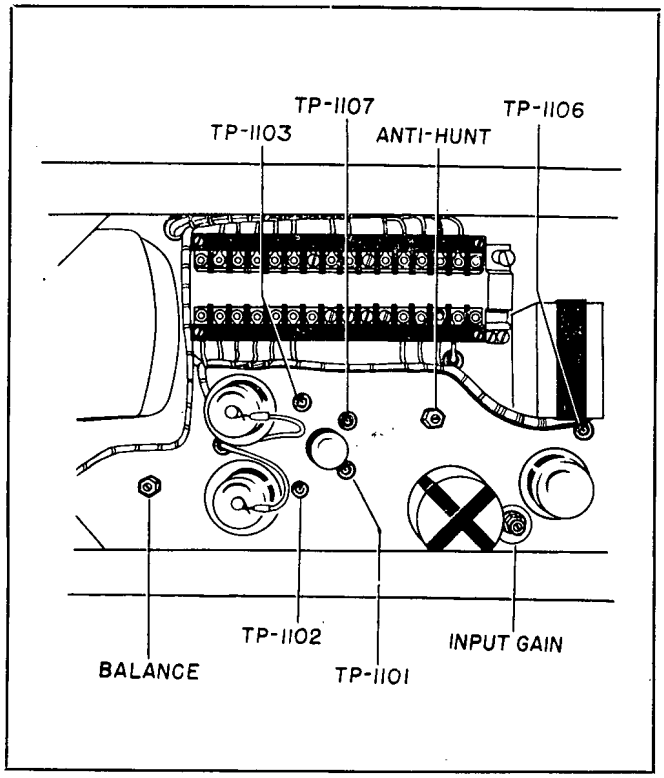


Figure 3-46. Internal Controls of Servo Amplifier

50-volt range to terminals 63 and 64 on terminal board. Then adjust the BALANCE control (R-1112) until the system ceases to hunt and the voltage reading is steady. This control is shown in Fig. 3-46.

(36) Place the SLEWING MOTOR switch in one of its 1¼ positions.

(37) Advance the setting of the INPUT GAIN control until the Antenna follows smoothly in both CW and CCW rotation. This can be observed by watching the Bearing Indicator dials.

(38) If the voltage indicated on the meter is fluctuating at 42 cps, adjust the ANTI-HUNT control R-1118 until the rotation is even and smooth and the voltage fluctuation disappears. This control is shown in Fig. 3-46. Again advance the INPUT GAIN control until hunting starts and re-adjust the ANTI-HUNT control as before to stop the hunting. Continue these two adjustments alternately until the optimum point is reached where any further advance of the INPUT GAIN control cannot be compensated by adjusting the ANTI-HUNT control. Disconnect the voltmeter and connect it with a 0.5 mf capacitor in series with one of its leads to terminals 68 and 69 on terminal board E-1101. Adjust the ANTI-HUNT control for minimum voltage.

(39) Reverse the direction of rotation several times in rapid succession. The Antenna should come to a full stop without hunting. With the SLEWING MOTOR switch in its OFF position, the Antenna should follow the HAND SLEW control smoothly and instantaneously. If it does not, repeat all of th adjustments.

(40) Place the ROTATION switch in i or EMERGENCY position. The Antenna shou tate smoothly at approximately 7 rpm.

NOTE

THE FOLLOWING STEPS APPLY ONLY TO MODIFIED SYSTEMS.

(41) Place the ROTATION switch S-804 on the panel of the Bearing Indicator in its NORMAL position. This switch is shown in Fig. 3-42.

(42) With all switches in their OFF position, proceed in adjusting the modified system in the same way as was described for adjusting the unmodified system, in steps (32) through (39) inclusive.

(43) Place the SLEWING MOTOR switch in one of its four rotational positions, and count the revolutions per minute of the Bearing Indicator dials. If the speed is too low, which sometimes occurs as a result of aging of the rectifier units, move the taps on transformer T-1104. The lead normally on tap 4 should be moved to tap 5, and the lead normally on tap 7 should be moved to tap 8.

f. INDICATOR CONSOLE ADJUSTMENTS.

(1) Place the INDICATOR CONSOLE switch S-405 on the panel of the General Control Unit in its ON position. This switch is shown in Fig. 3-42.

(2) Place the ON-OFF switch S-501 on the PPI Indicator in its ON position, and the CENTER EXPAND switch S-502 in its OFF position. See Fig. 3-42.

(3) Turn the RANGE SELECTOR switch S-500 on the PPI Indicator to the point where 200 appears in the window above the switch.

(4) Adjust the FINE INTENSITY R-554 control on the PPI Indicator until the PPI trace is barely visible. Then adjust the FOCUS control R-576 and FINE INTENSITY control until the line is sharp and barely visible.

(5) Turn the VIDEO GAIN control R-559 on the PPI Indicator until echoes appear on the PPI trace. It may be necessary to rotate the Antenna to locate a target.

(6) Rotate the HAND SLEW wheel on the Bearing Indicator and note whether the trace is starting from the center of the face of the PPI tube.

NOTE

AN OSCILLOSCOPE TS-34/AP (SERIES) OR EQUIVALENT, A NAVY MODEL OBQ (SERIES) VACUUM TUBE VOLT-OHM MILLIAMMETER OR EQUIVALENT, AND A RANGE CALIBRATOR TS-358/UP (SERIES) OR EQUIVALENT, ARE REQUIRED FOR ADJUSTMENT OF THE PPI INDICATOR. THE SOURCE OF MARKER VOLTAGE MUST SUPPLY FOUR MARKER PIPS EACH FOR THE 4-, 20-, 80-, AND 200

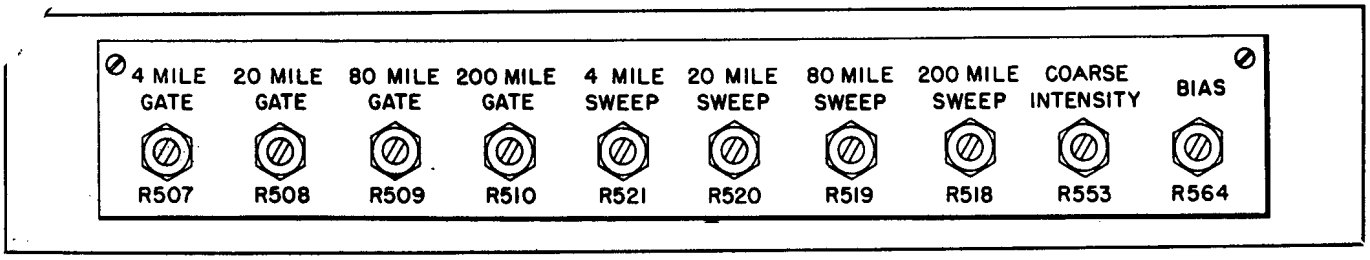


Figure 3-47. PPI Alignment Controls

MILE RANGES. AN ALIGNMENT TOOL, ADJUSTABLE WRENCH AND GLYPTOL ARE ALSO REQUIRED.

(7) Connect a d-c vacuum tube voltmeter between terminal 1 of L-513 and ground. See Fig. 7-151. Adjust potentiometer R-564 until the meter reads —65 volts. This control is shown in Fig. 3-47.

(8) Set the RANGE SELECTOR switch on the 4-mile range, the CENTER EXPAND switch to OFF and the MARKERS control completely off. Turn the FINE INTENSITY control all the way on, and then gradually raise or lower the COARSE INTENSITY control, R-553, on the right side of the chassis, as shown in Fig. 3-47 until a light clean line appears on the scope face. Lock the COARSE INTENSITY control R-553 in this position. Switch the RANGE SELECTOR knob to the other 3 positions successively, lowering the FINE INTENSITY control each time until approximately the same line intensity appears on the scope face. There should be adequate range on the FINE INTENSITY control to accomplish this test and blank the PPI tube on the 200-mile range. If this condition is not obtainable, circuit-check the unit for trouble as directed in Section 7.

(9) Loosen the clamp locks and clamps on the focus coil, L-514, and grasp the handle. The clamp and focus coil adjustment are shown in Fig. 3-48. Rotate the coil until the start of the sweep line is in the center of the tube. The center is located at the end of the etched bearing line over the face of the tube. Re-tighten clamps and locks. It may be necessary to readjust the focus coil after all the other tests have been made.

(10) Apply a 120-200 cps trigger to the equipment and observe the unblanking pulse on the plate of V-501 on an oscilloscope such as the Oscilloscope TS-34/AP (Series) or equivalent. With the Range Selector Switch of the PPI on the 80-mile range, observe how many scale divisions, on the scale over the face of the oscillograph tube, are occupied by a complete repetition cycle, and adjust R-509, Fig. 3-47, until the position pulse occupies one-fifth of the entire repetition cycle.

(11) With the same trigger applied to the equipment, turn the Range Selector to the 200 mile range. Adjust potentiometer R-510 until the positive pulse occupies approximately one-half of the entire repetition cycle (actually 12/25 of it). See Fig. 3-47. Tentatively lock potentiometers R-507, R-508, R-509, and R-510. They will receive final adjustment later.

(12) Adjust potentiometers R-521, R-520, R-519 and R-518 on range positions 4, 20, 80 and 200 miles, respectively, until the sweep length runs out to approximately one-half inch from the edge of the cathode ray PPI tube. Tentatively lock all four controls. These controls are shown in Fig. 3-47.

NOTE

THE ADJUSTMENT DESCRIBED IN STEPS (13) AND (14) IS SEALED AT THE FACTORY. IT SHOULD ***NOT*** HAVE TO BE MADE EXCEPT UNDER MOST UNUSUAL CIRCUMSTANCES.

(13) Using the range calibrator, feed its 1-mile output into video terminals 180A and 01. The I.F. Gain control on the panel of the Console Receiver

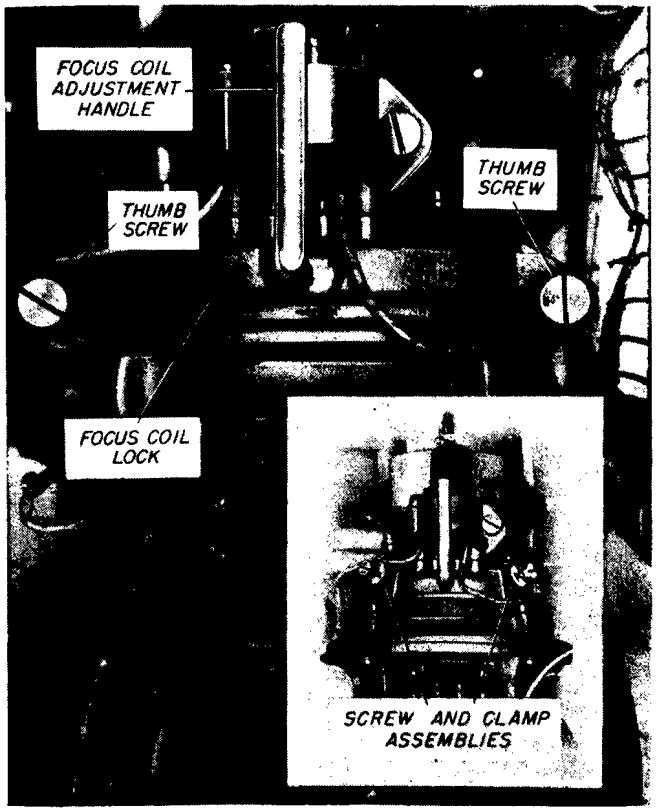


Figure 3-48. PPI Focus Coil Adjustment

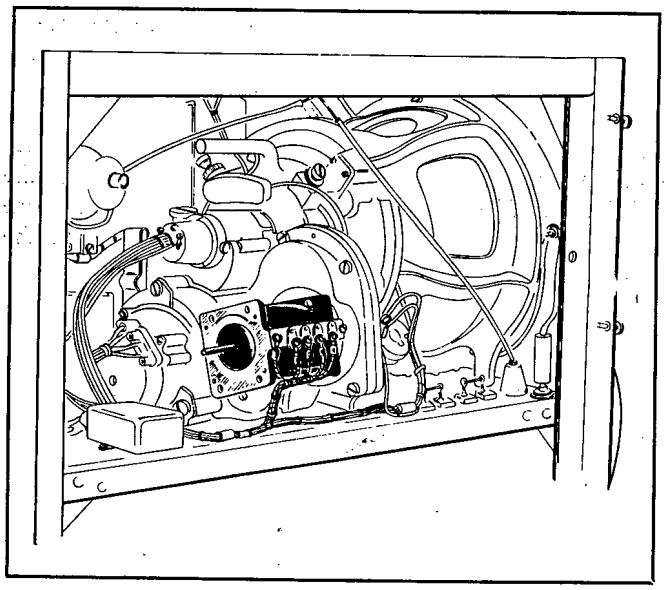


Figure 3-49. PPI Drive Motor

must be set to zero in this case. The MARKERS control on the PPI Scope should be turned off. With the RANGE SELECTOR switch in the 4-mile position, adjust the VIDEO GAIN and INTENSITY controls so that four small dots appear on the face of the scope. Turn the phase shift knob on the calibrator until one dot coincides as closely as possible with the start of the sweep circuit. Now slowly increase the marker output on the PPI scope until 4 more dots appear. These dots should be very close to the original set of dots. If they are not, adjust the screw on inductor L-502 until the two sets of marks coincide as closely as possible. Then, holding the screw at this position, tighten the lock nut and seal the adjustment with glyptol. Check to make sure that the adjustment has not been changed during tightening.

(14) In a similar manner, using appropriate marks from the calibrator, align the 20, 80, and 200 mile ranges by adjusting L-503, L-504 and L-505 respectively.

(15) With a trigger applied, the RANGE SELECTOR switch at 80 miles, the MARKERS control and INTENSITY CONTROL adjusted so that dots appear, adjust potentiometer R-509, shown in Fig. 3-48, so that exactly 4 dots (not counting the center) appear on the face of the tube. Next, adjust potentiometer R-519 so that the fourth dot is about one-half inch from the usable edge of the tube.

(16) Switch the RANGE SELECTOR to 200 miles and adjust potentiometer R-510 so that the fourth dot is at the end of the sweep. Now adjust potentiometer R-518 so that the fourth dot on both ranges coincide when the RANGE SELECTOR is rapidly shifted from 200 to 80. The other dots should also coincide very closely. Repeat this adjustment on the 20-mile range using potentiometers R-508 and R-520, and on the 4-mile range using potentiometers R-507 and R-521. When these adjustments have been made, all of the screwdriver controls on the right side bracket of the scope should be firmly locked. The adjustments just described are shown in Fig. 3-47.

(17) Connect a test oscilloscope between plate 2 of V-514A and ground.

(18) Remove fuse F-501A from its holder. This fuse is the second 3 amp fuse from the left on the front panel. Removing this fuse breaks the O.S.C. circuit to the PPI drive motor.

(19) Place the ON-OFF switch on the PPI Indicator in its ON position.

(20) Rotate the shaft of the PPI drive motor manually approximately 45 degrees from the zero output position as shown on the scope. The drive motor is shown in Fig. 3-49.

(21) Adjust the anti-hunt potentiometer, R-590, for minimum amplitude on the oscilloscope. Lock the control. This control is shown in Fig. 3-50.

(22) Connect the test oscilloscope between test point J-528 and ground.

(23) Rotate the shaft of the drive motor until the amplitude of the 60-cycle pattern on the test oscilloscope is zero. Note the position of the trace on the PPI scope with respect to the azimuth scale.

(24) Rotate the drivemotor shaft until the trace has moved exactly one degree on the azimuth scale.

(25) Adjust the vertical amplifier on the test oscilloscope until the amplitude of the 60-cycle pattern is exactly two inches.

(26) Replace fuse F-501A and rotate the Antenna. The height of the test pattern should never be less than one inch, or one large square, during the rotation of the Antenna. This indicates that the bearing error at the Indicator does not exceed one-half of one degree.

(27) Watch the PPI sweep while the Antenna is rotating. Reverse the direction of the Antenna several times. The PPI trace should follow the Antenna

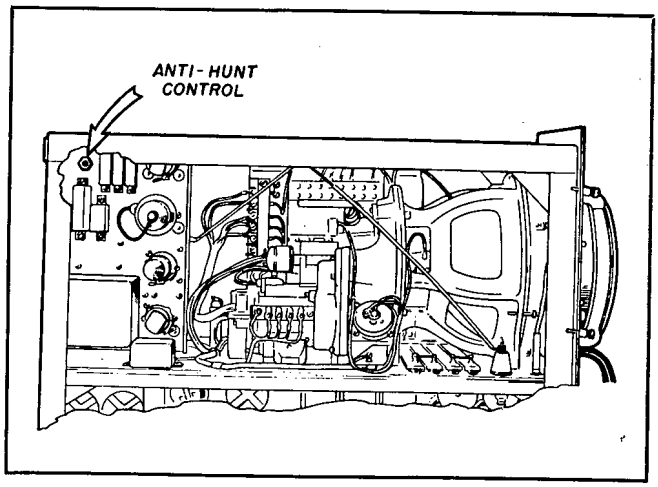


Figure 3-50. Anti-Hunt Control on PPI Indicator

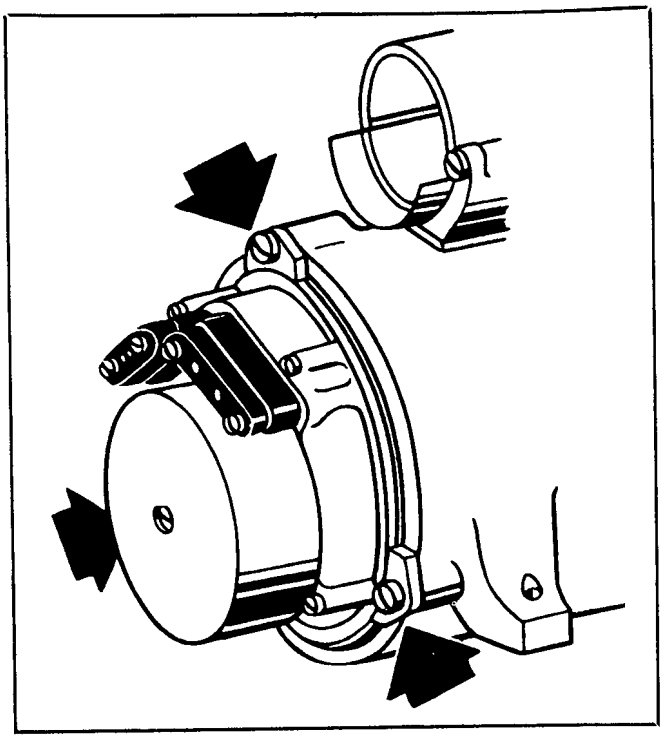


Figure 3-51. Adjustment of Synchro Control Transformer

smoothly with very little jumpiness. If jumpiness is observed, readjust the anti-hunt control, R-590, until the jumpiness disappears.

(28) Stop the Antenna on zero degrees azimuth as indicated by the ship's head marker. Loosen the clamps on the synchro-control transformer B-502 and rotate it until the PPI trace also indicates zero degrees of azimuth. See Fig. 3-51. Tighten the clamps. The indicator will now indicate the position of the Antenna in azimuth.

(29) Adjust the INTENSITY control R-658 until the sweep appears. Then adjust the FOCUS control (R-655) until the line becomes sharp and clean. If there is a vertical step in the sweep line, push the RANGE STEP control in until the switch snaps and the step disappears. The operating controls are shown in Fig. 3-42.

(30) If the sweep line is not three-eighths of an inch above the numbers, adjust the VERTICAL CENTERING control, R-642, until the correct spacing is obtained.

(31) Adjust the HORIZONTAL CENTERING control (R-695) until the line starts directly over the zero on the left side of the screen.

(32) Turn the RANGE switch S-600 until the number 20 appears in the MILES window, and turn the MARKERS switch S-602 to the ON position. These controls are shown in Fig. 3-42. Four markers should appear as vertical pips *below* the sweep line. Each of these markers should fall directly behind the numbers on the range scale on the face of the tube.

(33) If the markers do not fall in the right place, adjust the SWEEP LENGTH control, R-671, until the markers line up with the numbers.

(34) Turn the RANGE SWITCH to each of the other ranges and note whether markers appear. They will not necessarily fall behind the numbers since the SWEEP LENGTH control must be adjusted each time the range is changed. Set the RANGE switch to the 4-mile range and adjust the length of the sweep.

(35) Pull out the RANGE STEP control. A vertical step or break should appear in the sweep line. Turn the RANGE STEP control until the step just touches the left of the 1-mile marker and note the reading on the RANGE YARDS counters. It should be 2,000 yards. Repeat this test for each of the other markers. The markers on the 20 mile range should each be 10,000 yards apart with an allowable error of plus or minus 100 yds. The markers are 20 miles apart on the 80 mile range. Return the RANGE STEP control to its former position.

(36) Advance the I.F. GAIN control on the panel of the Console Receiver until grass, which represents noise, appears on the sweep line of the Range Scope. This control is shown in Fig. 3-42. Adjust the control until the grass is one-quarter of an inch high.

(37) Rotate the HAND SLEW wheel on the Bearing Indicator until a target appears. The target will be a vertical pip above the sweep line.

(38) Adjust the R.F. control on the panel of the Monitor Receiver for maximum target amplitude, with the TIME CONSTANT control S-702 of the Console Receiver in its No. 1 position, and all other controls inside the door on the Console Receiver turned all the way counterclockwise.

(39) Place the CHALLENGE switch (S-901) on the IFF Coordinator (See Fig. 3-42) in its MOMENTARY position. A second line should appear three-eighths of an inch below the numbers.

NOTE

THE FOREGOING STEPS INDICATE THE CORRECT OPERATION OF THE CONSOLE RECEIVER AND THE RANGE SCOPE. IF THE ADJUSTMENTS JUST DESCRIBED CANNOT BE MADE TO PRODUCE THE CORRECT RESULTS IT MAY BE THAT SOME OF THE CIRCUITS REQUIRE ALIGNMENT. IT SHOULD SELDOM BE NECESSARY TO COMPLETELY ALIGN THE RANGE SCOPE. IT IS RECOMMENDED THAT INSTALLATION PERSONNEL REFER TO THE STEPS APPLICABLE TO THE DIFFICULTY THAT IS EXPERIENCED, AND NOT ATTEMPT TO COMPLETELY ALIGN THE RANGE SCOPE EXCEPT WHERE THE PERFORMANCE INDICATES THAT IT IS NECESSARY. THE RANGE MARKER COILS ARE

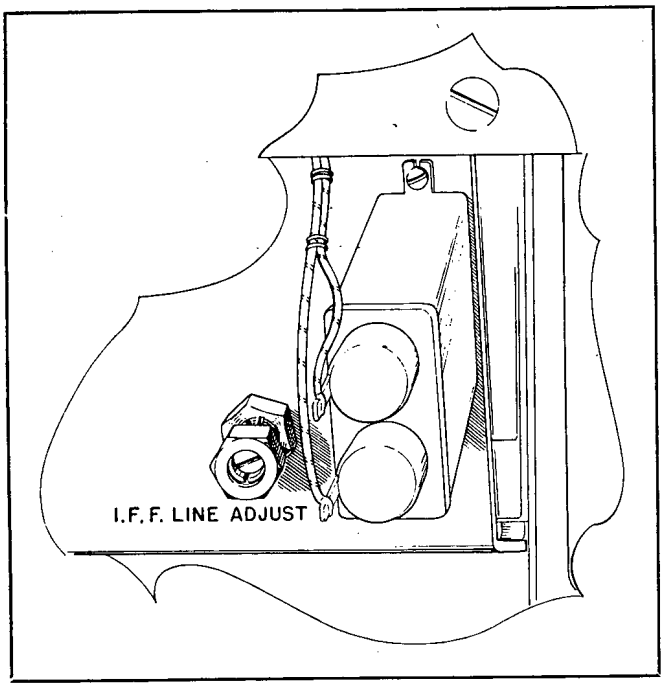


Figure 3-52. IFF Line Adjustment Control in Range Scope

CORRECTLY ADJUSTED AND SEALED AT THE FACTORY AND THEY SHOULD ONLY BE READJUSTED IF NECESSARY IN A MANNER SIMILAR TO THAT DESCRIBED FOR CALIBRATING THE MARKERS IN THE PPI.

(40) If the radar and IFF sweep lines are not sufficiently separated or if the IFF sweep is above the radar sweep, place the CHALLENGE switch shown in Fig. 3-42 in its ON position. The Range Scope chassis must be pulled two-thirds of the way out of the chassis for the remainder of the alignment. Adjust the screwdriver operated IFF LINE ADJUST control R-6026 until the IFF sweep is properly located. This control is on the rear of the righthand deck and is shown in Fig. 3-52.

(41) If the sweep cannot be properly focused, turn the I.F. GAIN control on the panel of the Console Receiver to zero and turn the MARKERS switch S-602 on the panel of the RANGE SCOPE to ON. Adjust the FOCUS BAL. control, R-645, and the FOCUS Control, R-655, alternately to obtain the best definition of the sweep. The FOCUS BAL. control is shown in Fig. 3-53 and the FOCUS control is shown in Fig. 3-42. The ideal adjustment is reached when both the sweep and marker pips are as thin and sharp as possible.

(42) If the RANGE YARD readings do not fall within the tolerance given, the range step must be adjusted. Turn the MARKERS switch ON, and set the RANGE switch to the 4-mile range. Pull out the RANGE STEP control and rotate it until the step

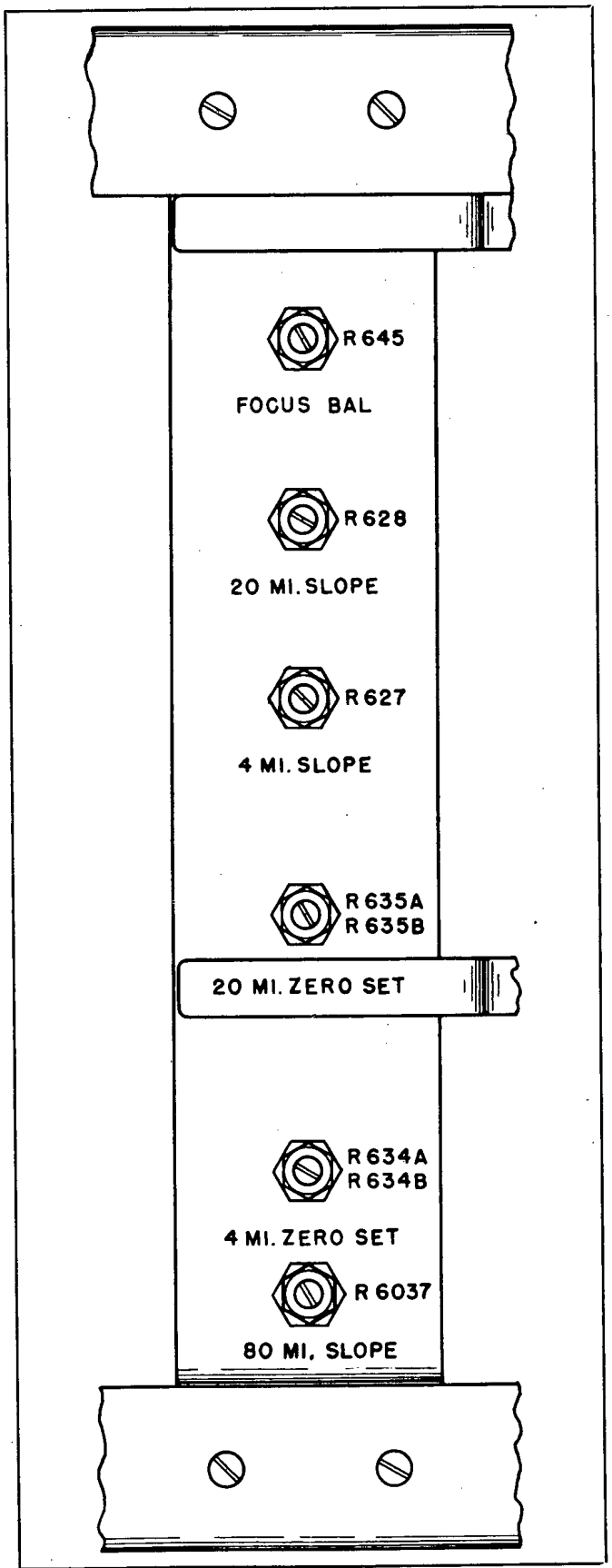
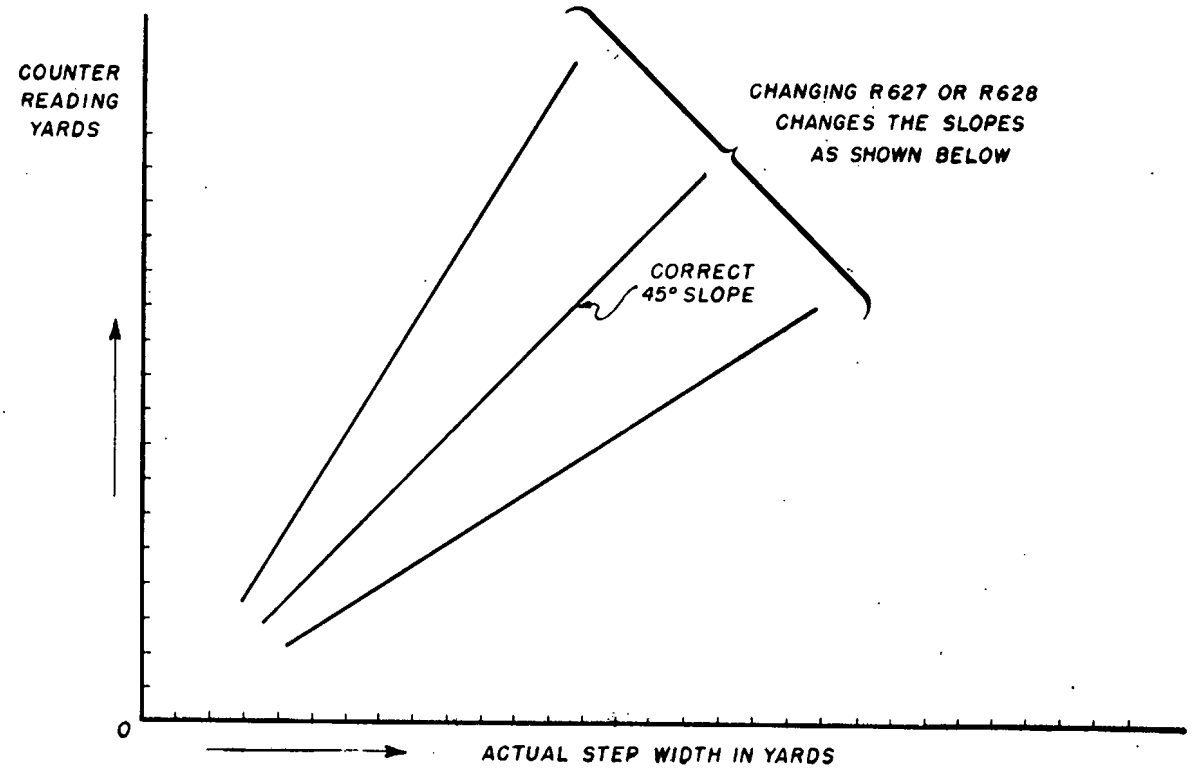


Figure 3-53. Controls on Left Hand Side of Range Scope Chassis



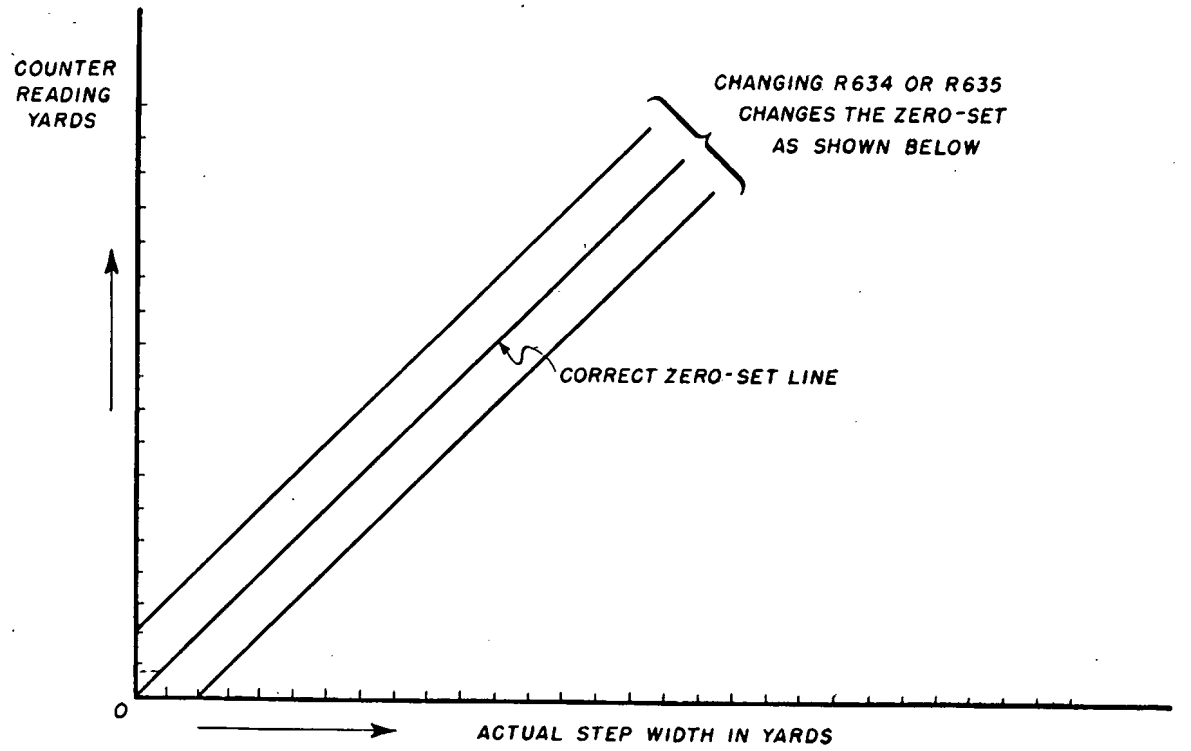


Figure 3-54. Plot of Range vs. Counter Readings

lines up with the left-hand range marker. Record the reading in the RANGE YARDS window. Repeat this operation for each marker. Plot the results graphically as shown in Fig. 3-54. A line drawn through the points on the graph should be straight and should bisect the 90-degree angle formed by the two coordinates of the graph. If it does not, adjust the 4-MILE SLOPE control (R-627) shown in Fig. 3-53 and repeat the test. Continue this procedure until the readings do not vary over plus or minus 100 yards. Repeat this procedure for the 20-mile and 80-mile ranges if necessary, using the 20-MILE and 80-MILE SLOPE controls, R-628 and R-6037, shown in Fig. 3-53. Extend the line on the final graphs to see whether they pass through zero on the graph. See Fig. 3-54. If they do not, either of two methods may be used to make the necessary adjustment. One method is to make a slight adjustment of the 4-MILE ZERO SET control, R-634, for the 4-mile range and the 20-MILE ZERO SET control, R-635, for the 20-mile and 80-mile ranges and replot the graphs, continuing this procedure until the line passes through the zero point on the graph. This is the most accurate method. If it is impossible to obtain a straight line in the graphs, it will be necessary for maintenance personnel to adjust the linearity of potentiometer R-632 or replace it. It is not practical for installation personnel to make this adjustment since special equipment and skill are required.

(43) Another calibration method is to rotate the RANGE STEP control until 10,000 appears on the lower counter. Then adjust the 20-MILE ZERO SET control R-635 shown in Fig. 3-53 until the first marker coincides with the vertical portion of the range step. Now rotate the RANGE STEP control until 30,000 appears in the lower window and adjust the 20 MI. SLOPE control R-628 until the third marker and the vertical portion of the range step coincide. Repeat these two operations until the markers are aligned with the counters. Check the markers at 20,000 and 40,000 yards. If they are in error over ± 100 yards the helipot must be adjusted or changed. See Section 7. Place the RANGE SELECTOR switch in its 4-mile position, and rotate the RANGE STEP control until 10,000 appears in the window. Then adjust the 4-MI. ZERO SET control R-634 shown in Fig. 3-53 until the first marker and range step coincide. Next, rotate the RANGE STEP control until 30,000 appears in the lower window and adjust the 4-MI. SLOPE control R-627 until the third marker and the range step coincide. Place the RANGE SELECTOR switch in its 80-mile position and rotate the RANGE STEP control until 40,000 appears in the lower window. Adjust the 80-MI. SLOPE control R-6037 until the fourth marker coincides with the range step.

(44) If an SR-a radar system is being considered, it may be necessary, in order to obtain satisfactory operation of the Range Scope, to adjust the amplitude of the trigger supplied from the Transceiver. The amplitude of this trigger is adjusted by means of potentiometer R-116, located on the lower left-hand side of the Transceiver. This potentiometer is visible with the side shield of the Transceiver removed. Increase the trigger amplitude until the sweep on the Range Scope becomes steady.

(45) Rotate the HAND SLEW wheel and note the movement of the PPI trace. It should rotate in synchronism with either the TRUE BEARING dial or the RELATIVE BEARING dial, depending upon the type of operation in use.

(46) Turn the SLEWING MOTOR switch, shown in Fig. 3-42 to all of its different positions. In relative bearing operation the PPI trace should revolve at 1¼ and 5 rpm for the corresponding positions of the dial.

(47) Adjust the ROTATION switch to the PPI-OR-EMERGENCY position. The PPI trace and the dials should rotate at approximately 7 rpm.

(48) If the speed of the slewing motor is fast or slow, it may be adjusted by changing the taps on transformer T-801. The wires connected to terminals 6 and 7 should be placed on smaller numbered terminals in the same order to increase the speed. They should be moved to higher numbers to decrease the speed. If the Indicator Console has been in use at some other installation and is being re-installed, this adjustment should be checked because the speed decreases as the dry disc rectifiers in the Bearing Indicator age.

(49) If the Range Scope does not show two sharp well defined lines when the CHALLENGE switch is operated, and the trouble cannot be corrected in the Range Scope, connect a vacuum tube voltmeter to the arm of the BIAS ADJUST Control R-944. The location of this control is shown in Fig. 3-55.

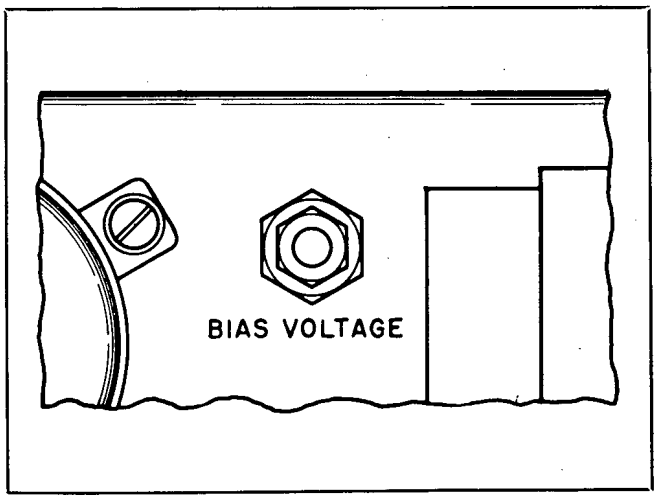


Figure 3-55. Bias Voltage Control on IFF Coordinator

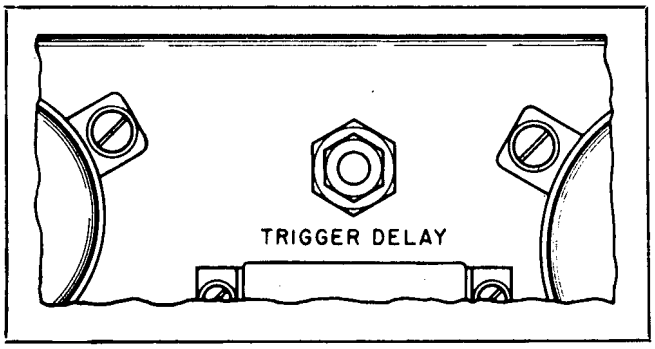


Figure 3-56. Trigger Delay Control on IFF Coordinator

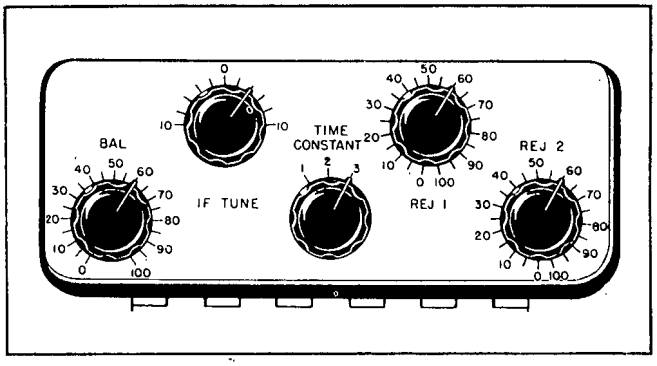


Figure 3-57. Console Receiver Anti-Jam Controls

(50) Adjust the BIAS ADJUST control until the meter reads —85 volts.

(51) Train the Antenna on a friendly ship or aircraft equipped with IFF equipment, and place the CHALLENGE switch in its ON position. The IFF response pip should appear directly below the radar target pip. If it does not, adjust the IFF REC. GAIN control, R-934, for an amplitude that is easily visible. Then adjust the TRIGGER DELAY control, R-917, until the IFF pip is directly under the radar pip. Lock the control. This control is shown in Fig. 3-56.

(52) If a source of jamming signals is available, pick up a CW or MCW jamming signal with a radar target and with the BAND PASS control in its BROAD position, adjust the controls REJ 1 and REJ 2 for a maximum reduction of the reading on the JAMMING INDICATOR meter. These controls are shown in Fig. 3-57. A large saturated signal should appear on the Range Scope. Adjust the BAL video control, shown in Fig. 3-57, until the amplitude of the large signal is reduced to the base line and only the radar video signal is left.

(53) Readjust the BAL VIDEO control until the jamming block is again visible, with the TIME CONSTANT control in position 1. Turn the control to position 2. The blocking pulse should build up quickly on the Range Scope screen and decay at a slow rate. Turn the control to position 3. The blocking pulse should build up to full height almost instantaneously and then drop to about half of its initial height and remain there for the duration of the pulse. Return the TIME CONSTANT control to position 1.

(54) Turn the BANDPASS control from its BROAD to its MEDIUM position and adjust the I.F. TUNE control for maximum signal amplitude. Repeat this operation for the SHARP position. Unless the jamming signal frequency is the same as the radar transmitter frequency, these controls should greatly reduce the effect of the jamming signal. These controls are shown in Fig. 3-57.

(55) Completely recheck the operation of the equipment. It should now be properly installed and ready to turn over to operating personnel.

SECTION 4

OPERATION

1. GENERAL.

a. The instructions in this section describe the use of controls normally required to operate the equipment. Two types of operation are described. Both types are similar except that in LOCAL operation the controls are all operated at each component. In REMOTE operation, most of the functions are controlled from the Indicator Console. The steps required to operate the SR Equipment and the SR-a Equipment are both given. The methods are identical except for the steps involved in starting the Transceiver and Modulator. Both methods assume that the Transceiver is properly aligned and operating on the correct frequency. However, since it is the duty of operating personnel to keep the equipment tuned, the tuning procedure is also given.

2. STARTING THE EQUIPMENT.

a. ENERGIZING POWER EQUIPMENT.

(1) Place the Controller Disconnect Line Switch in its ON position. This makes the ship's d-c power available to the motor starting circuits.

(2) Push the START switch on the Pushbutton Station. This switch energizes the Magnetic Controller and starts the motor on the Motor-Generator. If the overload device trips it may be reset by pressing the Reset button. See Fig. 4-1. In the later SR Equipment resetting occurs automatically when the START button is pressed.

(3) Place switch S-1461 shown in Fig. 4-2 in its AUTO position and read the meter on the Voltage Regulator. It should indicate 120 volts. If it does not, adjust the VOLT ADJ RHEO control R-1462 until it does. See Fig. 4-2. If manual voltage regulation is desired place switch S-1461 in its MAN position and regulate the voltage with rheostat R-1466.

b. ENERGIZING THE SR RADAR SYSTEM.

(1) Place the EMERGENCY MAIN POWER switch S-101 in its ON position. See Fig. 4-3. The MAIN POWER ON and FILAMENT ON lamps should glow. Five seconds must elapse before the POWER ON switch is operated.

(2) Place the CONTROL switch S-107 in the position desired. If the LOCAL position is used, the rest of the Transceiver power circuits are energized at the Transceiver and the steps in the remainder of this paragraph are used. If REMOTE operation is used, the rest of the Transceiver power circuits are energized at the General Control Unit in the Indicator Console. In this case use the POWER, PLATE VOLTAGE, and RADIATION switches on the General Control Unit instead of the ones on the Transceiver. When LOCAL control operation is used, the LOCAL CONTROL lamps on the Transceiver and the General Control unit are illuminated.

(3) In the unmodified SR Equipments, place the PULSE LENGTH switch S-158 on the Keyer Unit in the desired position. See Fig. 4-4. The 20 position is used on long range targets, the 4 position is used on short range targets and the 1 position is used at extremely close ranges and when better definition is desired where two or more targets are closely spaced.

(4) Adjust the FILAMENT VOLTAGE control

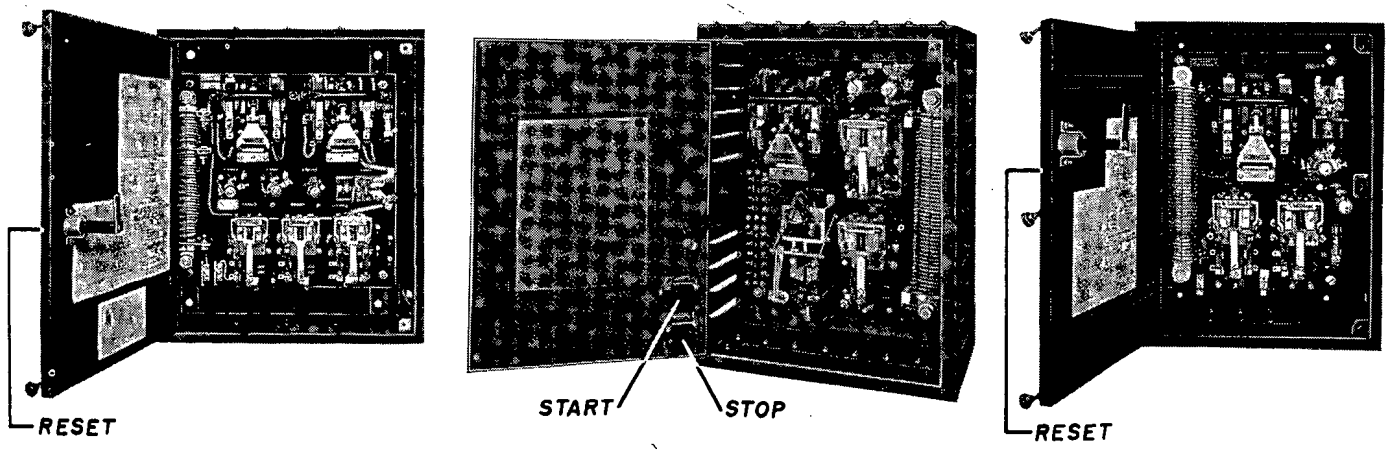


Figure 4-1. Magnetic Starters

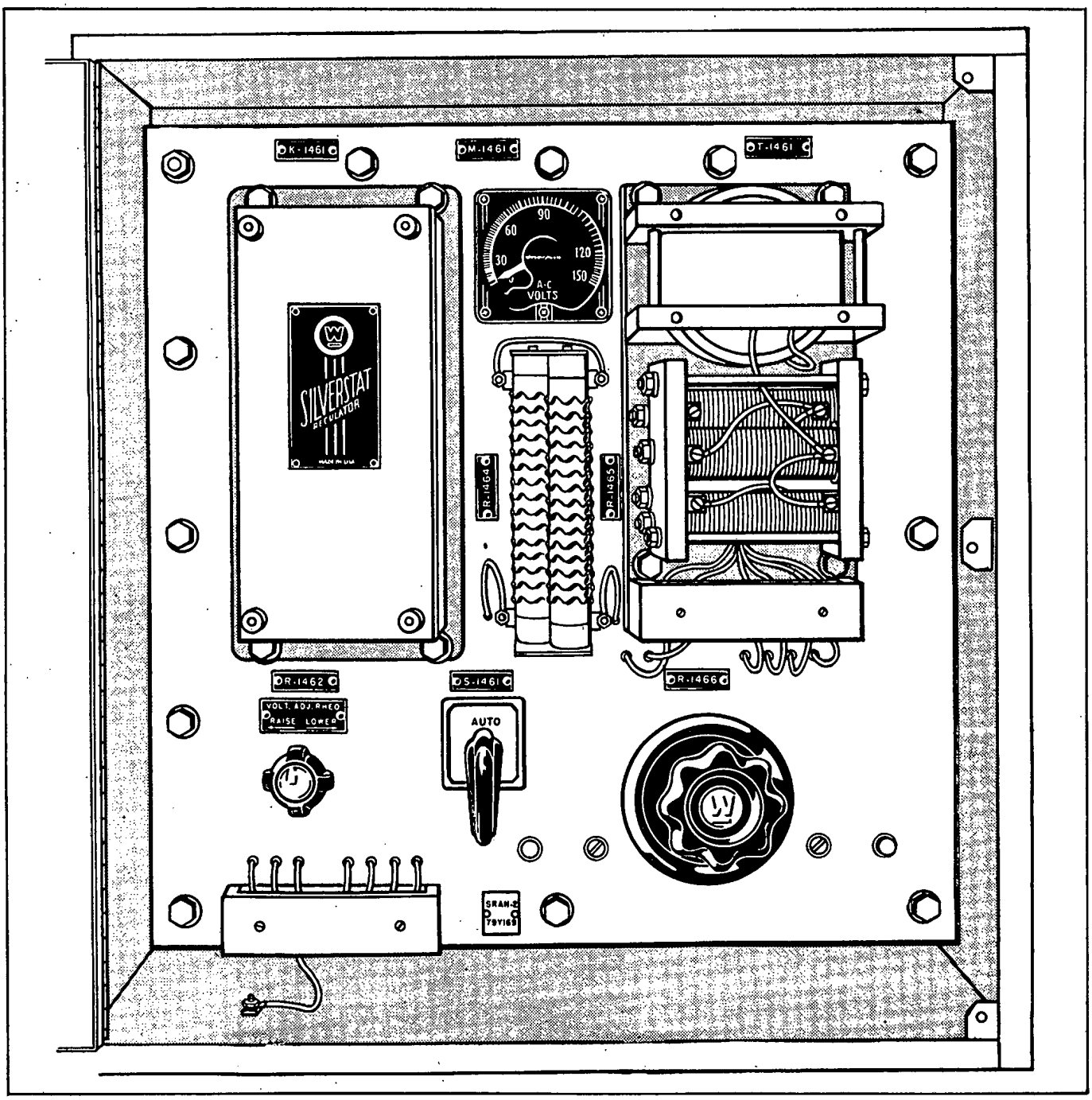


Figure 4-2. Voltage Regulator, Operating Controls

T-106 until the FILAMENT VOLTAGE meter M-106 indicates 10 volts. These controls are shown in Fig. 4-3.

(5) Press the POWER ON switch S-103. The PLATE VOLTS lamp should glow.

(6) Press the RAISE switch S-105, holding it in until the PLATE VOLTAGE meter M-103 indicates five kilovolts. These controls are shown in Fig. 4-3.

(7) Place the ON-OFF switch on the Monitor Scope in its ON position. This switch is shown in Fig. 4-5.

(8) Place the INDICATOR CONSOLE switch in its ON position. This control is shown in Fig. 4-6.

(9) Place the ON-OFF switch S-501, on the PPI Indicator in its ON position. See Fig. 4-7.

(10) Place the RADIATION switch S-108 in its ON position. The indication on the PLATE VOLTAGE meter M-103 should increase to 11 kilovolts and the TRANSMITTER ON lamp I-402 on the General Control Unit should glow.

(11) Place the ON-OFF switch S-201 on the Monitor Receiver in its ON position. See Fig. 4-10.

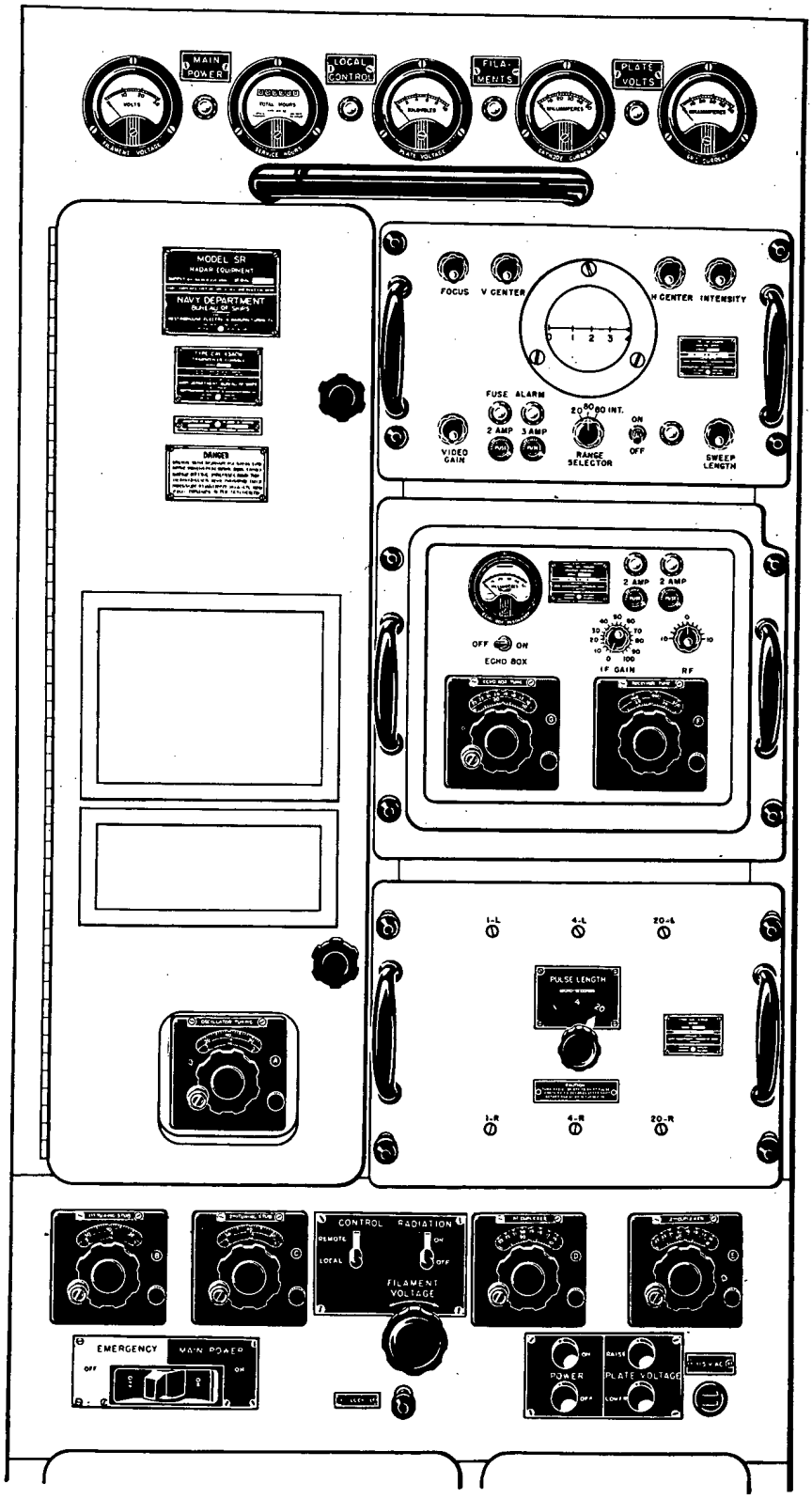


Figure 4-3. Transceiver, Operating Controls

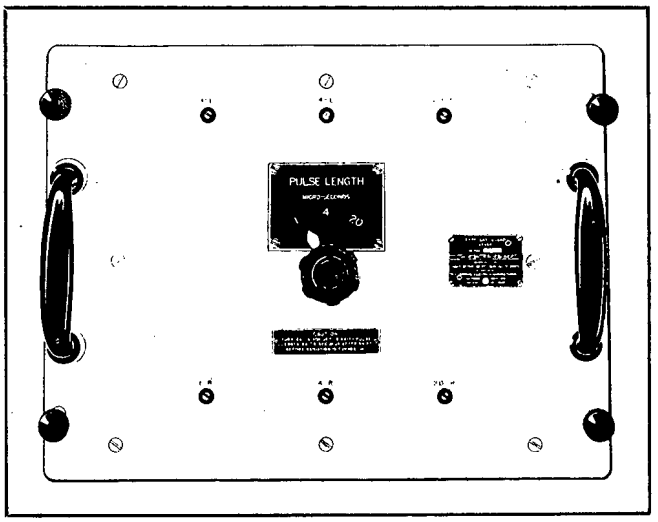


Figure 4-4. Keyer Unit, Operating Controls

If Echo Box is modified tune the ECHO BOX TUNE control for a sharp dip on the Echo Box Meter. If it is not modified tune for Maximum Meter deflection. Determine transmitter frequency from calibration chart for ECHO BOX TUNE Control. If the transmitter is off, frequency tune it as directed in Par. 5 of this section.

(12) Record all meter readings in the log. The following meter readings are normal to a reasonably close approximation.

PULSE LENGTH	PLATE VOLTS	CATHODE CURRENT	GRID CURRENT
20 us	11 kv.	35-55 ma.	10-13 ma.
4 us	11 kv.	30-40 ma.	6- 9 ma.
1 us	11 kv.	15-25 ma.	2- 4 ma.

(13) To stop operation, place all switches in their OFF positions.

c. ENERGIZING THE SR-a RADAR SYSTEM.

(1) Energize the power equipment as directed in Par. 2a of this section.

(2) Place the EMERGENCY MAIN POWER switch S-101 in its ON position. This control is on the Transceiver as shown in Fig. 4-3. The MAIN POWER ON and FILAMENT ON lamps should glow.

(3) Place the CONTROL switch S-107 shown in Fig. 4-3, in the position desired. See Par. 2b(2) of this section.

(4) Adjust the FILAMENT VOLTAGE control T-106 until the FILAMENT VOLTAGE meter indicates 10 volts. These controls are shown in Fig. 4-3.

(5) Five minutes must elapse between the performance of step (2) and the operation of the POWER ON switch. After this time has elapsed, the time delay relay in the Modulator closes its contacts and the POWER ON switch S-103 may be pressed. The PLATE VOLTS lamp I-104 should glow. These controls are shown in Fig. 4-3.

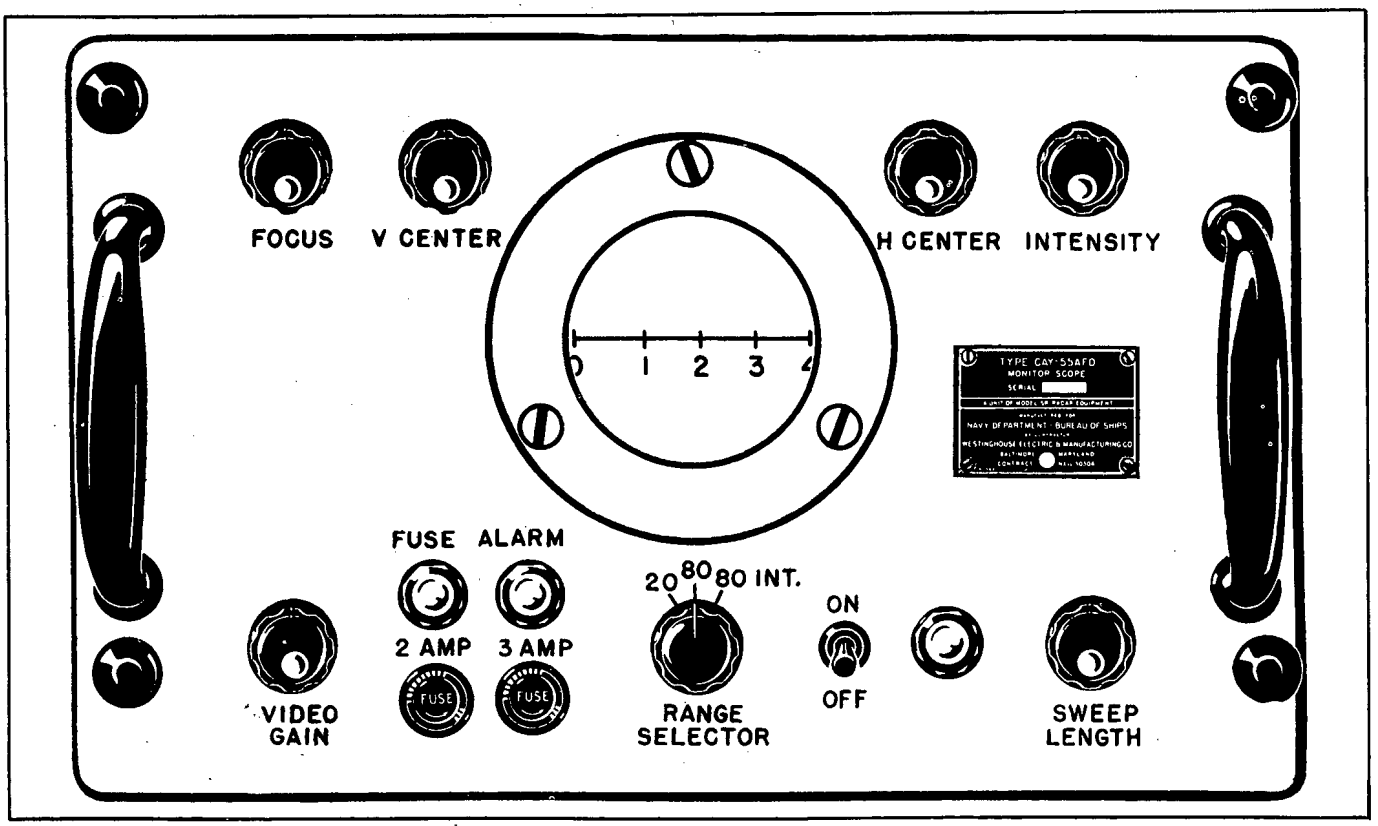


Figure 4-5. Monitor Scope, Operating Controls

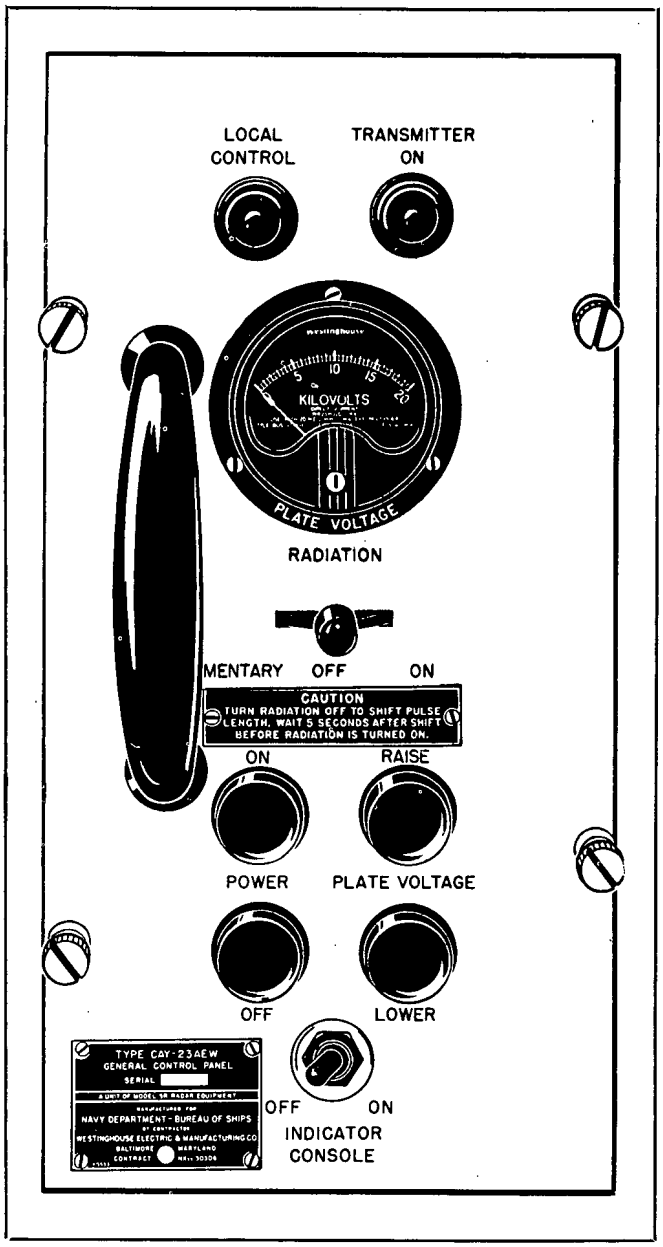


Figure 4-6. General Control Unit, Operating Controls

(6) Place the RADIATION switch S-108 in its ON position. See Fig. 4-3. The TRANSMITTER ON lamp on the General Control Unit should glow.

(7) Press the RAISE switch S-105, holding it in until the PLATE VOLTS meter M-103 indicates five kilovolts. This indicates that 15 kilovolts is being applied to the plates of the Transmitting oscillators. Measure the frequency as described in Par. 5*b* of this section. If the overload relay trips before the plate voltage reaches five kv. retune the transmitter as described in Par. 5 of this section.

(8) Read and record the meter readings. The following meter readings are typical. If the meter readings differ radically from those given or if the transmitter does not oscillate see Par. 5 of this section.

PLATE VOLTAGE	PLATE CURRENT	CATHODE CURRENT
5 kv.	20-30 ma.	4-8 ma.

(9) Place the ON-OFF switches on the Monitor Scope and the PPI Indicator in their ON positions. Then place the INDICATOR CONSOLE switch in its ON position. See Par. 2b of this section.

d. ENERGIZING ANTENNA POSITIONING SYSTEM.

(1) Place the SYNCHRO SYSTEM switch S-1105 on the Rotation Control Unit in its A.C. or O.S.C. position, depending upon whether true or relative bearing information is desired. This control is shown in Fig. 4-8.

(2) Place the SERVO-GEN. MOTOR circuit breaker K-1108, the ANT. TRAIN MOTOR circuit breaker K-1107 and the REMOTE INDICATOR switch S-1104 in their ON positions.

(3) Place the ON-OFF switch S-1101 in its ON position. This control is shown in Fig. 4-8.

(4) Place the SYNCHRO AMPLIFIER POWER switch on the Synchro Amplifier in its ON position. The red POWER lamp on the Synchro Amplifier should glow. These controls are shown in Fig. 4-9. The antenna positioning system is now energized and ready for operation.

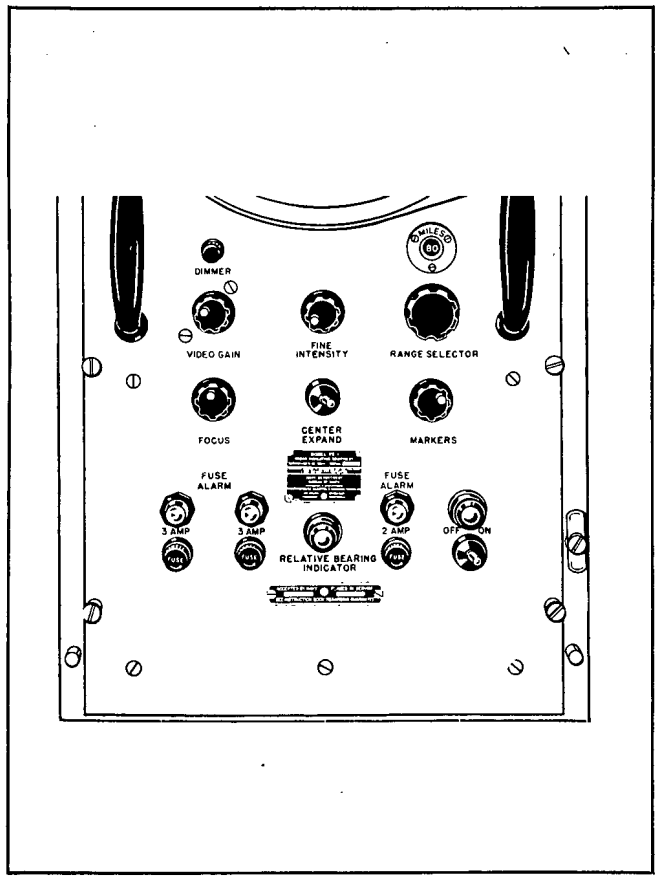


Figure 4-7. PPI Indicator, Operating Controls

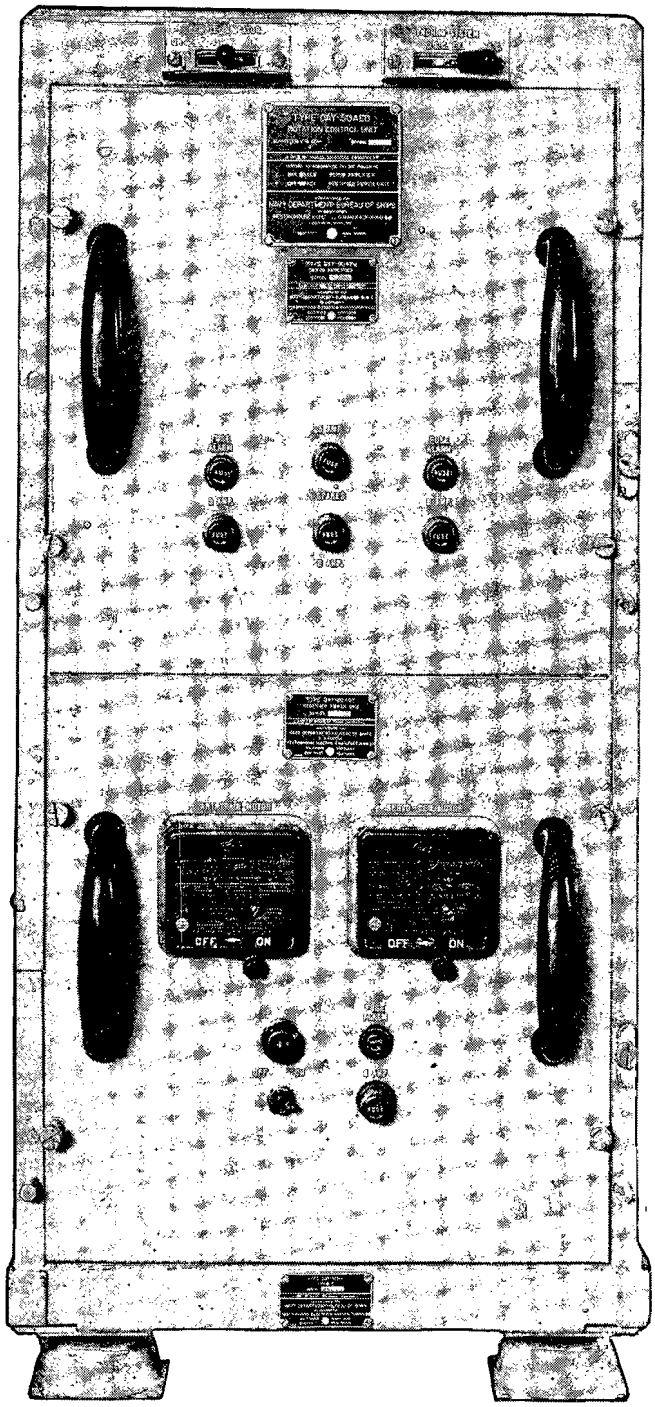


Figure 4-8. Rotation Unit, Operating Controls

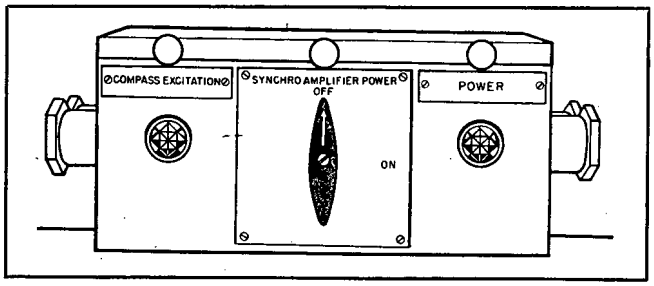


Figure 4-9. Synchro Amplifier, Operating Controls

3. PRE-OPERATION CHECKS AND ADJUSTMENTS.

a. GENERAL.

(1) The procedures in Par. 2 of this section apply power to the entire SR and SR-a Equipments. When they have been performed, the system is radiating and requires only a pre-operation check before commencing actual operation. The pre-operation checks consist of checking the adjustments of all operating controls that, once adjusted, normally require no further attention during routine operation. The procedure for these controls is given in the next paragraph.

b. ADJUSTMENT OF OPERATING CONTROLS.

(1) Adjust the FOCUS control R-331, and the INTENSITY control R-328 alternately for best definition and clarity of the sweep. These controls are shown in Fig. 4-5.

(2) Referring to Fig. 4-5, adjust the V CENTER control, R-324, until the sweep on the Monitor Scope coincides with the etched line.

(3) Adjust the H CENTER control R-322 until the start of the sweep coincides with the zero etched on the screen. See Fig. 4-5 for the location of this control.

(4) Adjust the SWEEP LENGTH control R-313 until the sweep length is equal to the length of the etched line.

(5) Place the RANGE SELECTOR switch S-301 in its 20 position.

(6) Adjust the RECEIVER TUNE CONTROL (F) and the R.F. control on the Monitor Receiver for best appearance of targets on the Monitor Scope. See Fig. 4-10. Adjust the VIDEO GAIN control R-342 for the desired amplitude on the Monitor Scope.

(7) Adjust the I.F. GAIN control on the Monitor Receiver for approximately one-quarter to one-half inch grass on the Range Scope in the Indicator Console. See Fig. 4-10.

(8) Turn the I.F. GAIN control on the Console Receiver to the minimum, or zero position. See Fig. 4-11. Set the PPI MARKERS and ECHO BOX switches on this same unit to OFF.

(9) Turn the VIDEO GAIN and MARKERS controls on the PPI Scope to maximum counterclockwise position. Also, place the CENTER EXPAND switch in its left-hand position so that the trace on the tube begins at the very center of the tube face. These controls are shown in Fig. 4-7.

(10) The SLEWING MOTOR switch on the Bearing Indicator should be in the OFF position, and the ROTATION switch in the NORMAL position. See Fig. 4-12.

(11) Place the CHALLENGE switch in its OFF position. See Fig. 4-13.

(12) A fine horizontal line should be observed on the face of the range scope tube. This line runs horizontally across tube and should appear just above

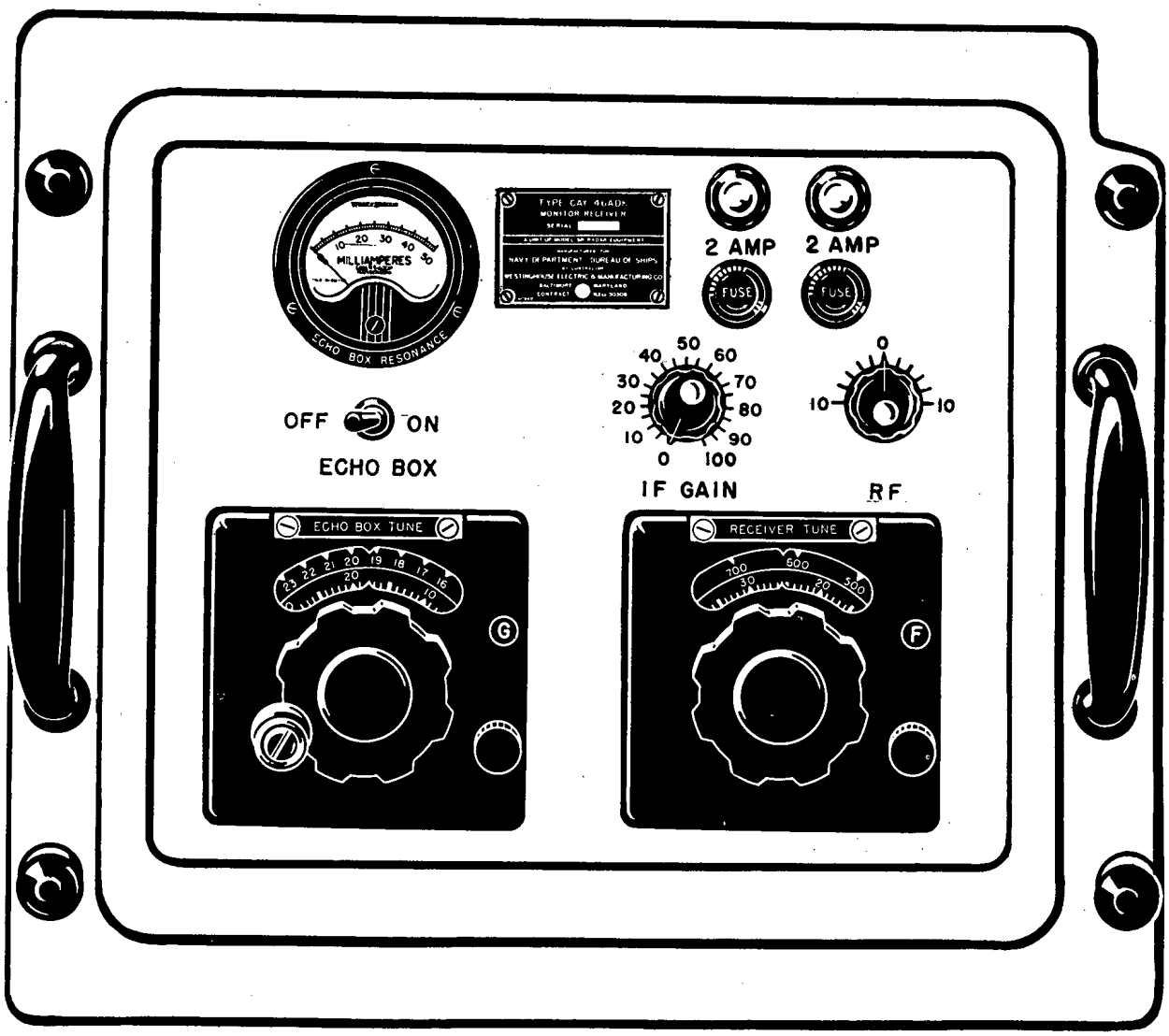


Figure 4-10. Monitor Receiver, Operating Controls

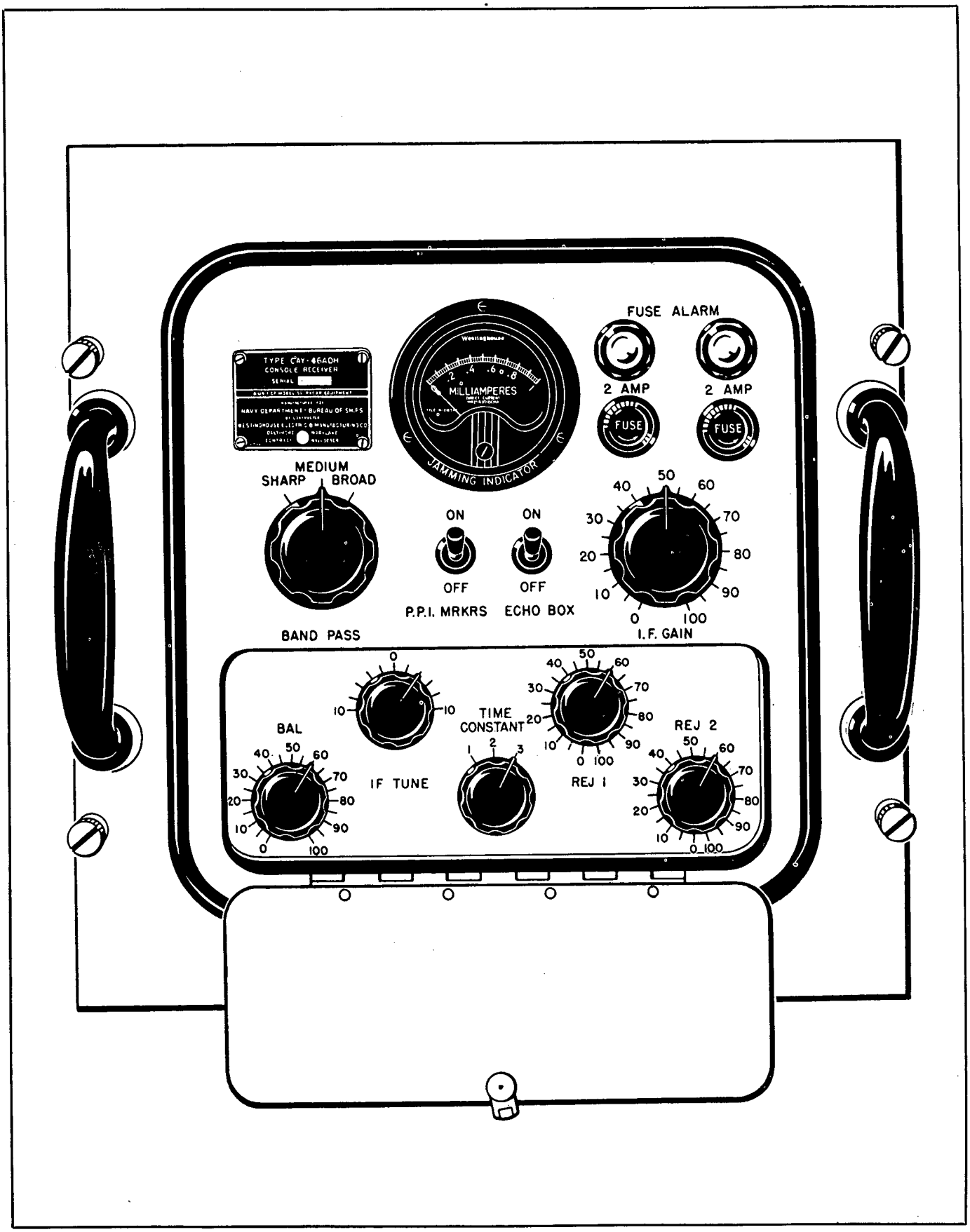


Figure 4-11. Console Receiver, Operating Controls

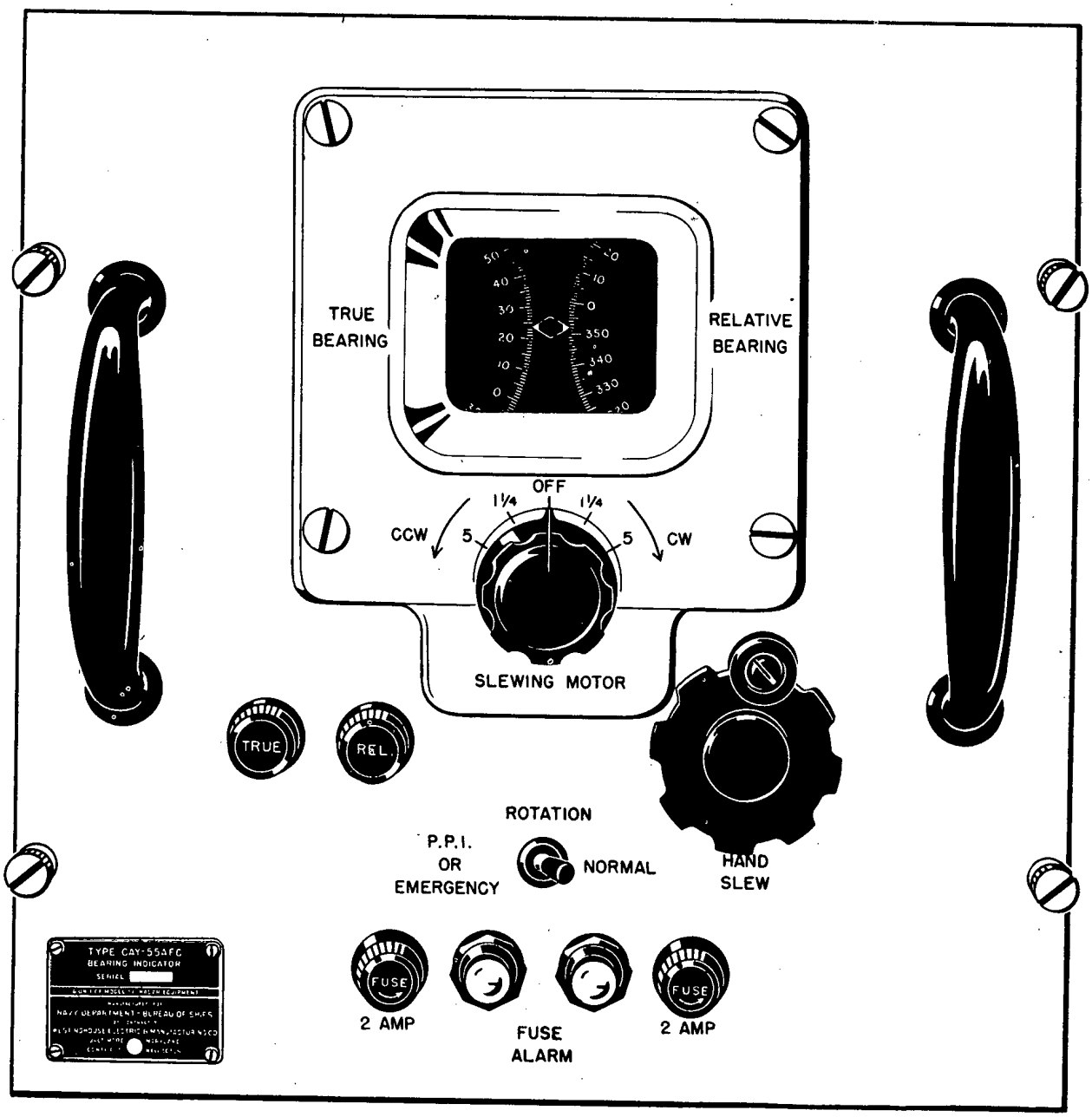


Figure 4-12. Bearing Indicator, Operating Controls

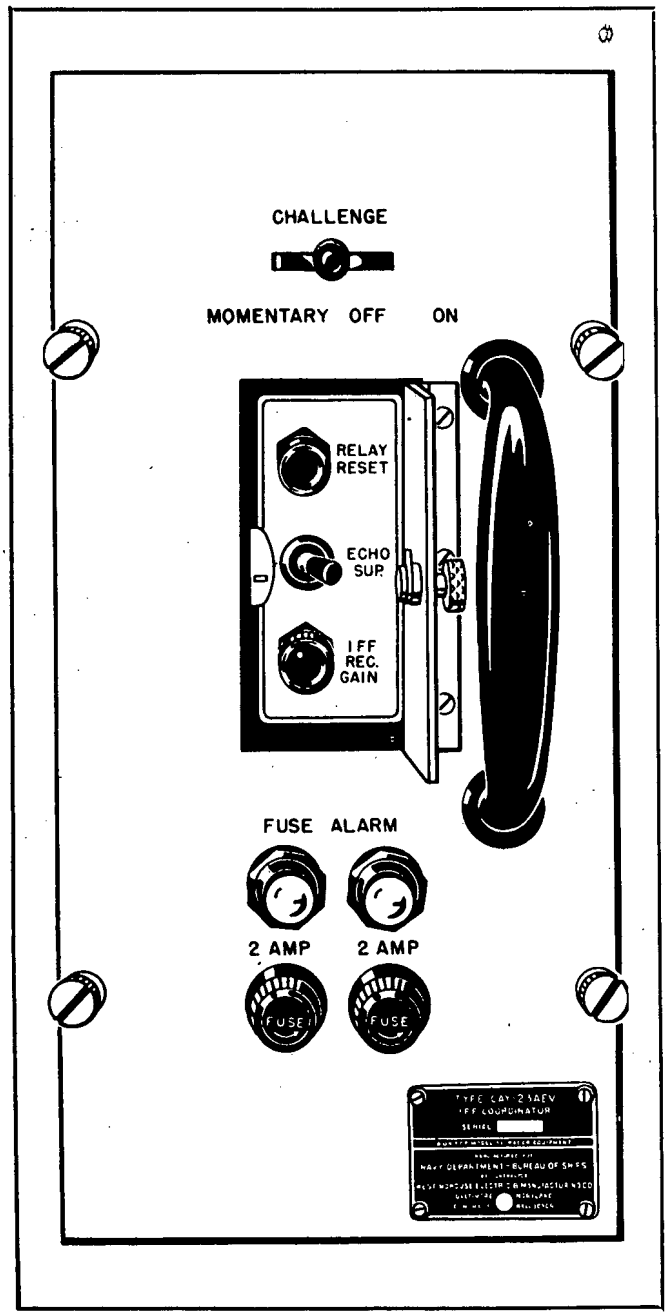


Figure 4-13. IFF Coordinator, Operating Controls

the top set of figures engraved on the transparent window over the front of the range scope cathode ray tube. See Fig. 4-14. If this line does not appear, the INTENSITY control, shown in Fig. 4-14, must be adjusted until the line appears with normal brilliance. If the line is fuzzy, the FOCUS control should be regulated until the line is sharp, and well defined. Sometimes it is necessary to operate the INTENSITY and FOCUS controls together until a sharp, clean line is present on the tube face. If there is a vertical step on the sweep line, this indicates that the phantastron is running. It should be turned off by pushing the RANGE STEP switch in. See Fig. 4-14.

(13) The start of the sweep on the left-hand side of the tube face should be centered directly over the zero figure on the scale. If the line does not start directly above the zero figure, it may be shifted laterally on the face of the tube with the HORIZONTAL CENTERING control shown in Fig. 4-14. If the sweep line is not three-eighths of an inch above the numbers, it may be moved vertically with the VERTICAL CENTERING control shown in Fig. 4-14. After adjusting these two controls, the line should appear just above the top row of numbers. The left-hand starting point of the line should be directly above the center of the zero figure.

(14) The sweep length should be checked next. Set the RANGE SWITCH shown in Fig. 4-14, so that the number 20 appears in the small window indicated as MILES on the panel and is directly above the RANGE switch. This places the Range Scope on the 20-mile range. Turn the MARKERS switch on the ON position. See Fig. 4-14. Four markers should appear as vertical pips below the sweep line. Each of these should fall behind one of the figures on the scale over the face of the tube as shown in Fig. 4-15. If they do not fall behind the figures, the SWEEP LENGTH control shown in Fig. 4-14, should be turned until all four markers line up. Turn the RANGE SWITCH to the 4-mile, 80-mile and 200-mile ranges and make certain that the markers appear. They will not necessarily fall behind the numbers on the other ranges. This check is made to make certain that the markers are present on all of the four ranges. It is necessary to adjust the SWEEP LENGTH control each time the range is changed during operation.

(15) With the MARKERS switch still in the ON position and the equipment on the 20-mile range, pull out the RANGE STEP control. This control is shown in Fig. 4-14. A vertical break, or step, should appear on the sweep line as shown in Fig. 4-16. Crank the RANGE STEP handle until the break just touches the left-hand side of the first, or 5-mile marker. This is the marker just at the Figure *1* on the lower scale which indicates 10,000 yards or five nautical miles. Read the RANGE YARDS counters shown in Fig. 4-14; they should indicate 10,000 yards. Repeat this operation with the other markers. ALL RANGE COUNTERS should read correctly to within 100 yards on all marker points. Turn the RANGE SWITCH to the 4-mile and 80-mile ranges and repeat this check of the RANGE STEP on these ranges. If the range counters do not indicate to the required accuracy, the phantastron circuit should be adjusted as described in Section 3 or Section 7.

CAUTION

DO NOT ATTEMPT TO FORCE THE RANGE STEP CONTROL BEYOND ITS LIMITS. TURN CONTROL SLOWLY WHEN NEARING THE END OF ITS

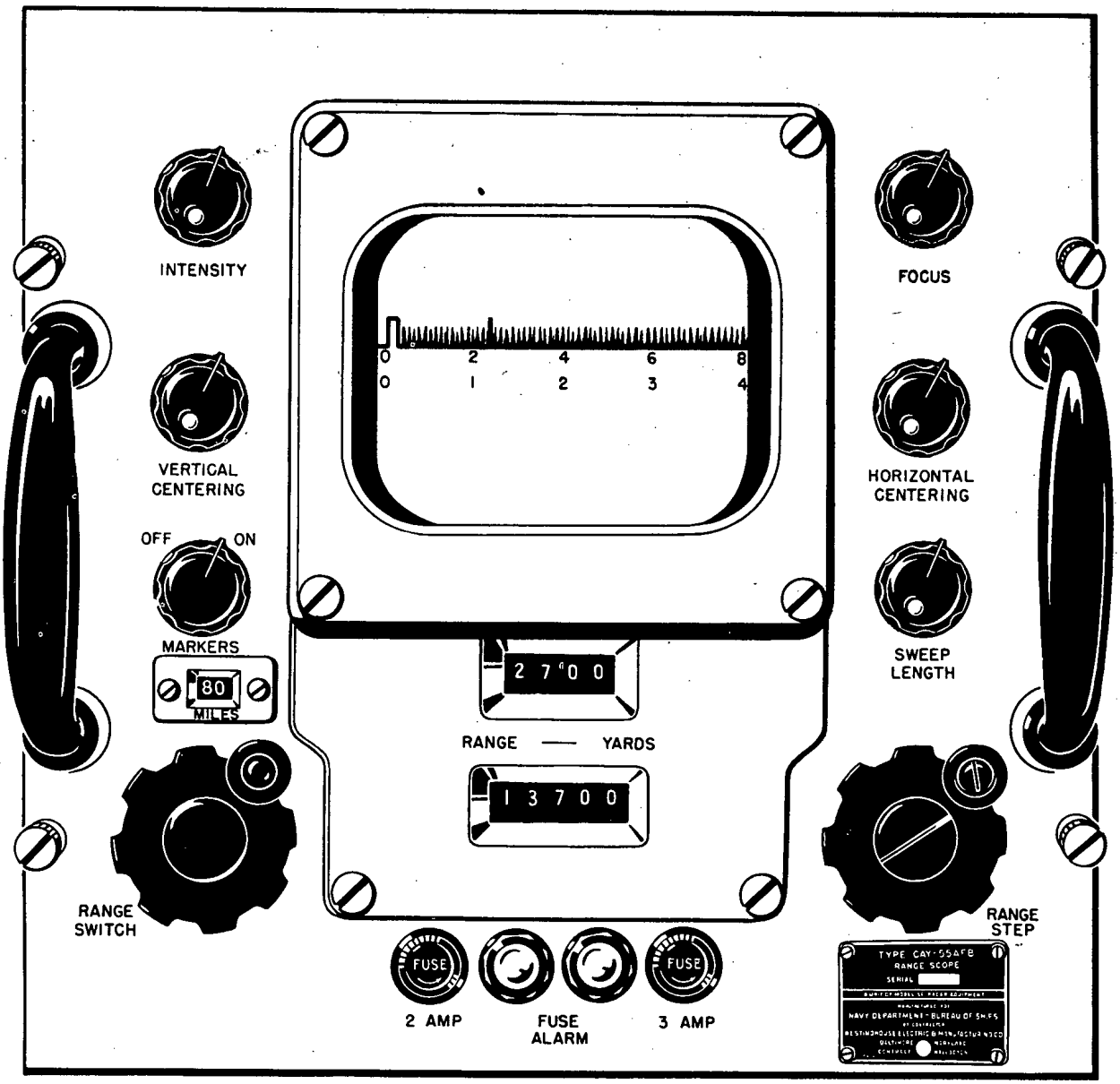


Figure 4-14. Range Scope, Operating Controls

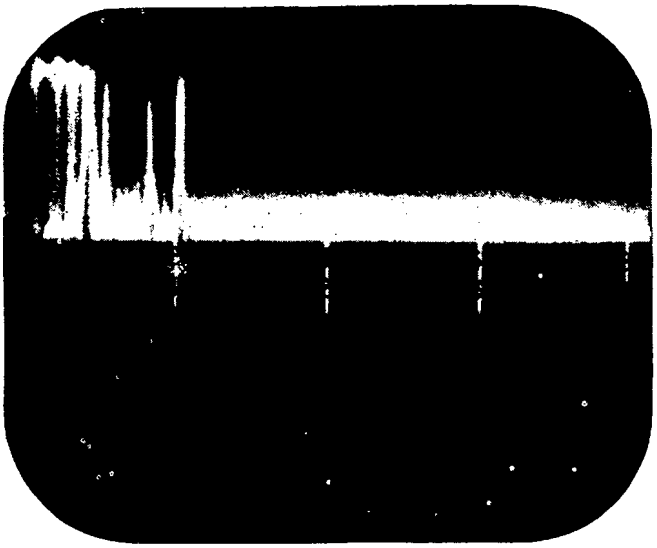


Figure 4-15. Range Markers on Range Scope

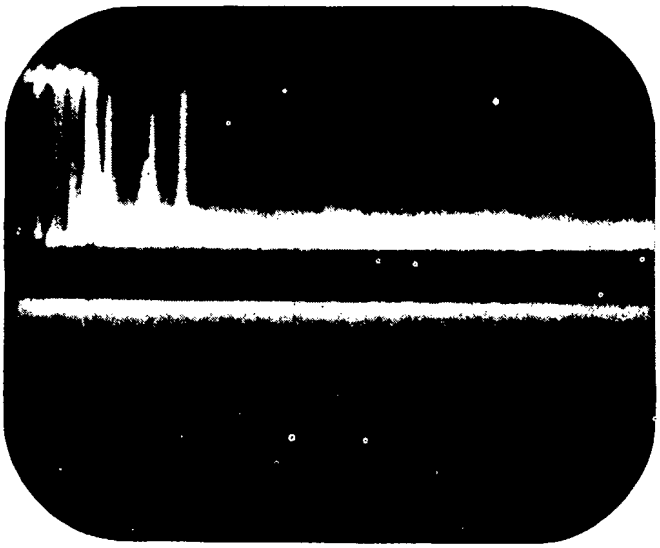


Figure 4-17. IFF Sweep on Range Scope

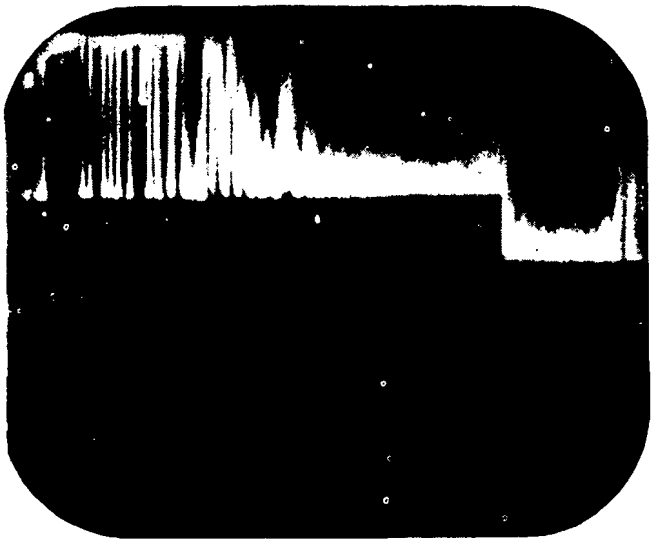


Figure 4-16. Range Step on Range Scope

Figure 4-18. IFF Target on Range Scope

TRAVEL SO AS NOT TO FORCE IT AGAINST THE STOPS. FAILURE TO OBSERVE THIS CAUTION WILL RESULT IN SERIOUS DAMAGE.

(16) Turn off the range step by pushing the RANGE STEP control in towards the panel and turn off the MARKERS switch. Adjust the CHALLENGE switch shown in Fig. 4-13, to the MOMENTARY position. Hold it there for a moment and observe the pattern on the Range Scope. A second line should appear about three-eighths of an inch below the numbered scale as shown in Fig. 4-17. If it does not appear, or if it is not in the proper position, the IFF Coordinator should be adjusted by maintenance personnel. Grass from the IFF receiver should be visible. If it is not, set the remote IFF receiver controls inside the door in the panel of the IFF Coordinator according to instructions. These controls are shown in Fig. 4-14. Release the CHALLENGE switch which should return to the OFF position.

(17) Turn up the I.F. GAIN control shown in Fig. 4-11 until noise or grass appears on the range scope sweep as shown in Fig. 4-15. Set this control at the point where the grass is ½ inch high on the sweep. Then operate the HAND SLEW wheel shown in Fig. 4-12, until a target appears on the Range Scope. Adjust the antenna position until the target is at maximum height. Then adjust the I.F. TUNE control inside the door so that the target is at maximum amplitude. This control should be readjusted after the set

has warmed up. The TIME CONSTANT control should be in the No. 1 position and the BANDPASS control should be in the BROAD position. These controls are shown in Fig. 4-11. The Range Scope is now ready for operation.

(18) If the radar target is equipped with IFF equipment, a pattern similar to the one shown in Fig. 4-18 will be obtained, when the CHALLENGE switch is operated to either the MOMENTARY or ON positions.

(19) Adjust the RANGE SELECTOR switch shown in Fig. 4-7 to the 200-mile range. The number appearing in the small opening above the RANGE SELECTOR switch indicates the range on which the equipment is operating.

(20) Adjust the FINE INTENSITY control shown in Fig. 4-7 so that the line is barely visible. Then adjust the FINE INTENSITY control and the FOCUS control, alternately, until the line appears sharp and just barely visible. The FOCUS control is shown in Fig. 4-7. To obtain the proper setting of the FINE INTENSITY control on any of the four ranges, the following procedures should be used. First, turn the VIDEO GAIN control completely counterclockwise. This control is shown in Fig. 4-7. Then turn the FINE INTENSITY control counterclockwise. Turn the INTENSITY control clockwise until a light fuzzy picture having the appearance of grass appears on the face of the tube. This picture should be turned up high enough only to be barely visible. Turn the VIDEO GAIN control clockwise until signals appear in sharp focus, and with relatively bright illumination. The INTENSITY control should *not* be adjusted again. After a range has been set in this manner, the operation will be incorrect if the INTENSITY control is turned. Signals will be seen if the INTENSITY control is turned, but the weaker signals may be lost.

(21) Turn the VIDEO GAIN control, shown in Fig. 4-7, in a clockwise direction until echoes appear on the face of the tube. Observe the RELATIVE BEARING INDICATOR light on the panel. If this lamp is lighted, it is an indication that the radar equipment is operating on a relative bearing, and not on a true bearing. The light does not glow when true bearing operation is being employed. Adjust this light so that while its brilliance is not annoying, it will be visible to indicate any change in the type of bearing being used.

(22) The face of the tube should be observed carefully while the sweep is rotating, to make certain that the sweep starts in the center of the tube. If not, the equipment should be adjusted as described in the alignment procedure in Sections 3 and 7.

(23) Turn up the MARKERS control slowly until four bright dots appear along the sweep line on the face of the tube. This control is shown in Fig. 4-7. These will be equally spaced. If the radar antenna is rotating, these dots will trace out four circles on the face of the tube, concentric with the center of the tube. Turn the RANGE SWITCH to the other three ranges and check to see if the dots also appear on these three ranges. The intensity of these dots can be adjusted by the MARKERS control. They should be adjusted so that the lines they trace when the antenna is rotating are as narrow and clear as possible.

(24) If the RELATIVE BEARING INDICATOR lamp is lighted, the radar system is operating on relative bearing. If the equipment is being operated on relative bearing, and the antenna is rotating, entire groups of echoes will be seen to shift around the face of the tube as the ship turns. In this type of operation, the targets are shown on the face of the tube in relation to the ship's course. If the RELATIVE BEARING INDICATOR bulb is not lighted, the targets will remain the same during several rotations of the antenna. On this type of operation the targets are shown in relation to North, or to some other fixed reference point. If the ship is dead in the water (not moving or swinging at anchor), the targets will stay in the same position on the PPI tube face; that is, except for normal changes in range and azimuth, due to the movement of the target itself.

(25) Adjust the DIAL DIMMER control, shown in Fig. 4-7, until the illumination from the lights around the bezel permits the image on the tube face to be seen clearly, but not bright enough to tire the eyes.

NOTE

ECHOES MAY BE SEEN ON ALL RANGES WITHOUT READJUSTMENT OF THE INTENSITY OR VIDEO GAIN CONTROLS. BUT FOR MAXIMUM EFFECTIVENESS THE PROPER SETTING SHOULD BE OBTAINED EACH TIME THE RANGE SWITCH IS MOVED. THIS INSURES THAT THE INTENSITY AND VIDEO CONTROL SETTINGS WILL SHOW UP THE WEAKER ECHOES.

(26) The CENTER EXPAND switch, shown in Fig. 4-7 should be adjusted for proper operation. Adjust the RANGE SELECTOR switch for operation on the 4-mile range, and set the VIDEO GAIN and INTENSITY controls for this range. If near land, the entire center of the tube may be a mass of echoes, and it will not be possible to distinguish any individual one. Turn the CENTER EXPAND switch to the ON position. The sweep circuit will not start at the center of the tube, but at a point about ½ inch from it. This spreads out the echoes so that individual signals may be distinguished.

(27) With the SLEWING MOTOR switch shown in Fig. 4-12, in the OFF position, rotate the HAND SLEW control. The TRUE BEARING or RELATIVE BEARING indicator dials should move as the handwheel is turned. These dials are shown in Fig. 4-12.

The sweep on the PPI scope should also move and the direction it indicates should always read the same as the TRUE BEARING or RELATIVE BEARING indicator dial, depending upon the type of bearing indication used by the radar equipment. If a target of known bearing is available, the accuracy of the indicator dial readings may be gauged. In order to check the system on a target of known bearing, this target should be maximized on the Range Scope. This is performed by operating the antenna with the HAND SLEW wheel. When the target extends the maximum distance above the sweep line, the Bearing Indicator should show the correct true or relative bearing of the target. If it is necessary to realign the entire antenna system, the method to follow will be determined by the procedure applicable to the radar system as a whole.

(28) Check the automatic slew mechanism of the Bearing Indicator. This is done by turning the SLEWING MOTOR switch to all of the different positions and checking the speed by observing the indicator dials. This should only be done on relative bearing operation. Otherwise, any change in the ship's course would cause a change in the slewing rate as indicated by the indicator dials. The speed of rotation should be as indicated on the nameplate over the switch.

(29) If the Rotation Control Unit and Bearing Indicator have not been modified, place the SLEWING MOTOR switch in its OFF position. Adjust the ROTATION switch to its EMERGENCY position. See Fig. 4-12. The antenna should rotate at approximately 7 r.p.m., and the dials should indicate this rotation. Return the ROTATION switch to NORMAL position.

CAUTION

WHEN OPEARTING THE ANTENNA FROM THE BEARING INDICATOR, DO NOT REVERSE THE DIRECTION OF THE HAND SLEW HANDWHEEL TOO RAPIDLY. DO NOT TURN THE SLEWING MOTOR SWITCH FROM OFF TO THE 5-RPM POSITION WITHOUT ALLOWING IT TO OPERATE FOR A SHORT PERIOD OF TIME IN THE 1¼ POSITION. DO NOT SUDDENLY REVERSE THE ANTENNA DIRECTION WITH THE SLEWING MOTOR CONTROL. ALLOW THE ANTENNA TO COAST TO A STOP. THESE PRECAUTIONS ARE NECESSARY TO PREVENT OVERLOADING THE ROTATION GEAR.

(30) If the system has been modified, loosen the panel screws and pull the Bearing Indicator forward. Close the interlock switches and with the SLEWING MOTOR switch place the switch inside the unit in each of its positions. The antenna should rotate as indicated on the switch.

4. ROUTINE OPERATION.

a. GENERAL.

(1) The routine operation of the SR and SR-a Equipments may be broken down into two classifications. These are searching operations and ranging operations. The following paragraphs contain a description of the recommended mechanical and electrical procedure for conducting these operations.

b. SEARCHING OPERATION.

(1) This is the type of operation during which the radar set is used to search for and observe all targets within the range of the equipment, and in an azimuth of 360° around the ship. A limited form of searching, sometimes called sector scanning, may also be used. In this mode of operation, the antenna is swept back and forth within a limited sector. The antenna may be rotated through the entire 360° of azimuth by operation of the HAND SLEW wheel on the Bearing Indicator. See Fig. 4-12. Hand operation is only used for 360° scanning on long ranges when the operator desires to scan slowly and stop from time to time to observe a number of targets which are picked up during the scanning operation. Generally, the SLEWING MOTOR control is adjusted to one of its four positions. In the unmodified Antenna Positioning System, this energizes the slewing motor and regulates its speed. In this manner, the antenna can be rotated in either clockwise (CW) or counterclockwise (CCW) direction automatically. Therefore, the operator is free to observe the indicating components for target displays. When the slewing motor is used for PPI SEARCH the direction of the antenna should be reversed every hour. This equalizes the wear on the motor brushes and also prevents residual magnetism from building up in the servo-generators in the associated equipment. In the modified system the above function is performed with power obtained from the dry disc rectifier in the Rotation Control Units.

(2) The ROTATION control on the Bearing Indicator may be used to turn the antenna in azimuth by placing the switch in the EMERGENCY position. See Fig. 4-12. While this is primarily for emergency operation, it may also be used as part of the normal operating procedure. When the switch is in its EMERGENCY position, the rotation control unit and the servo-generator of the radar set are cut off. The antenna motor is connected directly to a d-c source in the radar equipment. This saves wear on these components, and provides a rotation speed of approximately 7 r.p.m. This is the normal method of operation in the modified systems. Slightly improved definition on the PPI Scope is obtained in this type of operation. With the antenna rotating at the desired speed, targets will appear and disappear on the Range Scope as the antenna beam sweeps across them. The Range Scope is of little value in searching operations except to tell when targets are present that should appear on the PPI Scope.

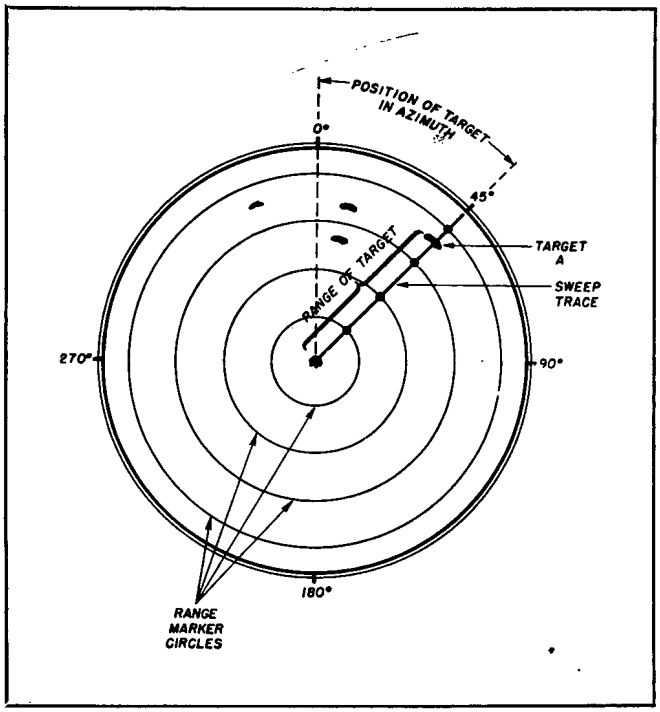


Figure 4-19. Targets and Range Markers on PPI Scope

(3) Echoes will appear on the face of the PPI tube in the form of round dots, if the indicator is being used in conjunction with a micro-wave radar equipment. When used in conjunction with a longer-wave set, the echo has an elongated appearance. This is due to the beam width of the ship's radar antenna, which is usually much narrower on the micro-wave equipments. The narrower beam means that the dot appears for a very few degrees only during the rotation of the antenna. When the beam is wider, as on the longer-range equipments, the dot appears for a larger number of degrees. It thus traces out the elongated form around the circumference which represents the target's range, as shown in Fig. 4-19. To determine the range of a target on the face of the PPI tube, turn up the MARKERS switch until the four range marker rings shown in Fig. 4-19 appear. If the antenna is not rotating, four range marker dots appear. On the four-mile range, these markers are 1 mile apart. On the twenty-mile range they are 5 miles apart. They will be 20 miles apart on the 80-mile range, and 50 miles apart on the 200-mile range.

(4) Adjust the RANGE SELECTOR switch (see Fig. 4-7) to the lowest possible range on which the target may be seen on the screen. Estimate the distance to the target by comparing its position with the nearest range marker. For example, if operating on the 20-mile range, and the target is half-way between the second and third rings, the range will be read as 12½ miles from the ship.

(5) To obtain the proper bearing on the target, place both hands on the cursor ring and turn it until the line on the Plexiglass disc splits the middle of the echo. The cursor ring is rotated by means of a control wheel on the CAY-55ADV-1 Indicator. The Plexiglass disc has two lines engraved on it—one on each side. Make sure that both lines on the disc line up with each other, as well as with the echo. This minimizes parallax, which is caused by the observer looking at the indication with his vision at an angle to the cursor line. With the cursor lines lined up on the target, read the bearing of the echo signal at the point where the cursor lines appear over the graduated scale around the rim of the PPI tube. The bearing indication will need to be interpreted in accordance with the type of bearing on which the equipment is being operated. If the equipment is on relative bearing the indication will be read in azimuth with reference to the bow of the ship. If the equipment is on true bearing the indication will be read in azimuth with reference to North, or some other pre-determined reference point.

(6) Unless the equipment is operated in complete darkness, it will be advisable to use one of the filters provided in front of the tube. The purpose of the filter is to intensify the illumination effect of the screen, and to ease the operator's eyes. For indoor or daylight work, an amber filter will be found most satisfactory. For night work, it may be desirable to use a red filter. To insert the filter on the CAY-55ADV, merely push it into the center of the cursor ring so that its slots line up with the screw heads in the ring. After the slots have been engaged, give the filter a slight twist, locking it against the screw heads. To replace the filter on the CAY-55ADV-1 Indicator, unscrew the thumbscrews that hold the retaining ring and remove the ring. The filter can then be exchanged and the ring replaced.

(7) Small amber lights are located directly above the fuses. These lamps normally do not light, except to indicate a blown fuse. When one of these lights glows, it is a sign that the fuse below it has been blown. Replace the blown fuse with one of the spare fuses. If the fuse was blown by something of a transient nature, the light will go out when the fuse is replaced. However, if the fuse goes out a second time, it means that a second fuse has blown and that some trouble may have developed requiring repair inside the equipment. Refer to Section 7 for methods of correcting trouble. The convenience outlet at the top of the PPI Indicator is provided to supply power for test equipment or trouble lamps.

c. RANGING OPERATION.

(1) The purpose of this type of operation is to isolate a target, or group of targets in one direction, and to obtain accurate indications of the bearing and range of these targets. Usually, the targets have been located on the PPI indicator screen during a searching operation, and it has been decided to secure more accurate data concerning them. If the antenna is rotating

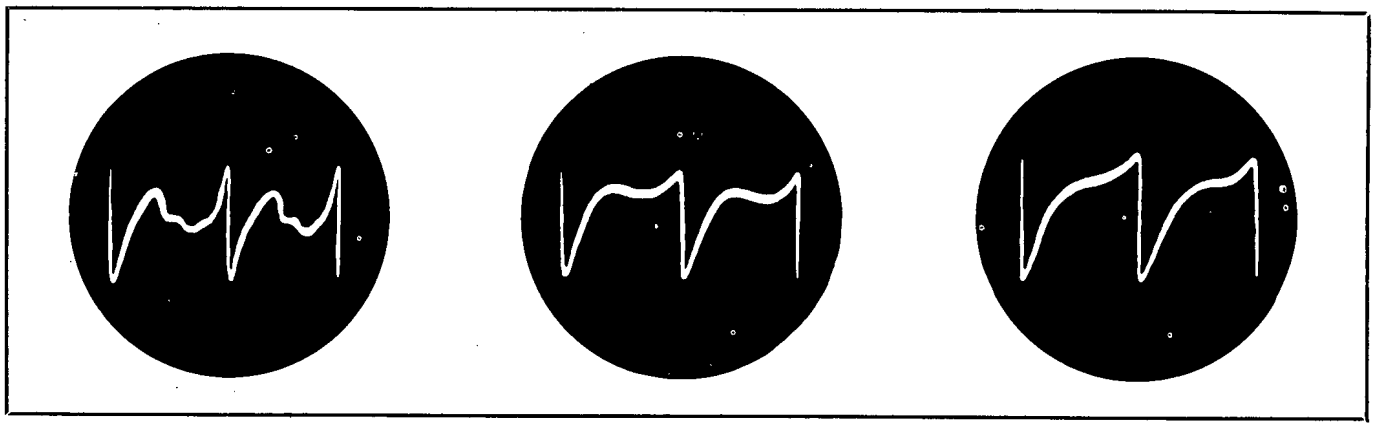


Figure A
Good 20 Microsecond Grid Pulse Shape

Figure B
Good 4 Microsecond Grid Pulse Shape

Figure C
Good 1 Microsecond Grid Pulse

Figures A, B and C illustrate proper shapes of grid pulse patterns; the first hump is sufficiently high to insure a steep rise at the point of oscillation, thus keeping the time of plate current flow just before oscillation to a minimum. The hump itself is well below the level at which it would cause the tube to draw plate current.

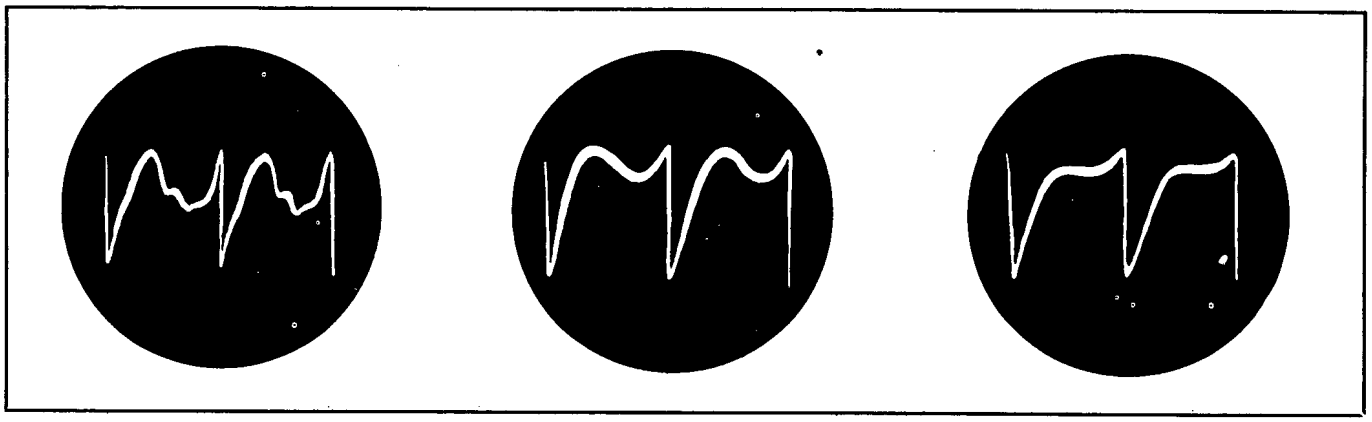


Figure D
Poor 20 Microsecond Grid Pulse Shape

Figure E
Poor 4 Microsecond Grid Pulse Shape

Figure F
Poor 1 Microsecond Grid Pulse Shape

Figures D, E and F illustrate grid pulse shapes in which the hump is too high and is causing plate current to flow at the top. If the hump were to go still higher, it would rise above the level at which the tube oscillates resulting in "multiple pulsing" and erratic patterns on both the grid pulse viewing scope and the indicator scopes.

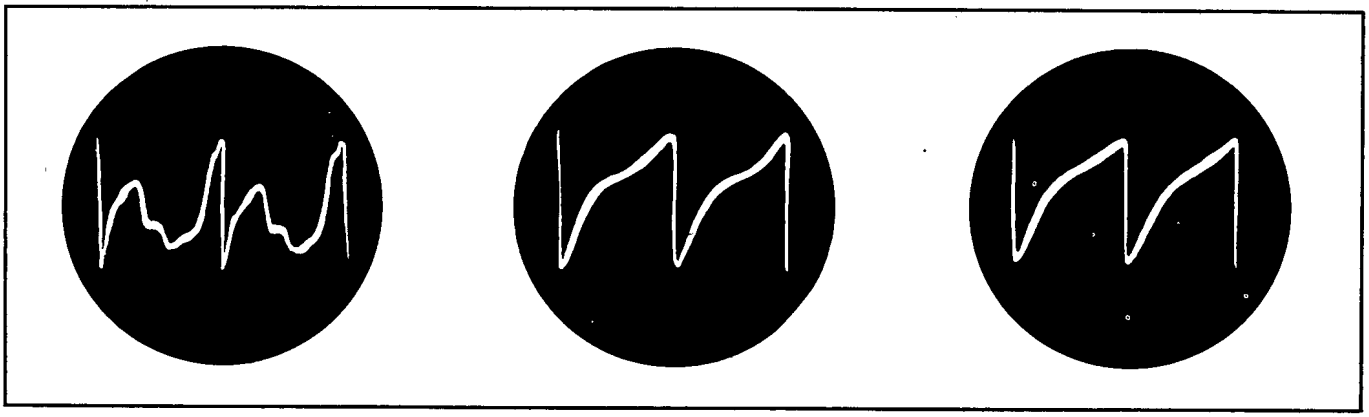


Figure G
Poor 20 Microsecond Grid Pulse Shape

Figure H
Poor 4 Microsecond Grid Pulse Shape

Figure I
Poor 1 Microsecond Grid Pulse Shape

Figures G, H and I illustrate grid pulse shapes in which the hump is too low, causing the rise at the firing level to be too flat, thus resulting in plate current flow for some time before oscillation begins.

Figure 4-20. Keyer Wave Forms

automatically, the SLEWING MOTOR switch should be switched to the OFF position so that the antenna can be operated by the HAND SLEW control. The HAND SLEW control is operated so that the height of the target will be as great as possible on the Range Scope screen. If it is desired to find out whether or not the target is friendly, the CHALLENGE switch on the IFF Coordinator is moved to the MOMENTARY position. See Fig. 4-13. The IFF base line will appear on the Range Scope. If the target is friendly and equipped with IFF equipment a signal will appear below the radar target extending downward from the IFF base line. See Fig. 4-18. If no such indication appears, the radar target is an enemy target or a friendly target not equipped to respond to the ship's IFF equipment. Operating the CHALLENGE switch to the ON position will also provide an IFF response from the target. However, it is better to set the switch to the MOMENTARY position and only hold it there long enough to secure a convincing response from the target. This will help prevent the enemy from discovering the frequency of the IFF equipment.

(2) The range of the target may be roughly determined by the scale on the face of the indicator tube. More accurate indications may be secured by turning the MARKERS switch (see Fig. 4-14) to the ON position and comparing the position of the target with the marker nearest to it. On the 4-mile, 20-mile, and 80-mile ranges, the range step may be used to secure very accurate data. To use the range step pull out the RANGE STEP switch shown in Fig. 4-14. The step will appear in the range sweep. The RANGE STEP control should be turned until the left side of the target just touches the right-hand side of the step. Do not allow the target to *walk* up the step. The correct range may then be read from the counters when the target is in the position described above. With the step in this position, read the range in yards from the range counters shown in Fig. 4-14. The RANGE STEP switch is only effective on the 4-mile, 20-mile and 80-mile ranges. The accuracy available from the range step is not required on the 200-mile range.

(3) As the target moves in or out on the range sweep, the RANGE SWITCH should be utilized to change the range to a shorter or longer range. Whenever this is done, the MARKERS switch should be adjusted to the ON position and the SWEEP LENGTH control adjusted until the markers lie behind the numbers on the scale on the front of the tube. This enables the approximate range to be read from the scale.

(4) When the target is at its greatest height on the Range Scope, the bearing may be accurately read on the dials of the Bearing Indicator. The reading is dependent on the type of bearing indication in use by the radar set at the time. If the REL bearing light on the Bearing Indicator and the RELATIVE BEARING INDICATOR light on the PPI Indicator are illuminated, the bearing indication should be read from the RELATIVE BEARING, or right-hand dial of the Bearing Indicator. See Fig. 4-12. If the equipment is being operated on TRUE BEARING, the TRUE bearing light (Fig. 4-12) will be illuminated on the Bearing Indicator and the RELATIVE BEARING lamp on the PPI Scope will be out. In this case, the bearing should be read from the TRUE BEARING dial on the Bearing Indicator.

(5) The IF TUNE control on the Console Receiver, shown in Fig. 4-11, requires adjustment during the radar equipment warm-up period. It should also be checked at regular intervals. The correct position of this knob should be such that it will cause the target indication on the Range Scope to be maximum at all times. Adjustment should be made, if possible, on the 200-mile range, with the BANDPASS switch in the SHARP position.

d. OPERATION THROUGH JAMMING.

(1) Five special anti-jamming controls are located behind a small door on the front panel of the console receiver. These controls are supplied for use during different types of jamming operations which might be directed against the radar and Console equipment. They are shown in Fig. 4-11.

(2) The receiver rejection filters are controlled by the two knobs, REJ 1 and REJ 2 shown in Fig. 4-11. They consist of two sharply tuned wave-traps across the input to the Console Receiver. In the case of straight CW jamming, the filters may be used to keep out, or attenuate, the CW signal which causes the jamming. One of the controls should be adjusted across its entire range and the JAMMING INDICATOR meter observed for a reduction in its reading. This reduction indicates that the jamming frequency is being removed by the rejection filter. Each filter can be tuned over one-half of the broad band-width of the receiver. If one of the filters does not cause a reduction of jamming signal, indicated on the JAMMING INDICATOR meter, try the other one. One of them should produce a reduction on the JAMMING INDICATOR meter. This filter control should be set for maximum attenuation in the jamming signal, as indicated by a maximum drop in the meter reading. If the filters cause a large reduction in the jamming signal, the operator can be almost certain that it was a CW or MCW signal used for jamming. In this case, the video signals should again be seen on the Range Scope. If the jamming signal is modulated CW, the jamming would appear as a widened sweep line, with extremely fast or slow sine waves. Changing operating ranges may speed up or slow down these sine waves. The widening effect on the line may be minimized by accurate adjustment of the rejection filters.

(3) The BAL VIDEO control behind the door on the Console Receiver is for use against particularly strong railing, blocks or pulsed signals used in block-

ing operations by the enemy. When adjusted properly, this control tends to block out any strong signal and let the weak signals ride through. Radar indications can be seen on the Range Scope, even in the absence of strong jamming signals, due to the fact that the height of a strong signal is limited. If a large, saturated signal appears on the Range Scope, the control should cause the large signal to decrease in amplitude almost to the base line while the video signal will be seen to ride through. The noise also should remain unaffected. Thus, in the presence of strong blocking signals, it should be possible to make the video signals come through and appear on the Range Scope. The operation of this control will not affect the JAMMING INDICATOR meter. Adjustment should be made while observing the pattern on the Range Scope tube.

(4) THE TIME CONSTANT control is located inside the door on the panel of the console receiver as shown in Fig. 4-11. It is also useful when jamming signals are present. It should be set in such a manner that signals or jamming blocks are allowed to build up quickly and die down at a rate which makes it possible to see video indications on the Range Scope. In the wide time constant position, or position No. 3, the normal picture appears on the Range Scope. In the medium, or position No. 2, the blocking pulse will build up quickly and die down at a relatively slow rate. In the normal position No. 1, the blocking pulse rises to its full height very rapidly, then drops to approximately half its height and remains at this level for the duration of the pulse. The blocking pulse is therefore allowed to saturate the screen *for only a very small part of its duration.* In this manner, the pulse may be broken up into a series of small blocks. The action of the control changes these to very narrow spikes, and the radar video signal will ride through the spikes and be seen on the scope.

(5) The I.F. TUNE control and the BANDPASS control, shown in Fig. 4-11, may be used together to help eliminate jamming. When the BANDPASS control is in the BROAD position, the band width of the receiver is about 1.5 megacycles. When it is in the MEDIUM position, the band width is about 500 kilocycles and when in the SHARP position, about 250 kilocycles. The reduction of the bandwidth may cut out a jamming signal which might otherwise be allowed to pass through the BROAD bandpass, but is outside the limits of the narrow bandpasses. The I.F. TUNE control enables the operator to locate the narrowed bandpass at any point within the 1.5 megacycle bandwidth. When the control is set for one end of the range, it will permit signals within 250 kilocycles at that end of the band to pass through the receiver channels. All other signals will be excluded. Consequently, by operation of this control, the i-f channel of the receiver may be adjusted so that it will exclude the undesired signal while passing the radar echo through to the receiver circuits. *This rejection control will be generally successful if the jamming frequency falls within the total BANDWIDTH, yet does not fall exactly on the frequency of the radar transmitter.*

5. TRANSMITTER TUNING PROCEDURE.

a. GENERAL.

(1) It is the responsibility of operating personnel to keep the transmitter correctly tuned. This requires frequent checks with the Echo Box and, in the case of the SR transmitter, frequency checks on the appearance of the keying waveform with a general purpose test oscilloscope. The following paragraphs give tuning instructions in a simple step-by-step procedure. With the exception of the Keyer the procedures for the SR and SR-a are very similar.

b. TUNING THE SR TRANSCEIVER.

(1) Check the number and placement of the grid straps used on the transmitting oscillator. For the *blue* antenna two straps are required. The *yellow-green* antenna requires only the bottom strap with corona balls attached to the tube pins that customarily hold the other strap.

(2) Adjust the duplexer length so that the distance between the lower flange of the upper U-shaped casting and the center of the spark-gap adjusting knob is 9⅞ inches for the blue band and 11⅝ inches for the yellow-green band.

(3) Adjust the spark gaps for a spacing of 1/32 to 1/16 of an inch between the points. This is equivalent to one full turn of the adjusting knob from its fully closed position. The spark gaps may be seen when the Monitor Receiver is removed from its compartment.

(4) Place the CONTROL switch S-107 in its LOCAL position.

(5) Determine the approximate settings of the OSCILLATOR TUNING, 1st TUNING STUB, and 2nd TUNING STUB controls from the calibration chart on the oscillator door on the Transceiver. Set these controls to the values given. See Fig. 4-3.

(6) Place the PULSE LENGTH control S-158 on the Keyer in its 20 position. This control is shown in Fig. 4-4.

(7) Energize the equipment as directed in Par. 2 of this section.

(8) Connect a general purpose oscilloscope to test jack J-106 and to ground. Use the internal sweep frequency of the oscilloscope and adjust it as nearly as possible to the repetition rate. Stop the pattern on the scope with the sync control. J-106 is on the front panel of the Transceiver near the POWER switch.

(9) Place the RADIATION switch S-108 in its ON position and press the RAISE switch until the PLATE VOLTAGE meter indicates 11 kv. or as near to this voltage as possible. These Controls are shown in Fig. 4-3.

(10) If tuning an unmodified SR Transceiver, adjust the 20-L and 20-R adjustments on the Keyer until the ideal waveform shown in Fig. 4-20 is obtained on the test oscilloscope. Change the 20-R adjustment one step and then vary the 20-L adjustment over its range. Continue this operation until the ideal waveform is obtained. If the overload relay trips, back the 20-R control off one step and readjust the 20-L control. The positive peak of the waveform should be at least 15 per cent of the overall waveform amplitude. This peak is the dimension D in the figure and the overall amplitude is the dimension E in Fig. 4-20. The top of the waveform should be sharply peaked. If the R adjustments are properly made it should be possible to vary the L adjustments over three or four taps before unstable operation occurs. If several humps appear between points *a* and *b* in Fig. 4-20 while operating with the PULSE LENGTH control in the 20 position, the waveform is not incorrect. These humps are caused by the 60 cps external synchronizing voltage.

(11) Place the ON-OFF switch on the Monitor Receiver in its ON position. See Fig. 4-10. If the Echo Box has not been modified, tune the ECHO BOX TUNE control for maximum indication on the ECHO BOX RESONANCE meter. If the Echo Box has been modified, tune for a sharp dip. Tune far enough over the range to insure that the Echo Box is not tuned to a false peak. In either case the frequency of the transmitter is determined from the Echo Box calibration chart which shows dial settings versus frequency. The frequency should be within plus or minus five megacycles of the center of the band. The center of the yellow-green band is 190 megacycles per second and the center of the blue band is 220 megacycles per second.

(12) If the frequency as determined in step (11) is incorrect, adjust the OSCILLATOR TUNING (A) control shown in Fig. 4-3, and repeat step (11). Repeat this operation until the correct frequency is obtained. As a rule, tuning the (A) dial to higher numbers lowers the frequency. Tune for the largest peak on the ECHO BOX RESONANCE meter that lies in the frequency band of the Antenna. It is important that the Keyer waveform be checked each time that the frequency is changed.

(13) Adjust the 1st TUNING STUB (B) dial and the ECHO BOX TUNE (G) dial alternately for maximum deflection on the ECHO BOX RESONANCE meter. If the Echo Box has been modified, it must be detuned slightly for this operation. If the grid waveform changes during this operation, readjust the L and R controls on the Keyer and then continue with the adjustment of the (B) and (G) dials.

(14) Repeat step (13) using the 2nd TUNING STUB (C) dial and the (G) dial.

(15) Repeat steps (13) and (14).

(16) Place the RADIATION switch in its OFF position and place the PULSE LENGTH switch on the Keyer in its 4 position. Then place the RADIATION switch in its MOMENTARY position for a brief period of time and observe the waveform of the grid pulse. Compare its shape with those shown in Fig. 4-20.

(17) Adjust the 4-R and 4-L controls shown in Fig. 4-4, using the technique described in step (10). Do not disturb the setting of any other controls during this operation.

(18) Repeat steps (16) and (17) using the 1 position of the PULSE LENGTH switch and the 1-R and 1-L controls shown in Fig. 4-4. Check the grid pulse against the 1-us waveforms shown in Fig. 4-20.

(19) Adjust the Monitor Scope using steps (1) to (5) inclusive of Par. 3b of this section.

(20) Place the PULSE LENGTH switch in its 20 position and place the RADIATION switch in its ON position.

(21) Set the RF control on the Monitor Receiver to its 0 position and set the IF GAIN control at 100. These controls are shown in Fig. 4-10. As the tuning proceeds in the following steps, reduce the setting of the IF GAIN control to prevent saturation of the Monitor Scope.

(22) Adjust the RECEIVER TUNE (F) dial until target echoes appear on the Monitor Scope.

(23) Adjust the 2nd DUPLEXER (E) dial for maximum amplitude on the Monitor Scope and then adjust the 1st DUPLEXER (D) dial in the same manner.

(24) Adjust the RF control for maximum amplitude on the Monitor Scope.

(25) Adjust the knurled knobs on the spark gaps in the duplexers until the amplitude on the Monitor Scope is maximum and the spark is clean and blue. These adjustments are accessible when the rear panel of the Transceiver is removed. The outer conductors of the r-f lines in the Transceiver are at ground potential and may be handled with safety. DO NOT TOUCH ANY OTHER PART OF THE TRANSCEIVER.

(26) Carefully trim the adjustment of the 2nd TUNING STUB (C), RECEIVER TUNE (F), 2nd DUPLEXER (E), 1st DUPLEXER (D) and the RF control in the order given.

(27) Check the transmitter frequency with the Echo Box. If it has shifted beyond the limits during the tuning procedure, readjust the OSCILLATOR TUNING (A) dial to obtain the correct frequency and repeat the entire tuning procedure.

(28) Make a final check to see that the Transceiver operates correctly on all three pulse lengths and repetition rates. Turn the RADIATION switch OFF when switching from one pulse length to another.

(29) Read and record the settings of all controls adjusted during the tuning procedure. Also record the

meter readings. The meter indications should closely approximate the following:

PULSE LENGTH	PLATE VOLTS	CATHODE CURRENT	GRID CURRENT
20	11 kv.	35-55 ma.	10-13 ma.
4	11 kv.	30-40 ma.	6- 9 ma.
1	11 kv.	15-25 ma.	2- 4 ma.

c. TUNING THE SR-a TRANSCEIVER.

(1) The only difference in the tuning procedures of the SR and SR-a equipments is the elimination of the Keyer adjustments and the substitution for them of the repetition rate adjustment of the Modulator. The following procedure assumes that the equipment has been energized up to the point where the high voltage circuits are ready to be energized.

(2) Place the RADIATION switch in the ON position.

(3) Press the RAISE switch until the PLATE VOLTAGE meter indicates 3.5 kv.

(4) Tune the transmitter as previously described in Par. 5*b* of this section.

(5) Adjust the repetition rate of the Modulator if the frequency is not 120 cps. Connect the 60 cps line voltage to one set of deflection plates on the oscilloscope and connect the output from J-2004 to the other set of plates. Adjust the REP RATE control R-2001 (see Fig. 4-21) until a two-to-one Lissajou pattern is obtained. This indicates that the repetition rate is twice the line frequency. Another good indication of the correct repetition rate is the behaviour of targets on the Monitor Scope. At 120 cps the targets are steady. At other frequencies they jitter back and forth horizontally at a frequency equal to the difference between 120 cps and the actual repetition frequency.

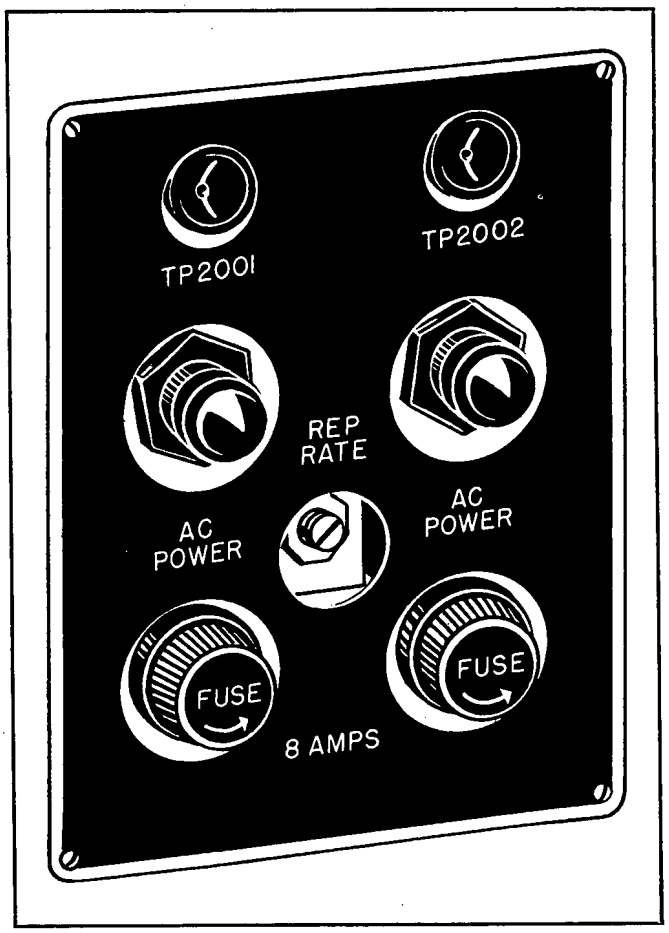


Figure 4-21. Modulator Adjustments

(6) Increase the plate voltage to five kv. and check all measurements. This completes the tuning procedure.

TABLE 4-1

OPERATING ADJUSTMENTS

Control	Location	Instructions
Pushbutton Station		ON during operation. Can be left on during shutdown. START button starts Motor Generator. STOP button stops it.
Switch S-1461	Voltage Regulator	Place in AUTO position for automatic voltage regulation. Place in MAN position for Manual voltage regulation.
VOLT ADJ RHEO	Voltage Regulator	Adjust for 120 v. in AUTO operation.
Rheostat R-1466	Voltage Regulator	Adjust for 120 v. in MAN operation.
CONTROL switch	Transceiver	Place in LOCAL or REMOTE positions as desired.
EMERGENCY MAIN POWER switch	Transceiver	Place in ON position to energize primary power circuits.

TABLE 4-1 (Continued)

OPERATING ADJUSTMENTS

Control	Location	Instructions
PULSE LENGTH	Keyer Unit	Set to 20 for long range; 4 for medium range; 1 for short ranges.
FILAMENT VOLTAGE	Transceiver	Adjust for 10 v. on FILAMENT VOLTAGE meter. Should indicate 10 v.
FILAMENT VOLTAGE meter POWER ON	Transceiver Transceiver or General Control Unit	Press to energize high voltage circuits.
RAISE switch	Transceiver or General Control Unit	Press to increase oscillator plate voltage.
LOWER switch	Transceiver or General Control Unit	Press to decrease oscillator plate voltage.
PLATE VOLTAGE meter	Transceiver or General Control Unit	Indicates 11 kv on SR; 5 kv on SRa.
ON-OFF switch	Monitor Scope	Place on ON position to energize Monitor Scope.
INDICATOR CONSOLE switch	General Control Unit	Place in ON position to energize all Indicator Console Units except PPI.
ON-OFF switch	PPI Indicator	Place in ON position to energize PPI Indicator.
RADIATION switch	Transceiver and General Control Unit	ON for continuous radiation; MOMENTARY for intermittent operation.
ECHO BOX ON-OFF	Monitor Receiver	Place in ON position to energize Echo Box.
ECHO BOX TUNE	Monitor Receiver	Unmodified:—Tune for maximum amplitude for frequency indication; Modified:—Tune for dip. To measure power, detune and make adjustments for maximum amplitude.
CATHODE CURRENT meter	Transceiver	SR:—20 μs-35 to 55 ma; 4 μs-30 to 40 ma; 1 μs-15 to 25 ma. SR-a:—20 to 30 ma.
GRID CURRENT meter	Transceiver	SR:—20 μs-10 to 13 ma; 4 μs-6 to 9 ma; 1 μs-2 to 4 ma. SR-a:—4 to 8 ma.
SYNCHRO SYSTEM	Rotation Control Unit	Place in OSC position for true bearing; AC position for relative bearing.
SERVO GEN. MOTOR.	Rectifier Power Unit	Place in ON position to start Servo Generator.
ANT. TRAIN MOTOR	Rectifier Power Unit	ON to energize armature of antenna drive motor.
REMOTE INDICATORS	Rotation Control Unit	ON to supply data voltage to Indicator Console and remote PPI units.

TABLE 4-1 (Continued)

OPERATING ADJUSTMENTS

Control	Location	Instructions
ON-OFF switch	Rectifier Power Unit	ON to energize unit.
SYNCHRO AMPLIFIER POWER switch	Synchro Amplifier	ON to energize Synchro Amplifier.
V CENTER	Monitor Scope	Adjust until sweep coincides with etched line.
H CENTER	Monitor Scope	Adjust until sweep starts at 0 on etched line with VIDEO GAIN at 0.
SWEEP LENGTH	Monitor Scope	Adjust until length of sweep equals length of etched line.
FOCUS	Monitor Scope	Adjust for sharp definition.
INTENSITY	Monitor Scope	Adjust for desired brilliancy.
RANGE SELECTOR	Monitor Scope	Set to desired range; usually 20 miles.
RECEIVER TUNE	Monitor Receiver	Tune for maximum amplitude on Monitor Scope.
RF	Monitor Receiver	Tune for maximum amplitude on Monitor Scope.
IF GAIN	Monitor Receiver and Console Receiver	Adjust for ½ inch grass on Range Scope.
VIDEO GAIN	Monitor Scope	Adjust for desired amplitude.
PPI MARKERS	Console Receiver	ON to supply markers to remote PPI units.
ECHO BOX switch	Console Receiver and Monitor Receiver	ON to energize Echo Box.
INTENSITY	Range Scope	Adjust for desired intensity.
FOCUS	Range Scope	Adjust for sharp definition.
HORIZONTAL CENTERING	Range Scope	Adjust start of sweep over 0 on scale.
VERTICAL CENTERING	Range Scope	Adjust sweep ⅜ inches above scale.
RANGE SWITCH	Range Scope	Set to desired range.
MARKERS	Range Scope	ON when markers are desired.
SWEEP LENGTH	Range Scope	Adjust until markers coincide with numbers.
RANGE STEP	Range Scope	Pull out for range step. Rotate to align step with target.
CHALLENGE	IFF Coordinator	MOMENTARY or ON to interrogate target.

TABLE 4-1 (Continued)

OPERATING ADJUSTMENTS

Control	Location	Instructions
RANGE SELECTOR	PPI Indicator	Set to desired range.
FINE INTENSITY	PPI Indicator	Adjust until sweep is just visible.
FOCUS	PPI Indicator	Adjust for best definition.
VIDEO GAIN	PPI Indicator	Adjust alternately with FOCUS and FINE INTENSITY.
MARKERS	PPI Indicator	Adjust for desired marker brilliance.
DIAL DIMMER	PPI Indicator	Adjust for desired illumination.
CENTER EXPAND	PPI Indicator	ON to separate nearby targets.
CURSOR	PPI Indicator	Align cursor with target, read bearing on scale under cursor.
FILTER	PPI Indicator	Use amber for daylight and indoor; red for open bridge and night.
BANDPASS	Console Receiver	Adjust to bandwidth necessary to eliminate jamming.
IF TUNE	Console Receiver	Tune for best target each time BAND-PASS is changed.
REJ 1	Console Receiver	Adjust for maximum dip on JAMMING INDICATOR. Use against CW and MCW jamming.
REJ 2	Console Receiver	See REJ 1.
BAL VIDEO	Console Receiver	Adjust to eliminate pulse, railing, etc.
TIME CONSTANT	Console Receiver	Adjust to reduce the effect of pulsed signals.
ROTATION	Bearing Indicator	NORMAL position unless EMERGENCY operation is desired.
HAND SLEW	Bearing Indicator	Rotate to manually control antenna.
SLEWING MOTOR	Bearing Indicator	Set to desired antenna speed and direction.
OSCILLATOR TUNING	Transceiver	Adjust for desired frequency.
1-, 4-, and 20-R	Keyer Unit	Adjust for best waveform.
1-, 4-, and 20-L	Keyer Unit	Adjust for best waveform.
1st TUNING STUB	Transceiver	Adjust for maximum deflection on Echo Box.
2nd TUNING STUB	Transceiver	Adjust for maximum deflection on Echo Box.
2nd DUPLEXER	Transceiver	Tune for maximum amplitude on Monitor Scope.
1st DUPLEXER	Transceiver	Tune for maximum amplitude on Monitor Scope.
Spark Gap Controls	Transceiver (interior)	Adjust for clean blue spark.
REPETITION RATE	MODULATOR	Adjust for 120 cps.
POWER OFF	Transceiver	Press to remove high voltage.

SECTION 5
OPERATOR'S MAINTENANCE

1. GENERAL.

a. The procedures described in this section are for the use and guidance of operating personnel. They are supplementary to the maintenance procedures that must be performed by maintenance personnel. By means of the simple tests and procedures described in this section, the operator can perform simple preventive maintenance of a mechanical nature, replace fuses, determine the operating conditions for the purpose of entering data in a daily log, and in emergencies, effect certain electrical repairs. Operating personnel should not make any extensive or complicated repairs since special test equipment, tools, replacement parts, and a high degree of technical knowledge, skill and experience are required.

2. ROUTINE CHECKS.

a. The operator should perform certain routine checks each day. These checks should consist of tests to determine if the equipment is performing satisfactorily, and mechanical inspection to determine the general condition of the equipment. It is recommended that routine checks be made at the beginning of each watch and data such as frequency meter readings, pulse length, repetition rate, and bandwidth selected, be recorded in a daily log book. The following paragraphs describe in detail the methods and procedures to be used. Table 5-1 shows the steps that should be performed.

3. MECHANICAL CHECKS.

a. At the beginning of each watch, check all assembly bolts, studs and screws that are visible on the exterior of the various components. Usually a cursory examination will disclose anything of an unusual nature and the entire procedure will actually require very little time. Particular attention should be given the bondings on the shockmounts, since there is always a possibility that they might become frayed or broken through carelessness during cleaning. The condition of all cabling should be inspected periodically and any repairs or replacements indicated by the inspection should be immediately reported. Examine the panel thumbscrews that hold the units in the cabinets. If a unit is loose in the cabinet, it might slide out until stopped by the latches when the ship rolls. In this case the interlocks would open and the equipment would not operate. The condition of the paint on the various components should be inspected. If the painted surface is scratched or rusty this condition should be reported since unpainted metal corrodes easily in salt air.

b. The control knobs should also be inspected to see that none of them are broken or loose and that the control shafts are not bent. On the units with locks for the control knob, check to see that the locks are in good condition and that none of them have become loosened. A loose lock may mean that the control is out of adjustment and this should be determined as soon as the equipment is energized. When the equipment is first energized, observe each fuse warning lamp to see that all of the fuses are in good condition. If a viewing shield is used on the Range Indicator check its condition to see if it fits properly and remains firmly in place after it is attached. Observe the action of all switches when the equipment is turned on to see whether they are in good condition or whether they are worn and require replacement. Check the action of all operating controls to see that they perform their functions correctly.

TABLE 5-1

UNDERWAY—EACH WATCH

What to Check	How to Check	Precautions
1. High Voltage	Read PLATE VOLTAGE Meter on Transceiver or General Control Unit. Record Voltage.	
2. Filament Voltage	Read FILAMENT VOLTAGE Meter on Transceiver and record.	
3. Cathode Current	Read CATHODE CURRENT Meter on Transceiver and record.	
4. Grid Current	Read GRID CURRENT meter on Transceiver and record.	

UNDERWAY—EACH WATCH

TABLE 5-1 (Continued)

What to Check	How to Check	Precautions
5. Transmitter Freq.	Measure with Echo Box and record twice daily. (See Par. 5 of Section 4).	
6. Service Hours	Read SERVICE HOURS Meter on Transceiver at beginning of watch and again if a failure occurs. Record readings.	
7. Transmitter Controls	Record settings of controls at beginning of watch. Record any changes made during watch with appropriate explanation.	
8. Pulse Shape (SR only)	Observe on Monitor Scope. If necessary, observe on test scope.	
9. Mechanical Inspection	Check panel screws, mountings assembly bolts, meter glasses, controls, paint, cabling and connectors.	
10. Fuses	Check fuses and fuse warning lamps when a-c power is applied.	
11. Motor Generator	Should be running smoothly and quietly. Check lubrication of bearings. Oil cups should be filled.	
12. Servo Generator	See above.	
13. Magnetic Controller	Make mechanical inspection. Note if relays have tendency to chatter.	
14. Voltage Regulator	Record meter reading and type of operation in use. Make mechanical inspection.	
15. Synchro Amplifier and Synchro Unit	Make mechanical inspection. Check pilot lamps, both should be glowing.	
16. Rotation Control Unit	Make mechanical inspection. Check fuses.	
17. Modulator (SR-a only)	Make mechanical inspection and check fuses. Check repetition rate adjustment by noting if targets jitter horizontally on Range Scope.	
18. Antenna Pedestal and Antennas	Make mechanical inspection and clean deposits of soot and salt from dipoles and insulators.	Pedestal must be in stowed position with stowing lock engaged.
19. Power Supply. Main Power Switch on.	Place the Indicator Console and the PPI ON-OFF switches in ON position. Lamp above PPI switch should glow. Traces should appear on scopes.	

UNDERWAY—EACH WATCH

TABLE 5-1 (Concluded)

What to Check	How to Check	Precautions
20. Dial Lamps	Advance DIAL DIMMER control on PPI Unit. MILES window and azimuth scale should be illuminated. MILES window and RANGE-YARDS windows on Range Scope should be illuminated. Dials on Bearing Indicator should be illuminated if on true bearing.	See par. 5 of this section before replacing lamps.
21. Focus and Intensity	Examine sweep on scopes. They should be sharp and thin and just bright enough to be seen..	
22. Range Markers	Turn the RANGE switches on each of the scopes to each of their four positions and advance MARKER controls. Four marker dots should appear on sweep for each position. Dots on each range should coincide with dot positions on each of the other ranges on PPI scope. SWEEP LENGTH control will have to be adjusted for each range on Range Scope.	Do not attempt to adjust the range marker circuits. Special equipment is required.
23. Sweep Length	Turn RANGE SELECTOR switch to each position and advance MARKER control. Sweep should end with fourth marker dot. Sweep should start at center and end ½ inch from edge of tube on PPI scope. Sweep on Range Scope should start on 0 and end on 8.	
24. Center Expand on PPI Scope	Operate CENTER EXPAND switch. Sweep should shift about .5 inch radially from center of tube.	
25. Video	Advance I.F. GAIN control on Console Receiver. Target and noise amplitude on Range Scope should increase as long as control can be turned.	
	Advance VIDEO GAIN control on PPI scope. Target and noise intensity should increase as long as control can be turned.	Report failure or rough controls to repair personnel.
26. IFF	Hold CHALLENGE switch in MOMENTARY POSITION. IFF trace should appear on Range Scope.	Report failure to maintenance personnel.
27. IFF Video	Advance IFF REC GAIN control. Noise amplitude should increase as long as control can be turned.	Report faulty controls to repair personnel.
28. Bearing Indicator and General Control Unit	Check these units by turning on the entire equipment. Use REMOTE operation.	
29. Range Step on Range Scope	Pull out RANGE STEP control, check accuracy of step against markers and check zero setting.	Do not force RANGE STEP control against stops at each end of range.

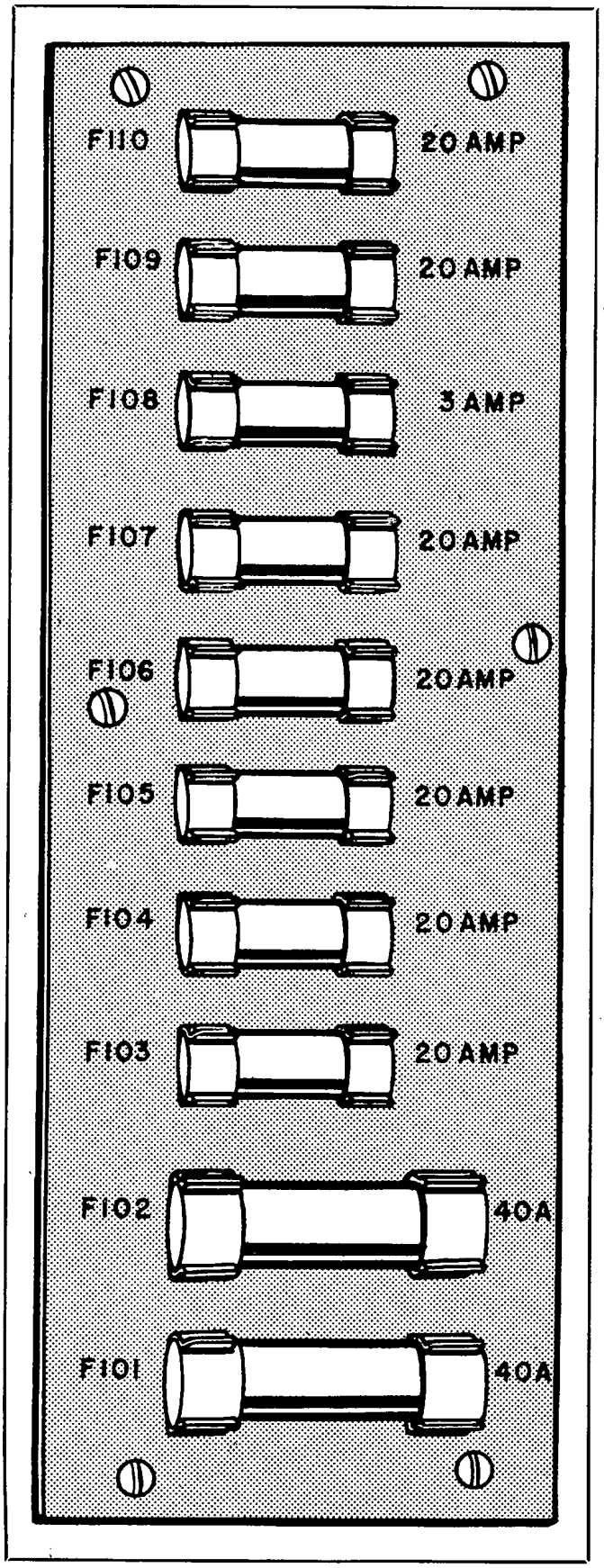


Figure 5-1. Transceiver Fuses

4. FUSE REPLACEMENT.

a. A blown fuse is indicated by the FUSE ALARM lamp directly above it. If a FUSE ALARM lamp is illuminated, the fuse beneath should be replaced. The fuses and the alarm lamps of the various components are shown in Figs. 5-1 to 5-12 inclusive. They are listed in Table 5-2. Symptoms are given for the fuses that have no fuse alarm lamps.

WARNING

NEVER REPLACE A FUSE WITH ONE OF HIGHER RATING UNLESS CONTINUED OPERATION OF THE EQUIPMENT IS MORE IMPORTANT THAN PROBABLE DAMAGE. IF A FUSE BURNS OUT IMMEDIATELY AFTER REPLACEMENT, DO NOT REPLACE IT A SECOND TIME UNTIL THE CAUSE OF THE TROUBLE HAS BEEN CORRECTED.

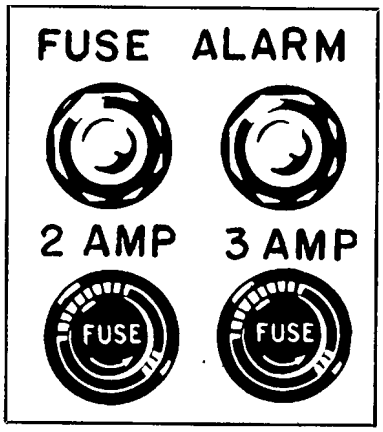


Figure 5-2
Monitor Scope Fuses

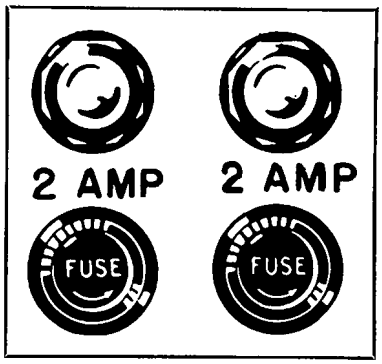


Figure 5-3
Monitor Receiver Fuses

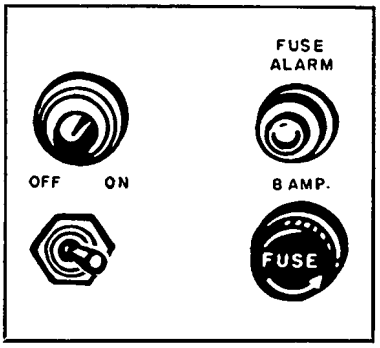


Figure 5-4
Rectifier Power Unit Fuses

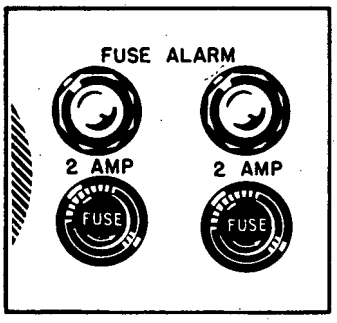


Figure 5-5

Console Receiver Fuses

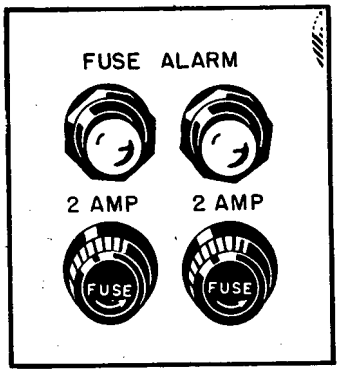


Figure 5-6

IFF Coordinator Fuses

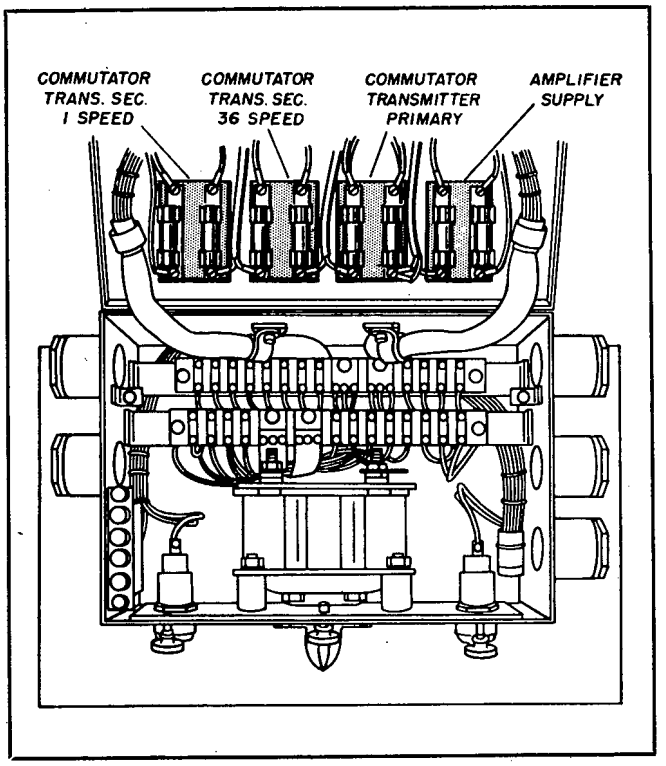


Figure 5-8. Synchro Amplifier Fuses

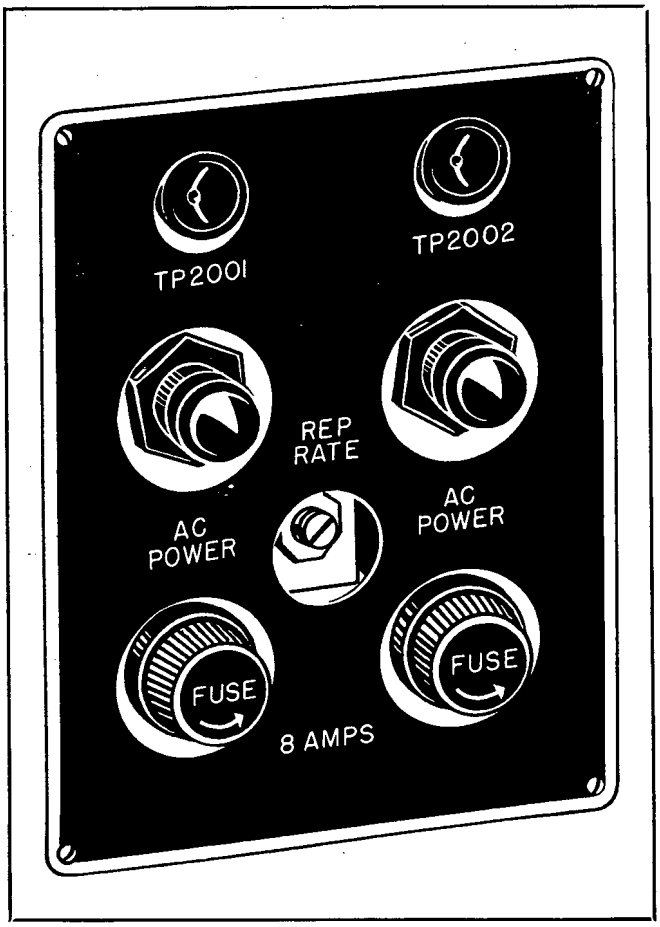


Figure 5-7 Modulator Fuses

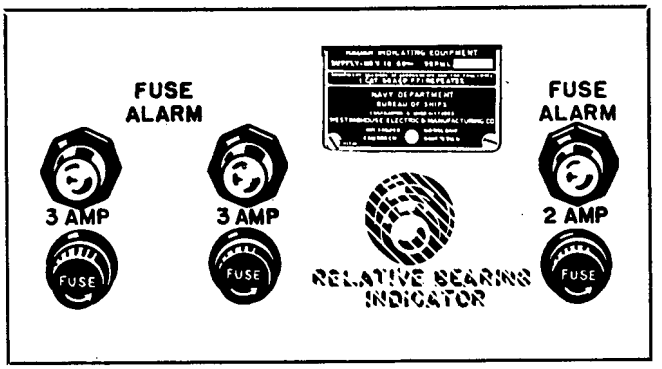


Figure 5-9. PPI Indicator Fuses

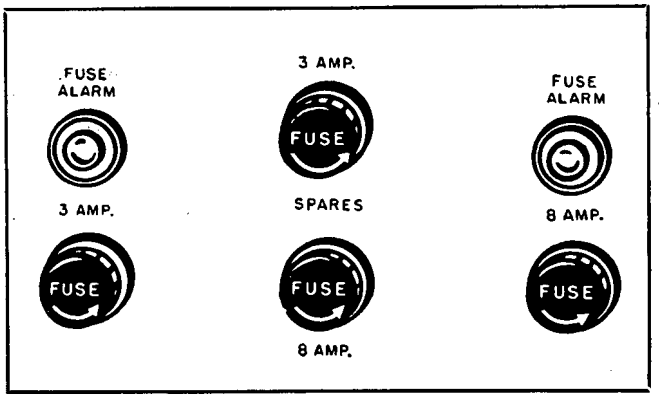


Figure 5-10. Servo Amplifier Fuses

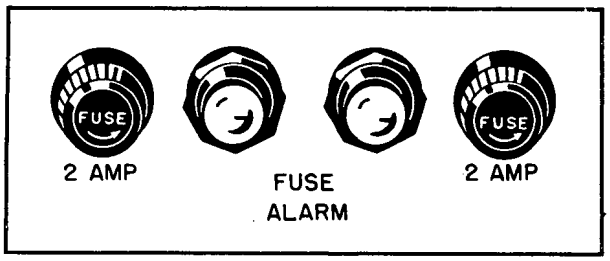


Figure 5-11. Bearing Indicator Fuses

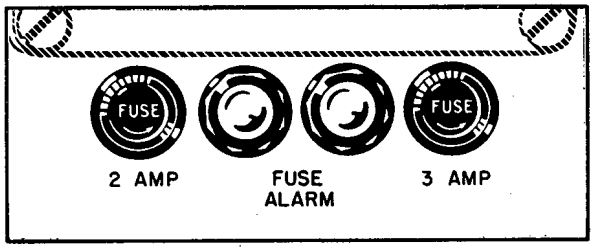


Figure 5-12. Range Scope Fuses

TABLE 5-2

FUSE LOCATIONS

Fuse and Value	Location	Function	Test Point or Symptom
F-101A, 250 V., 40 amps.	Fuse panel, lower left compartment, Transceiver.	Plate Supply	No plate voltage
F-102A, 250 V., 40 amps.	Fuse panel, lower left compartment, Transceiver.	Plate Supply	No plate voltage
F-103A, 250 V., 20 amps.	Fuse panel, lower left compartment, Transceiver	Filament Supply	No filament voltage
F-104A, 250 V., 20 amps.	Fuse panel, lower left compartment, Transceiver	Filament Supply	No filament voltage
F-105A, 250 V., 20 amps.	Fuse panel, lower left compartment, Transceiver	Voltage Regulator Input	No A-C voltage at Indicator Console
F-106A, 250 V., 20 amps.	Fuse panel, lower left compartment, Transceiver	Voltage Regulator Input	No A-C voltage at Indicator Console
F-107A, 250 V., 20 amps.	Fuse panel, lower left compartment, Transceiver	Blower Motor	Blower Motor won't run
F-108A, 250 V., 3 amps.	Fuse panel, lower left compartment, Transceiver	Variac Drive Motor	Drive Motor won't run to increase H.V.
F-109A, 250 V., 20 amps.	Fuse panel, lower left compartment, Transceiver	H.V. Primary	No plate voltage
F-110A, 250 V., 20 amps.	Fuse panel, lower left compartment, Transceiver	H.V. Primary	No plate voltage.
F-201A, 250 V., 2 amps.	Monitor Receiver, front panel	Power Supply primary	Fuse alarm lamp I-201
F-202A, 250 V., 2 amps.	Monitor Receiver front panel	Power Supply primary	Fuse alarm lamp I-202
F-301A, 0.25 amp.	Monitor Scope front panel	H.V. Primary	Fuse alarm lamp I-301
F-302A, 3 amps.	Monitor Scope front panel	L.V. Primary	Fuse alarm lamp I-302
F-500A, 3 amps.	Front panel PPI Scope	L.V. primary fuse	Fuse alarm lamp I-500
F-501A, 3 amps.	Front panel PPI Scope	H.V. primary fuse	Fuse alarm lamp I-501
F-502A, 2 amps.	Front panel PPI Scope	Yoke motor fuse	Fuse alarm lamp I-502
F-600A, 3 amps.	Front panel Range Scope	L.V. primary fuse	Fuse alarm lamp I-600

TABLE 5-2 (Concluded)

FUSE LOCATIONS

Fuse and Value	Location	Function	Test Point or Symptom
F-601A, 2 amps.	Front panel Range Scope	H.V. primary fuse	Fuse alarm lamp I-601
F-701A, 2 amps.	Front panel Receiver	Primary fuse power sup.	Fuse alarm lamp I-701
F-702A, 2 amps.	Front panel Receiver	Primary fuse power sup.	Fuse alarm lamp I-702
F-801A, 2 amps.	Front panel Bearing Indicator	Primary fuse power sup.	Fuse alarm lamp I-801
F-802A, 2 amps.	Front panel Bearing Indicator	Primary fuse power sup.	Fuse alarm lamp I-802
F-901A, 2 amps.	Front panel IFF Coordinator	Primary fuse power sup.	Fuse alarm lamp I-901
F-902A, 2 amps.	Front panel IFF Coordinator	Primary fuse power sup.	Fuse alarm lamp I-902
F-1101A, 250 V., 3 amps.	Servo Amplifier Unit Front Panel	Power Supply	Fuse alarm lamp I-1101
F-1102A, 250 V., 8 amps.	Servo Amplifier Unit Front Panel	Synchrotie	Fuse alarm lamp I-1102
F-1103A, 250 V., 8 amps.	Rectifier Power Unit Front Panel	Rectifier Transformer primary	Fuse alarm lamp I-1103
F-1441, 250 V., 10 amps.	Magnetic Controller	Control fuse	Motor Generator won't start
F-1451, 250 V., 10 amps.	Magnetic Controller	Control fuse	Motor Generator won't start
F-1571, 250 V., 200 amps.	Line Switch	Main Power	No power available
F-1572, 250 V., 200 amps.	Line Switch	Main Power	No power available
F-1581, 250 V., 10 amps.	Magnetic Controller	Control fuse	Motor Generator won't start
3 amps.	Junction Box Synchro Amplifier	Amplifier power supply	Commutator drive motor doesn't run. Tubes dark
3 amps.	Junction Box Synchro Amplifier	Amplifier power supply	Commutator drive motor doesn't run. Tubes dark
10 amps.	Junction Box Synchro Amplifier	Relayed 1-speed	1-speed circuits inoperative
10 amps.	Junction Box Synchro Amplifier	Relayed 1-speed	1-speed circuits inoperative
10 amps.	Junction Box Synchro Amplifier	Relayed 36-speed compass	36-speed circuits inoperative
10 amps.	Junction Box Synchro Amplifier	Relayed 36-speed compass	36-speed circuits inoperative
15 amps.	Junction Box Synchro Amplifier	Commutator primary	No relayed voltages
15 amps.	Junction Box Synchro Amplifier	Commutator primary	No relayed voltages

5. DIAL LIGHT REPLACEMENT.

a. To replace the dial lights behind the cursor assembly on the PPI Indicator, unscrew the two large thumbscrews on the right-hand side of the cursor frame. Swing the hinged assembly away from the panel. This exposes the lamps and they can easily be replaced. See Fig. 5-13.

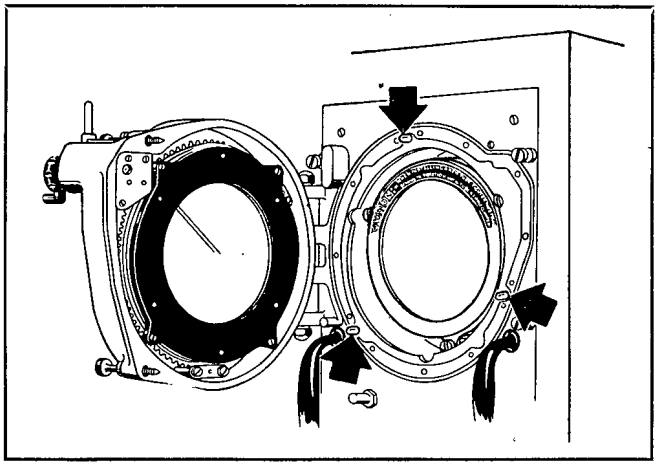


Figure 5-13. Dial Lamps in Geared Cursor

b. To replace the dial lamps behind the hand operated cursor assembly on the unmodified PPI Indicators, unscrew the three thumbscrews on the front of the cursor assembly. Pull the assembly away from the front panel and remove the phone plug on the left-hand side behind the panel. Pull the two frames as far apart as the nuts on the thumbscrews permit, after which the dial lamps can be removed. See Fig. 5-14.

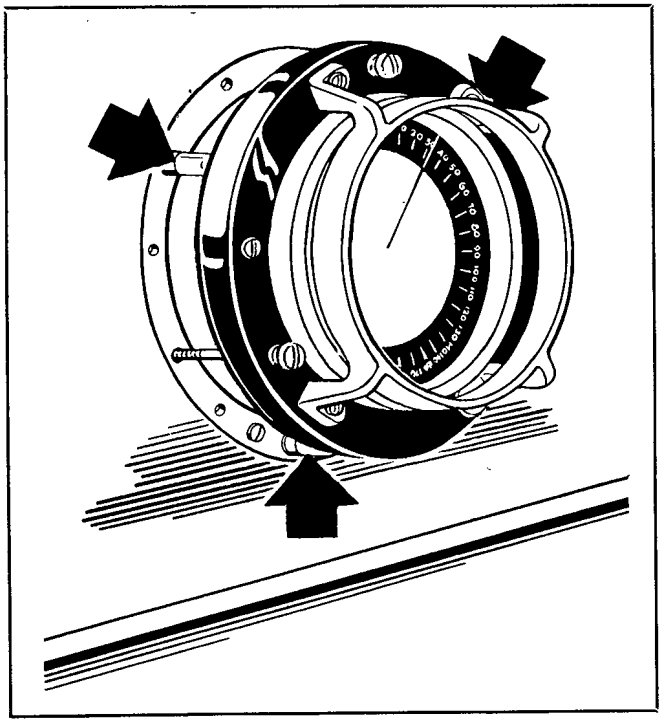


Figure 5-14. Dial Lamps in Manual Cursor

c. To replace the dial lamp behind the MILES windows, unscrew the eight panel thumbscrews and slide the chassis out until it locks. The dial lamp is accessible from the right-hand side as shown in Fig. 5-15. After replacing the lamp, release the chassis lock by pressing the pushbuttons, and slide the chassis back into the case. All other lamps are replaced by unscrewing the jewel over the lamp and twisting the bulbs out of and into the sockets.

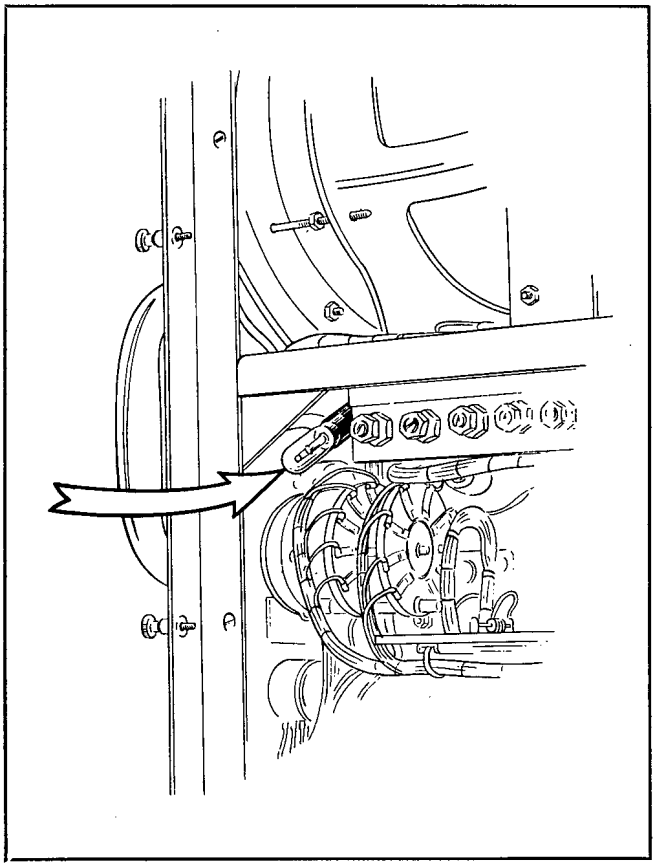


Figure 5-15. Dial Lamp Behind MILES Window on PPI Indicator

d. The dial lamps behind the RANGE-YARDS window on the Range Scope become accessible when the bezel is removed as shown in Fig. 5-16. The bulbs are encased in a metal cover to which is attached a bent lucite rod to carry the light over to the counter dials. The metal cover is easily removed by pulling it off the lamp base assembly. With the cover removed, the lamps may be twisted out of their sockets and new lamps inserted. The cover assembly is then replaced and the bezel reassembled to the panel and secured with its captive thumb screws.

e. The lamp behind the MILES window on the Range Scope is not so easily removed. To remove it, loosen the front panel thumbscrews and pull the chassis forward from its case until the locks are engaged. The lamp is mounted on a frame gusset on the

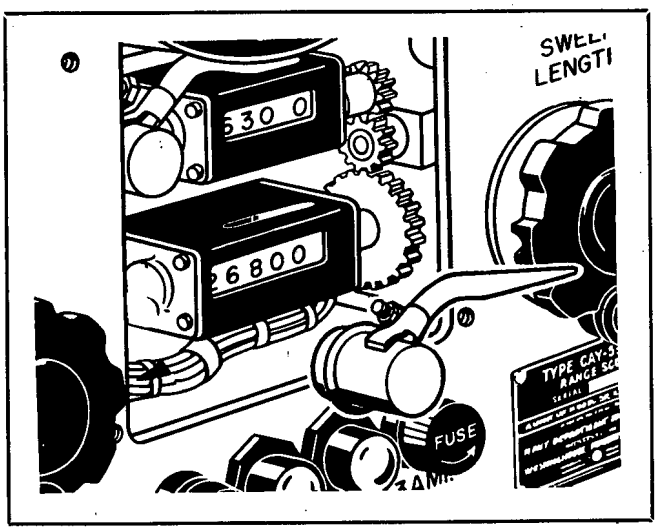


Figure 5-16. Dial Lamp Behind RANGE—YARDS Window on Range Scope

left-hand side as shown in Fig. 5-17. The lamp socket is mounted on a movable bracket behind the gusset. The bracket must be swung upward in order to remove and replace the lamp. Both positions of the bracket are shown in Fig. 5-17. Loosen the left-hand nut and swing the bracket upward as shown in Part B of the figure. Replace the bulb, return the bracket to its original position as shown in Part A and tighten the nut. Return the chassis to the case and tighten the panel thumbscrews.

f. There is only one dial lamp in the Bearing Indicator. To replace it, loosen the front panel thumbscrews and pull the chassis forward until the locks are engaged. The lamp is located on the frame between the two synchro units. It is mounted on a bracket as shown in Fig. 5-18. Loosen the thumbscrews, grasp

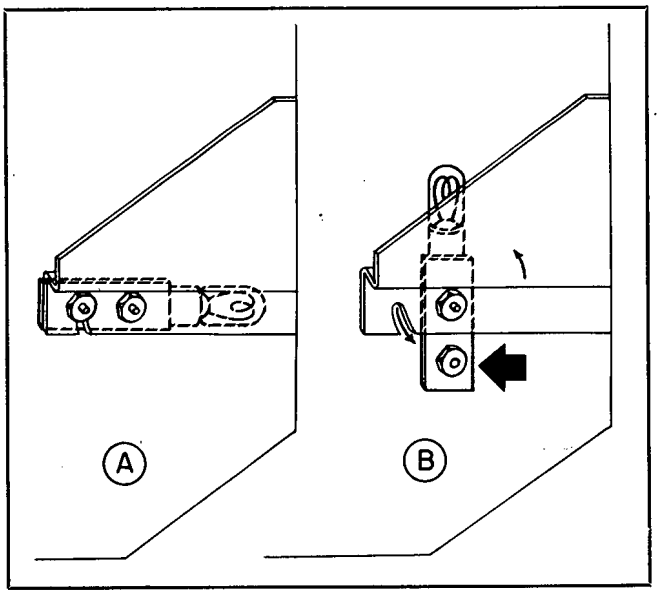


Figure 5-17. Dial Lamp Behind MILES Window on Range Scope

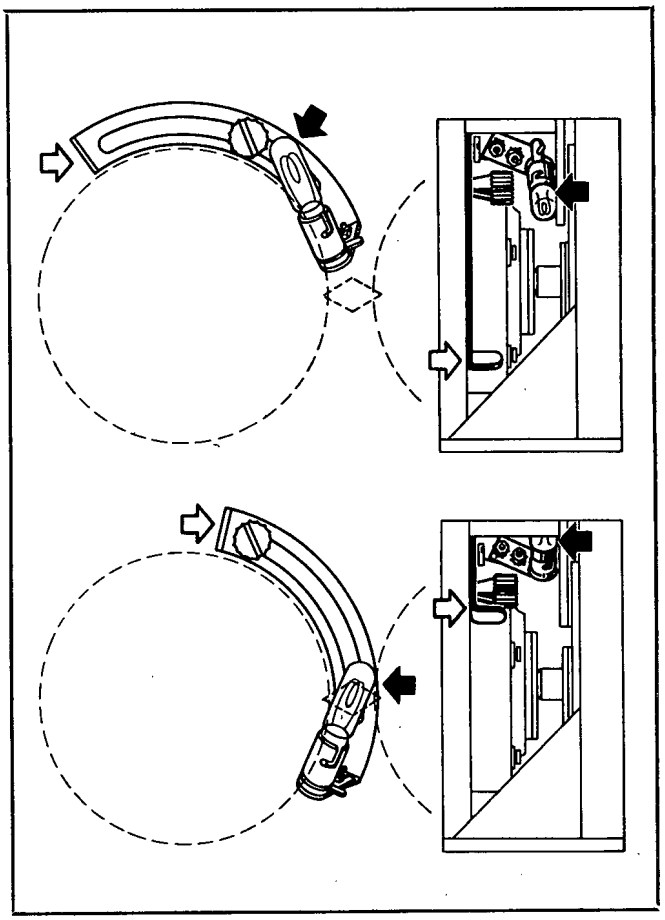


Figure 5-18. Dial Lamp in Bearing Indicator

the top of the bracket and pull it upward as far as it will go. Hold it in this position and remove the bulb with the other hand, then return the bracket to its original position and tighten the thumbscrew. See Fig. 5-18. Release the chassis locks, return the chassis to the case and tighten the thumbscrews on the front panel.

g. The Indicator lamps as well as the fuse alarm lamps on all of the units are easily replaced. To replace any of these lamps, unscrew the small glass bezel over the lamp and remove the lamp from its socket. The replacement may then be installed and the bezel replaced.

6. TUBE REPLACEMENT (Emergency only).

a. GENERAL.

(1) *Tubes should normally be replaced only by experienced technical personnel.* However, emergencies may arise during battle when a technician is not available. To cover such emergencies, the instructions and precautions that follow are given for the guidance of non-technical personnel.

WARNING

DANGEROUS VOLTAGES ARE PRESENT IN THE TRANSCEIVER, MODULATOR

AND INDICATOR CONSOLE. DO NOT TOUCH ANY TUBES UNLESS ABSOLUTELY NECESSARY. NO ATTEMPT SHOULD BE MADE TO REPLACE TUBES UNTIL THE A-C POWER IS DISCONNECTED AND THE CAPACITORS DISCHARGED BY GROUNDING THEIR TERMINALS TO THE CHASSIS FOR AT LEAST FIVE SECONDS. DO NOT MAKE CONTACT WITH METAL CONNECTORS ON HIGH VOLTAGE LEADS. FAILURE TO COMPLY WITH THIS WARNING MAY RESULT IN DEATH.

b. LOCATING DEFECTIVE TUBES.

(1) The ability to replace defective tubes is limited by the lack of test equipment. Generally speaking, the operator can only replace tubes with open heaters since this is about the only defect that can be determined by visual inspection. If the interior of a tube is dark, its heater may be open and it should be replaced. When a chassis is pulled out for inspection the interlocks must be closed or the a-c power circuit will be open and none of the tubes will be illuminated. Always replace a tube with another that has the same type number. Do not replace any tube that has a cap on top of the glass envelope until the cap has been grounded for approximately one minute. These tubes are high voltage tubes and are connected to capacitors that are normally charged to several thousand volts. Use a discharge stick to discharge the capacitors. If the proper equipment is not available to discharge the capacitors, *leave the tube alone and wait until maintenance personnel, with the proper equipment, can take care of the trouble.* The tubes are secured in their sockets with tube clamps around the base of the tube. Pull the loop on the clamp to the left to release it. Then pull the tube straight out of the socket. When replacing tubes be sure that the key on the guide pin on the base is aligned with the key way in the guide pin hole in the center of the socket. Be sure to push the tube all of the way down into the socket and then tighten the clamp around the base of the tube. Tubes with red circles around the socket may be removed and used elsewhere without completely disrupting the functions of the equipment. Defective tubes may also be detected by observing the indications on meters, scopes and the failure to respond to switches. It is not anticipated that the operator will have much occasion to resort to locating defective tubes by this method. The locations of the tubes in the various units are shown in Figs. 5-19 to 5-30 inclusive. Spare tubes are located in the General Control Unit. See Fig. 5-28. Do not attempt to replace the cathode ray tubes. This should only be done by maintenance personnel.

NOTE

ALL TUBES OF A GIVEN TYPE SUPPLIED WITH THE EQUIPMENT SHALL BE CONSUMED PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

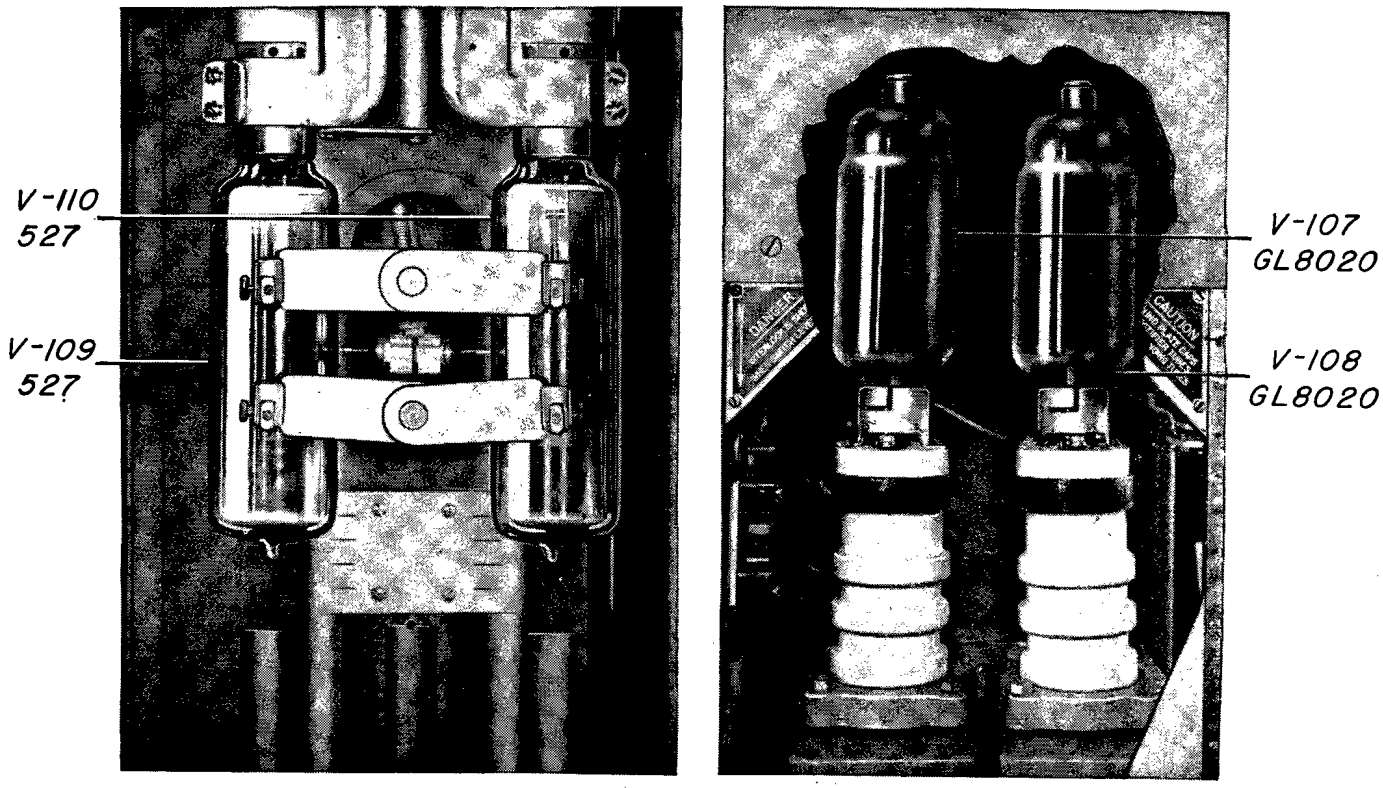


Figure 5-19. Transceiver, Tube Locations

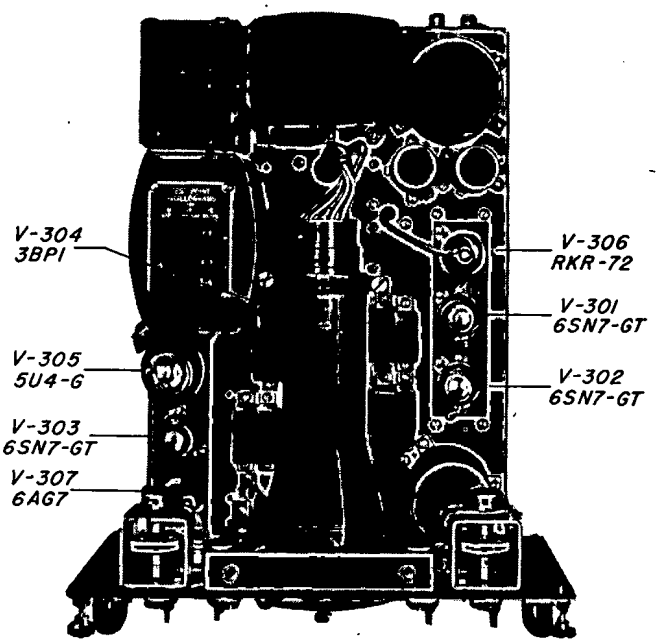


Figure 5-20. Monitor Scope, Tube Locations

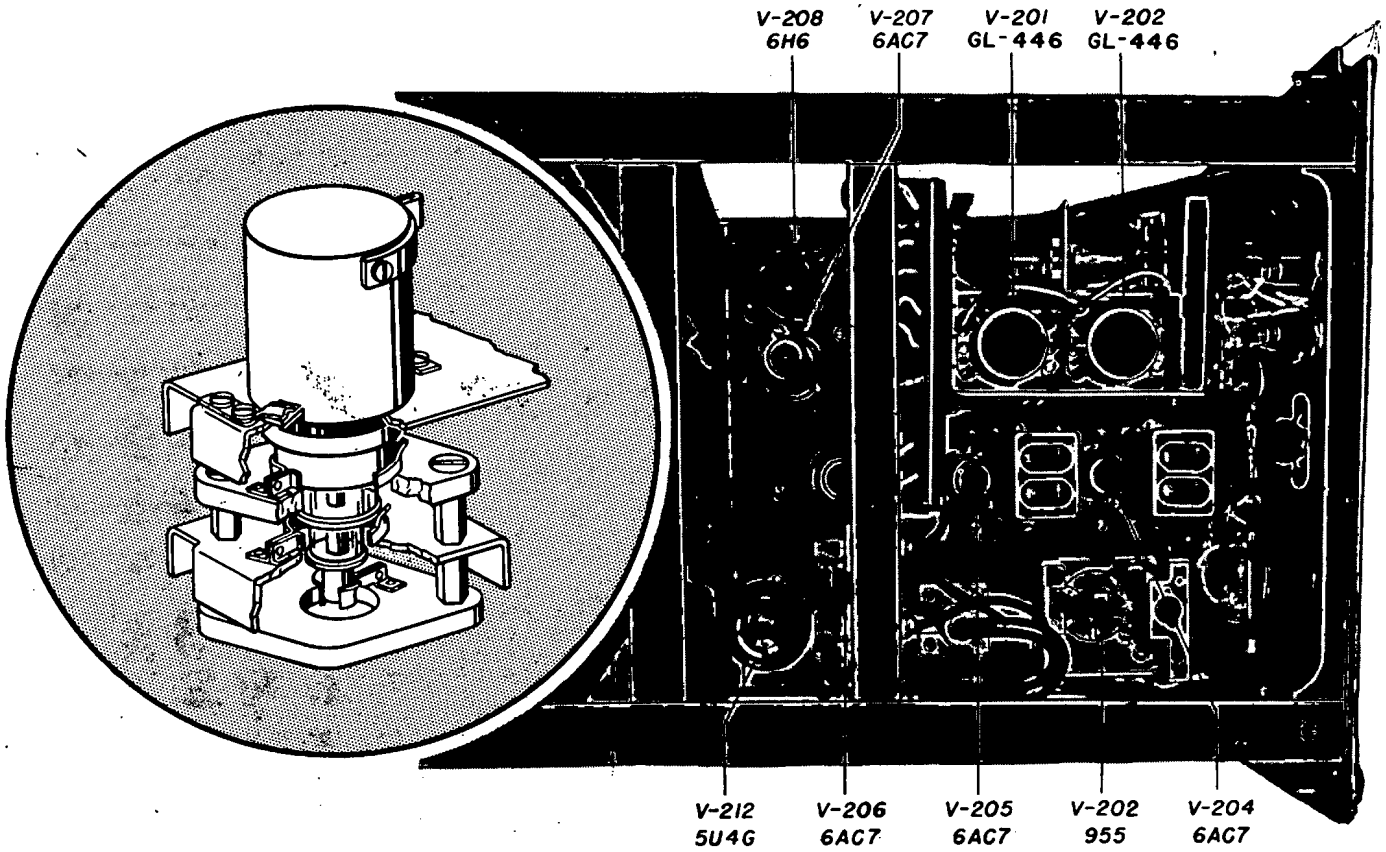


Figure 5-21. Monitor Receiver, Tube Locations

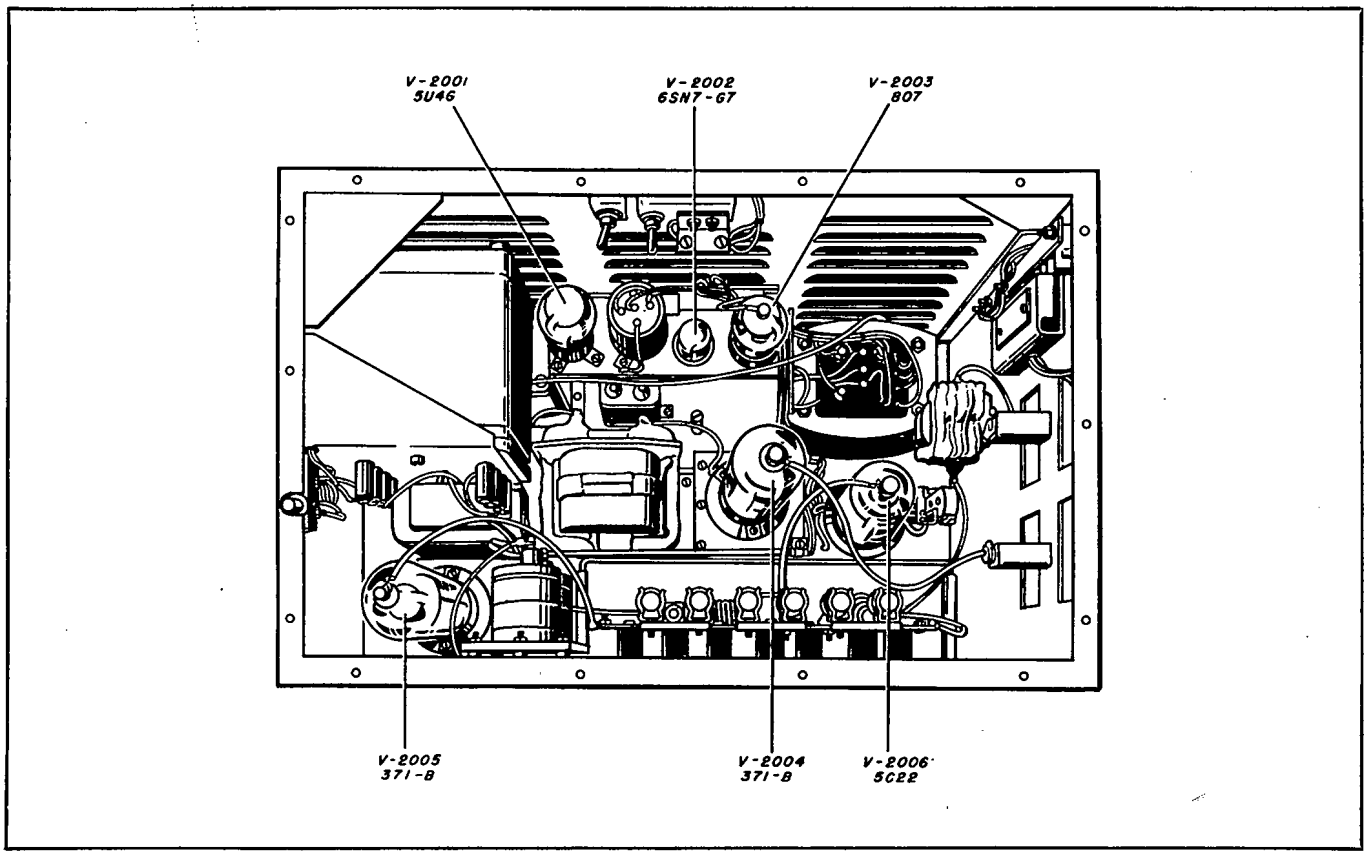


Figure 5-22. Modulator, Tube Locations

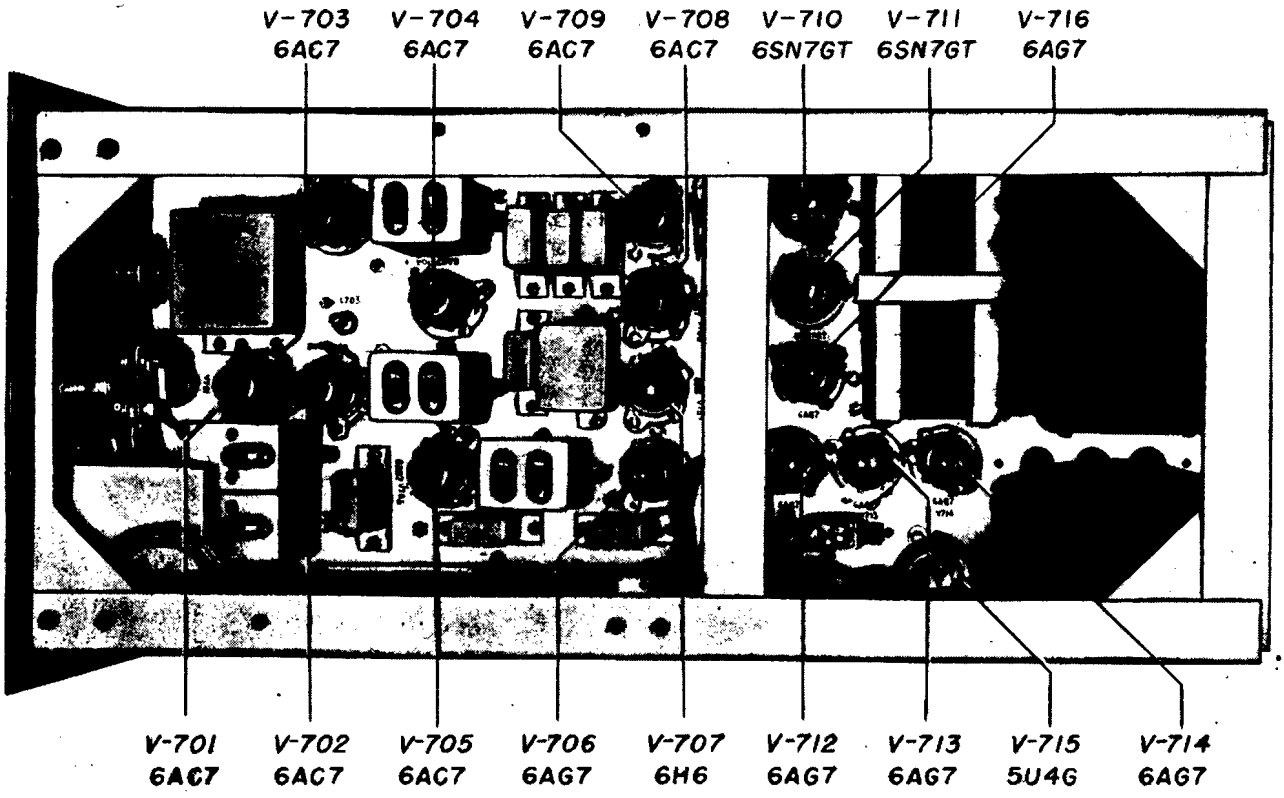


Figure 5-23. Console Receiver, Tube Locations

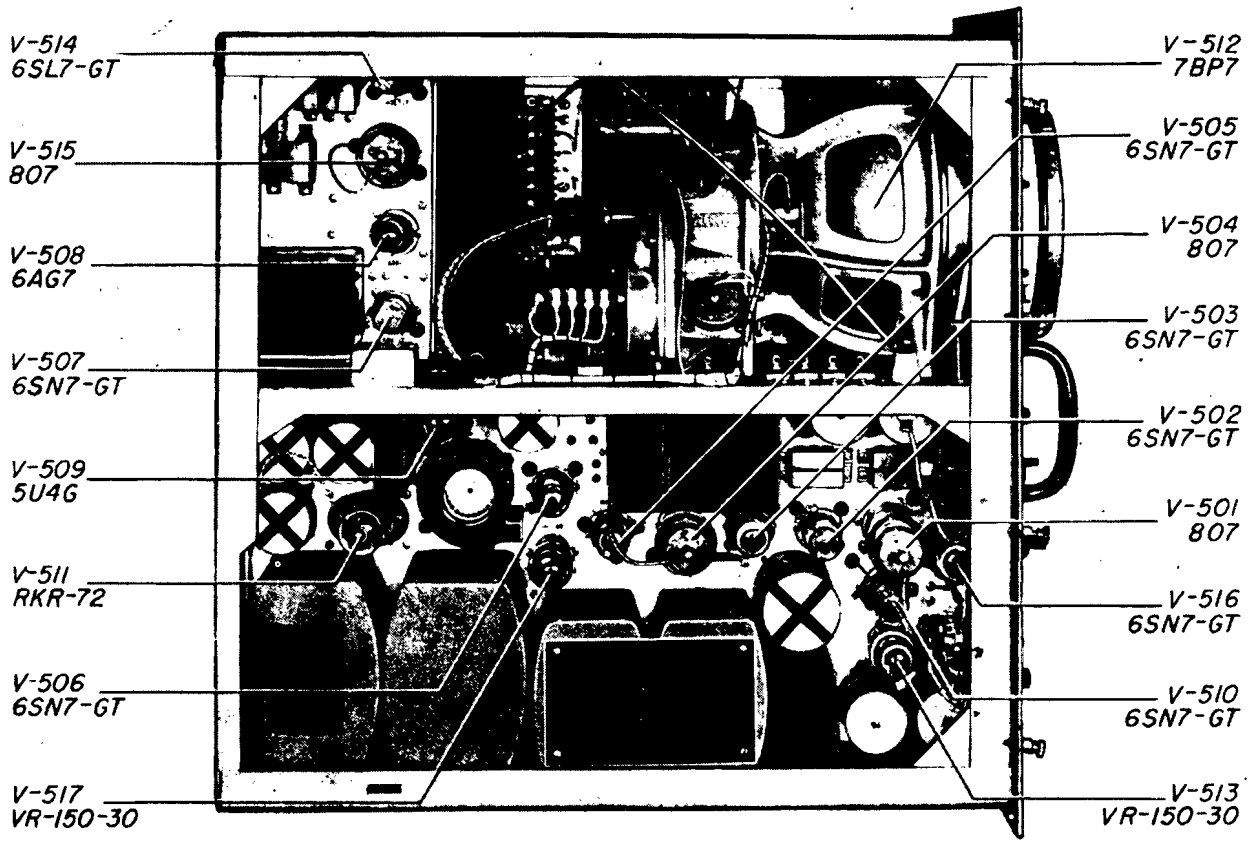


Figure 5-24. PPI Indicator, Tube Locations

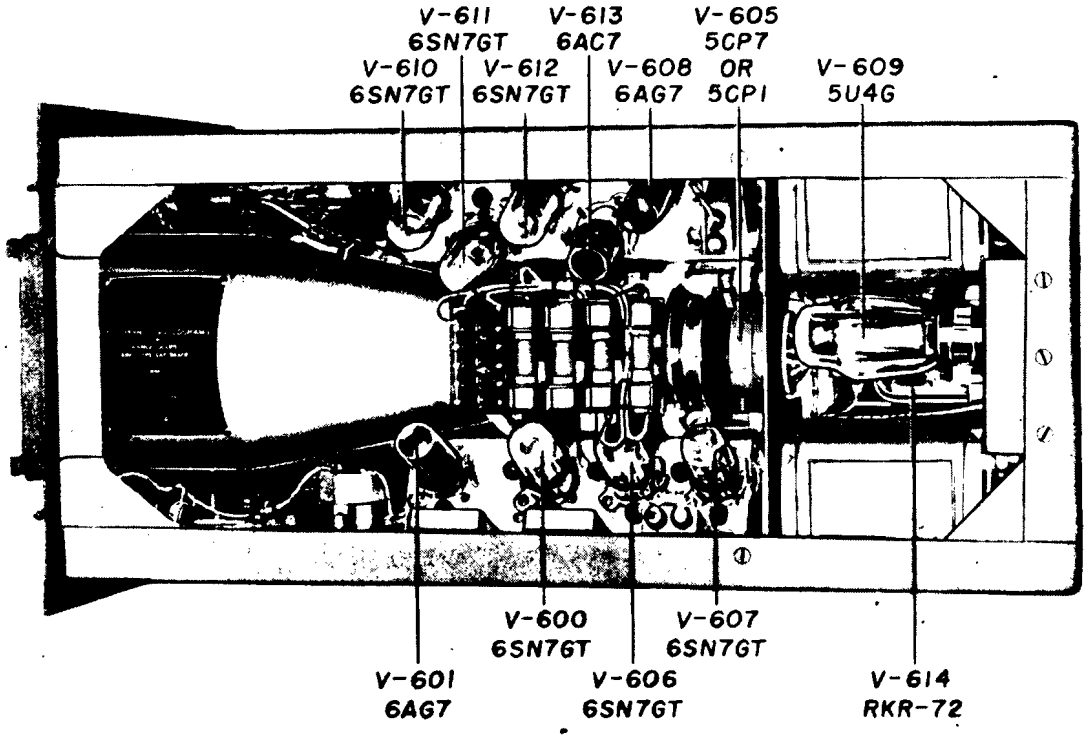


Figure 5-25. Range Scope, Tubes on Top of Chassis

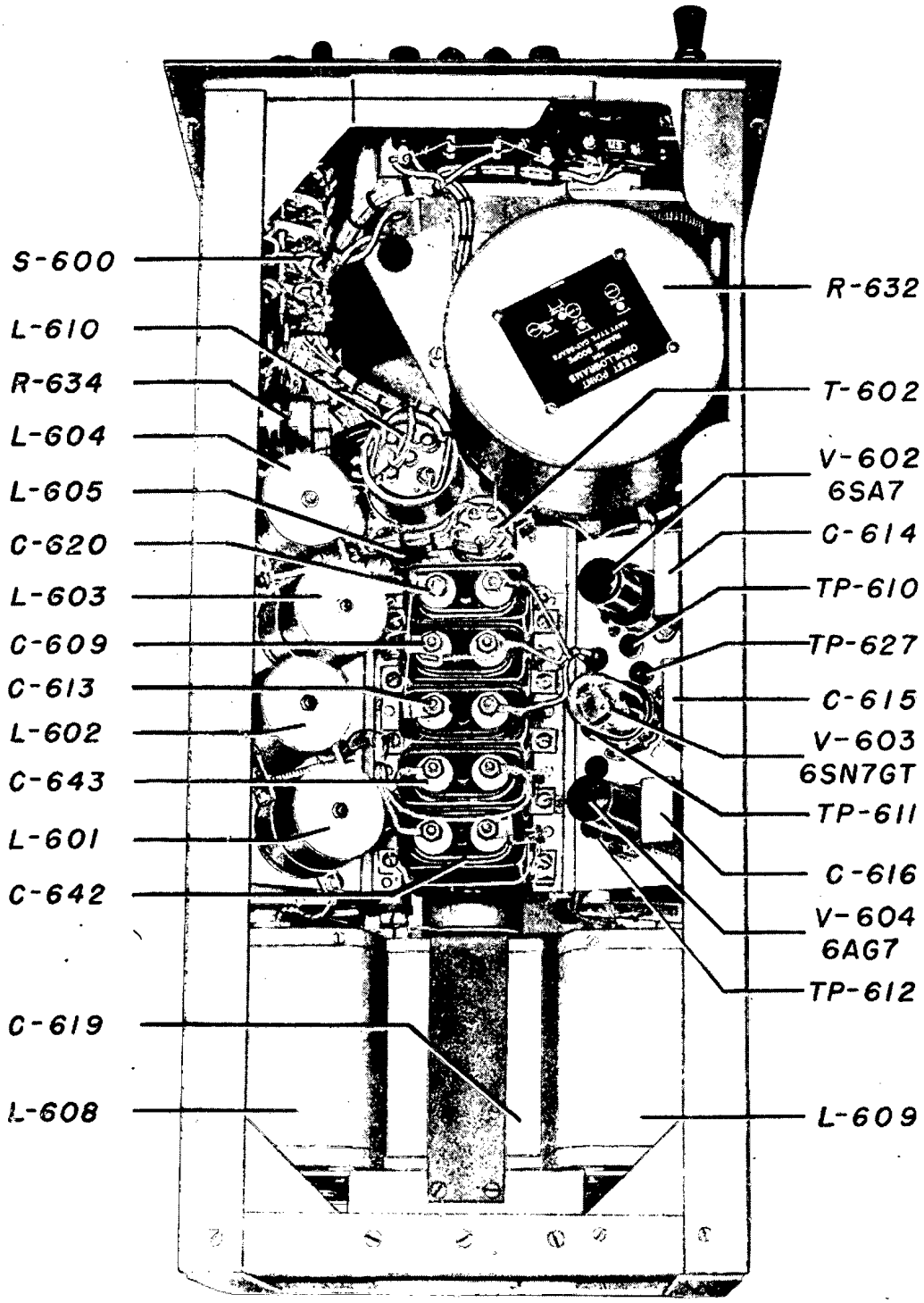


Figure 5-26. Range Scope, Tubes on Bottom of Chassis

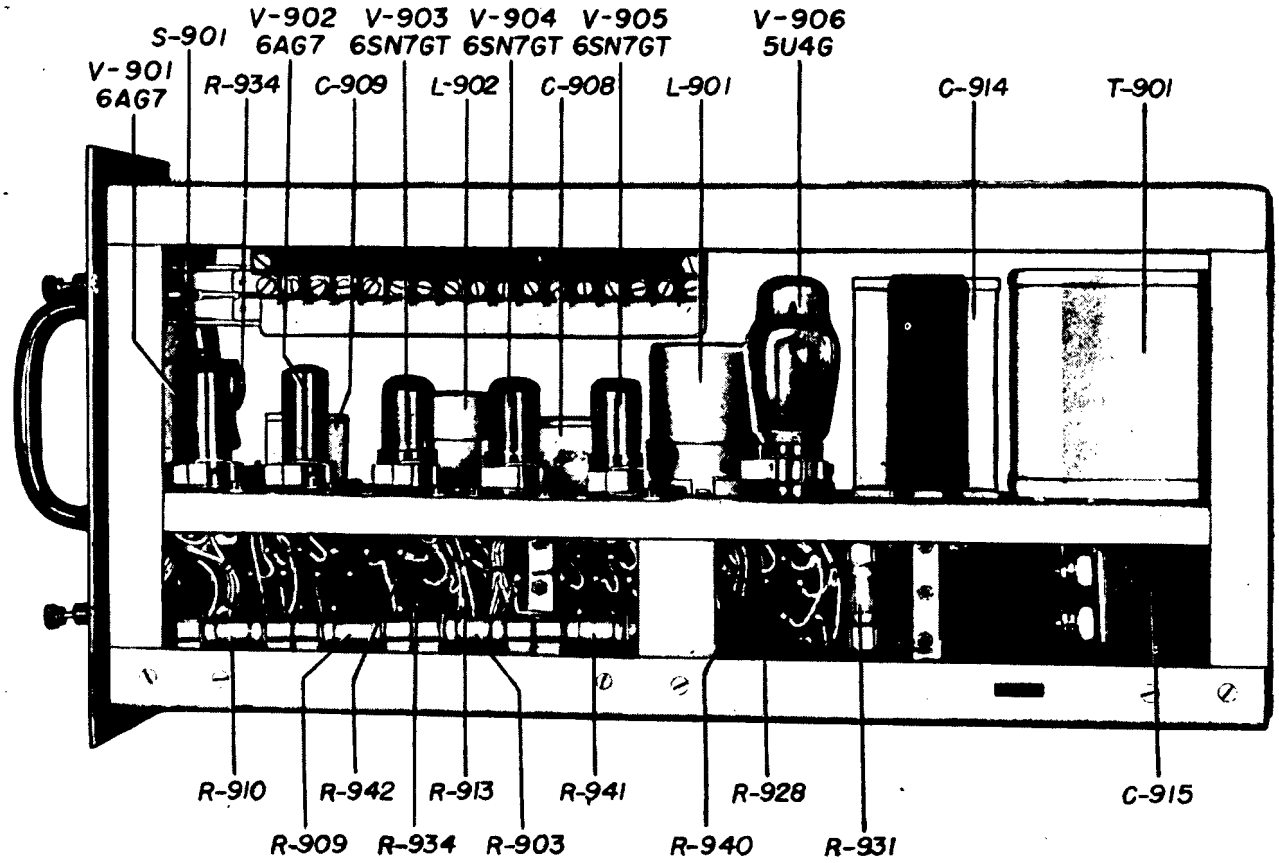


Figure 5-27. IFF Coordinator, Tube Locations

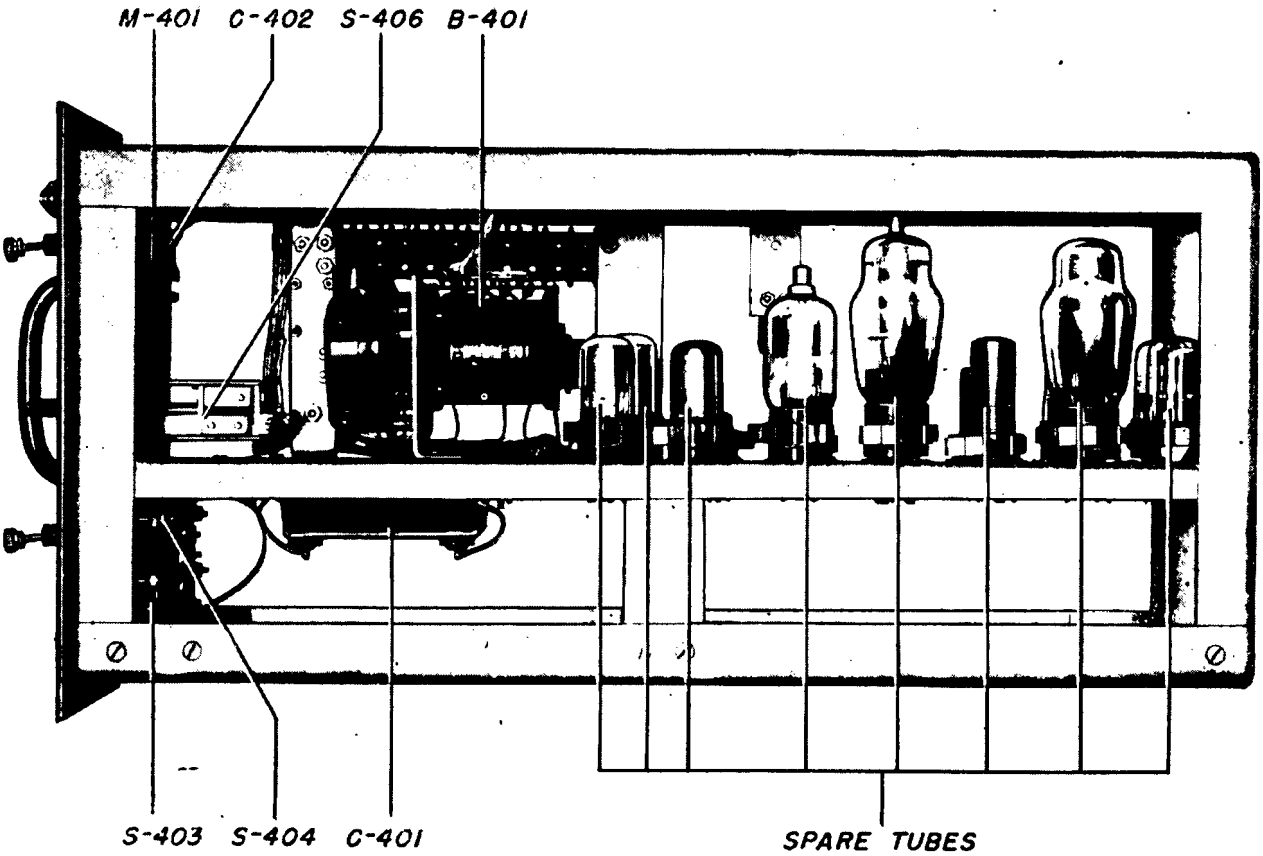


Figure 5-28. General Control Unit, Location of Spare Tubes

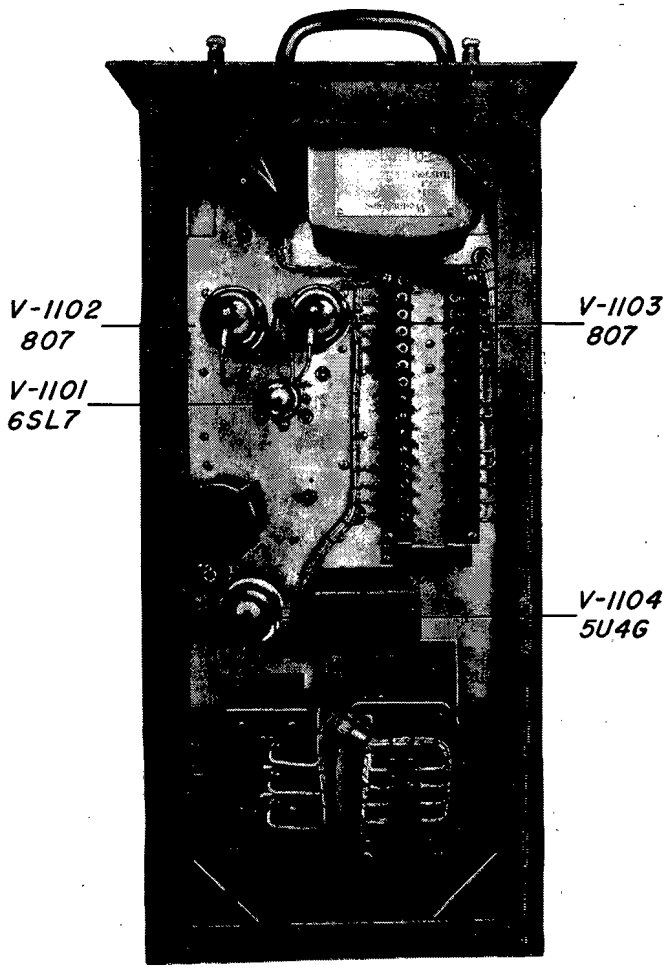


Figure 5-29. Servo Amplifier, Tube Locations

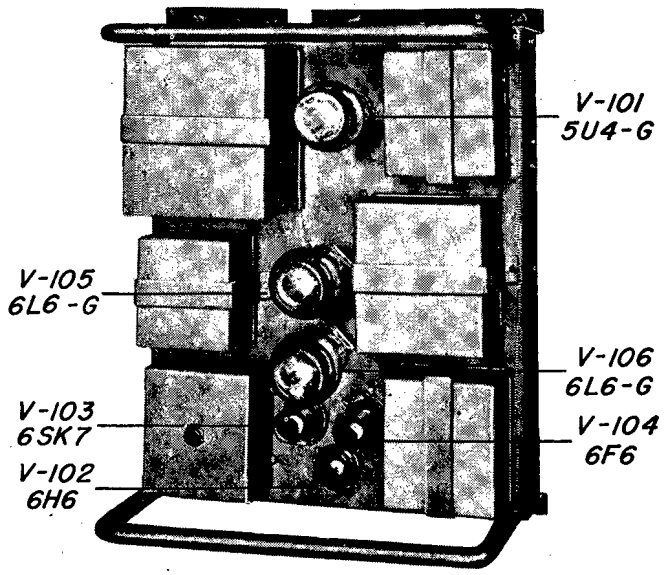


Figure 5-30. Synchro Amplifier, Tube Locations

SECTION 6

PREVENTIVE MAINTENANCE

1. GENERAL.

a. The object of preventive maintenance is to anticipate as far as possible, the occurrence of troubles and to take steps designed to prevent their occurrence. Preventive maintenance consists of inspecting the equipment, at periodic intervals, for loose or broken parts, loose connections and improper adjustment. It also includes cleaning and lubrication. This section contains suggested maintenance schedules for the use of personnel responsible for this phase of maintenance. Instructions describing the procedures to be followed are given in this section and in Section 5.

2. MAINTENANCE TEST SCHEDULE.

a. In addition to the duties outlined in the following test schedules, the operators should check the readings of the equipment every hour and should also check the operation of any component whose performance is not readily apparent during the course of normal operation. Some of the items in the maintenance schedules are also given in Section 5 and should be performed by the operators. Other items, particularly the items requiring partial disassembly of the equipment, should be performed by maintenance personnel. Alignment and adjustments requiring test equipment or special tools should also be performed by maintenance personnel. (See Tables 6-1 to 6-5 inclusive at the end of this Section.)

NOTE

THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 (OR 68) OF THE "BUREAU OF SHIPS MANUAL", OF THE LATEST ISSUE.

3. MECHANICAL MAINTENANCE.

a. One of the most important items in the care of electrical equipment is cleanliness. If the interiors of the components are kept clean and free from dust, dirt, and other deposits, occurrence of arc-overs is reduced, corrosion is minimized. Dust and dirt particles ionize easily and therefore contribute to the likelihood of arc-overs. Dirt deposits are spongy and have a tendency to absorb moisture from the atmosphere and thus contribute to corrosion. Therefore the trouble-free life of the equipment will be greatly increased if the interiors are cleaned periodically. The components exposed to salt air should be cleaned to remove deposits of salt. The interiors of the units should be cleaned with a cloth free from lint. If a cloth is used that leaves lint on high voltage terminals it would be better not to clean them at all.

b. All mounting bolts and studs should be inspected to see that they are tight. It is also well to occasionally inspect the assembly bolts and screws on the various components to see that none of them are loose, especially if any of the units have been disassembled for any reason. Since the antennas and the antenna pedestal are subject to the most wear, particular attention should be paid them. The brackets supporting the waveguide and the IFF coaxial transmission line should also be inspected to see if any of them are loose.

c. The exteriors of the various components should be inspected for broken meter glasses, sticking meter needles, loose, broken or bent controls, and loose or missing jewels over the indicator lamps. The air filters on the Transceiver and Rotation Control Unit should be cleaned whenever they begin to restrict the passage of air. The filter unit should be removed, and washed in gasoline, and then allowed to dry thoroughly. If the filter is very badly clogged, it may be necessary to use an air hose to remove the dirt in the interior of the filter. After the filter has been dried, it should be impregnated with either of the following lubricants:

Spec.	*Navy Symbol*	*Federal Stock Catalog No.*
NBS431	NS2190T	14-0-2879-25 or 14-0-2879
14-0-13	NS9250	14-0-2187 or 14-0-2195

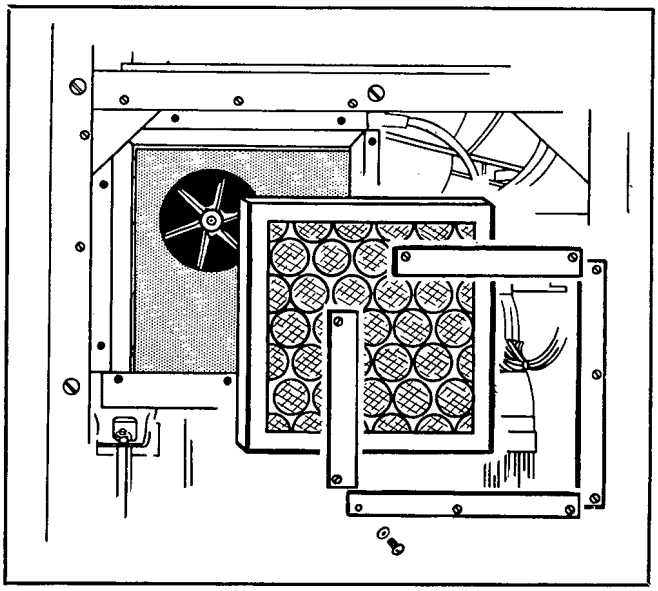


Figure 6-1. Air Filter in Transceiver

The filter on the Rotation Control Unit is removed by lifting it up and out of the brackets that hold it in place. The filter in the Transceiver is removed by removing the panel on the lower right-hand side. The screws holding the retaining plates can be removed to permit the filter to be lifted out. See Fig. 6-1.

d. While the filters are being cleaned check the fans on the blower motors. Check each fan assembly to see that it is tightly mounted on the drive shaft of the blower motor. If it is not, tighten the set screws. The fan motor mountings should be checked to see that they have not loosened and shifted position. If the mounting is loose, be sure to align the motor so that the fan is centered in the shroud before tightening the mounting bolts.

e. The Antenna Drive Motor and the gear train in the Pedestal are subject to more mechanical wear and usage than any other parts of the equipment. These parts should be inspected regularly. The motor should be inspected for worn bearings and the gear train should be inspected for excessive backlash. If evidence of either trouble is present, it should be corrected as directed in Section 7. Regular lubrication as directed in Paragraph 6*f* of this section will greatly prolong the life of the gear and gear train.

f. The control knobs are secured to the control shafts by means of Allen head set-screws. There are two screws for each knob. An Allen set-screw wrench is supplied with the equipment to use when tightening the control knobs or whenever they must be removed. Allen wrenches are also provided to tighten the set screws in the fans on the blower motors. The Allen wrenches are carried in Fahnestock clips mounted on the chassis frames at easily accessible points. After all other maintenance has been performed, any rust should be cleaned away with a fine grade of sandpaper and paint applied to the rusty and scratched places.

4. ELECTRICAL MAINTENANCE.

a. Electrical preventive maintenance consists of visually inspecting the electrical parts and circuits of the equipment for evidence of trouble, both of a mechanical nature and an electrical nature. Quite frequently trouble discovered during preventive maintenance will require the application of the instructions given in Section 7 Corrective Maintenance. All cabling and wiring should be inspected for defects of all kinds. Check each plug and terminal board for poor connections. The terminal boards should be clean and the connections should be free from corrosion. Check the condition of the wires where they enter the solder lugs. There should be no bare wire exposed and the insulation should not be frayed. See that all connections are tight. The plugs on the plug-in type units should be securely mounted on the chassis and the pins should be straight so that they align perfectly with the female contacts. If the female contact seems to be too loose to make good contact, squeeze it together. If the contacts are dirty or corroded, burnish them with crocus cloth or a fine grade of sandpaper. To burnish the inside of sleeve contacts, roll up a small strip of crocus cloth or sandpaper, insert it in the contact, and rotate it until the contact is burnished. Use this same treatment on coaxial connectors except that only crocus cloth can be used for burnishing since these connectors are silver plated and sandpaper will destroy the plating.

b. The cables should be inspected for damaged insulation and broken conductors at points where they pass around the corners of equipment, come out of holes in chassis, and run from bulkhead straps to the units. Support all cables that are limp and subject to accidental strains which might break them. If any of the cables have a tendency to kink, slip a short length of flexible plastic tubing over them at the point where the kink occurs. Check all soldered connections for cold soldered joints and resolder any defective joints found. Check the stuffing tubes to see that they seal tightly around the cables and are water tight. Where coaxial cables pass through stuffing tubes be sure that the stuffing tubes are tight enough to seal but not tight enough to force the cable dielectric to flow away from that point. If the cable shows any tendency to bulge at the point where it enters a stuffing tube, it is recommended that the cable be replaced or spliced since a discontinuity with its attendant electrical losses has developed at that point. Pulse cables that have been in use for long periods should be checked for leakage with a d-c bridge or a good megger. A high potential test may also be used to determine the condition of a cable carrying pulses of high voltage.

c. The various chassis should be carefully inspected at regular intervals. The tubes should be removed and tested in a good tube checker, preferably a mutual conductance type. This should be done once each quarter. Care should be exercised to prevent breakage when removing and replacing tubes. Be careful to replace the tubes in their original sockets after testing. The tube clamps should be tightened when the tubes are replaced. The tubes should be pushed all the way down into their sockets when they are replaced. Any tubes that do not test satisfactorily should be replaced.

NOTE

ALL TUBES OF A GIVEN TYPE SUPPLIED WITH THE EQUIPMENT SHALL BE CONSUMED PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

d. Heater resistors should be checked with an ohmmeter once every quarter. It will be necessary to disconnect the heater resistor from its circuit to get an effective test. The parts in the chassis should be inspected for dust and corrosion. The circuit resistors should be inspected to see if any of them are charred or discolored from overheating. If any are found they should be replaced. Capacitors should be inspected for oil leakage and cracked insulators. The insulation

of transformers, chokes and motors should be inspected for signs of overheating wherever possible. Overheating of these parts is usually caused by a circuit condition which overloads them beyond their current carrying capacity or by a breakdown of the insulation between turns. The first cause quite often produces the second. When an inductor has once been overheated, the burned insulation may be detected by its characteristic odor and in some cases, the impregnating wax melts and runs out of the can. Corrective maintenance procedures should be employed to determine the cause of overheating before the defective parts are replaced. The circuits are fused to protect the transformers and very little difficulty of this kind should be experienced.

e. The relays should be inspected periodically to see that they are clean, have not been subjected to overheating, and that their mechanical operation is satisfactory. The armatures should move freely, and the contacts should close together firmly. Examine the contacts for evidence of burning, pitting, or excessive wear. If they require cleaning and burnishing, use a standard relay service kit of tools. Do not use sandpaper on silverplated contacts. Use only crocus cloth. Replace any relay whose contacts are so badly burned as to require reshaping with a file. The reconditioning and restoration of contacts is not a preventive maintenance duty. It is a repair job and it is much more satisfactory to return the relay for new contacts and adjustment. After the relays have been cleaned, operate the switches that energize them and watch them operate. They should operate with a good positive action without arcing and should remain closed without chattering. If the relays arc or chatter, they should be adjusted or replaced. The tension adjustment on the relays is readily accessible. Most of them have no adjustment and should be replaced when trouble develops.

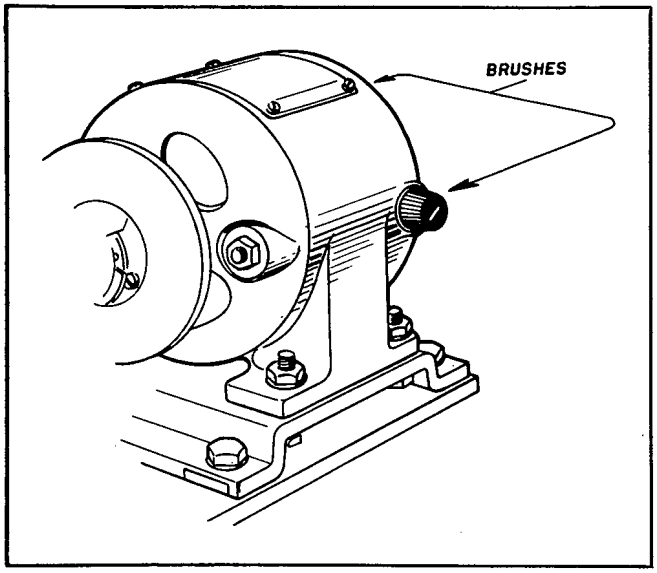


Figure 6-2. Slewing Motor Brushes in Bearing Indicator

5. CARE OF BRUSHES.

a. The care of the brushes in the various components is usually a preventive maintenance item. The Bearing Indicator must be removed from its compartment to inspect the slewing motor brushes. The slewing motor is located near the rear of the chassis behind the indicator dials and the synchro units. The brushes are removed from the brush holders by unscrewing the knurled caps with screwdriver slots. See Fig. 6-2. The brush holders are located on the rear bell housing of the motor. The brushes should be replaced whenever inspection shows that only one-quarter of an inch of active brush material remains. The commutator should be inspected to see if it requires dressing and undercutting. If it does, the motor should be replaced and the old motor sent to a repair depot equipped to make such repairs.

b. The brushes on the exciter and d-c generator of the Servo Generator should be serviced in the same way described for the slewing motor. The exciter brushes are held in place by slotted caps on the brush holders similar to the brush holders on the slewing motor. See Fig. 6-3. Retaining straps are placed over the caps to keep vibration from working them loose. These straps are held in place with two screws. To remove the brushes, remove one of the screws holding the strap and loosen the other. Swing the strap away from over the brush cap and replace the strap screw in the hole in the housing so that it will not be misplaced. Use a screwdriver to remove the brush cap and then lift out the brush. The brushes on the d-c generator are accessible when the brush cover is removed from the housing. This cover is located adjacent to the grease cup. To remove the cover, take out the screws and rotate the cover until the open ends are

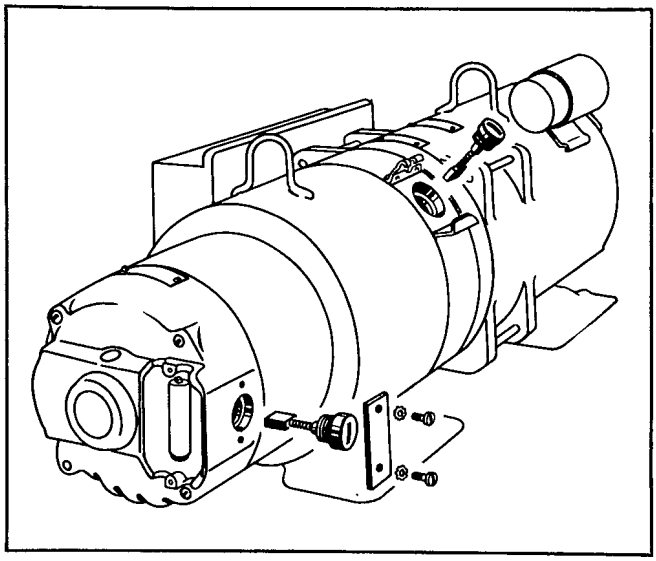


Figure 6-3. Replacing Brushes in Servo Generator

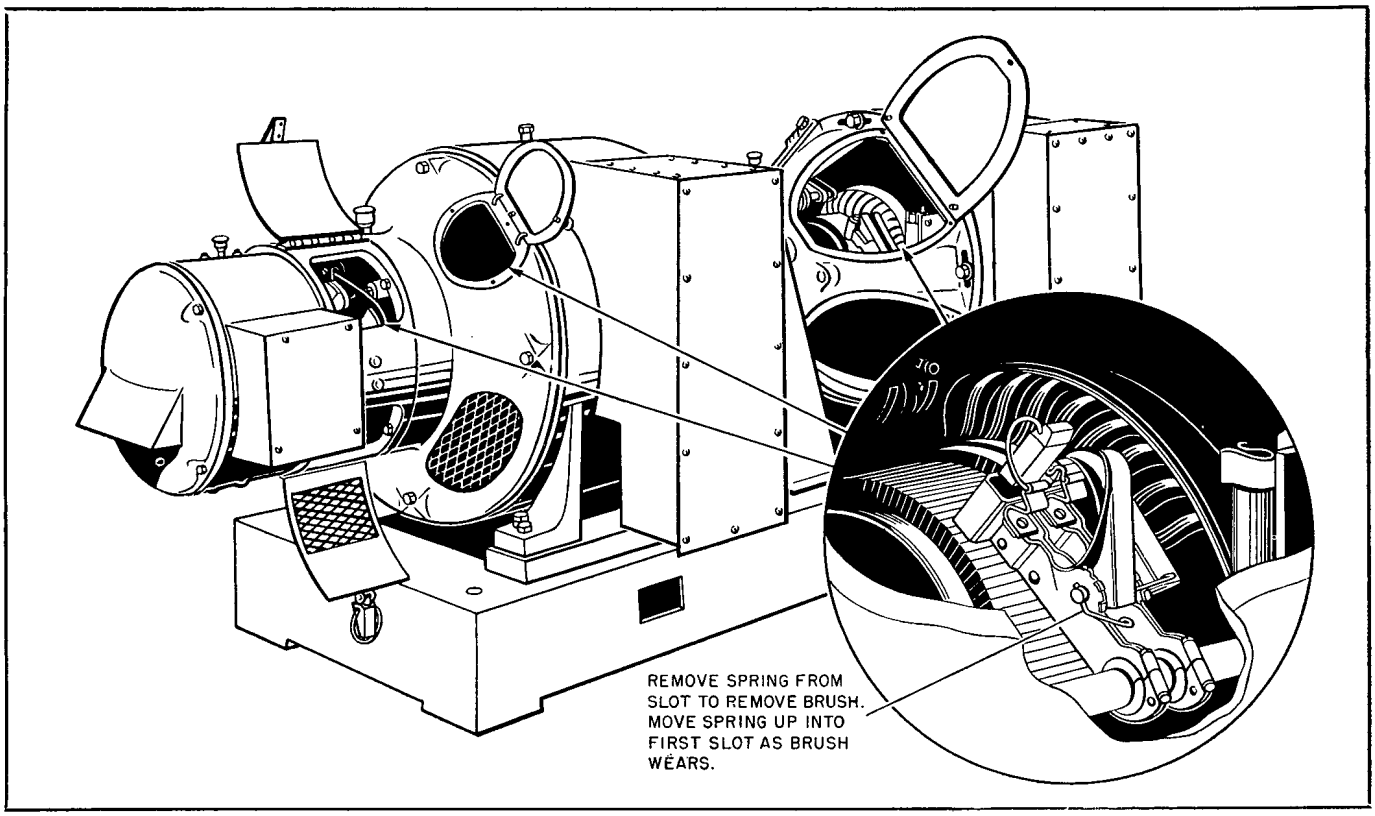


Figure 6-4. Replacing Brushes in Motor-Generator

behind the junction box. Then spring the cover so that it can be slipped off the frame.

c. The brushes in the motor generator are shown in Fig. 6-4. The exciter brushes are accessible when the cover on the exciter is removed. This cover consists of three sections hinged together and is held in place by two rings over retaining posts. When these brushes are replaced they should be seated with a seating stone. The brushes should be placed in the brush holders and the stone held lightly against the commutator while it is running. The seating stone should be applied two or three times for a few seconds each time. The brushes in the d-c drive motor are accessible when the hinged covers are opened. These covers are on the coupler side of the bell housing as shown in Fig. 6-4. These brushes should be replaced and seated as previously described. When servicing the brushes note the appearance of the commutators. If the bars are worn down to the insulating spacers in the motor or exciter, the unit should be replaced and returned to the shop for a complete over-hauling. The exciter and generator must be removed together as one unit. The d-c drive motor can be removed as a separate unit. The brushes should be replaced whenever they have worn sufficiently to materially reduce the spring pressure and cause the brushes to ride lightly on the commutator.

d. The brushes in the antenna drive motor should be inspected quarterly and replaced whenever the amount of wear reduces the spring pressure below the point where positive contact can be continuously maintained. The motor brushes are shown in Fig. 6-5. They can be removed by unscrewing the screw caps on the brush holders. The brush holders are located on the upper and lower sides of the rear bell housing. If the commutator shows signs of wear, it should be replaced.

e. The replacement of the slip ring brushes in the antenna pedestal is shown in Fig. 6-6. To inspect the brushes, loosen the eight captive screws that hold the brush cover to the housing and pull the brush assembly

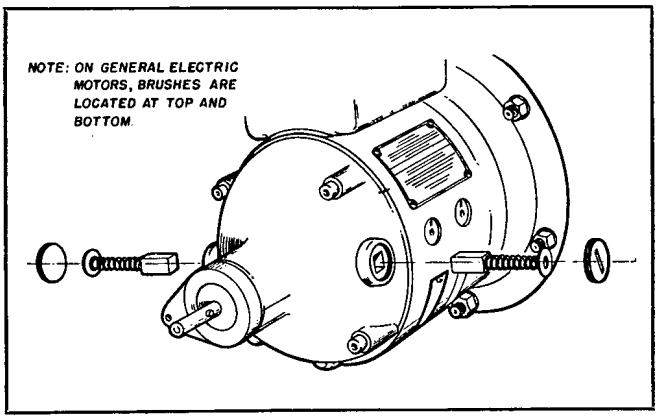


Figure 6-5. Replacing Brushes in Antenna Drive Motor

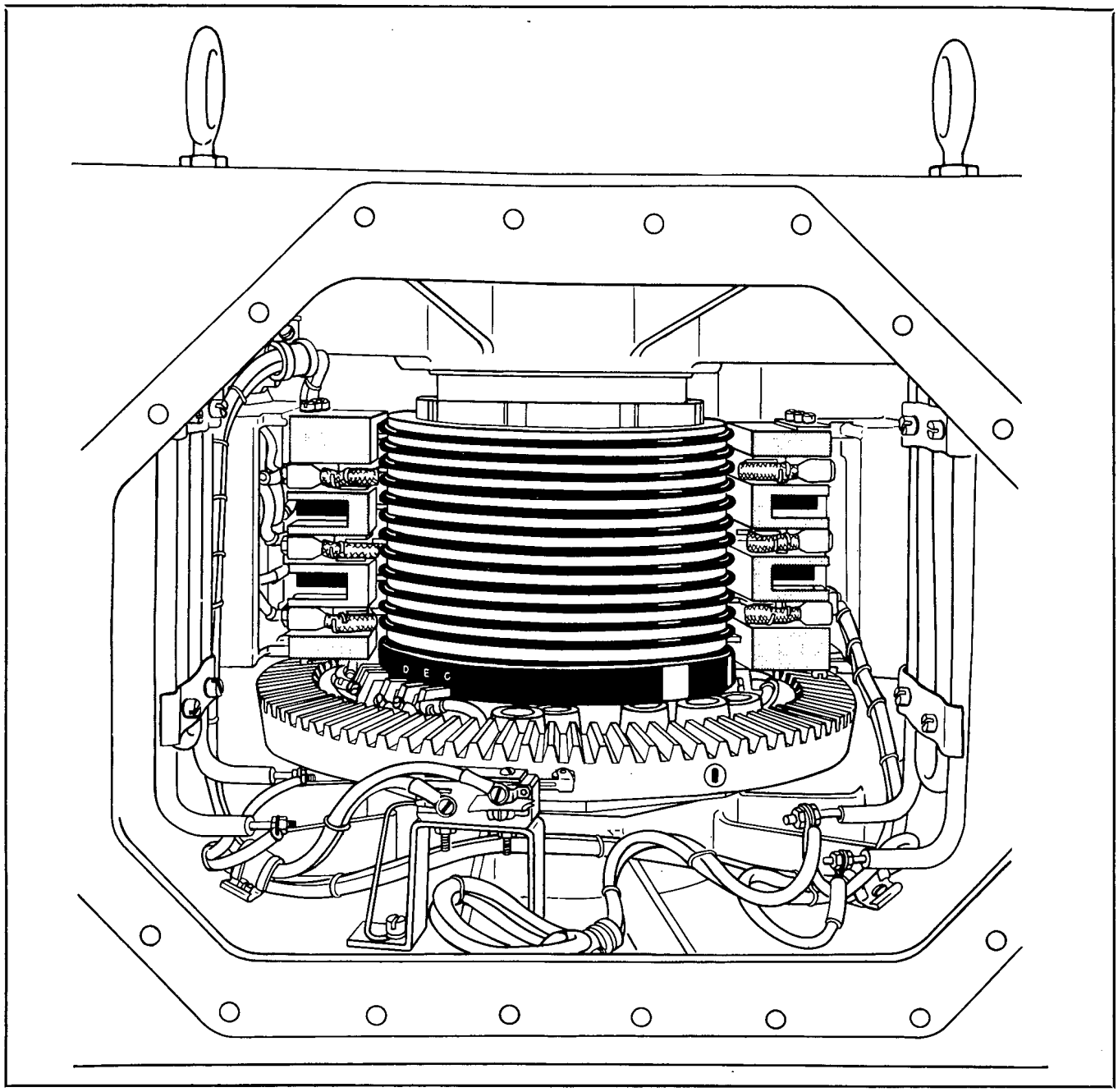


Figure 6-6. Brushes in Antenna Pedestal

straight out. The amount of wear on the brushes can be determined by comparing the brushes in use with the spare brushes on the brush block.

WARNING

DO NOT PERFORM ANY MAINTENANCE ON THE ANTENNA PEDESTAL UNLESS THE ROTATION CONTROL UNIT AND SERVO GENERATOR ARE OFF. REMOVE THE MOTOR DISCONNECT PLUG IN THE BASE OF THE PEDESTAL BEFORE PERFORMING ANY MAINTENANCE.

To remove a brush assembly, remove the screw at the end of the brush block that serves as a connection for the motor lead wire and the braided brush lead. Remove the hexagonal nut and washers from the end of the brush holder that projects out from behind the brush block. Press on the threaded end of the brush holder and push the defective brush assembly out of the brush block. To replace the brush assembly, push its threaded end through the hole in the brush block. Be sure the square shank is registered in the slot in the brush holder. Place the braided brush lead and the proper motor lead on the fillister head screw and thread the screw into the hole in the brush holder.

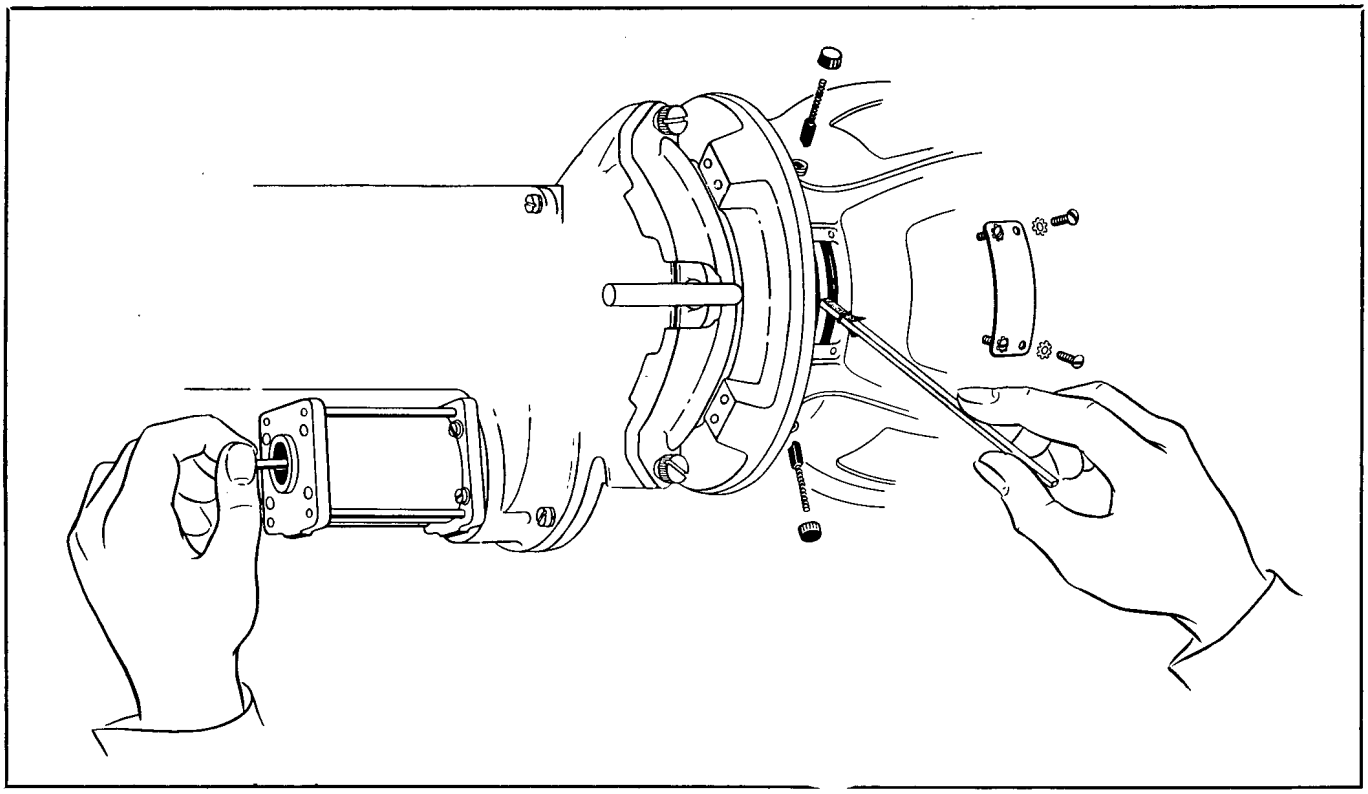


Figure 6-7. Brushes and Slip Rings on PPI Assembly

Place a flat washer and a lock washer on the threaded end of the brush holder. Then screw the hexagonal nut down tight on the threaded end of the brush holder. Replace the brush holder in the main housing and close the cover door, making certain that all gaskets are smooth and properly in place before bolting the cover in position. The removal and replacement of the entire brush block assembly is described in Section 7.

f. Particular attention should be paid to the neck of the PPI tube where it passes through the yoke coil. Deposits may form under the coil that makes it hard to turn or else causes it to turn with a jerky movement. This can often be detected by manually turning the shaft of the drive motor. If trouble is detected, the PPI tube should be removed and the deposit cleaned away. This procedure is primarily a corrective maintenance procedure because of the extreme delicacy required to remove the PPI tube. Refer to the procedure given in Section 7. The slip rings on the PPI yoke coil should be cleaned every three months. The brushes should also be removed and inspected for excessive wear, and to see that they make good contact with the slip rings. To clean the slip rings, remove the four screws that hold the access cover in place as shown in Fig. 6-7. Remove the brushes at the same time. If the old brushes are replaced, they should be replaced in the same holders from which they were removed and they should not be turned around in the holder. When the access cover is removed, the slip rings may be easily reached for cleaning. Use a flat piece of wood slightly wider than the slip ring, with a piece of crocus cloth wrapped lengthwise over one end. If a suitable piece of wood is not available, wrap the crocus cloths strip back over the forefinger. Insert the piece of wood or the forefinger into the opening and gently press it against one of the slip rings. See Fig. 6-7. Rotate the shaft of the drive motor with the left hand until the slip ring is clean. Repeat the operation for the other slip ring. After the rings have been cleaned, wipe the rings and yoke coil assembly with a dry clean cloth that is free of lint. Be careful not to allow any dust to get into the yoke coil bearings or it will be necessary to disassemble them for cleaning also. After cleaning, replace the access cover.

g. The location of the brushes in the Synchro Amplifier is shown in Fig. 6-8. There are six commutator brushes on the commutator arms and six collector brushes on the slip rings. The tension on the commutator brushes is manually adjustable. As shown in Fig. 6-8, a screw may be turned to increase or decrease the compression of the spring that forces the brush against the commutator face on the transformer. The tension should be adjusted so that positive contact is maintained without binding. When the brush has worn to the point where the spring is almost in contact with the shoulder inside the holder, replace it with a new brush. To replace the brush unscrew the hexagonal nut and sleeve assembly that holds the adjusting screw. See Fig. 6-8. Remove the spring and work

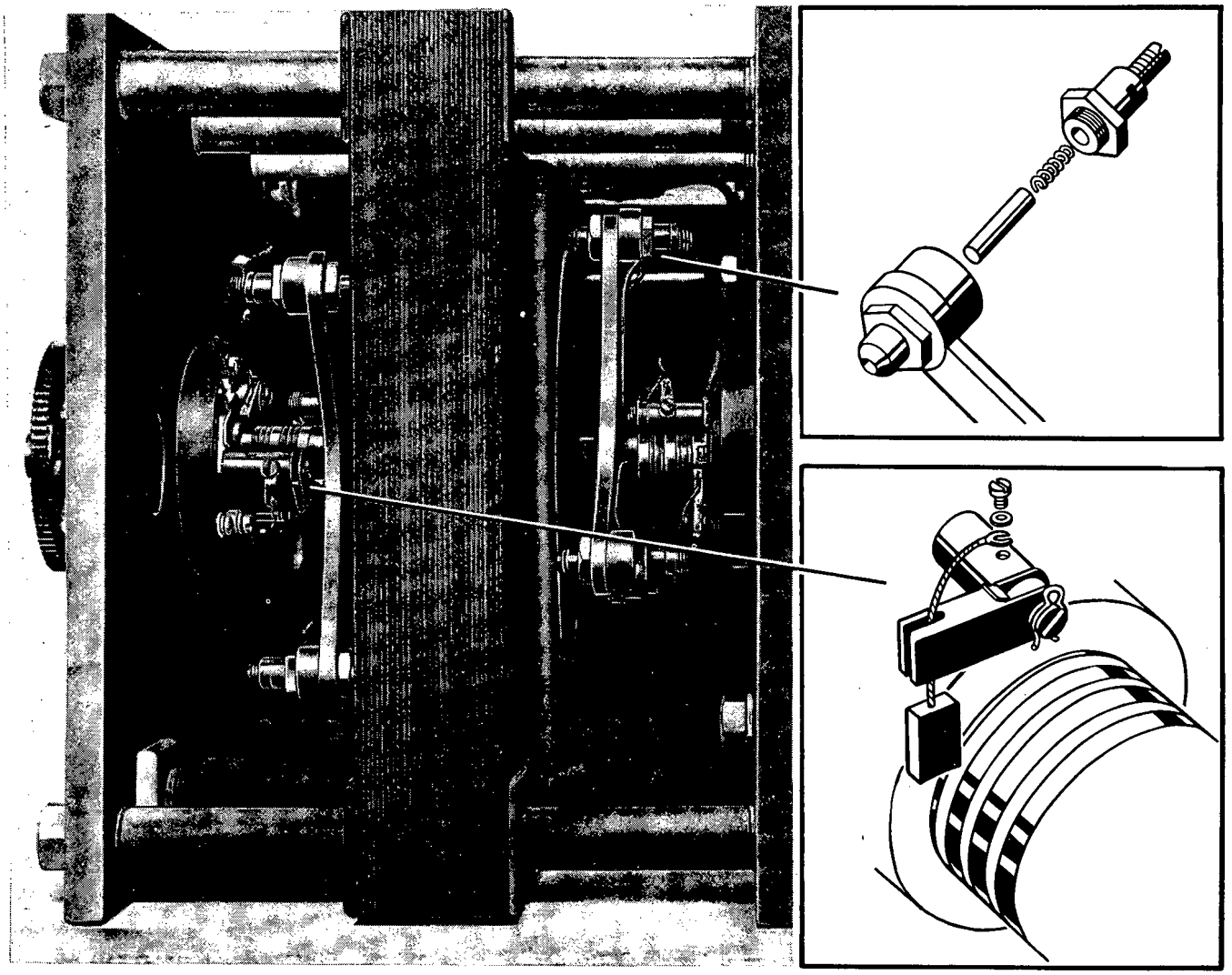


Figure 6-8. Brush Assemblies in Synchro Amplifier

the brush out through the rear of the spider arm. Insert the new brush, then the spring and screw the hexagonal nut and sleeve back into position. Adjust the screw to the proper tension. To remove the slip ring or collector brushes, unscrew the fillister head screw that holds the brush braid as shown in Fig. 6-8. Raise the brush arm and slip the brush out. Note that the brush may be removed for inspection by lifting the brush arm, dropping the brush down and sliding the braid out through the slot in the end of the brush holder. The brush should be replaced whenever it wears to the point where the holder is about one-eighth of an inch away from the slip ring. If the slip rings become dirty, clean them with a cloth dipped in an approved solvent. Then polish the rings with a dry cloth. The brush holder assembly may be removed by first removing the brush and then removing the hairpin clip that holds the brush holder on the shaft. The brush holder and spring assembly may be slipped off of the shaft when the clip has been removed. When replacing the holder be sure the spring is positioned to enter the slot so that pressure will be exerted against the brush. Do not use brush seating compound when replacing the brushes in the synchro amplifier.

b. The brushes in the switch drive motor in the Keyer Unit are shown on the lubrication diagram in Fig. 6-17. The brushes are accessible from the bottom of the unit. They are removed by unscrewing the brush caps shown and pulling out the spring and brush.

6. LUBRICATION.

a. GENERAL.

(1) Figs. 6-9 to 6-17 inclusive show the points in each unit that require lubrication, the frequency of lubrication, the type of lubricant to be used, and brief instructions. Supplementary instructions are also given in the following paragraphs. These instructions refer to parts of the equipment that require disassembly in order to lubricate the parts. Chassis runners and rails should be lubricated quarterly with petrolatum

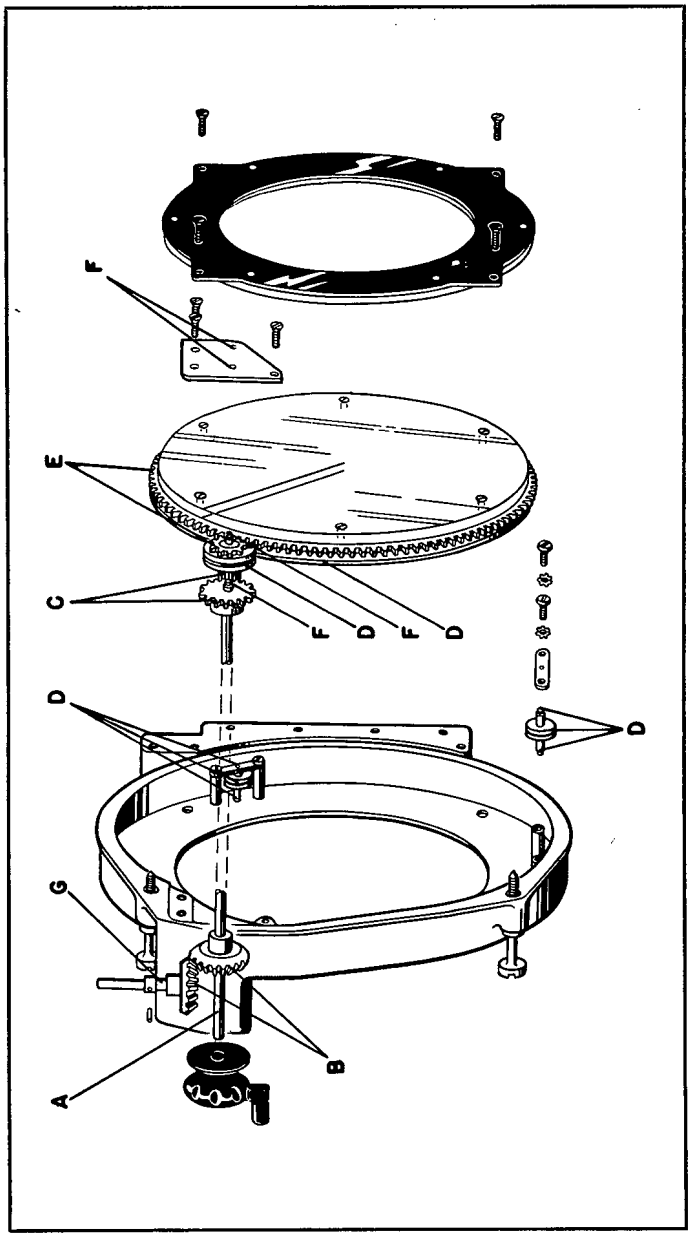


Figure 6-9. Lubrication of Geared Cursor

LUBRICATION

GEARED CURSOR

	Point	Part	Location	Lubricant	Instructions
Quarterly	A	Control shaft	Front of Cursor	Spec. N.B.S. 431, Navy Symbol NS 2075 Fed. Std. Stock, Cat. No. 14-O-2586	Remove control knob. Apply one drop.
	B	Bevel gears	Gear housing	Spec. N.B.S. 431, Navy Symbol NS 2075 Fed. Std. Stock, Cat. No. 14-O-2586	Swing cursor open. Remove plate, apply two drops to each gear.
	C	Gear and pinion	Gear housing	Spec. N.B.S. 431, Navy Symbol NS 2075 Fed. Std. Stock, Cat. No. 14-O-2586	Swing cursor open. Remove plate, apply two drops to each gear.
	D	Grooved rollers	Cursor housing	Spec. N.B.S. 431, Navy Symbol NS 2075 Fed. Std. Stock, Cat. No. 14-O-2586	Swing cursor open. Apply one drop to each roller.
	E	Ring Gear and Pinion	Cursor housing	Spec. N.B.S. 431, Navy Symbol NS 2075 Fed. Std. Stock, Cat. No. 14-O-2586	With cursor open. Apply four drops to ring gear.
	F	Bearings	Plate on gear housing	Spec. N.B.S. 431, Navy Symbol NS 2075 Fed. Std. Stock, Cat. No. 14-O-2586	With cursor open. Apply one drop to each bearing.
	G	Shaft	Top of cursor	Spec. N.B.S. 431, Navy Symbol NS 2075 Fed. Std. Stock, Cat. No. 14-O-2586	Apply one drop around collar.

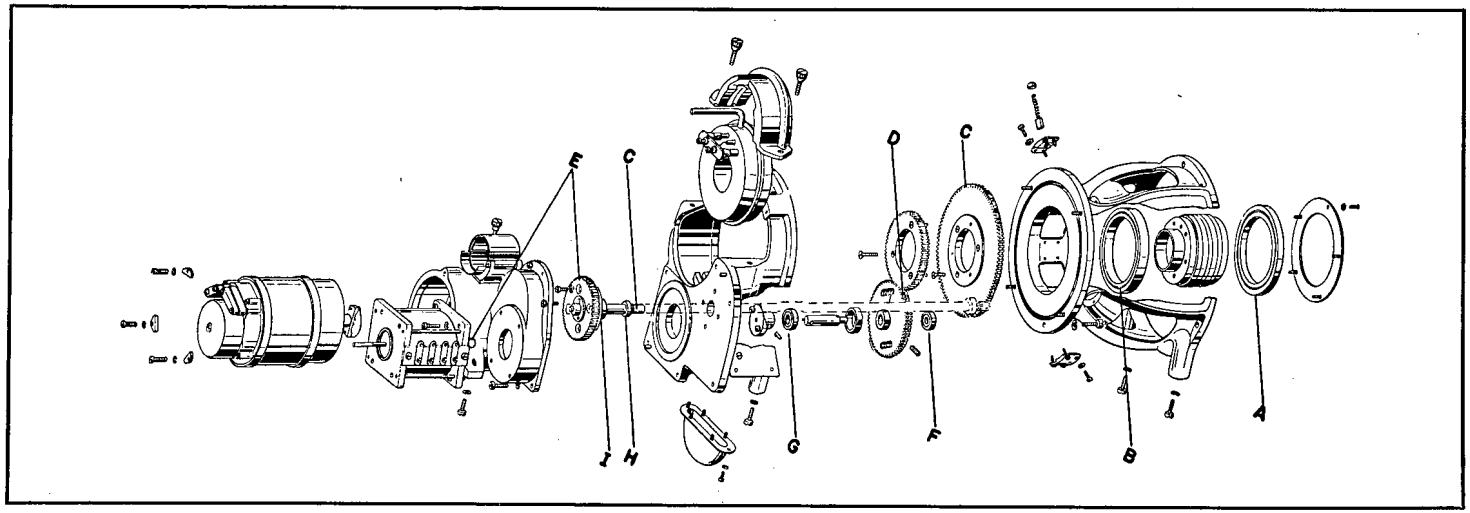


Figure 6-10. Lubrication of PPI Assembly

LUBRICATION

PPI ASSEMBLY

Point	Part	Location	Lubricant	Instructions
Semi-Annually A	Yoke Coil bearing	On front of yoke coil behind bell of PPI Tube	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595 (Alternate—Gulf Petrolatum B)	Clean with solvent. Dry, and apply one 1/16" drop of lubricant.
B	Yoke Coil bearing	On rear of yoke coil behind bell of PPI Tube	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595 (Alternate—Gulf Petrolatum B)	Clean with solvent. Dry, and apply one 1/16" drop of lubricant.
C	Yoke Coil drive gears	In front of focus coil	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595; (Alternate—Gulf Petrolatum B)	Remove focus coil. See Section 7, Par. 27 b (3). Apply one 1/16" drop of lubricant where gears mesh.
D	Yoke Coil Servo gears	In front of focus coil	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595 (Alternate—Gulf Petrolatum B)	Remove focus coil. See Section 7, Par. 27 b (3). Apply one 1/16" drop of lubricant where gears mesh.
E	Drive gears	Drive gear housing	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595 (Alternate—Gulf Petrolatum B)	Remove drive motor. See Section 7, Par. 27 b (6). Apply one 1/16" drop of lubricant to drive motor pinion.
Annually F	Ball Bearing	Servo drive shaft	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-I-2595 (Alternate—Gulf Petroleum B)	Disassemble mount. See Section 7, Par. 27 b (7). Clean with solvent. Apply 1/16" drop of oil.
G	Ball Bearing	Servo drive shaft	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595 (Alternate—Gulf Petrolatum B)	Disassemble mount. See Section 7, Par. 27 b (7). Clean with solvent. Apply 1/16" drop of oil.
H	Ball Bearing	Jack shaft	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595 (Alternate—Gulf Petrolatum B)	Disassemble mount. See Section 7, Par. 27 b (7). Clean with solvent. Apply 1/16" drop of oil.
I	Ball Bearing	Jack shaft	Spec. N.B.S. 431, Navy Symbol NS 2100 Fed. Std. Stock Cat. No. 14-O-2595 (Alternate—Gulf Petrolatum B)	Disassemble mount. See Section 7, Par. 27 b (7). Clean with solvent. Apply 1/16" drop of oil.

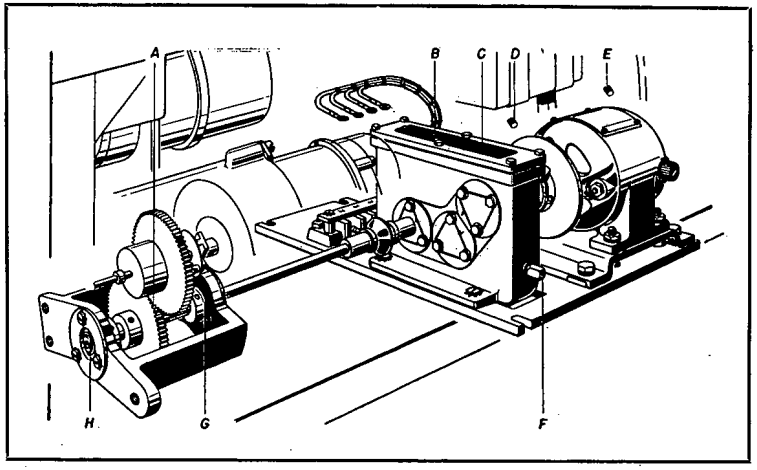


Figure 6-11. Lubrication of Bearing Indicator

BEARING INDICATOR

	Point	Part	Location	Lubricant	Instructions
Weekly	B	Gear Box	On Bedplate near center of Bearing Indicator	Spec. N.B.S. 431, Navy Symbol NS 2110 Fed. Std. Stock Cat. No. 14-O-2595	Three drops from flexible spout can in each hole.
	C	Gear Box		Fed. Spec. VV-G-671, Fed. Std. Stock Cat. No. 14-G-950 or Fed. Spec. SS-G-659, Fed. Std. Stock Cat. No. 14-G-570 when needed	Remove cover, dust graphite over teeth while turning several rotations by hand.
Monthly					
Quarterly					
Semi-Annually	A	Jacket-shaft spur gear and drive gear	On jack-shaft in bracket at front of Bearing Indicator. Drive gear on control shaft	Ordnance Spec. 0S1350 (Fed. Std. Stock Cat. No. 14-G-715)	Wipe lubricant on with a saturated cloth or brush. Do not leave any surplus on gears.
	F	Drain plug	Gear box		Remove plug and drain out excess lubricant. Do not flush gear box.
Annually	D	Motor Bearing	Slewing Motor	Navy Spec. 14L3 Grade C (Fed. Std. Stock Cat. No. 14-L-85-5)	Remove set screw. Use grease gun, spatula or other means to force lubricant into hole until full.
	E	Motor Bearing	Slewing Motor	Navy Spec. 14L3 Grade C (Fed. Std. Stock Cat. No. 14-L-85-5)	Remove set screw. Use grease gun, spatula or other means to force lubricant into hole until full.
	G	Bearing	Gear box output shaft	No lubrication necessary	
	H	Bearing	Gear box output shaft	No lubrication necessary	

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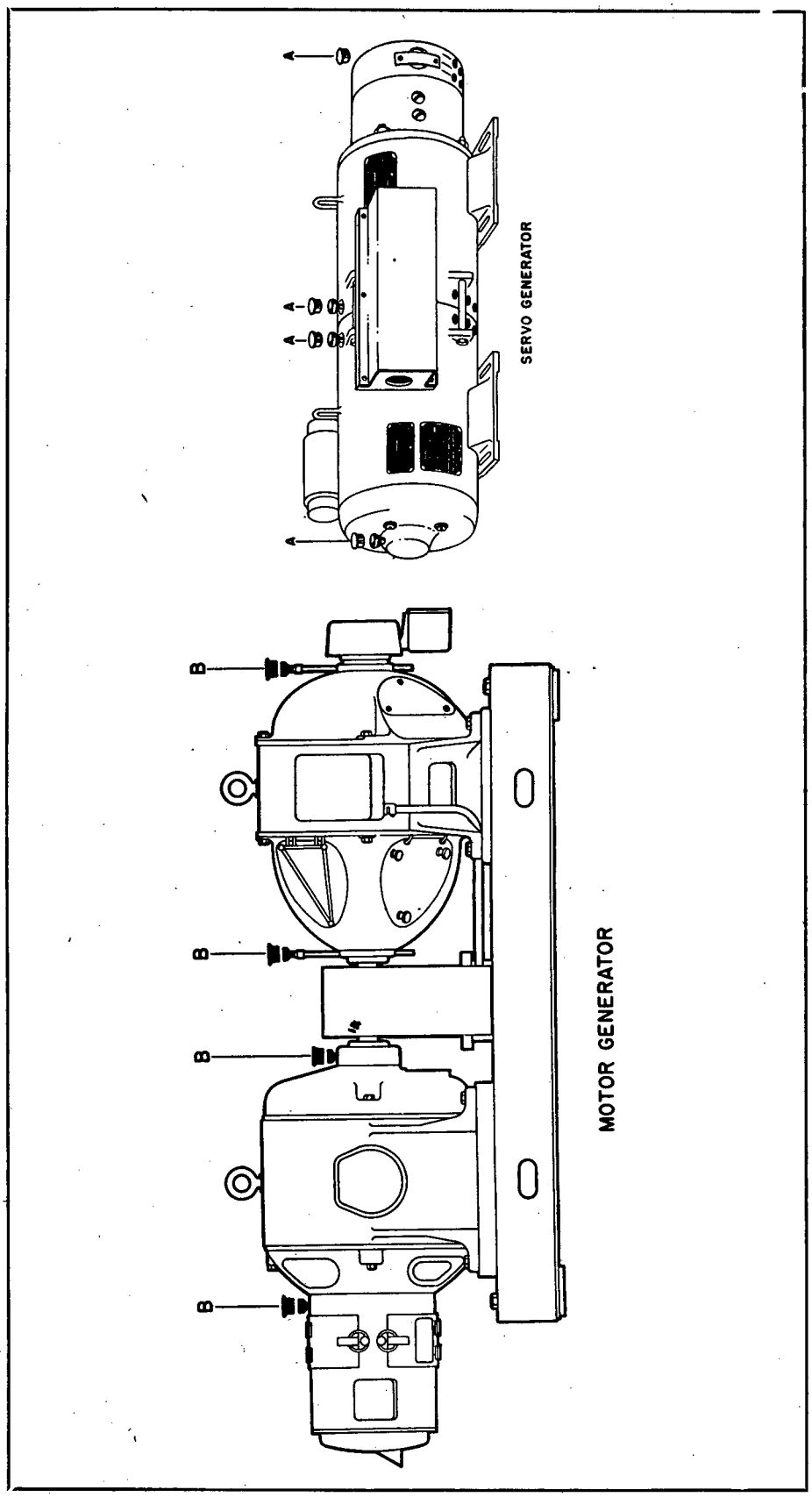


Figure 6-12. Lubrication of Servo Generator and Motor Generator

LUBRICATION

SERVO AND MOTOR GENERATORS

	Point	Part	Location	Lubricant	Instructions
SEMI-ANNUALLY	A	Ball Bearings	Servo Generator	Navy Spec. 14-L-3 Grade A (Fed. Std. Stock Cat. No. 14-L-131 or 14-L-132)	Fill grease cups with lubricant and screw down to force lubricant into bearing.
	B	Ball Bearings	Motor Generator	Navy Spec. 14-L-3 Grade A (Fed. Std. Stock Cat. No. 14-L-131 or 14-L-132)	Remove 5/16" drain plug and, after making sure drain line is clear, with unit running force in clean grease by screwing down cap of grease cup until grease appears at drain plug.

NOTE. Center post bearings are oil impregnated bronze and require no lubrication. This type of bearing is used because lubrication would require too much mechanical disassembly. When these bearings show excessive wear they should be replaced.

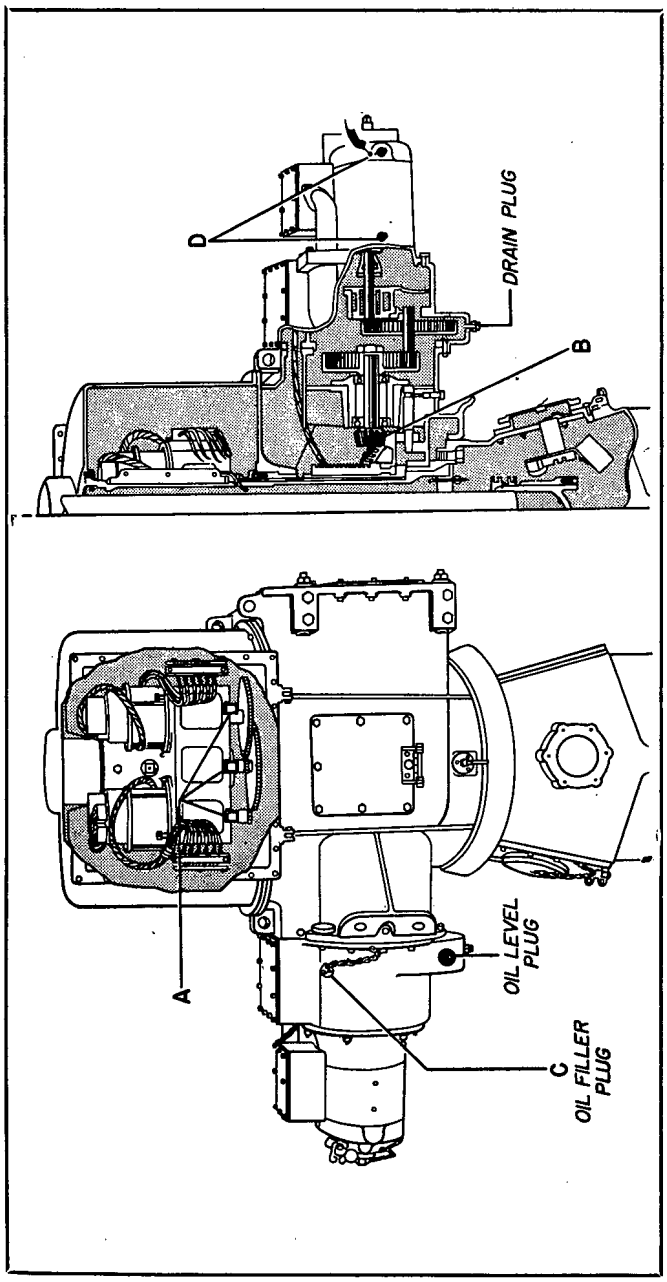


Figure 6-13. Lubrication of Antenna Pedestal

LUBRICATION

ANTENNA PEDESTAL

	Point	Part	Location	Lubricant	Instructions
MONTHLY	A	Synchro Shafts	Synchro Housing of Antenna Pedestal	Ordnance Spec. OS-1113 (Fed Std. Stock Cat. No. 14-O-884-10)	Remove cap screws from synchrotie inspection door. Lower the cover, exposing three oil cups. Fill each cup.
	B	Drive Pinion and Ring Gear	Rotaing Housing on Antenna Pedestal	Spec. SS-G-659 (Fed Std. Stock Cat. No. 14-G-950)	Open brush cover door. Dust graphite lubricant on on gear. Wipe away any excess.
	C	Gear Case	Rotating Housing on Antenna Pedestal	Navy Spec. 14-O-13, Navy Symbol, NS-9110 (Fed. Std. Stock Cat. No. 14-O-2162) or Spec. N.B.S. 431 Navy Symbol NS-2135 (Fed. St. Stock Cat. No. 14-O-2608)	Remove oil level plug and oil filter plug. Fill until even with bottom of oil level hole. Do not mix one type of lubricant with the other. Drain old lubricant if type is changed.
SEMI-ANNUALLY	D	Motor Bearings	Rotaing Housing	Navy Spec. 14-O-13, Navy Symbol NS-9110 (Fed. Std. Stock Cat. No. 14-O-2162)	Remove $\frac{5}{16}$" pipe plugs. Insert spout of oil can and add oil. Do not overfill.

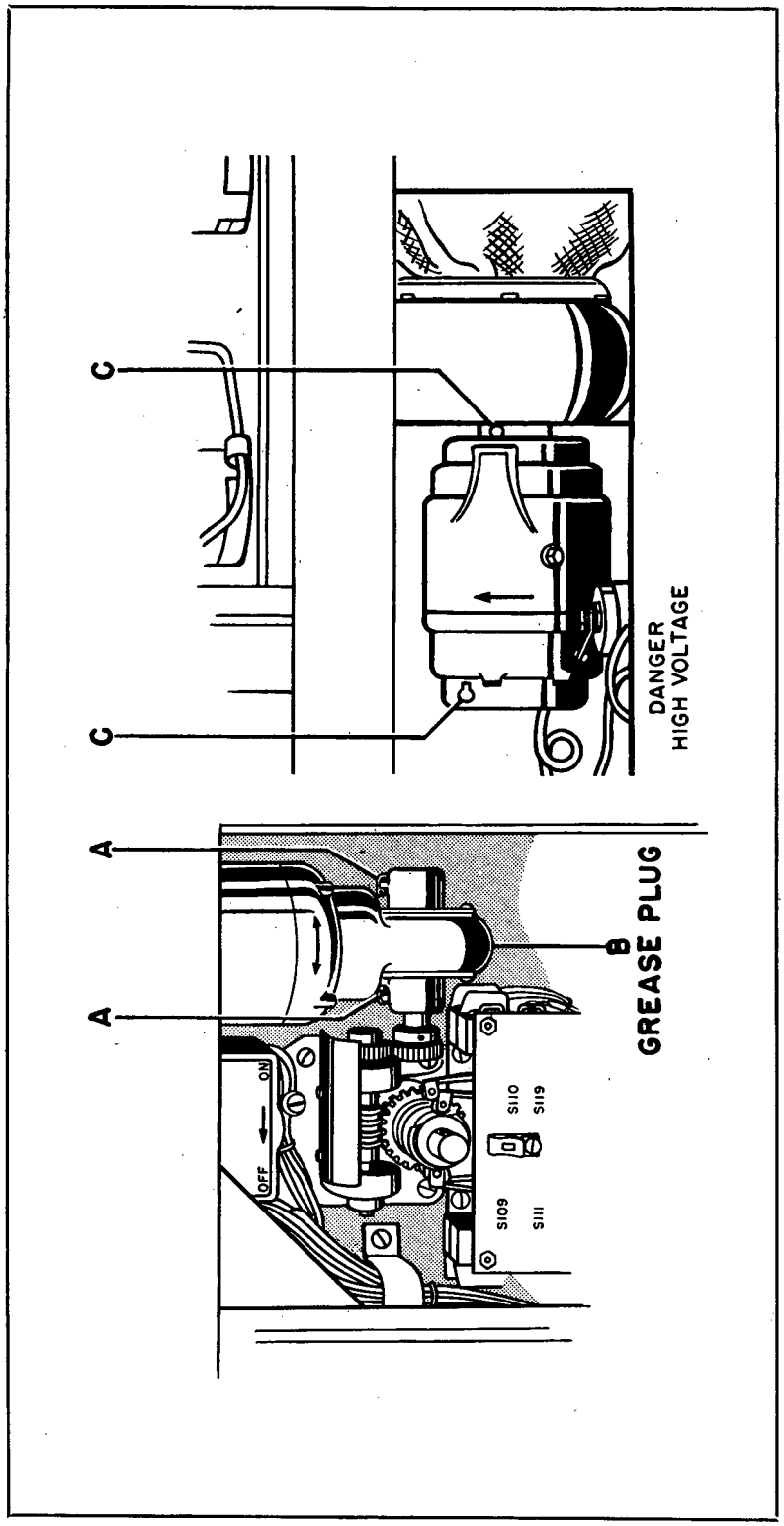


Figure 6-14. Lubrication of Transceiver

LUBRICATION

TRANSCEIVER

	Point	Part	Location	Lubricant	Instructions
SEMI-ANNUALLY	A	Sleeve Bearings	Gear Box on Variac drive motor	Navy Spec. 14-O-13, Navy Symbol NS-9500 (Fed. Std. Stock Cat. No. 14-O-2215)	Put five drops of oil in each oil cup.
	B	Worm gears	Gear Box on Variac drive motor	BuShip Spec. N.B.S. 431, Navy Symbol NS-3100 (Fed. Std. Stock Cat. No. 14-O-2685)	Remove grease 5/16" plug and fill gear box with lubricant.
ANNUALLY	C	Bearings	Blower Motor at rear of cabinet	Navy Spec. 14-L-3 Grade B (Fed. Std. Stock Cat. No. 14-L-90-15)	Disconnect and remove motor. Disassemble bell housings from motor frame and drive out bearings. Clean with solvent, Fed. Spec. VV-K-211, Fed. Std. Stock Cat. No. 14-K-225 or 14-K-235. Dry thoroughly and repack with lubricant.

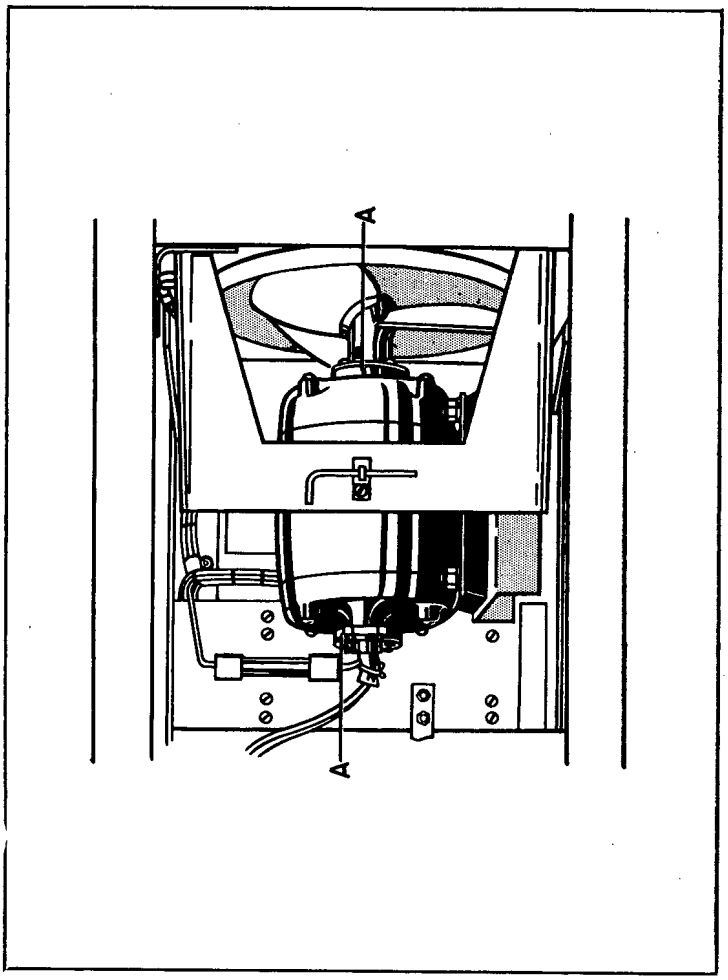
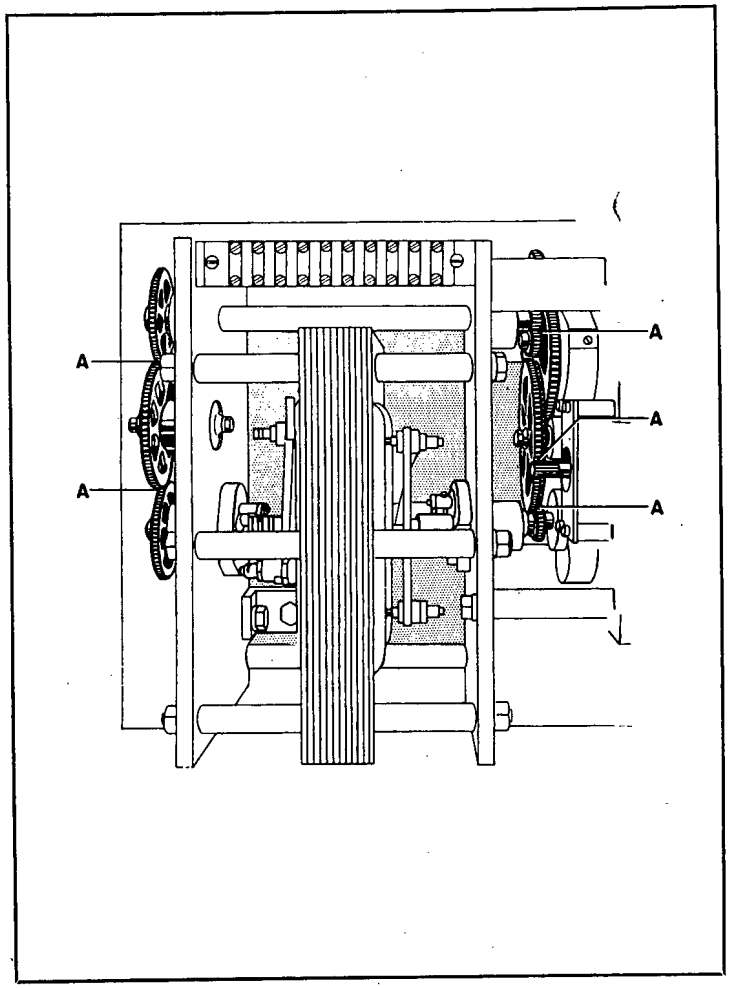


Figure 6-15. Lubrication of Rectifier Power Unit

LUBRICATION

RECTIFIER POWER UNIT

	Point	Part	Location	Lubricant	Instructions
ANNUALLY	A	Bearings	Blower Motor	Navy Spec. 14-L-3 Grade B (Fed. Std. Stock Cat. No. 14-L-90-15	Remove motor from mounting. Disassemble bell housings from motor frame and remove bearings. Clean bearings with solvent, Fed. Spec. VV-K-211, Fed. Std. Stock Cat. No. 14-K-225 or 14-K-235. Dry thoroughly and repack with lubricant flush to bearing race.



LUBRICATION

SYNCHRO AMPLIFIER

	Point	Part	Location	Lubricant	Instructions
SEMI-ANNUALLY	A	Gears and Pinions	Synchro Unit	Ordnance Spec. OS-1350, Fed. Std. Stock Cat. No. 14-G-715	Clean with solvent, Fed. Spec. VV-K-211, Fed. Std. Stock Cat. No. 14-K-225 or 14-K-235. Apply very light smear of grease, wipe off excess.

Figure 6-16. Lubrication of Synchro Amplifier

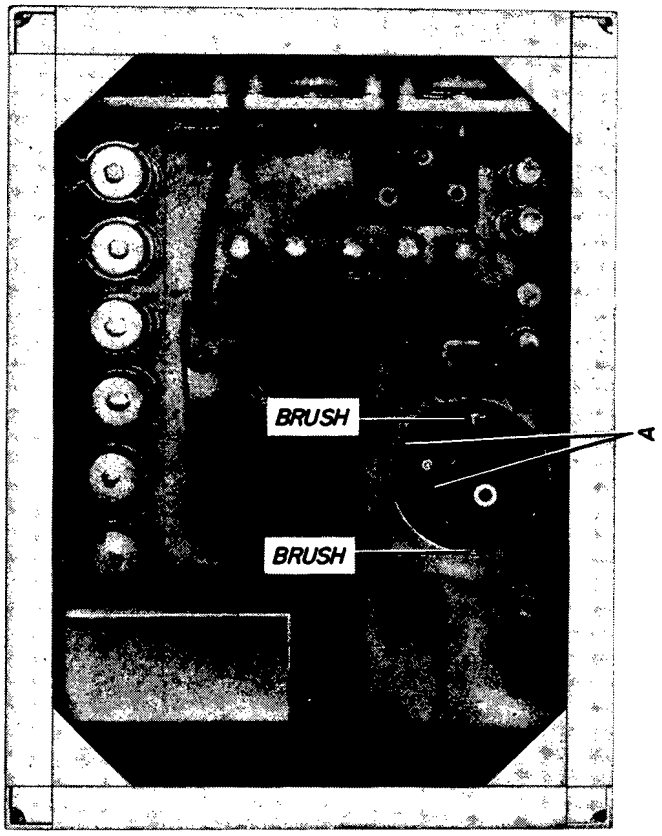


Figure 6-17. Lubrication of Keyer Unit

LUBRICATION

KEYER UNIT

	Point	Part	Location	Lubricant	Instructions
SEMI-ANNUALLY	A	Switch Drive Motor	Bottom of Keyer Unit	BuShip Spec. N.B.S. 431, Navy Symbol NS-2110 (Fed. Std. Stock Cat. No. 14-O-2595)	Apply five drops of oil to each bearing.

Navy Spec. 14-P-1 (Federal Standard Cat. No. 14-P-98 for 1 lb. can; 14-P-100 for a 5 lb. can; 14-P-110 for a 10 lb. can.) Air filters should be washed in gasoline, thoroughly dried, and dipped in Federal Standard Cat. No. 14-01-2187 Navy Symbol 9250 once each three months. Do not attempt to lubricate permanently lubricated bearings or gears or any parts that do not require lubrication.

b. PPI INDICATOR.

(1) Examine the cursor assembly. If it turns hard, it needs cleaning and possibly lubrication. The hand operated cursor is easily cleaned by removing the rubber ring and safety glass from the back of the cursor and by removing the cursor ring. To remove the cursor ring, remove the screws that hold the protective casting on which the viewing shield clamps. Then remove the filter by twisting it slightly to the left and pulling it straight out. Next remove the screws inside the cursor ring. This allows all moving parts to be removed for cleaning. The parts are assembled in reverse order. The gear driven cursor should be lubricated as directed in the lubrication chart in Fig. 6-9. This figure shows an exploded view of the geared cursor but it is not necessary to disassemble it except that the small plate with point F on it must be removed from over the bevel gear assembly.

(2) A partial disassembly permits semi-annual lubrication of the PPI mount, but the remainder of the mechanical assembly must be completely disassembled in order for it to be cleaned and lubricated. To disassemble the PPI Unit for semi-annual lubrication, refer to Par. 27*b* of Section 7. Lubricate the unit as directed in Fig. 6-10. Apply lubricant to both gears of the cluster attached to the yoke coil and to the pinion of the drive motor. To disassemble the PPI assembly for annual lubrication, see par. 27*b* of Section 7. Lubricate as directed in Fig. 6-10.

c. BEARING INDICATOR.

(1) To lubricate the Bearing Indicator, remove its chassis from the Indicator Console case. It will be necessary to disconnect the cable. After the chassis is removed, lubricate the unit using an oil can with a curved or flexible spout so that the nozzle can be easily applied to the holes in the top of the gear box. Apply three drops of Navy Symbol N.S. 2110 oil, as directed in Fig. 6-11. If a gear box becomes noisy, remove the top of the gear box and dust the gears lightly with powdered graphite 14-G-570, while turning the gears over by hand. The 36X synchro (B-803) driving gears should be brushed with a light Navy grease 14-P-98, twice each year. It is not necessary to completely remove the chassis from the case to do this. The gear box should be drained at least once each year. A drain plug is provided for this purpose. Do not flush the box or the grease in the bearings will be removed. The slewing motor should be lubricated annually. It is necessary to remove the chassis from the case for this operation. Remove the set-screws over the bearings and force the bearing full of lubricant. The fan motors have special type bearings which are permanently lubricated. Therefore, they require no lubrication. The lubrication of the synchro units requires special treatment and is described in par. 6*k* of this section.

d. SERVO GENERATOR.

(1) The Servo Generator should be lubricated once every three months. The lubrication chart is shown in Fig. 6-12. Some of the early Servo Generators are equipped with sleeve bearings equipped with oil cups. This type of bearing should be lubricated with a lubricant such as Federal Standard Stock Catalog No. 14-0-2715, Navy Symbol 4065 or some other good machine oil suitable for bearings. Most of the Servo Generators are equipped with ball bearings and grease cups. They are lubricated as directed in Fig. 6-12.

e. MOTOR GENERATOR.

(1) The Motor Generator is equipped with ball bearings and with grease cups for lubrication. The lubrication points are shown in Fig. 6-12.

f. ANTENNA PEDESTAL.

(1) The lubrication chart for the Antenna Pedestal is shown in Fig. 6-13. The plain bearings, such as the bearings between the rotating housing and the center post, are graphite impregnated and require no lubrication throughout the life of the equipment. The ball bearings do not require any special attention except during the annual overhauling process. At this time they should be cleaned, inspected and lubricated. The oil reservoir housing should not require refilling unless leakage occurs. However, the oil level should be inspected as directed in Fig. 6-13. The Antenna Pedestal should be level when the oil level is inspected. To check the oil level, remove the plug shown in Fig. 6-13. The oil should be even with the bottom of the oil level plug hole. If the oil level is low, remove the oil filler plug shown in Fig. 6-13 and add Federal Standard Stock Catalog No. 14-O-2162, Navy symbol N.S. 9110 lubricant or its equivalent. When the oil runs out of the oil level hole, the proper amount of lubricant has been added. In cases where the oil appears to be dirty, the oil should be drained. To do this remove the drain plug and the filler plug. The gear case can be flushed if necessary. The synchrotie gear shafts shown in Fig. 6-13 are accessible when the inspection door is removed. To do this, remove the cap screws that secure the door and then raise the covers on the three oil cups and fill the oil cups with Federal Standard Stock Catalog No. 14-O-884-10 symbol Ordnance Spec. OS-1113. The synchro units are lubricated as described in par. 6*k* of this section.

g. TRANSCEIVER.

(1) The variac drive motor requires no lubrication but the sleeve bearings on the gear box should be lubricated every six months. The drive motor is

the oil cups shown in Fig. 6-14. The gear box should be lubricated every five or six months. To lubricate the gears, remove the filler plug and fill the gear box, using Federal Standard Stock Catalog No. 14-G-715 Ordnance Spec. OS-1350. The blower motor located in the rear of the Transceiver should be lubricated once each year. The motor is accessible when the rear panel of the Transceiver is removed. The bearings are lubricated through oil cups as shown in Fig. 6-14. Use the lubricants described above.

h. RECTIFIER POWER UNIT.

(1) The only point in the Rectifier Power Unit that normally requires lubrication is the blower motor. The points to be lubricated are shown in Fig. 6-15. The Motor must be removed for lubrication. The first step is to remove the motor from its mounting. Then the fan must be removed. An Allen wrench is provided to loosen the set screw in the fan. The location of this wrench is shown in Fig. 6-15. To lubricate the bearings remove the plates from over the bearings, flush them with an approved solvent, Fed. Spec. VV-K-211, Federal Standard Stock Catalog no. 14-G-950, let them dry thoroughly and repack with Navy Spec. 14-L-3 Grade C as directed in Fig. 6-15. Avoid using an excess of lubricant.

i. SYNCHRO AMPLIFIER.

(1) The bearings in the Synchro Unit are sealed in grease and should never require lubrication. If one of these bearings runs dry it is better to replace it with a new bearing than to try to lubricate it. The grease should be removed from the gears once every six months with an approved solvent. A light smear of grease should then be applied with a brush. After the mechanism has been rotated a few times, any excess lubricant should be wiped off. Fig. 6-16 shows the points to be lubricated and the type of lubricant to use.

j. KEYER UNIT.

(1) The only part of the Keyer Unit requiring lubrication is the switch drive motor B-151. The Keyer Unit must be pulled out far enough to gain access to the Motor. If an oil can with a straight spout is used, the Keyer must be removed completely. There is an oil hole at each end of the motor as shown in Fig. 6-17. Lubricate the bearings as directed in the figure.

k. SYNCHRO UNITS.

(1) The synchro units must be removed and disassembled in order to lubricate them. This should be done once each year. To disassemble a synchro unit, remove the cover opposite the brush end by removing the assembly screws and prying the cover off gently with a screw driver. Exert pressure successively all the way around the cover. Do not strain shaft or bearing. Next remove the brush cover. Hold the unit horizontally and remove the rotor, holding the brushes clear of the slip rings. If it is necessary to remove any parts from the shaft, note their position and reassemble them in exactly the same position. Wash the bearings with Federal Spec. PS-661 and wipe them dry with Viscose Rayon Twill spec C-7-8271 dyed white. Then wipe the slip rings clean with the cloth described above. Lubricate the bearings by applying 14-L-3 Grade C lubricant. Use just enough to bring the grease flush with the top of the bearing race. Replace the rotor, holding the brushes away from the slip rings. Reassemble the unit carefully. The bearings must be carefully aligned and must not bind. Tag the synchro with the date of lubrication and enter this date in the log. *Do not lubricate or service a synchro manufactured by the Control Instrument Co.*

TABLE 6-1

DAILY CHECKS

What to Check	How to Check	Precautions
Cabinets, cases, dust covers, control panels	Dust exterior, check operation of controls.	See Section 4 for proper operation of controls.
Operation	Check normal operation. All functions normally performed should be satisfactory.	
Motor Generator, Servo Generator	Check frame temperature and inspect commutator to see if brushes are sparking.	
Meters	Read all meters and record readings in daily log.	

TABLE 6-2

WEEKLY CHECKS

What to Check	How to Check	Precautions
1. Cabinets and chassis.	1. Inspect for scratches, rust, moisture, fungus growth and condition of cables and wiring. Clean interiors.	1. Power must be off when working inside case and chassis.
	2. Inspect for loose or broken tubes, loose assembly screws or mountings, and damaged parts. Examine rubber gaskets. Clean dirty tube contacts.	1. Clean and repaint or revarnish if necessary. Tape or replace cables with damaged insulation.
	3. Rotate Antenna Pedestal by hand. Note whether gears operate smoothly and whether there is evidence of binding.	1. See Section 7 if trouble is detected.
	4. Check all fan motors and fans to see if fans are securely mounted.	1. Tighten fans or motor mountings if loose.
2. Operating Controls	1. Inspect knobs for looseness or breakage. Look for evidence of binding in control shaft movement. Note evidence of roughness in potentiometers which indicates wear. Try action of switches.	1. Return all controls to original position.
	2. Check for loose, broken, or burned out dial lamps.	1. Replace all defective parts.
3. Alignment	1. Check sweeps, sweep length, and range step. Check orientation of bearing indicator with Radar Antenna.	1. For procedure, refer to Section 3.
4. Fuses and Ferrule type resistors.	1. Check for corrosion. Clean with sandpaper if necessary.	
5. Insulators and switches.	1. Clean with cloth free from lint.	1. Do not leave any lint on parts.
6. Gear Box in Bearing Indicator	1. Lubricate with 2 or 3 drops of oil, as directed in Lubrication Chart.	
7. Cables and all electrical connections.	1. Look for broken or damaged cables, and loose or dirty connections. Replace cables where necessary. Clean and tighten loose connections.	

TABLE 6-3

QUARTERLY CHECKS

What to Check	How to Check	Precautions
1. General mechanical inspection.	1. Repeat weekly inspection.	1. Replace all defective parts.
	2. Check condition of shockmount.	
	3. Lubricate rollers on chassis.	1. Use graphite base lubricant.
	4. Mechanically check all plugs, connectors, terminal boards and connections for looseness or corrosion. Clean chassis.	
	5. Clean all plugs and connectors.	
	6. Clean and lubricate air filters.	
	7. Drain Gear Box in bearing indicator.	1. Do not flush gear box.
	8. Check condition of Antenna Pedestal and lubricate as directed.	
2. General Electrical inspection	1. Remove and electrically check each tube that can be checked on a standard tube checker.	1. Do not attempt to remove tubes while hot.
	2. Inspect each resistor for signs of overheating.	1. Replace all defective parts.
	3. Inspect oil filled capacitors for leakage.	
	4. Inspect inductors and transformers for evidence of over-heating.	
	5. Check continuity of heater resistors with ohmmeter.	
	6. Check condition of waveguide and coaxial cables.	
	7. Check condition of all other cables.	
3. Geared Cursor on PPI Indicator.	1. Lubricate. See Chart.	
4. Motor brushes	1. Check brushes to see if they are worn too much to make good contact.	
5. High Voltage	1. Read meter on Modulator and record in log.	1. RADIATION Switch must be ON.
6. Pulse Shape and Repetition Rate	1. Observe shape Monitor Scope and observe setting of switch on General Control Unit. Record switch setting in log.	1. Do not change repetition rate. 2. If pulse shape is not normal report it.
7. Magnetron filament volts.	1. Read meter on Transmitter-Receiver and record in log.	

TABLE 6-3 (Concluded)

QUARTERLY CHECKS

What to Check	How to Check	Precautions
8. Tube life	1. Read hours on meter on Transmitter-Receiver and record in log.	
9. Frequency	1. Check with Echo Box. Record in log.	
10. Standing Wave Ratios	1. Check with probe on Directional Coupler and read meter on Transmitter-Receiver.	1. Report poor VSWR to Maintenance personnel.
11. Receiver Tuning	1. Adjust local oscillator for tuning best video signal.	
12. Crystal Current	1. Read meter on Transmitter-Receiver and record in log.	1. Report incorrect reading to maintenance personnel.
13. Pulse Width and bandwidth	1. Note setting of switch on General Control Unit and record in log.	
14. Adjustment of Range Scope Operating Controls.	1. Check in accordance with operating instructions in Section 4.	
15. Sweep Length and Range Step	1. Check by moving Range step to start of sweep on each range. Move step to other limit. Sweep should extend beyond limit of step.	1. Report improper adjustment to maintenance personnel.
16. O.S.C. Voltage	1. Switch from True to Relative bearing and note operation of bearing dials on General Control Unit.	1. Always return to original type of data.
	2. Record type of data being furnished in log.	2. Report absence of O.S.C. voltage at once.
17. Hand Slew Control	1. Rotate control on General Control Unit and observe bearing dials and targets on Range Indicator to see that Antenna rotates.	1. Report any failure to maintenance personnel.
18. Antenna Control Switch	1. Place switch on General Control Unit in each position.	1. Report failure to maintenance personnel.
	2. Watch dials and Range Scope to see that Antenna is rotating.	
19. Overheat Indicators	1. Observe indicators on various units and enter observations in log.	1. Report overheating to maintenance personnel.
20. Fuse warning lamps.	1. Observe lamps. If one glows, replace fuse.	1. If second fuse blows, inform maintenance personnel.
21. Dial lamps.	1. Check each dial lamp, replace burned out lamps.	
22. General Mechanical condition of equipment.	1. Make visual check.	

TABLE 6-4

SEMI-ANNUAL CHECKS

What to Check	How to Check	Precautions
1. SR Equipment	1. Repeat weekly and quarterly checks.	
2. Antenna and Pedestal Assemblies	1. Lubricate thoroughly disassembling where necessary.	
3. Switches	1. Check action and lubricate with switch lubricant.	
4. Chassis runners	1. Lubricate	

TABLE 6-5

ANNUAL CHECKS

What to Check	How to Check	Precautions
1. Repeat all checks previously given.	1. See Par. 3 of this section. Completely lubricate equipment.	
2. Bearing Indicator slewing motor and Servo Generator.	1. Check brushes, commutator, lubricate. See chart.	1. Do not allow windings to become saturated with lubricant.
3. Bearing Indicator Gear Box	1. Dust gears with powdered graphite if noisy.	

FAILURE REPORT

FAILURE REPORTS

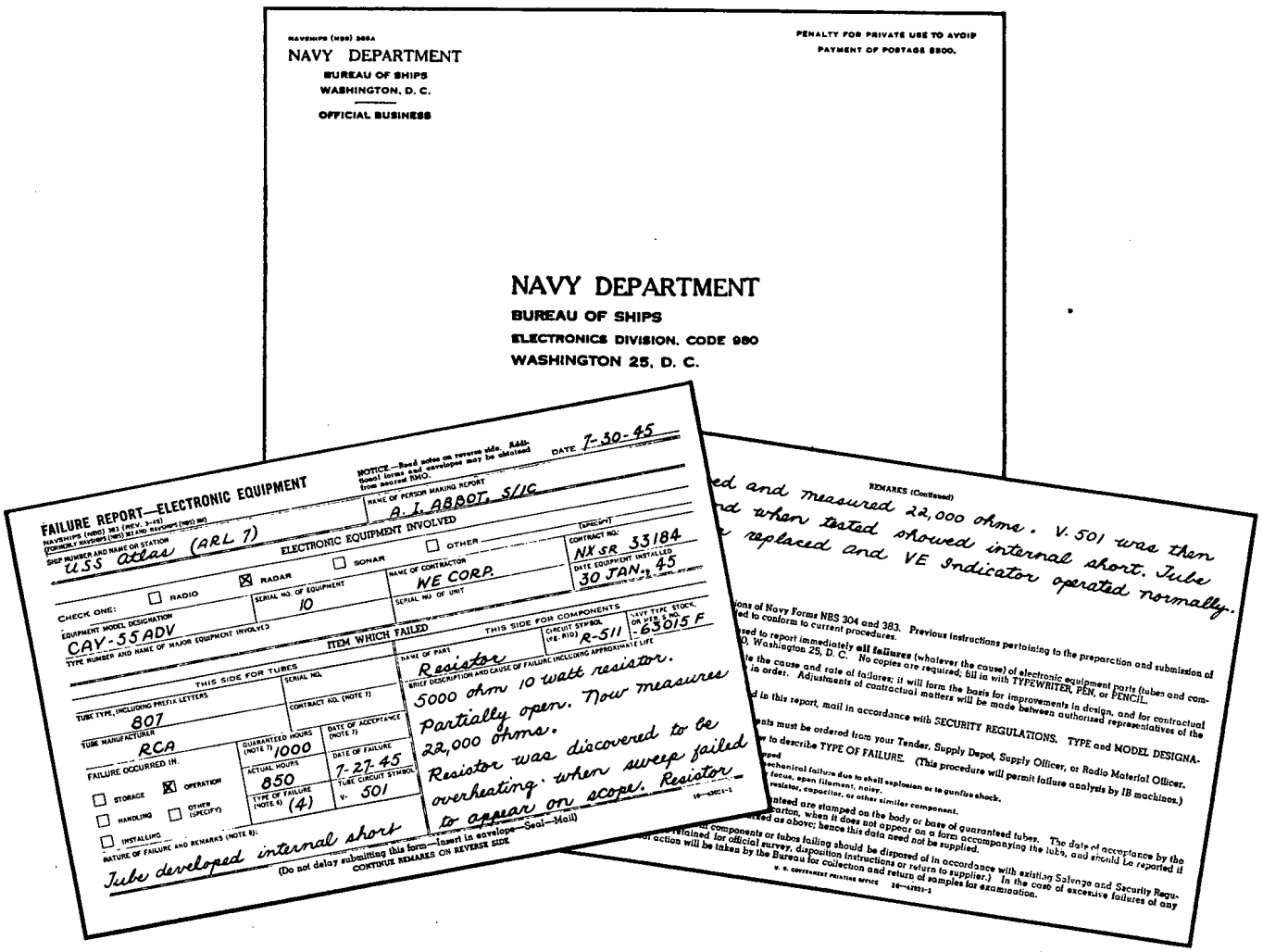
A failure report must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from any Electronic Officer.



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BUREAU OF SHIPS
ELECTRONICS DIVISION, CODE 950
WASHINGTON 25, D. C.

FAILURE REPORT—ELECTRONIC EQUIPMENT

DATE 7-30-45

NAME OF PERSON MAKING REPORT: A. L. ABBOT, S/1C

SHIP NUMBER AND NAME OR STATION: USS Atlas (ARL 7)

ELECTRONIC EQUIPMENT INVOLVED

CHECK ONE: ☐ RADIO ☒ RADAR ☐ SONAR ☐ OTHER (SPECIFY)

EQUIPMENT MODEL DESIGNATION: CAY-55 ADV

SERIAL NO. OF EQUIPMENT: 10

NAME OF CONTRACTOR: WE CORP.

SERIAL NO. OF UNIT:

CONTRACT NO.: NX SR 33184

DATE EQUIPMENT INSTALLED: 30 JAN 45

TYPE NUMBER AND NAME OF MAJOR EQUIPMENT INVOLVED:

ITEM WHICH FAILED

THIS SIDE FOR TUBES

TUBE TYPE, INCLUDING PREFIX LETTERS: 807

SERIAL NO.:

CONTRACT NO. (NOTE 7):

TUBE MANUFACTURER: RCA

GUARANTEED HOURS (NOTE 7): 1000

DATE OF ACCEPTANCE (NOTE 7):

FAILURE OCCURRED IN: ☐ STORAGE ☒ OPERATION ☐ HANDLING ☐ OTHER (SPECIFY) ☐ INSTALLING

ACTUAL HOURS: 850

DATE OF FAILURE: 7-27-45

TYPE OF FAILURE (NOTE 8): (4)

TUBE CIRCUIT SYMBOL: V-501

THIS SIDE FOR COMPONENTS

CIRCUIT SYMBOL (USE R1D): R-511

NAVY TYPE STOCK OR MFR'S NO.: 63015 F

NAME OF PART: Resistor

BRIEF DESCRIPTION AND CAUSE OF FAILURE INCLUDING APPROXIMATE LIFE: 5000 ohm 10 watt resistor. Now measures 22,000 ohms. Partially open. Resistor was discovered to be overheating when sweep failed to appear on scope.

NATURE OF FAILURE AND REMARKS (NOTE 8): Tube developed internal short

(Do not delay submitting this form—Insert in envelope—Seal—Mail)

CONTINUE REMARKS ON REVERSE SIDE

REMARKS (Continued)

ed and measured 22,000 ohms. V-501 was then
d when tested showed internal short. Tube
replaced and VE Indicator operated normally.

ions of Navy Forms NBS 304 and 383. Previous instructions pertaining to the preparation and submission of
ed to conform to current procedures.
sed to report immediately all failures (whatever the cause) of electronic equipment parts (tubes and com-
0, Washington 25, D. C. No copies are required; fill in with TYPEWRITER, PEN, or PENCIL.
te the cause and rate of failures; it will form the basis for improvements in design, and for contractual
in order. Adjustments of contractual matters will be made between authorized representatives of the
d in this report, mail in accordance with SECURITY REGULATIONS. TYPE and MODEL DESIGNA-
nts must be ordered from your Tender, Supply Depot, Supply Officer, or Radio Material Officer.
r to describe TYPE OF FAILURE. (This procedure will permit failure analysis by IB machines.)
ped
echanical failure due to shell explosion or to gunfire shock.
ferus, span filament, relay.
resistor, capacitor, or other similar component.
nteed are stamped on the body or base of guaranteed tubes. The date of acceptance by the
carton, when it does not appear on a form accompanying the tubs, and should be reported if
ked as above; hence this data need not be supplied.
components or tubes failing should be disposed of in accordance with existing Salvage and Security Requ-
tained for official survey, disposition instructions or return to supplier.) In the case of excessive failures of any
action will be taken by the Bureau for collection and return of samples for examination.

Sample Failure Report Card Properly Filled in

SECTION 7

CORRECTIVE MAINTENANCE

1. GENERAL.

a. Corrective maintenance consists of the location and correction of faults whenever the system fails to function. The trouble may be of a simple nature such that it can be corrected by mechanical or electrical adjustments or it may be necessary to replace one or more parts. The opposite page shows a sample Failure Report which must be made each time a defective part is replaced. This report is important since the statistics gathered from these reports can be used to determine the future stock spares requirements. These statistics may also be used to improve the design of equipments on future contracts. The procedures in this section are divided into two definite sequences of operations. The first sequence of operations is system troubleshooting. It is based on the starting procedure and its purpose is to locate and identify the unit in which the trouble occurs. The second sequence of operations locates the trouble in the unit or units indicated as defective by the system troubleshooting procedure. This sequence is unit troubleshooting. A separate procedure is provided for each unit in the system and therefore the unit troubleshooting procedure does not consist of one general procedure but of a number of separate specific procedures. After the defective unit has been located, the paragraph devoted to that unit may be consulted for further instructions regarding the location of the fault. Appropriate paragraphs are also included that describe the mechanical repair and adjustments and the electrical adjustments of each unit.

2. SYSTEM TROUBLESHOOTING.

a. GENERAL.

(1) System troubleshooting is based on the start-stop procedure of the equipment. The equipment is energized in the regular manner used to place it in operation, and the performance of each section and unit of the equipment is carefully noted. Meters, pilot lamps, fuses, cathode ray tubes, motor-generator, blower motors, and relays may be observed for indications of the location of the fault. Various supplementary tests may be used, such as checks on the voltages and waveforms obtained from external jacks and ohmmeter checks on the condition of interconnecting cables.

(2) In order to simplify the task of locating troubles, the SR Equipment may be considered as consisting of seven systems. These systems are:

(a) Primary Power and Control System.
(b) Transmitter System.
(c) R-F Transmission System.
(d) Monitoring System.
(e) Receiving System.
(f) Indicating System.
(g) Antenna Positioning System.

(3) The action of some of the above systems is dependent upon the functioning of one or more of the others. For example, if there is no trigger output from the transmitting system to the indicating system the latter cannot function even though the transmitting system could conceivably be functioning properly in every other respect. A situation such as this requires accurate judgment, because at first it appears that the trouble lies in the receiving or indicating systems. Therefore in locating troubles to a particular section, it is necessary to observe all of the various sections, noting the way in which any of them fail to function. If the trouble is correctly located, much time can be saved which would otherwise be spent in uselessly checking voltages in components that would operate normally if they could receive the proper excitation voltages. After the defective section has been located, the defective component should be found. This can be done by measuring input and output voltages and by observing the various indications on the control panels. Another method is to slide the unit forward from the case and with the interlock switches closed, note whether the tubes are glowing and whether any part is overheated. Often the start-stop procedure directly discloses the identity of the defective component.

(4) To facilitate the location of defective sections and components, Figs. 7-1 and 7-2 show the primary power distribution diagrams for the SR and SR-a equipments. Fig. 7-3 is a servicing block diagram of the entire SR and SR-a equipments. Fig. 7-4 shows a servicing block diagram of the antenna positioning systems. These block diagrams show the signal paths to and from each unit, and an idealized waveform of the voltage is shown, so that by means of an oscilloscope it can be easily and quickly determined which section is at fault. Fig. 7-5 is an external cabling diagram and is used in conjunction with the other figures. Troubleshooting charts of each individual component are included in this section which graphically portray some of the most commonly expected troubles. After the defective unit has been located,

waveforms are given to be used for comparison during the signal tracing process. After a careful visual inspection the unit should be energized and supplied with the required input excitation voltages and the input and output of the tube should be checked with an oscilloscope, beginning with the output stage and continuing toward the input until the defective stage is found. When the defective stage or stages have been located by the signal tracing method, a check of the circuit with a volt-ohmmeter should be made. The voltage and resistance readings obtained should be compared with the corresponding voltage and resistance charts which are found elsewhere in this section.

(5) Possibly the most common source of trouble is in the primary power circuits. The reason for this is that the continuity of the circuits is not only dependent upon the fuses and switches but also upon the various relay contacts, interlock switches, operating control switches, terminal board connections, cables, and cable connectors. All of the mechanically moving parts are subject to wear and, in the case of switches and relays, they are subject to the burning effects of electrical arcs between the contacts. Interlock switches may keep the circuits from functioning because a component may not be pushed all the way into its case and properly secured. The start-stop procedure in the following paragraph is a particularly effective method for locating troubles in the primary power circuits. However, it may be necessary to resort to more precise methods to actually locate the trouble. For this reason, Fig. 7-1 traces each circuit from terminal board to terminal board and also includes the primary windings of all power transformers.

b. START-STOP PROCEDURE.

(1) Close the Main Line Disconnect switch if it is open.

(2) Press the START button on the Push Button Station. This starts the Motor Generator and makes a-c power available at the Transceiver. This can be checked at receptacle J-105 on the Transceiver, using an a-c voltmeter. The Voltage at this point should be approximately 115 volts. If it is not, the trouble may be due to an improperly adjusted Voltage Regulator or incorrect Motor-Generator speed. The adjustments in each of these units are potentiometers. The methods of adjustment are described in Pars. 48c and 48d of this section. If no voltage reading is obtained, check the fuses in the line switch and check the input and output of the Motor Generator. Watch the action of the relays in the Magnetic Starter when the START button is pressed. If the Motor Generator runs but delivers no output, check the exciter and the Voltage Regulator. The meter on the Voltage Regulator should indicate 120 Volts. Another point to check is the commutator and brush assemblies in the Motor Generator.

(3) Place the PULSE LENGTH switch S-158 on the Keyer in its 20 position corresponding to a 20 microsecond pulse.

(4) Place the EMERGENCY-MAIN POWER switch S-101 in its ON position. This switch is on the Transceiver. The MAIN POWER ON and FILAMENT ON lamps should glow; relay K-102 should operate; blower motor B-102 should start; time delay relay K-104 should start its 5-second cycle; the oscillator filaments should heat up. These circuits are shown in Fig. 7-1. If the filaments and FILAMENT ON lamp do not glow, check switch S-102 in the oscillator compartment to see if it is open. If none of the above actions occur, check fuses F-103, F-104, and F-107 and also the interlock switches S-116 and S-117. For the location of the interlock switch circuits see Fig. 7-1.

(5) Place the LOCAL-REMOTE switch in its LOCAL position. LOCAL CONTROL lamps, I-102, on the Transceiver and I-401 on the General Control Unit should glow. If the pilot lamps mentioned in steps (1) to (3) do not glow when their circuits are energized, check the output between terminals 1 and 3 on transformer T-107. If any one of the lamps fails to glow, the fault lies in the circuit that energizes the lamp or else the bulb or socket is defective.

(6) Press the POWER ON switch S-103. This switch is on the Transceiver. If time delay relay K-104 has operated, relay K-103 should now be heard to operate. If this relay does not operate, check the LOCAL-REMOTE, POWER ON, and POWER OFF switches and the relay. When relay K-103 operates, it makes power available from the Voltage Stabilizer to the Indicator Console and also, to the time delay relay in the Modulator, if the equipment has been modified to SR-a equipment. K-103 also applies power to relay K-101 in the SR Equipment. In the SR-a equipment, time delay relay K-2002 in the Modulator must also close before K-101 can be energized. This requires five minutes. If relay K-101 does not operate, check both relays, the upper limit switch and overload relay K-105. See Fig. 7-1. The SR-a circuits are shown in Fig. 7-2. The upper limit switch is located on the cam assembly behind the lower left-hand door on the Transceiver. If transformer T-105 has not been rotated far enough by motor B-101 to close switch S-111, check relay coil K-105B and contacts K-101G and K-101H on relay K-101. These circuits may fail to function because of the absence of energizing voltage. This can be checked by placing the INDICATOR CONSOLE switch in its ON position and noting whether the Indicator Console components are energized. This switch is on the General Control Unit. If power is not available at the Indicator Console, check the input and output voltages of the Voltage Stabilizer. Also check the interconnecting cabling and the terminal boards.

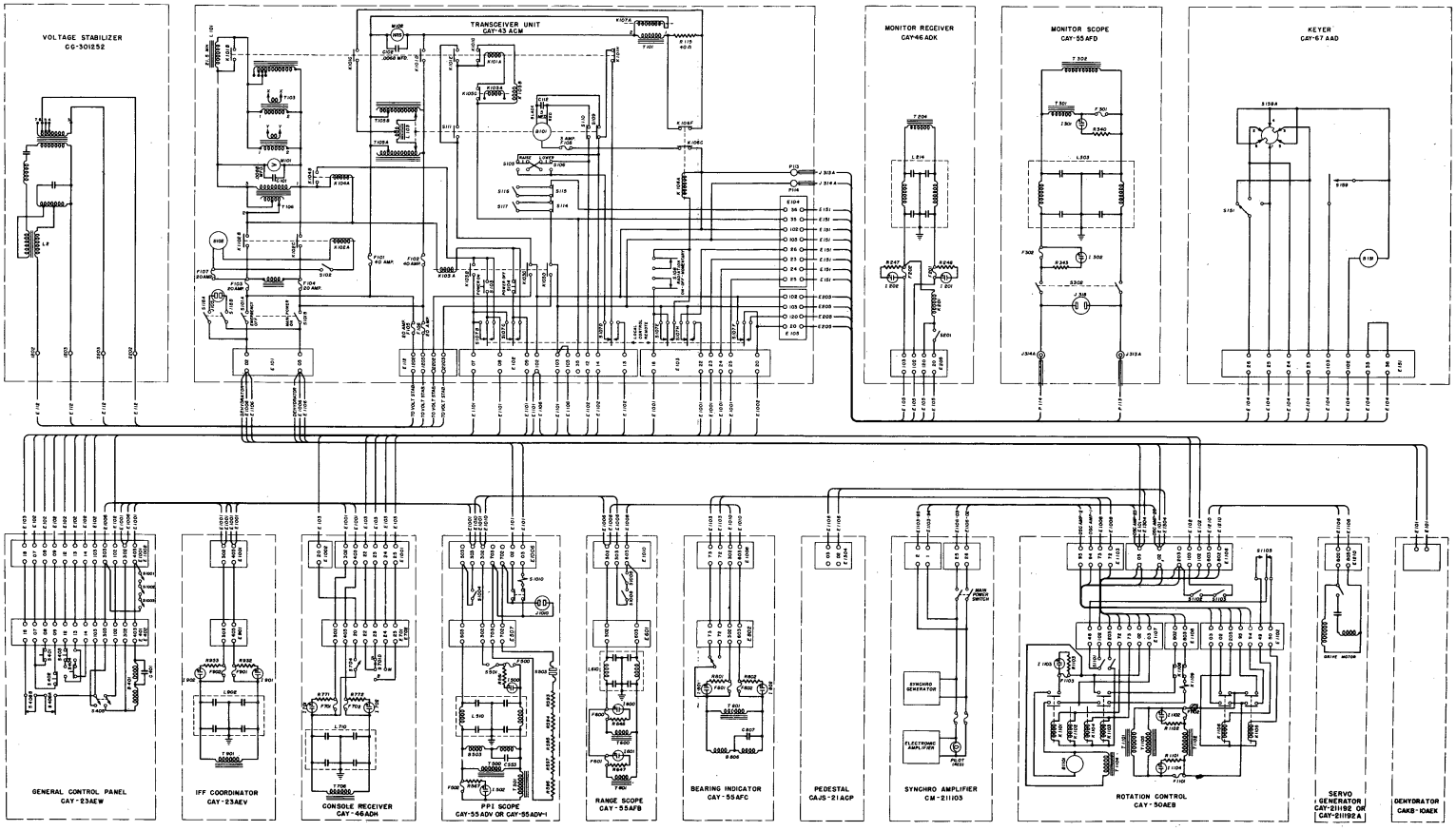


Figure 7-1. Primary Power Distribution Diagram, SR Equipment

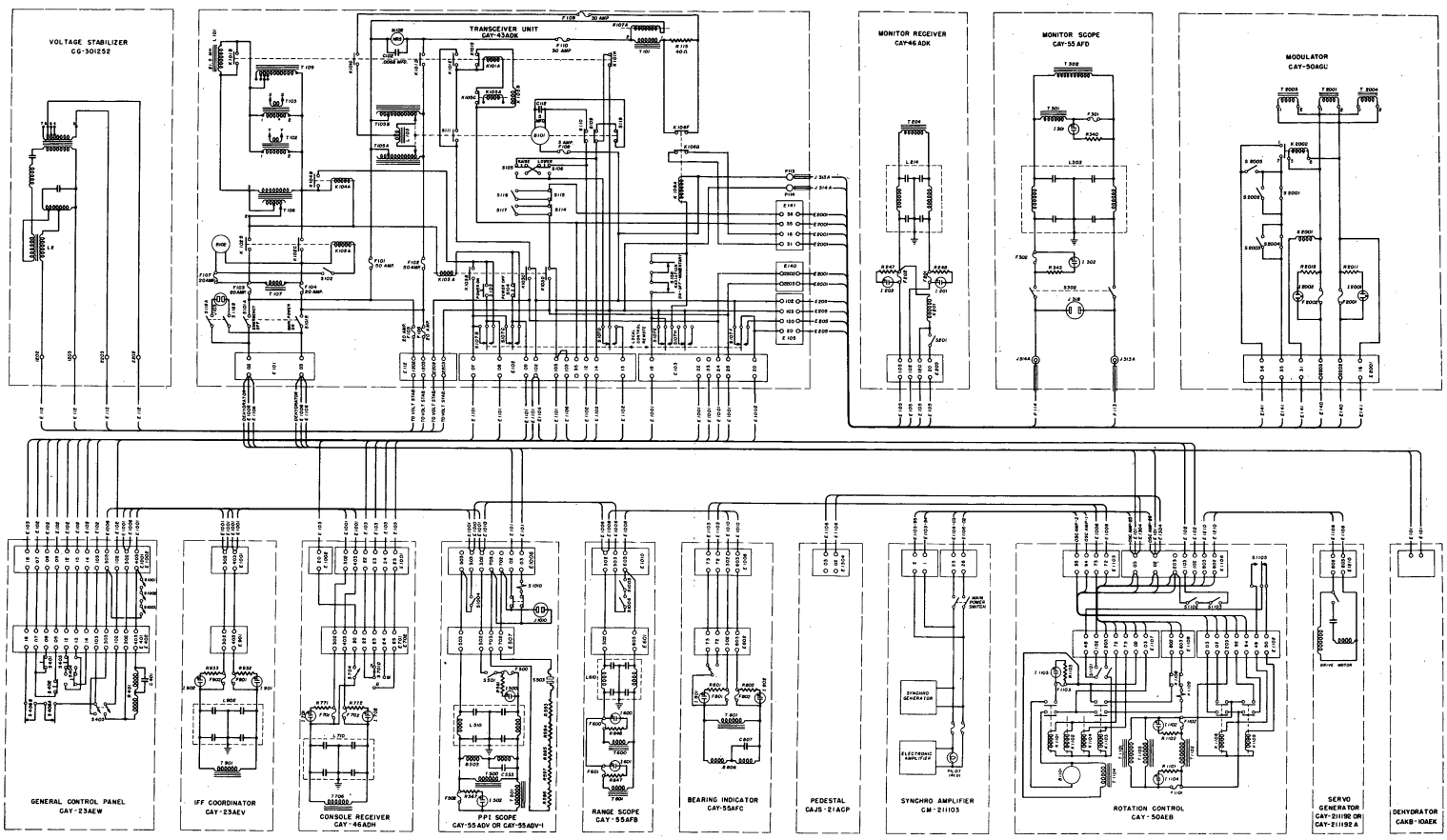


Figure 7-2. Primary Power Distribution Diagram, SR-a Equipment

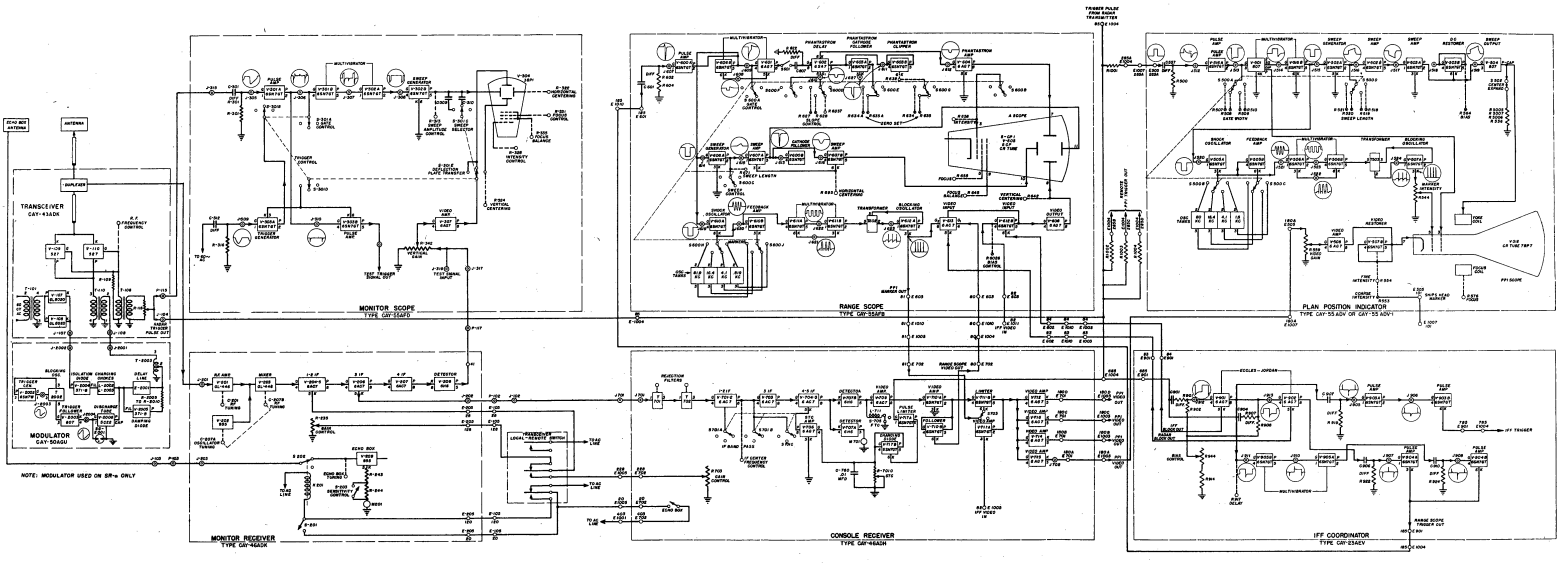


Figure 7-3. Servicing Block Diagram, SR and SR-a Equipment

Figure 7-3. Servicing Block Diagram, SR and SR-a Equipment

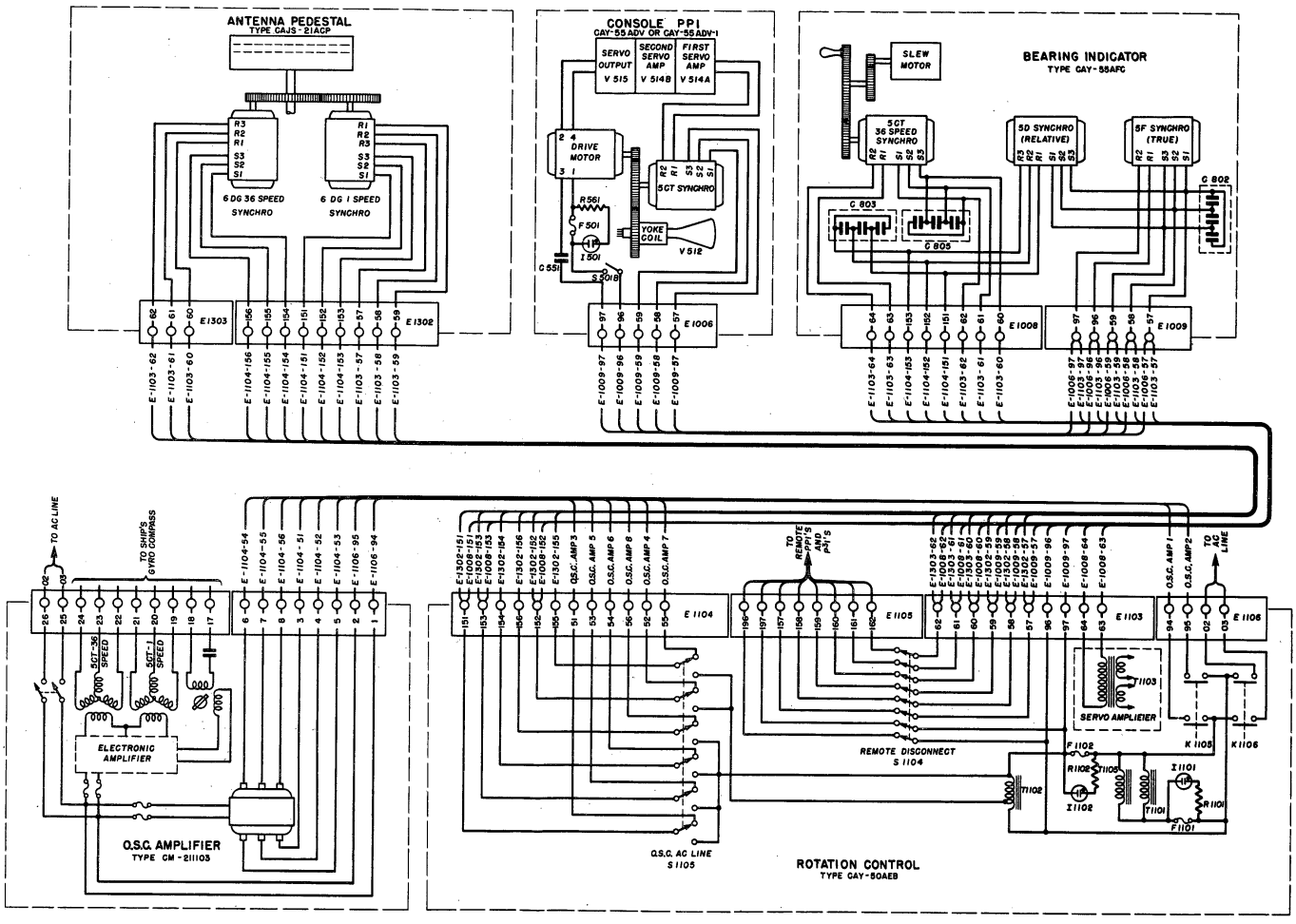


Figure 7-4. Servicing Block Diagram, Antenna Positioning System

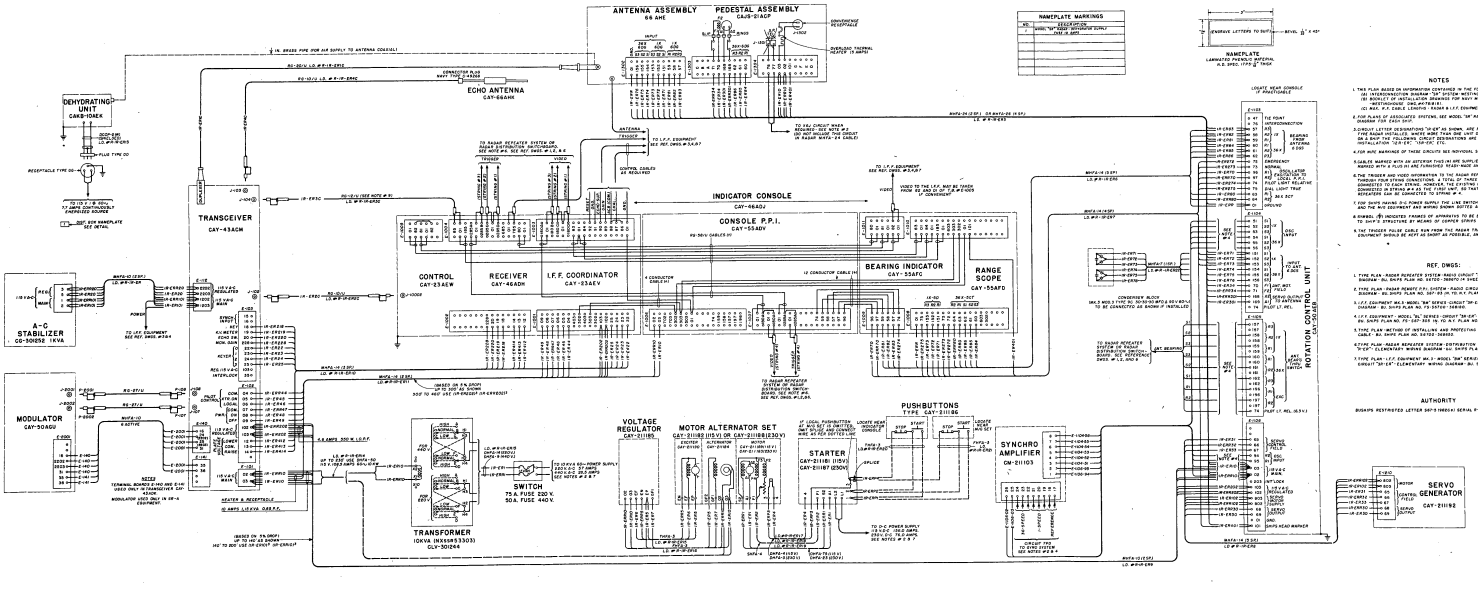


Figure 7-5. External Cabling Diagram SR and SR-a Equipment

Figure 7-5. External Cabling Diagram SR and SR-a Equipment

Other points to check are contacts K-103C and K-103D on relay K-103. When relay K-101 operates, it raises the oscillator filament voltage, and the oscillator filaments become perceptibly brighter. The FILAMENT VOLTS meter M-106 should indicate 10 volts. If the meter indication does not increase, check relay contact K-101B. If the meter does not indicate 10 volts, adjust the FILAMENT VOLTAGE control until 10 volts is registered. Another indication of the operation of K-101 is the illumination of PLATE VOLTS lamp I-104. These two indications may be used as a check on each other. Another function of relay K-101 is to energize the high voltage rectifier. This action is indicated by a deflection on the PLATE VOLTS meter M-103. If this meter does not register, check the high voltage rectifiers to see if they are heating. If they are not, check the tubes and if they are all right, check transformer T-103. If the tubes heat properly but there is no meter indication of an output voltage, check fuses F-109 and F-110. At the same time the high voltage rectifier begins to function, the TRANSMITTER ON lamp on the General Control Unit is illuminated.

(7) Place the ON-OFF switch S-302 on the Monitor Scope in its ON position. Check the fuse warning lamps. If they are glowing replace the fuses. If a replaced fuse burns out, look for a short circuit in the Monitor Scope. The presence of input voltage to the Monitor Scope can be checked at receptacle J-318 with an a-c voltmeter.

(8) Place the Indicator Console switch in its ON position if it was not left on in step (6). Fig. 7-1 shows the circuits energized by this switch. Blower motor B-401 in the General Control Unit and blower motor B-806 in the Bearing Indicator should start. If they do not start, check relay K-103 in the Transceiver. Check the a-c power circuits back to the Voltage Stabilizer as previously described if necessary. Check the fuse warning lamps on all units except the PPI Indicator. If a lamp is glowing, replace the fuse associated with it.

(9) Place the ON-OFF switch S-501 on the PPI Indicator in its ON position. Check the fuse warning lamps and replace the fuses if the lamps are glowing. Blower motor B-503 should start. If the motor does not start, check the interlock switches.

(10) On SR equipments press the RAISE switch S-105 until PLATE VOLTAGE Meter M-103 registers 8 kilovolts. If the equipment is SR-a equipment see step (14) and continue from there.

(11) Place the RADIATION switch S-108 on the Transceiver in its ON position. This should operate relay K-106.

(12) Momentarily press the RAISE switch S-105 at brief intervals, bringing the oscillator plate voltage up by easy stages to 11 kilovolts as indicated on the PLATE VOLTAGE meter M-103. If the overload relay K-105 trips each time the RADIATION switch is placed in the ON position, the transmitting oscillator may not be tuned to the correct frequency; the duplexer may be out of tune; or there may be trouble in the transmission line or antenna. Check the frequency of the transmitter as described in Par. 3b of this section. Time must be allowed for the plate voltage control transformer to be automatically reduced to its minimum output voltage position before the POWER ON switch is pressed. If the transmitter cannot be made to operate with 11 kilovolts it probably needs tuning. In this case refer to Par. 36d of this section. As the plate voltage is increased, watch the CATHODE and GRID CURRENT meters on the Transceiver. The indications of these meters should not exceed the values given in Table 7-1. To check the different meter readings, turn the PULSE LENGTH switch S-158 on the KEYER to each of its positions.

TABLE 7-1
TRANSCEIVER CURRENT READINGS

PULSE LENGTH	PLATE VOLTS	CATHODE CURRENT	GRID CURRENT
20 μs	11 kv	35-55 ma	10-13 ma
4 μs	11 kv	30-40 ma	6- 9 ma
1 μs	11 kv	15-25 ma	2- 4 ma

The data given in Table 7-1 may be used to determine whether the transmitter is oscillating. If the transmitter is functioning, it should be delivering trigger voltage to the Indicator Console. This can be checked by observing the oscilloscopes in the Range Scope and the PPI Indicator. Both of the scopes should have sweeps.

(13) Connect an oscilloscope such as Oscilloscope TS-346( )/AP and observe the grid pulse. The grid pulse should appear as described in Par. 36*d* of this section and Fig. 7-100. If it does not, adjust it as described in Par. 36*d* of this section.

(14) On SR-a equipments continue after step (9) by placing the RADIATION switch in its ON position. This should operate relay K-106.

(15) Press the RAISE switch S-105 until the PLATE VOLTAGE Meter M-103 indicates 3.5 kilovolts.

(16) Check the frequency of the transmitter as described in Par. 3b of this section. Retune according to Par. 36e of this section if necessary.

(17) Raise the plate voltage to 5 kilovolts. If arcing occurs in the oscillator compartment, retune the transmitter as described in Par. 36e of this section. When the SR-a transmitter is functioning normally, the filament voltage should be 10 volts, the plate voltage five kilovolts, the plate current 20-30 Ma, and the grid current 4-8 Ma.

(18) Check the repetition frequency by connecting an oscilloscope to test jack J-2004 on the Modu-

lator as directed in Par. 36e of this section. The repetition frequency should be 120 cps.

(19) Place the ROTATION switch S-804 on the Bearing Indicator in its NORMAL position.

(20) Place the SYNCHRO SYSTEM switch on the Rotation Control Unit in its A.C. position. This places relay K-1106 in the primary power circuit and connects the fixed reference voltage circuits to the synchro units in the Antenna Pedestal. The REL lamp on the Bearing Indicator should glow to indicate that the system is operating in the relative bearing position.

(21) Place the SERVO-GEN. MOTOR circuit breaker K-1108 and the ANT. TRAIN MOTOR circuit breaker K-1107 in their ON positions.

(22) Place the ON-OFF switch S-1101 on the Rotation Control Unit in its ON position. Relays K-1103, K-1104, and K-1106 in the Rotation Control Unit should be heard to operate. If they do not, check switch S-1101 and the relay circuits. Also check interlock switches S-1102 and S-1103 and the interlock circuit that connects to terminal 103 in the Rotation Control Unit. When the relays operate, A-C power is applied to the drive motor of the Servo Generator and this unit should be heard to start. If it does not, check the power circuit to the motor at terminals 802 and 803 in the Rotation Control Unit and at the Servo Generator. If voltage is available, check the starting switch and starting capacitor in the motor. If the circuit breaker trips each time it is placed in the ON position, check for a defective starting switch in the motor.

(23) If a displacement angle exists in the unmodified antenna positioning system, the Antenna Pedestal will slew to a new position. This will also be indicated by the rotation of the dials on the Bearing Indicator and the sweep on the PPI scope. If the Antenna hunts, the Anti-hunt circuit in the Servo Amplifier requires adjustment. If the Antenna does not hunt, but the PPI sweep does, adjust the Anti-hunt circuit in the PPI Indicator. If there is no movement of the Antenna when the HAND SLEW control is rotated, place the ROTATION switch on the Bearing Indicator in the PPI OR EMERGENCY position. Then place the SLEWING MOTOR switch on the Bearing Indicator successively in each of its 1¼ and 5 positions, unless the equipment has been modified, in which case the speeds are 2½ and 7 rpm. Check the direction and speed of rotation. They must be as indicated on the SLEWING MOTOR switch. If the Antenna Pedestal rotates, the external cabling and the relays and rectifiers in the Rectifier Power Unit are all right, but there is trouble in the synchro system. If there is no rotation in the PPI OR EMERGENCY position, check the external cabling, collector rings and brush assembly in the Antenna Pedestal, first checking to see that safety plug P-1301 in the Antenna Pedestal is in place. If the circuits are all right and voltage is available at the antenna drive motor, check its brushes and commutator. If the Antenna Pedestal is jammed, the fuses in the Rectifier Power Unit will be open.

(24) Return the ROTATION switch on the Bearing Indicator to its NORMAL position.

(25) Place the SYNCHRO AMPLIFIER POWER switch on the Synchro Amplifier in its ON position. The red POWER lamp on the right hand side of the switch should glow. If it does not, loosen the thumbscrews that hold the top in place. Remove the top and check the fuses in the power circuit. The fuses in the Synchro Amplifier are all located beneath the top and are identified on a nameplate directly above them.

(26) Check the amber COMPASS EXCITATION lamp on the left hand side of the switch. It should be glowing to indicate that compass excitation and data voltages are being supplied to the Synchro Amplifier. If it is not glowing, check the compass circuits.

(27) Place the SYNCHRO SYSTEM switch on the Rotation Control Unit in its O.S.C. EX. position. The left-hand dial on the Bearing Indicator and the sweep on the PPI Indicator should slew to new positions but the Antenna Pedestal should not move more than ten degrees. When the switch is operated, relay K-1106 should open and K-1105 should close. The TRUE lamp on the Bearing Indicator should glow and the REL lamp should be extinguished. If these indications are not observed, check the relays. Also check the synchro and commutator transformer fuses in the Synchro Amplifier. If the fuses are all right, it is possible that the trouble might lie in the brush assemblies on the commutator transformer in the Synchro Amplifier.

(28) Rotate the HAND SLEW control on the Bearing Indicator, observing the Antenna Pedestal, Bearing Indicator dials, and the PPI sweep. Each of these should rotate with the SLEWING control. If they do not, check the fuses in the synchro circuits of the Synchro Amplifier. Also check the Servo Amplifier in the Rotation Control Unit. If the Antenna hunts in true operation but does not hunt in relative operation, adjust the anti-hunt circuits in the Synchro Amplifiers.

(29) The orientation of the antenna positioning system may be checked by turning the antenna to the point where the ship's head marker appears on the PPI scope. In relative operation, this point will be at zero degrees on the PPI scope and if the system is properly aligned, both dials on the Bearing Indicator should also register zero degrees. If they do not, orient the system as directed in Par. 43b of this section. In true operation, the ship's head marker should appear at an angle on the PPI scope that is equal to the bearing of the ship with respect to true North. The left-hand dial on the Bearing Indicator should register the same angle. The right hand dial will still register

relative bearing. If one or both of these angular indications differs from the bearing angle of the ship, orient the system as directed in Par. 43b of this section.

(30) Adjust the operating controls on the Monitor Scope as follows:

CONTROL	ADJUSTMENT
V CENTER (R-324)	Position sweep under etched line.
H CENTER (R-322)	Position start of sweep with O etched on face of tube.
INTENSITY (R-328)	Adjust for comfortable brilliancy.
FOCUS (R-331)	Adjust to center of range.
FOCUS BALANCING (R-335)	Adjust for best definition of sweep.
RANGE SELECTOR (S-301)	Place in 20 position.

(31) Rotate the I-F GAIN control R-235 on the Monitor Receiver all the way clockwise to its 100 position. The noise level on the Monitor Scope should increase in amplitude. If it does not, there is trouble in the Monitor Receiver or Monitor Scope.

(32) Rotate the HAND SLEW control on the Bearing Indicator until a target appears on the screen of the Monitor Scope. Stop the antenna on this target. If echo pips do not appear on the Monitor Scope, watch the scopes on the Indicator Console. If none appear, the Monitor Receiver is defective. If they do appear, check the Monitor Scope.

(33) Adjust the RECEIVER TUNE (F) dial on the Monitor Receiver for maximum amplitude on the Monitor Scope. If the pattern saturates the screen, reduce its amplitude by rotating the I.F. GAIN control counterclockwise.

(34) Adjust the R-F control C-201 on the Monitor Receiver for maximum amplitude on the Monitor Scope.

(35) Rotate the Antenna and observe several other targets. If the average amplitude is too low, it may be that the spark gaps in the duplexer require adjustment. See Par. 36d of this Section.

(36) Turn the I.F. GAIN control on the Console Receiver to the minimum or zero position. Place the PPI MARKERS and ECHO BOX switches on the Console Receiver in their OFF position. Place the TIME CONSTANT control in its 1 position and place the BAND PASS switch in its BROAD position.

(37) See that the CHALLENGE switch on the IFF Coordinator is in its OFF position.

(38) A fine horizontal line should be observed on the face of the range scope tube. This line runs horizontally across the tube and should appear just above the top set of figures engraved on the transparent window over the front of the range scope cathode ray tube. If this line does not appear, adjust the INTENSITY control until the line appears with normal brilliance. If the sweep is fuzzy, adjust the FOCUS control until the line is sharp, and well defined. Sometimes it is necessary to operate the INTENSITY and FOCUS controls together until a sharp, clean line is present on the tube face. If there is a vertical step on the sweep line, this indicates that the phantastron is running. It may be turned off by pushing in the RANGE STEP control knob.

(39) The start of the sweep on the left-hand side of the tube face should be centered directly over the zero figure on the scale. If the line does not start directly above the zero figure, it may be shifted laterally on the face of the tube with the HORIZONTAL CENTERING control. If the sweep line is not three-eighths of an inch above the numbers, it may be moved vertically with the VERTICAL CENTERING control. After adjusting these two controls, the line should appear just above the top row of numbers. The left-hand starting point of the line should be directly above the center of the zero figure.

(40) Set the RANGE SWITCH so that the number 20 appears in the small window directly above the switch indicated as MILES on the panel. This places the Range Scope on the 20-mile range.

(41) Turn the MARKERS switch to the ON position. Four markers should appear as vertical pips below the sweep line. Each of these pips should fall behind one of the figures on the scale over the face of the tube. If they do not fall behind the figures, the SWEEP LENGTH control should be turned until all four markers line up. Turn the RANGE SWITCH to the 4-mile, 80-mile and 200-mile ranges and make certain that the markers appear. They will not necessarily fall behind the numbers on the other ranges. This check is made to make certain that the markers are present on all of the four ranges. It is necessary to adjust the SWEEP LENGTH control each time the range is changed. If the markers do not appear, check the range marker circuits in the scope.

(42) With the MARKERS switch still in the ON position and the equipment on the 20-mile range, pull out the RANGE STEP control. A vertical break, or step, should appear on the sweep line. Rotate the RANGE STEP control until the break just touches the left-hand side of the numerals 1 and 2 etched on the glass. The RANGE YARDS counters beneath the scope should indicate 10,000 yards. Repeat this operation with the other markers. ALL RANGE COUNTERS should read correctly to within 100 yards on all marker points. Turn the RANGE SWITCH to the 4-mile and 80-mile ranges where Field Change #24 has been made, and repeat this check of the RANGE STEP on these ranges. If the step does not appear or if the range counters do not indicate to the required accuracy, the phantastron circuit should be adjusted as described in Par. 39f of this section.

(43) Turn off the range step by pushing the RANGE STEP control in towards the panel and turn off the MARKERS switch.

(44) Place the CHALLENGE switch to the MOMENTARY position. Hold it there for a moment and observe the pattern on the Range Scope. A second line should appear about three-eighths of an inch below the numbered scale. If it does not appear, or if it is not in the proper position, the IFF Coordinator should be adjusted as described in Par. 40 of this Section. Grass from the IFF receiver should be visible. If it is not, turn the IFF REC. GAIN control inside the door in the panel of the IFF Coordinator until grass appears. If the noise amplitude still does not increase, check the IFF Video Circuits and the IFF equipment. Release the CHALLENGE switch which should return to the OFF position.

(45) Advance the I.F. GAIN control on the Console Receiver until noise or grass appears on the Range Scope. If grass does not appear, check the input and output of the Console Receiver and check the Video Circuits in the Range Scope. Set this control at the point where the grass is ½ inch high on the sweep. Then operate the HAND SLEW wheel on the Bearing Indicator, until a target appears on the Range Scope. Adjust the antenna position until the target is at maximum height.

(46) Adjust the I.F. TUNE control inside the door on the Console Receiver until the target is at maximum amplitude. If targets do not appear on the Range Scope, look for them on the PPI Indicator. If they do not appear on the PPI Indicator, there may be trouble in the Console Receiver. To determine this, check the input and output terminals of the Receiver.

(47) Turn the VIDEO GAIN and MARKERS controls on the PPI Scope to their maximum counterclockwise position. Also, place the CENTER EXPAND switch in its left-hand position so that the trace on the tube begins at the center of the tube.

(48) Adjust the RANGE SELECTOR switch on the PPI Indicator to the 200-mile range. The number appearing in the small opening above the RANGE SELECTOR switch indicates the range on which the equipment is operating.

(49) Adjust the FINE INTENSITY control so that the sweep is barely visible. If the sweep does not appear, check the trigger input circuits. If there is no trigger, check the trigger output from the transmitter.

(50) Adjust the FINE INTENSITY control and the FOCUS control, alternately, until the sweep appears sharp and just barely visible. To obtain the proper setting of the FINE INTENSITY control on any of the four ranges, turn the VIDEO GAIN control completely counterclockwise and turn the INTENSITY control clockwise from its counterclockwise position until a light fuzzy picture, having the appearance of grass, appears on the face of the tube. Turn the VIDEO GAIN control clockwise until signals appear in sharp focus, and with relatively bright illumination. The INTENSITY control should *not* be adjusted again. After a range has been set in this manner, the operation will be incorrect if the INTENSITY control is turned. Signals will be seen if the INTENSITY control is turned, but the weaker signals may be lost. If the sweep does not appear, check the trigger input to the Scope. If the trigger is present, there may be trouble in the PPI gate circuits, or the sweep circuits.

(51) Observe the RELATIVE BEARING INDICATOR light on the panel. If this lamp is lighted, it is an indication that the radar equipment is operating on a relative bearing, and not on a true bearing. The light does not glow when true bearing operation is being employed. If the light does not glow in relative bearing operation, check the bulb, socket, and energizing circuits.

(52) The face of the tube should be observed carefully while the sweep is rotating. Make certain that the sweep starts in the center of the tube. If it does not, or if the sweep hunts, the equipment should be adjusted as described in the alignment procedure in Par. 41 of this Section.

(53) Adjust the MARKERS control until four bright equally spaced dots appear along the sweep line on the face of the tube. If the radar antenna is rotating, these dots will trace out four circles on the face of the tube, concentric with the center of the tube. Turn the RANGE SWITCH to the other three ranges and check to see if the dots also appear on these three ranges. The intensity of these dots can be adjusted by the MARKERS control. They should be adjusted so that the lines they trace when the antenna is rotating are as narrow and clear as possible. If the dots do not appear, see Par. 11 of this Section.

(54) Adjust the DIAL DIMMER control on the front panel of the PPI Indicator until the illumination from the lights around the bezel permits the image on the tube face to be seen clearly, but not bright enough to tire the eyes. If the lights are not illuminated, check for defective bulbs, sockets, or a defective control.

(55) Place the CENTER EXPAND switch in its ON position. If it is functioning properly, the start of the PPI sweep should be shifted radially about one-half inch from the center of the tube.

c. SIGNAL TRACING.

(1) This method requires the use of an oscilloscope such as Oscilloscope TS-34( )/AP or its equivalent. The equipment must be placed in operation as described in the preceding paragraph. Before starting the test, check the appearance of the patterns on the Range and PPI Scopes. If a sweep is present, it is

obviously unnecessary to check the gate and sweep channels. If there is no sweep in one of the scopes, check the sync input with the test oscilloscope and if sync voltage is present, insert the test prod in the test jack nearest to the cathode ray tube and successively test each point back toward the sync input until a signal is obtained. The trouble will be located in the stage driven by the first stage from which an output can be obtained. If neither scope displays a sweep, the trigger input to the Indicator Console should be checked. If the IFF sweep does not appear on the Range Scope, the blocking voltage input should be checked. If there is no input, the logical location of trouble is the IFF Coordinator. If video signals fail to appear on both scopes and a test shows that there is a normal input to the Console Receiver, but no output, it is evident that the fault lies in the Console Receiver. Troubles in the General Control Unit and Bearing Indicator are usually evidenced by the lack of response to their controls. The use of a test oscilloscope is fully described in the Instruction Book that accompanies the instrument and need not be described here. The sweep of the test oscilloscope should be set to some multiple of the sync input frequency to the Indicator Console and the sync voltage should also be connected to the external sync terminals on the test oscilloscope. This insures a stationary signal on the test oscilloscope.

(2) If a sweep appears on the face of the PPI tube, note whether marker dots appear when the MARKERS control is turned in a clockwise direction. If they do not, look for trouble in the stages represented by the center row of blocks in Fig. 7-3. Observe the waveforms beginning at the test point nearest to the PPI tube and work back toward the gate multivibrator until an output is found. The trouble will be located in the last stage from which no output is obtained.

(3) If a sweep appears on the Range Scope, turn the MARKERS control ON and look for marker pips below the sweep. If they do not appear, check the test points in the range marker circuit as indicated in Fig. 7-3. If the range step does not appear when the RANGE STEP control is pulled out, check the phantastron circuit. Its test points are shown in Fig. 7-3.

(4) It is not advisable to depend entirely upon the oscilloscope. While the waveforms are being taken, look for tubes whose heaters are not illuminated. If such a tube is found, replace it at once since it may be the only trouble present and a complete waveform test cannot be made until it is replaced. Also look for signs of overheated inductors and resistors. This may save much time in locating troubles.

(5) If the range marker dots and pips appear on the scopes, turn up the VIDEO GAIN control on the PPI Indicator, and the I.F. GAIN control on the Console Receiver and note whether a video output appears on the cathode ray tubes. A video signal should be available for this test but, in its absence, note whether the intensity of the noise indications increase as the gain is increased. If the controls have no effect, sync the sweep of the test scope with the trigger input and check the output of the Console Receiver. If it is normal, the trouble lies in the video channel of the defective scope.

(6) The oscilloscope is not generally used to locate defective parts in a circuit. Its usefulness ends after it has located the defective stage. The defective part must be located by voltage, resistance, and continuity measurements. It should be pointed out that the facsimiles of the waveforms on the instruction plate are very much idealized because it is very difficult to show an exact reproduction by this method. More accurate representations are shown in the various drawings in this section, but they are also idealized to some extent. No waveforms are shown for the Console Receiver. However, the voltage gain per stage is shown. It is taken by connecting the oscilloscope to the output of the Receiver and applying an appropriate signal of known strength to each stage in turn and measuring the output on the oscilloscope which must be calibrated for this purpose. First, a video signal is fed into the video circuits, then a high frequency signal generator with a calibrated attenuator is used to feed a modulated CW signal into each i-f stage, beginning with the detector and working back to the i-f input. Some of the troubles that may be commonly expected are given in the troubleshooting charts. These troubles are described in the following paragraphs.

(7) The ease with which circuits can be traced against the schematic diagram is an important element in the location of troubles. For this reason, the wiring in the Monitor Receiver, Monitor Scope, Console Receiver, PPI Indicator, Range Scope, and IFF Coordinator is color coded as follows:

CIRCUIT	TRACER
B+	Red
Plate	Blue
Screen	Orange
Control Grid	Green
Cathode	Brown
Filament	White
Ground	Black

The sockets are also color coded to permit the socket connections to be quickly and easily identified. The color coding consists of color dots on the base, placed as near the appropriate pin as possible. The color coding is as follows:

TUBE ELEMENT	DOT COLOR
Plate	Blue
Grid	Green
Cathode	Black

Some of the tube sockets have green rings around

them. This indicates that the tube encircled by the green ring is essential to the basic operation of the equipment. In emergencies, the bare minimum of equipment functions can be obtained when all tubes not encircled with green rings are removed. Therefore, if a situation arises where it is impossible to obtain tube replacements, it is possible to remove a tube from a socket without a green ring and use it to replace a defective tube in a socket with a green ring. Both tubes must be of the same type.

3. TROUBLES IN THE TRANSCEIVER.

a. GENERAL.

(1) Most of the troubles that will be encountered in the Transceiver have been discussed in the system troubleshooting procedure. These troubles are in the primary power distribution system, the interlock system, and the various relays. Whenever service is required on the Transceiver it is advisable to determine whether it has been modified according to the Navy Field Changes included in the supplement at the end of this section. One of the first and most important steps to take in locating troubles in the Transceiver is to operate it and check its meter readings as described in the system trouble shooting procedure. If the meter readings indicate that the transmitter is oscillating, the output frequency and the loading should be checked.

b. TRANSMITTER FREQUENCY MEASUREMENT.

(1) A detailed description of the measurement of the transmitter frequency is given in Par. 36 of this section which describes the tuning procedure. However, a brief description is given here to facilitate the location of troubles. In order to check the transmitter frequency it is necessary to use the Echo Box. Originally the Echo Box was designed to be tuned to resonance which was indicated by a maximum reading on the ECHO BOX RESONANCE METER. To measure frequency with the unmodified Echo Box, place its ON-OFF switch in the ON position. Allow time for the tube to warm up and then rotate the ECHO BOX TUNE control marked (G) for maximum indication on the meter. If the meter goes off scale, loosen the panel screws of the Monitor Receiver and slide the chassis out far enough to permit access to the meter range switch located on top of the Echo Box assembly near the tube. Place this switch in the HI position. Continue tuning the Echo Box until a maximum is obtained on the meter. Read the dial over the index and determine the frequency from the calibration chart on the door of the oscillator compartment. If the Echo Box has been modified, tune the Echo Box for a sharp dip in the meter reading. Find the frequency from the calibration chart as described previously. Determine the type of antenna in use and note whether the frequency lies within plus or minus 3 megacycles of the center of the band covered by the antenna. If it does not, retune the transmitter as described in Par. 36 of this section. In addition to the transmitter tests described in Par. 2, System Troubleshooting, check the performance of the Monitor Receiver. This will often give an indication of how accurately the duplexer is adjusted.

c. TROUBLES.

(1) Some of the troubles commonly expected in the Transceiver are given in the troubleshooting chart in Fig. 7-6. Other service hints are given in this paragraph. When checking the Transceiver, check tubes V-107 and V-108 to see if they are properly insulated from ground. Another point to check is r-f arcs at the doors and panels. If the doors and panels are not secured so that they make complete contact, or if the surfaces are dirty, r-f arcs will occur. This trouble can be eliminated by cleaning the surfaces and properly tightening the doors and panels. If the Transceiver case is not properly grounded, the operator is subjected to r-f arcs each time contact is made with the panel. Such a condition is due to improper bonding around the shockmounts or the lack of any bonding at all. The condition of the bonding can be checked by grounding the Transceiver case with a screwdriver. If sparks can be drawn with the screwdriver, the bonding is ineffective and should be repaired. This test is effective when it is impossible to feel r-f energy with the hand.

(2) If the variable transformer T-105 jams, the trouble may be a defective limit switch S-109. To release the transformer, mark the position of the cam that actuates limit switch S-111. This switch and its cam are located behind the door in the lower left-hand corner of the Transceiver cabinet. See Fig. 7-7. After the position of the cam has been marked so that it can be returned to its position, loosen the cam on the shaft and rotate it until the upper limit switch S-111 closes. With the CONTROL switch in the LOCAL position, place the EMERGENCY-MAIN POWER switch in its ON position and then press the POWER ON switch. This energizes relay K-101 and opens contacts K-101H. Then press the RAISE switch repeatedly for brief periods until the motor rotates the transformer away from its jammed position. Replace switch S-109 and move the cam of switch S-111 back to its original position and secure it.

(3) In cases where the overload relay K-105 trips repeatedly, first check to see that the system is properly tuned. If it is not, it may be drawing excessive current. If the system is correctly tuned, check the adjustment of the overload relay. This relay should be adjusted to open when the current through it exceeds 100 ma. The adjustment of this relay is described in Par. 36*b* of this section. If the plate and grid current become erratic as indicated on the panel meters, check the condition of the oscillator lines. If the lines are

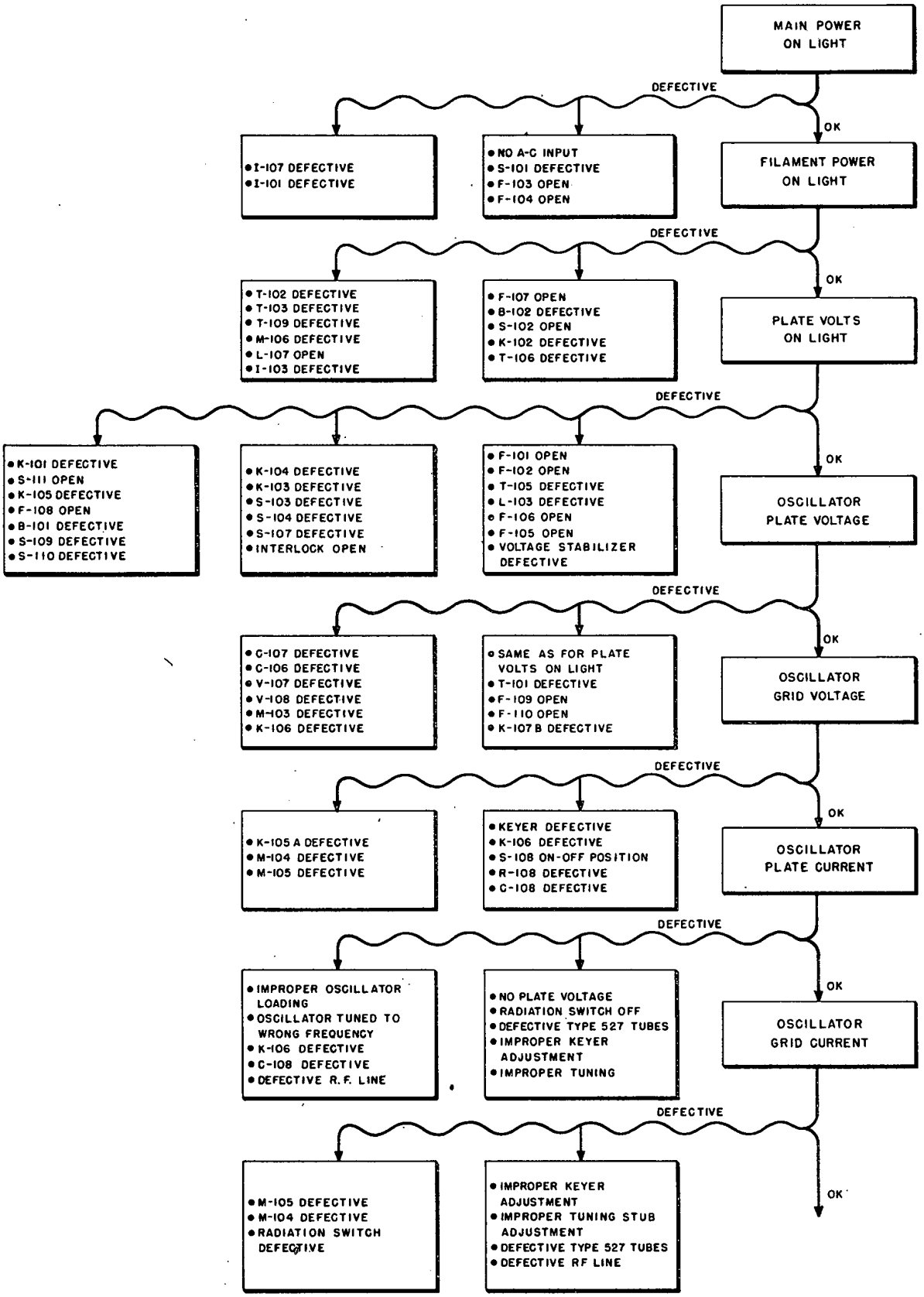


Figure 7-6. Transceiver, Troubleshooting Chart

Figure 7-6. Transceiver, Troubleshooting Chart

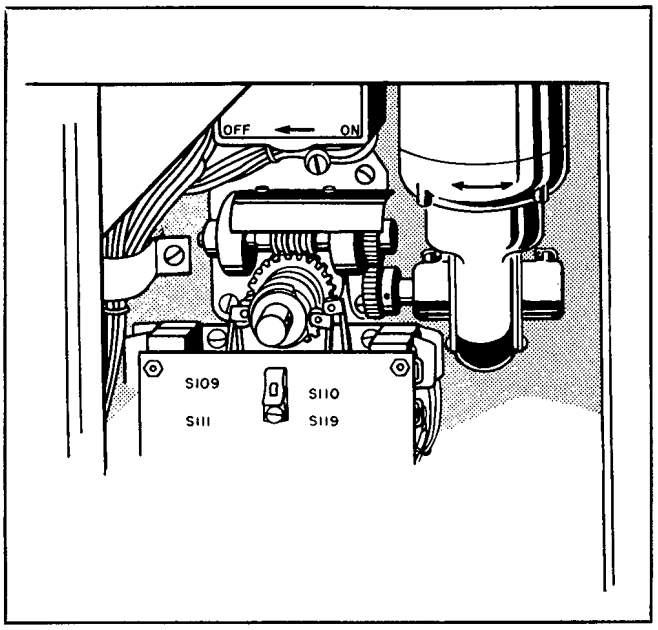


Figure 7-7. Switch and Cam Assembly on Transceiver

dirty or corroded, so that a high resistance contact exists between the shorting bars and the lines, or if the grid straps and corona balls are loose, the transmitter will exhibit a tendency to jump frequency and go out of oscillation. If the oscillator quits oscillating with power applied, the overload relay will trip. If the frequency changes, this condition will be reflected in the indications of the panel meters. A somewhat similar condition may be caused by defective oscillator tubes or by defective brushes in the variable transformer T-105.

(4) If pressing the RAISE switch does not cause the plate voltage to increase, check the limit switches on motor B-101 and check the motor windings for continuity. If the RAISE switch is pressed after the overload relay has tripped but before transformer T-105 has had time to recycle, motor B-101 may be burned out. Therefore, it is important that the operator wait until the PLATE VOLTAGE LAMP glows before pressing the RAISE switch.

(5) The SR transmitting oscillator includes the Keyer in its grid circuits. One of the principle sources of trouble is the improper adjustment of the Keyer. Consequently, when the transmitter draws excessive current or fails to key properly, the grid waveform at test jack J-106 should be checked as described in Par. 36*d* of this section. A sure indication of Keyer trouble is when the transmitter draws excessive plate current and trips the overload relay with the grid current remaining at zero.

(6) If the SR-a transmitter does not draw plate current, it is inoperative and the trouble may be due to defective pulse circuits in the Modulator, a defective cable to the Modulator, or defective transmitting tubes. In some instances the SR-a transmitter may be apparently tuned to the correct frequency and yet the output power is very low. This trouble is due to the fact that all of the transmitter power is not being radiated at the frequency indicated on the Echo Box. This can be determined by tuning over the Echo Box range to see if the transmitter is radiating at some other frequency. When the transmitter is properly tuned, practically all of the power will be concentrated at the output frequency.

(7) In some instances it has been found to be difficult to remove the Type 527 transmitting tubes from their sockets or to install new tubes. This trouble is due to burrs in the tube sockets. Examine the sockets carefully for burrs and remove them with a scraper or file; then polish the surface so treated with a fine grade of carborundum paper. Examine the transmitting tubes each time the Transceiver is serviced. Note particularly the condition of the plates. If holes appear in the plates of the tubes in the unmodified SR Transceiver, the oscillator is improperly tuned and this condition should be corrected before replacing the tubes.

4. TROUBLES IN KEYER UNIT.

a. GENERAL.

(1) Troubles in the Keyer Unit are usually of a simple nature and are confined to mechanical troubles in the geneva switch, open circuited inductors and resistors, and short circuited capacitors. As a rule very little trouble will occur in the Keyer Unit. Some of the representative troubles are listed in Fig. 7-8.

b. TROUBLES.

(1) The best method to use in locating troubles in the Keyer Unit is the observation of the grid waveform with an oscilloscope connected between test jack J-106 on the Transceiver and ground. For example, if normal waveforms are obtained for the 1 and 4 microsecond positions of the PULSE LENGTH switch, it is evident that trouble exists in the 16-microsecond section of the pulse line or in some portion of its associated circuits. If one of the inductors in the pulse line should open or if one of the capacitors should become shortcircuited, the grid waveform will immediately reflect the trouble. To locate the trouble, it is only necessary to remove the Keyer, discharge the pulse line, and make continuity measurements with an ohmmeter.

(2) The geneva movement that accomplishes remote switching of the pulse length circuits is an electro-mechanical device. If it fails to operate, check the drive motor circuits shown in the complete schematic diagram in Fig. 7-126. Mechanical troubles are limited to the switch and the mechanical drive. If the drive motor is all right and receives driving power, the drive mechanism may be loose on the shaft. If the motor does not run, check the condition of the contacts of switch section S-158A and switch S-159.

(3) If the transmitter does not pulse or if it pulses erratically in 20-microsecond operation, check the 60-cps sync voltage circuits and switch section S-158F. If the proper waveform cannot be obtained in any of the pulse positions check the appropriate transformer and associated switch that is in series with the section of pulse-line used in that position. For example, if an ideal waveform cannot be obtained in the 1-microsecond position, check transformer T-153, switches S-154, S-158E, S-158F, and capacitor C-151.

(4) Another possible source of trouble is the grid cable that connects terminal 40 to the grid circuit in the Transceiver. If trouble is experienced with the cabling in the grid circuits, replace the cable as directed in Navy Field Change #5 which is included in the supplement at the end of this section.

5. TROUBLES IN MONITOR RECEIVER.

a. GENERAL.

(1) A chart showing representative troubles in the Monitor Receiver is shown in Fig. 7-9. The complete schematic diagram is shown in Fig. 7-129. Fig. 7-128 shows the average voltages and resistances measured from the socket terminals to ground. The principle source of troubles is the tubes in the Monitor Receiver. Another source of trouble previously discussed in Par. 2 of this section, is the primary power circuits. The troubles in the Monitor Receiver fall into two categories. One is the Monitor Receiver circuits and the other is the Echo Box circuits. While these circuits are both located in the Monitor Receiver chassis, they are independent of each other and have no common function.

b. LOCATION OF TROUBLES.

(1) Trouble is located in the Monitor Receiver when it is established that there is no video signal displayed on either the Monitor Scope or the Range Scope. This means that the Monitor Receiver is entirely inoperative. If there is an output on the Range Scope but there is no output on the Monitor Scope, the trouble may be in the Monitor Scope or it may be between V-206 and V-208 in the Monitor Receiver. The best way to check the Monitor Receiver is with an audio modulated signal generator such as Navy Model LP (Series) or LX (Series) or equivalent and a test oscilloscope such as Navy Model OBL (Series) Oscilloscope or Oscilloscope TS-34()/AP, or equivalent. Connect the oscilloscope to terminals 41 and 01 and adjust its sweep to the modulation frequency of the signal generator or to some multiple of it. If this test is made on the bench, connect a jumper from terminal 128 to terminal 28 on the Monitor Receiver. If it is made in the Console be sure the CONTROL switch is in the LOCAL position. Adjust the signal generator to the i-f frequency, 15 megacycles, to which the transmitter is tuned and connect its output through a capacitor to the plate and grid of each tube beginning with V-208 and working back to the plate of V-203. Reduce the output of the signal generator as the mixer tube is approached to keep the increased gain from saturating the scope. If weak signals are encountered, try another tube. If no improvement is obtained, check the alignment. See Par. 37*b* of this section. If alignment does not help, it will be necessary to check the voltages and resistances at the socket of the defective stage. If no output can be obtained at any stage, the trouble is in that stage. If an output is obtained on a test oscilloscope connected to terminals 41 and 01, connect the signal generator to connector J-201 and tune it to the transmitter frequency. If no output is obtained, the trouble is in the r-f amplifier V-201 or in the local oscillator V-202. One method for isolating troubles in the r-f section is to connect a vacuum tube voltmeter across the cathode resistor of the mixer tube V-203 and with an input signal at the transmitter frequency, measure the voltage and pull out the r-f amplifier, then the local oscillator, noting any change in voltage when the tube is removed. For example, if the r-f amplifier is defective, there will be no change in voltage when it is removed. If the local oscillator is defective its removal will cause no change in voltage.

(2) When the Monitor Receiver does not deliver an output at the plate of any of its tubes, or at terminal 41 when the signal generator is connected to V-208, it is obvious that there is trouble in the power supply. This can be further established by checking the output voltage from the power supply. The principle source of trouble in the power supply is the rectifier and voltage regulator tubes. If the tubes are all right, the filter choke or one of the filter capacitors may be defective. This can be determined by a resistance check. An open filter choke or a shortcircuited capacitor is readily detected with this method. An open filter capacitor results in a lower voltage output and increased ripple voltage. The amplitude of the ripple content in the rectified output can be checked with an oscilloscope. It is readily detected as a 120-cps a-c voltage.

(3) If excessive noise or oscillation appears in the output of the Monitor Receiver, check the screen bypass capacitors. Another cause of oscillation is poor grounds or ineffective shielding of the i-f transformers. If corrosion or dirt form a film on the chassis where the i-f transformer can makes contact, there is a possibility for oscillation. The presence of oscillation in the i-f amplifiers of both receivers is indicated by excessive deflection on the JAMMING INDICATOR meter in the Console Receiver. If tuning the rejection filters in the Console Receiver changes the amount of deflection, the oscillation is in the Monitor Receiver. If the rejection filters have no effect the i-f amplifier in the Console Receiver is oscillating. Another evidence of oscillation in the Monitor Receiver is the appearance of an inverted main bang on the Monitor Scope.

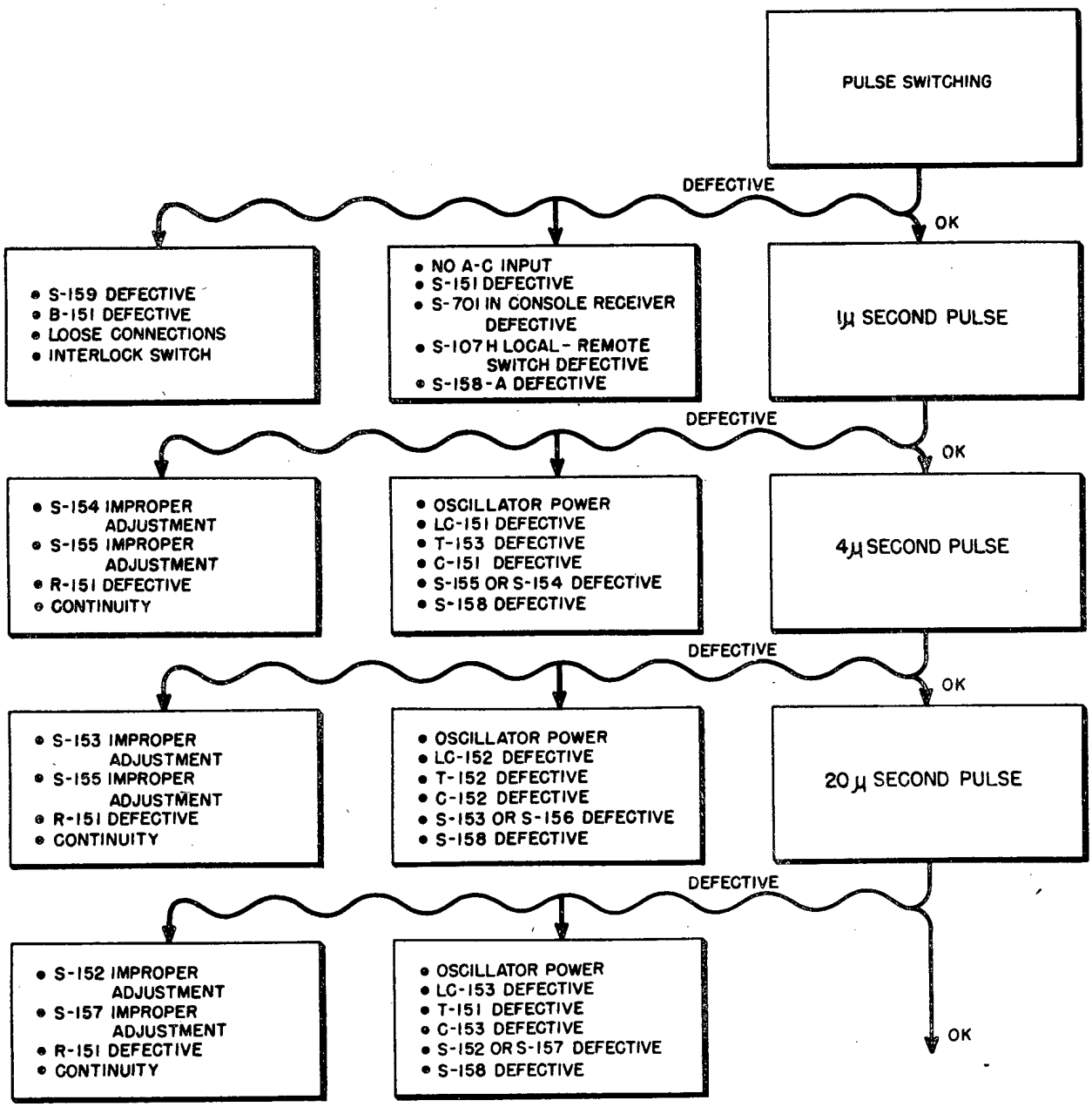


Figure 7-8. Keyer Unit, Troubleshooting Chart

Figure 7-8. Keyer Unit, Troubleshooting Chart

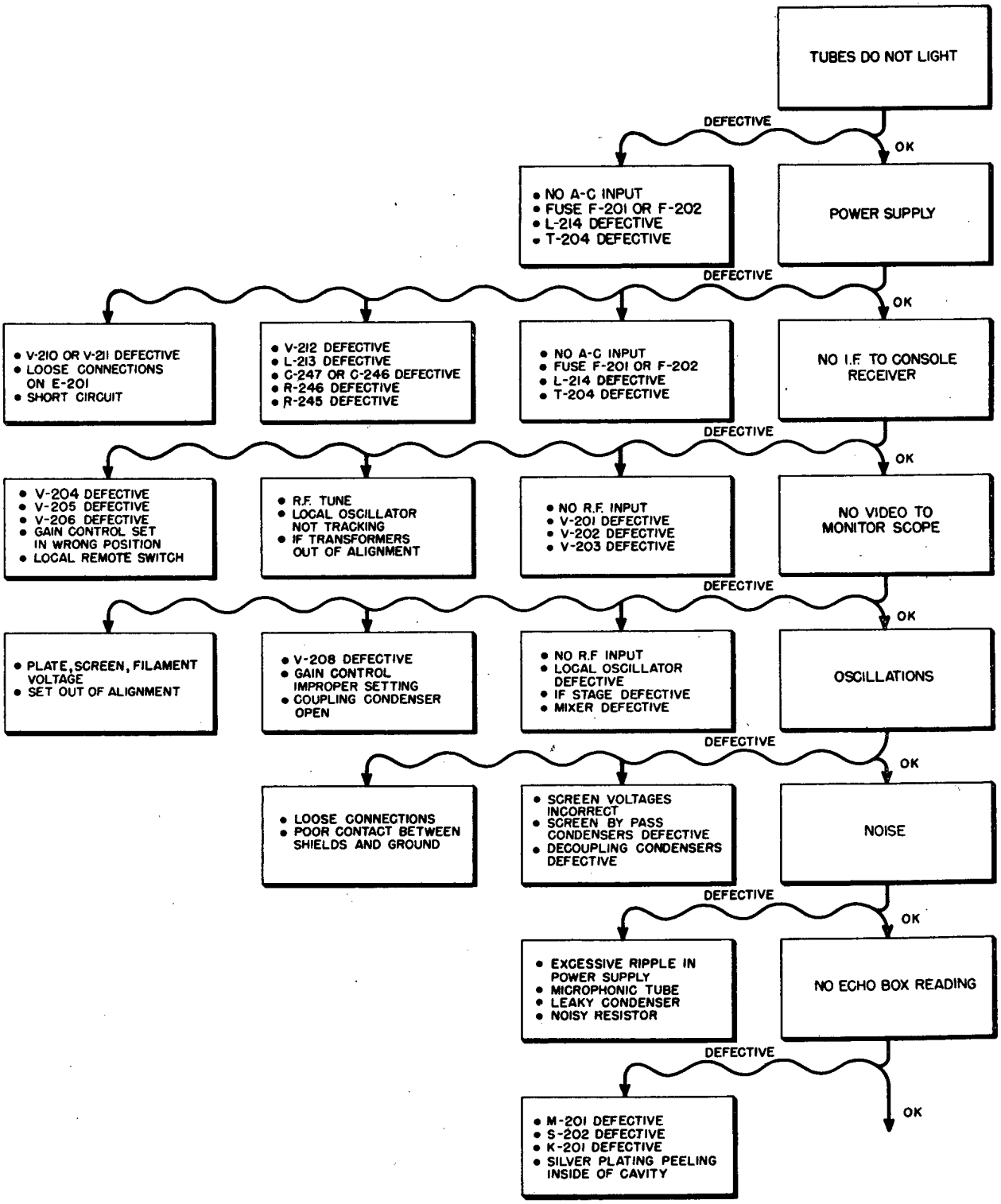


Figure 7-9. Monitor Receiver, Troubleshooting Chart

Figure 7-9. Monitor Receiver, Troubleshooting Chart

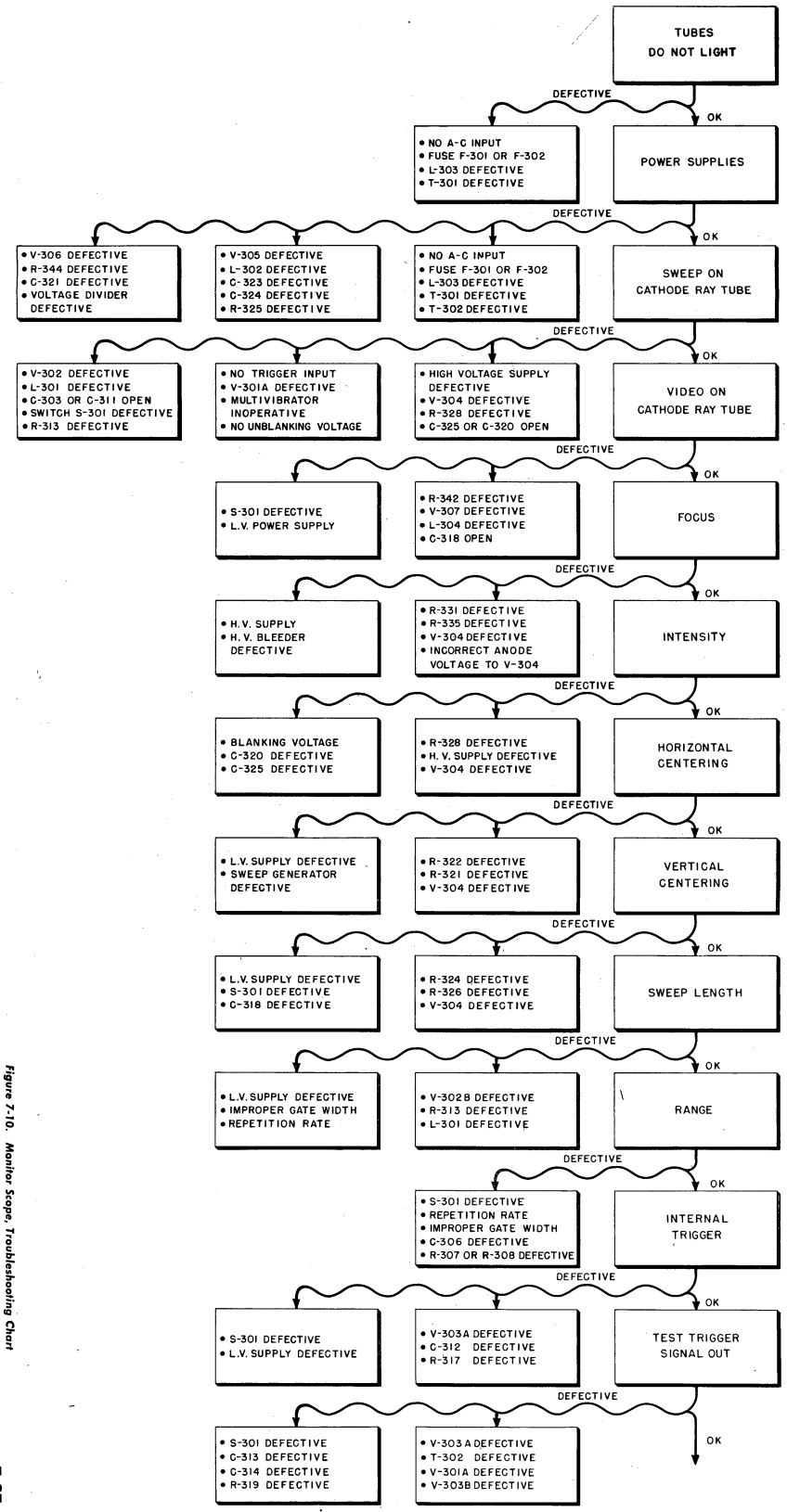


Figure 7-10. Monitor Scope, Troubleshooting Chart

Figure 7-10. Monitor Scope, Troubleshooting Chart

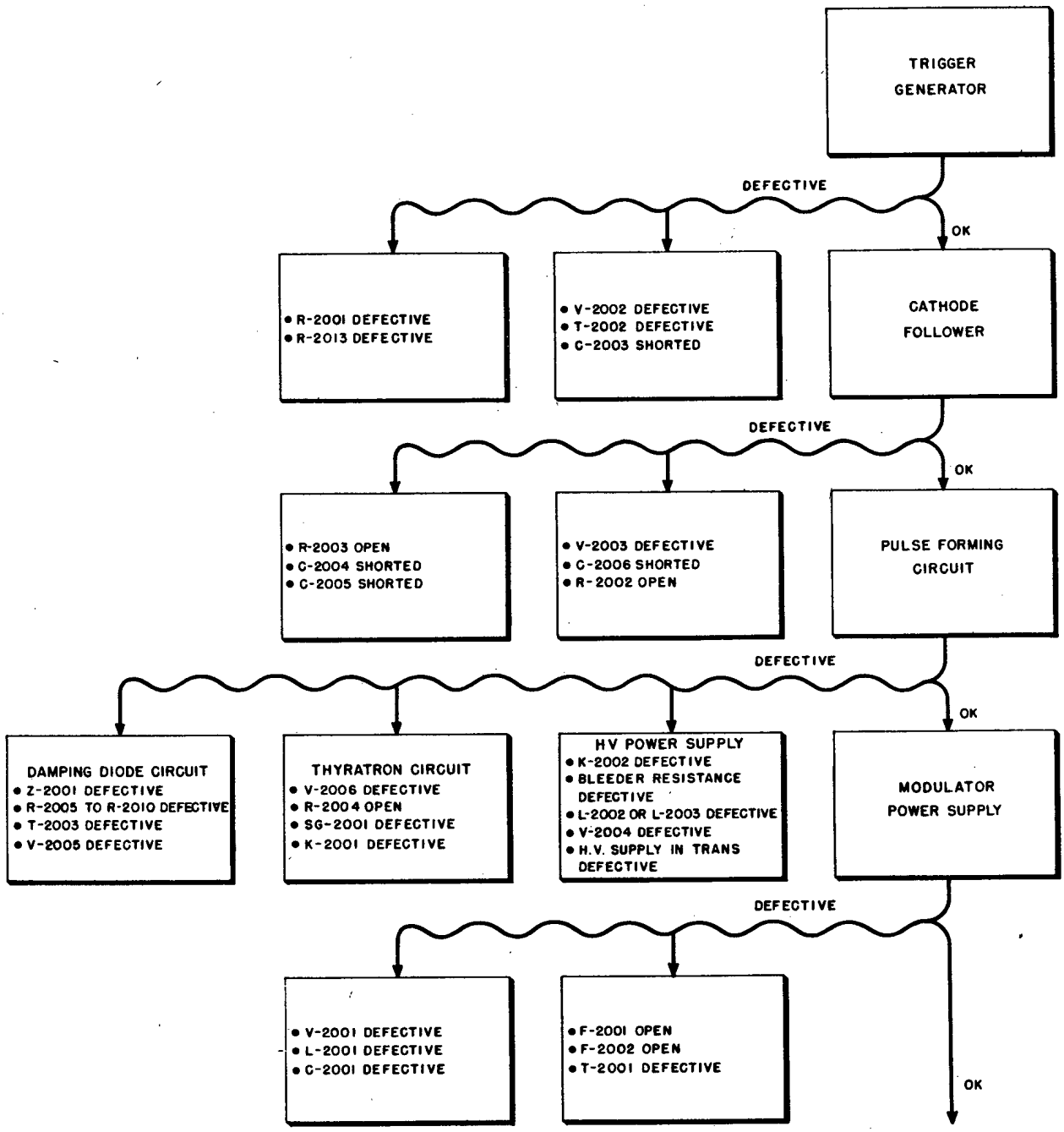


Figure 7-11. Modulator, Troubleshooting Chart

Figure 7-11. Modulator, Troubleshooting Chart

(4) The troubles in the Echo Box are mostly confined to the rectifier tube and the Echo Box cavity. If spurious readings are obtained with the Echo Box, disassemble the cavity assembly and examine the condition of the plating, the dial, and shaft mechanism. If no readings can be obtained on the meter, check the type 955 tube V-209. If the tube is all right, disassemble the Echo Box Antenna and examine the inner and outer conductors. It may be that the plating has peeled off, shorting the inner and outer conductors.

6. TROUBLES IN MONITOR SCOPE.

a. GENERAL.

(1) The Monitor Scope is connected to one of the outputs from the Monitor Receiver. If an output appears on the Range and PPI Scopes but does not appear on the Monitor Scope, there is trouble in the last two stages of the Monitor Receiver or in the Monitor Scope. One way to check the actual location of trouble is to connect an oscilloscope to the output of the Monitor Receiver that normally goes to the Monitor Scope. The sweep frequency of the test oscilloscope should be adjusted to the repetition rate or to some multiple of it. If an output appears on the test scope, the trouble is located in the Monitor Scope or in the interconnecting cabling. Practically the only way that trouble can be traced in the Monitor Scope is to use a test oscilloscope. Fig. 7-10 shows some of the troubles that might be expected. The schematic diagram of the Monitor Scope is shown in Fig. 7-133. The voltage and resistance chart and the wiring diagram are shown in Figs. 7-132 and 7-134 respectively.

b. LOCATION OF TROUBLES.

(1) The fact that trouble exists in the Monitor Scope is easily established in some instances. For example, if there is no trace visible, it is evident that the Monitor Scope is not being triggered, or has a defective tube or circuit. Most of the troubles can be traced to defective tubes. For example, one cause of an unstable trace is a certain type of defect occurring in the Type 5U4-G tube V-305 which is used as the low voltage rectifier. The replacement of this tube often clears up this type of trouble. The primary power circuit troubles have been previously discussed in Par. 2 of this section.

(2) If no video signals appear on the oscilloscope but its sweep appears to be normal, check the video input from the Monitor Receiver to connector J-317 on the Monitor Scope. If the Monitor Receiver is delivering an output and the video cable is all right, check the output of the video amplifier V-307 with a test oscilloscope. If there is no output from this tube, check the tube and if it is all right, check its socket voltages and resistances against the chart in Fig. 7-132. If no trace is visible, use the test oscilloscope to check for the presence of trigger voltage at connector J-315 on the Monitor Scope. If it is present here, check the circuits beginning with the grid of V-301A and proceeding to the grid and plate of each succeeding tube until the sweep generator V-302B has been checked. The trouble exists where an output voltage fails to appear. An easy way to check the presence or absence of trigger voltage is to switch to internal sync. If the multivibrator V-301B and V-302 and the sweep generator V-302B are operative, a sweep will appear on the cathode ray tube. If a sweep still does not appear, the emission of the cathode ray tube may be too low or there may be trouble in the high voltage rectifier circuits. Check the high voltage rectifier V-306 first.

(3) If the main bang appears to be inverted on the Monitor Scope, the i-f amplifiers in the Monitor Receiver are oscillating. This is usually the result of a poor ground connection. If an a-c ripple appears on the scope, check the ground and connector J-317. Another point to check is the filters in the power supplies. Excessive ripple is caused by open circuited filter capacitors. This trouble is also evidenced by a lower voltage output from the power supply. One important source of trouble that may occur after long periods of use is spotty controls. Mechanical wear in potentiometers is responsible for this trouble. The trouble is apparent when the operation of a control does not produce a smooth continuous response. Troubles such as this can only be corrected by replacing the defective potentiometer.

(4) Various modifications have been made in the Monitor Scope circuits that eliminate many of the troubles normally encountered. It is recommended that service personnel check the Monitor Scope against the appropriate Navy Field Changes included in the supplement at the end of this section to see if all of the recommendations have been made.

7. TROUBLES IN MODULATOR.

a. GENERAL.

(1) The circuits employed in the Modulator used in SR-a equipments are comparatively simple and it is not difficult to locate troubles. However, the procedures generally used cannot always be employed because of the high potentials employed in various parts of the circuits. The trigger circuits can be safely checked with a test oscilloscope if the high voltage from the rectifier in the Transceiver is disconnected. Some of the most likely troubles are shown in Fig. 7-11. The schematic and wiring diagrams are shown in Figs. 7-136, 7-138 and 7-137, 7-139. A voltage and resistance chart is shown in Fig. 7-135.

b. LOCATION OF TROUBLES.

(1) The principal source of trouble is in the tubes and in the high voltage insulation. The relay, primary power, and interlock circuits have been discussed previously in Par. 2 of this section. If trigger voltage is not delivered by the Modulator to the Transceiver, the high voltage power supply in the Trans-

ceiver, the cabling, or the Modulator may be at fault. The only safe way to check high voltage circuits is to make resistance checks and continuity checks. The tubes can be observed to see if they heat up when power is applied. The best method for locating defective tubes is to replace the suspected tubes with others that are known to be good. Voltages and resistances may be measured at the sockets of V-2002 and V-2003 and waveforms taken if the source of high voltage is disconnected. The low voltage power supply may also be checked. If the section of V-2002 that is in use becomes defective, it is sometimes possible to temporarily connect to the other section when this type of tube is not readily available.

8. TROUBLES IN CONSOLE RECEIVER.

a. GENERAL.

(1) Troubles in the Console Receiver are usually evidenced by a lack of video output on the Range and PPI Scopes. However, if noise, or grass is present on the Range Scope, it may be a sign that the trouble is located ahead of the Console Receiver in the Monitor Receiver. If no evidence of grass or video signals is present on the Range Scope or the PPI Scope, there is trouble in the Console Receiver. Representative troubles are shown in Fig. 7-12. The complete Schematic Diagram is shown in Fig. 7-143. Voltage and resistances are given in Fig. 7-142. Troubles may be isolated to the i-f or video stages by connecting a vacuum tube voltmeter or test oscilloscope to terminal 2 of T-708 and applying a 15-megacycle signal to the input through a signal generator. The other lead of the meter or scope should be grounded. If it is possible to secure a reading on the output indicator, the i-f stages are probably working and the trouble is in the video stages.

b. LOCATION OF TROUBLES.

(1) If the trouble is in the i-f stages, it can be isolated by coupling the output of the signal generator to the grid of each of the i-f stages beginning with the one nearest the scope or meter. The point at which the test signal disappears indicates the defective stage. Another trouble that might appear in the i-f section is oscillation. This trouble is indicated by a badly distorted pattern on the Range Scope. If adjustment of the rejection filters has no effect on the pattern, the trouble is in the Console Receiver. If the pattern is affected, the trouble is in the Monitor Receiver. Usually the cause of oscillation is due to poor ground connections, incorrect bias, or poor contact between the transformer shields and chassis. As a last resort, the trouble can sometimes be eliminated by washing the i-f transformer assemblies, especially the movable cores and interiors of the coil forms, with carbon tetrachloride or some other good solvent. Pin 3 of V-706 must be well grounded or oscillation will develop.

(2) If the fault is in the video stages, it may be isolated by coupling an audio frequency generator such as Model LAJ (Series) or equivalent to terminal 2 of T-708. Then, with a test oscilloscope, check the output of each of the video circuits. When the path of the signal is interrupted, or becomes seriously attenuated, this will serve to locate the fault in that stage. The stage should be circuit-checked to locate and correct the trouble.

(3) When PPI signals are absent from one PPI output, and present on others, the fault will be found in the cathode follower feeding the inoperative line. When signals appear on the Range Scope, and not on the PPI Scope, the fault will be in V-711, or the cathode follower which it drives. Trouble in the power supply may be located by measuring the output at test jack J-705. If the output is low or zero, replace V-715. If this does not correct the trouble, check the filter circuits and the power transformer. For low output and poor sensitivity check the alignment. When servicing the Console Receiver, check its circuits against the Navy Field Changes in the supplement at the end of this section to see that all recommended modifications have been made.

9. TROUBLES IN RANGE SCOPE.

a. GENERAL.

(1) The test jacks on the Range Scope serve as the best sources of indications of trouble. By connecting the test oscilloscope to these jacks, starting with the one associated with the input, and then moving the oscilloscope along stage by stage, it will be possible to locate the stage in which the trouble exists. These jacks are shown in Fig. 7-3. Compare the waveforms with the ones shown on the waveform instruction plate affixed to the unit or with the ones shown in Fig. 7-13. The instruction plates also show the location of the test points and the approximate wave shape. Representative troubles are shown in the troubleshooting chart in Fig. 7-14. The absence of the range marker, range step, or the IFF sweep on the Range Scope itself will also serve to indicate trouble in the stages which apply these indications to the cathode ray tube. When the stage, or circuit in which trouble exists has been located, it should be circuit-checked against the schematic diagram in Fig. 7-156 to determine which part is at fault. Average voltages, and resistance are shown in Fig. 7-152 to 7-155 inclusive.

b. LOCATION OF TROUBLES.

(1) If oscillations appear after the marker pips, watch the sweep closely and if a single sweep is seen, the trouble may be due to resistor R-682 being open, inductor L-605 defective, resistor R-677 open, capacitor C-629 defective, or capacitor C-628 being inductive. These parts should be checked and the one found to be defective should be replaced. If bench tests are made with the video line disconnected, terminal 80 must be grounded to prevent oscillations from appearing on the sweep.

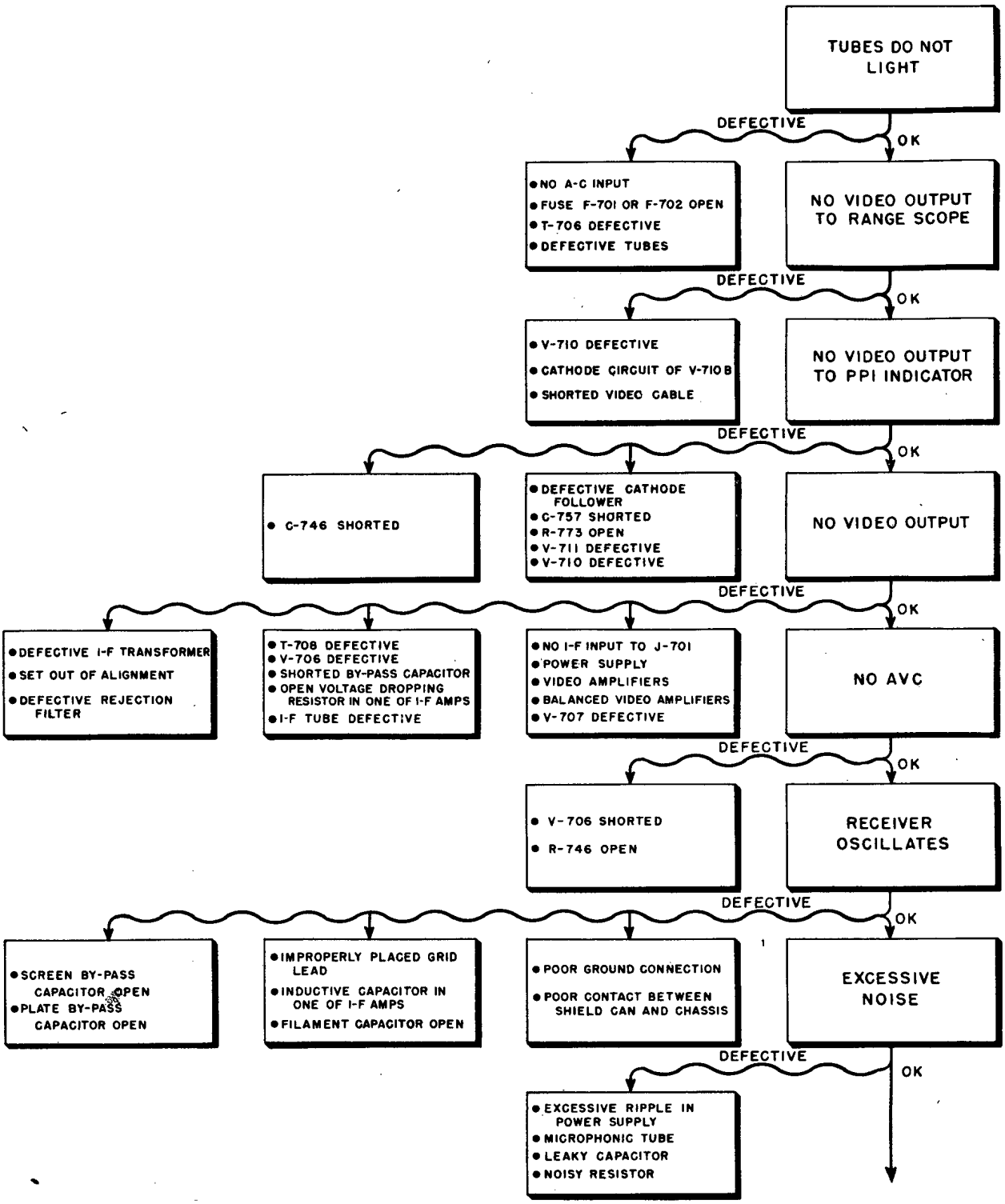


Figure 7-12. Console Receiver, Troubleshooting Chart

Figure 7-12. Console Receiver, Troubleshooting Chart

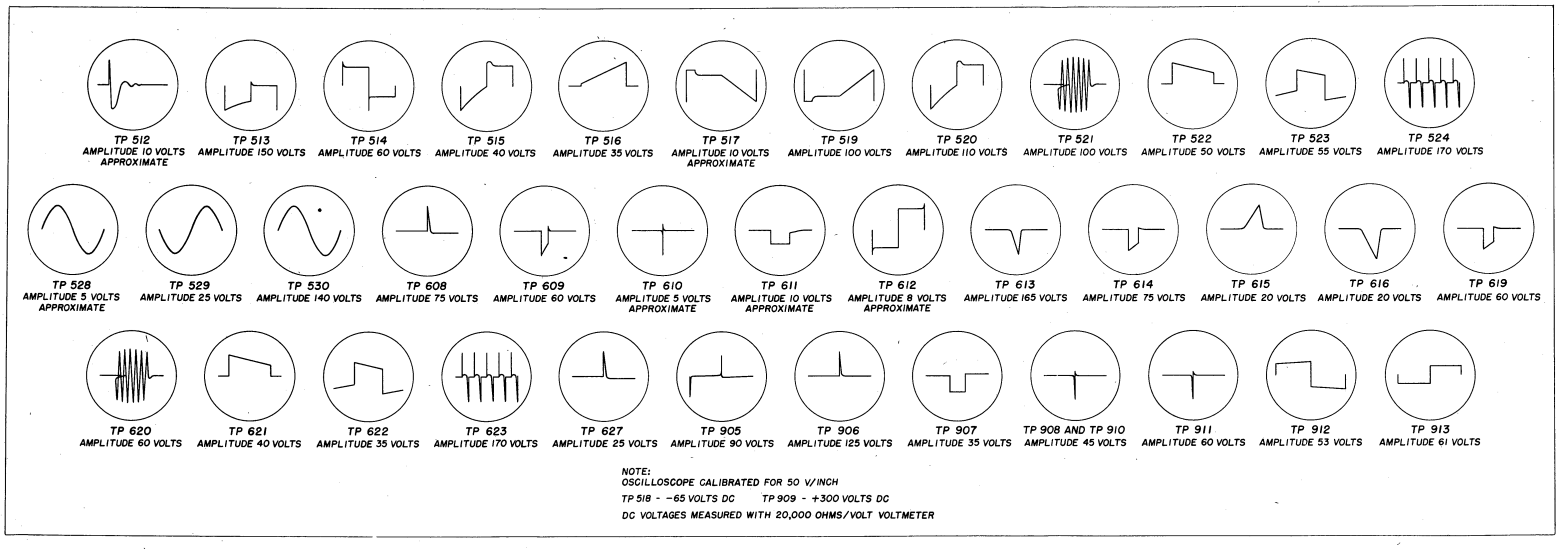


Figure 7-13. Waveforms in the Indicator Console

Figure 7-13. Waveforms in the Indicator Console

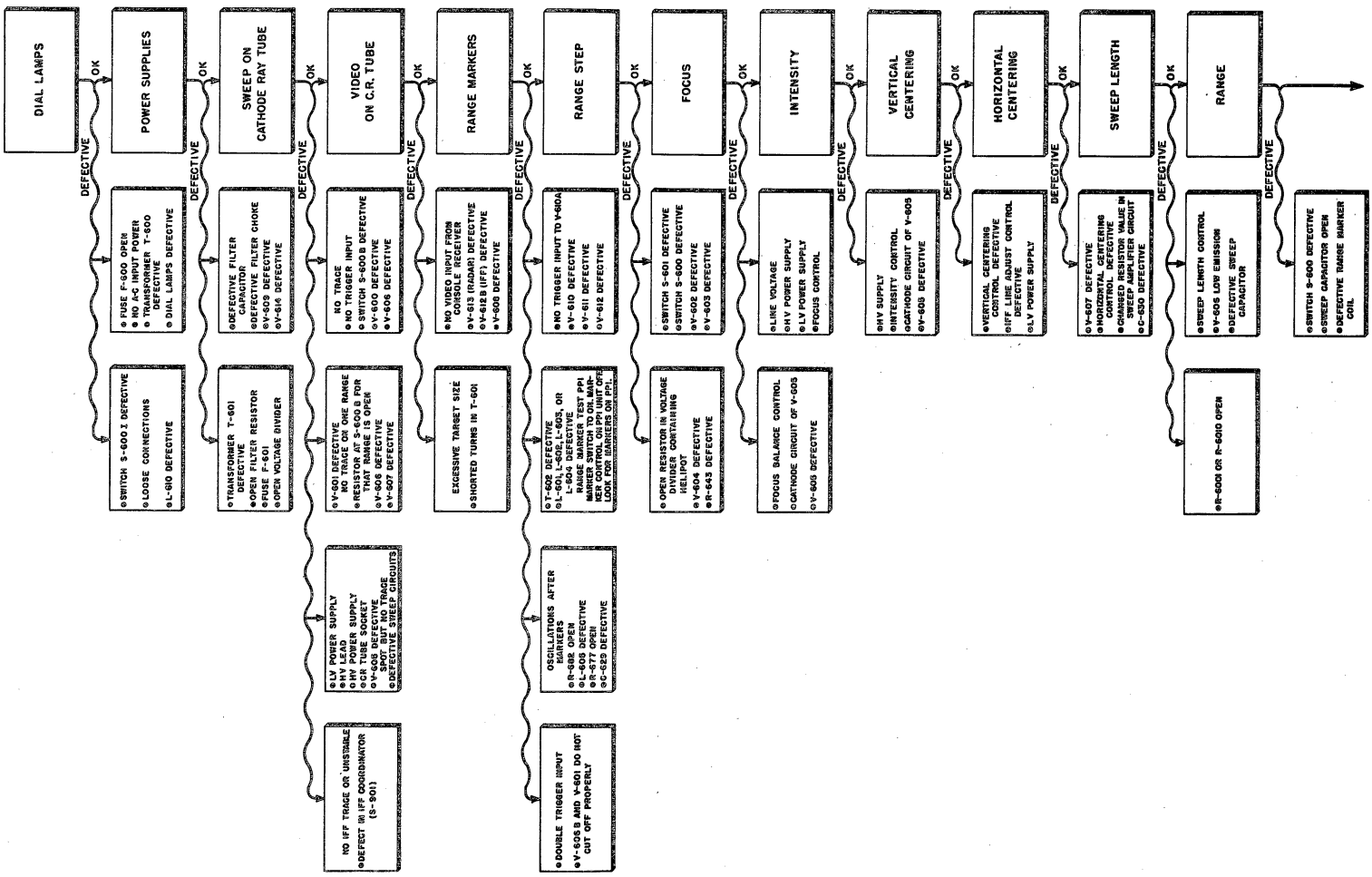


Figure 7-14. Range Scope, Troubleshooting Chart

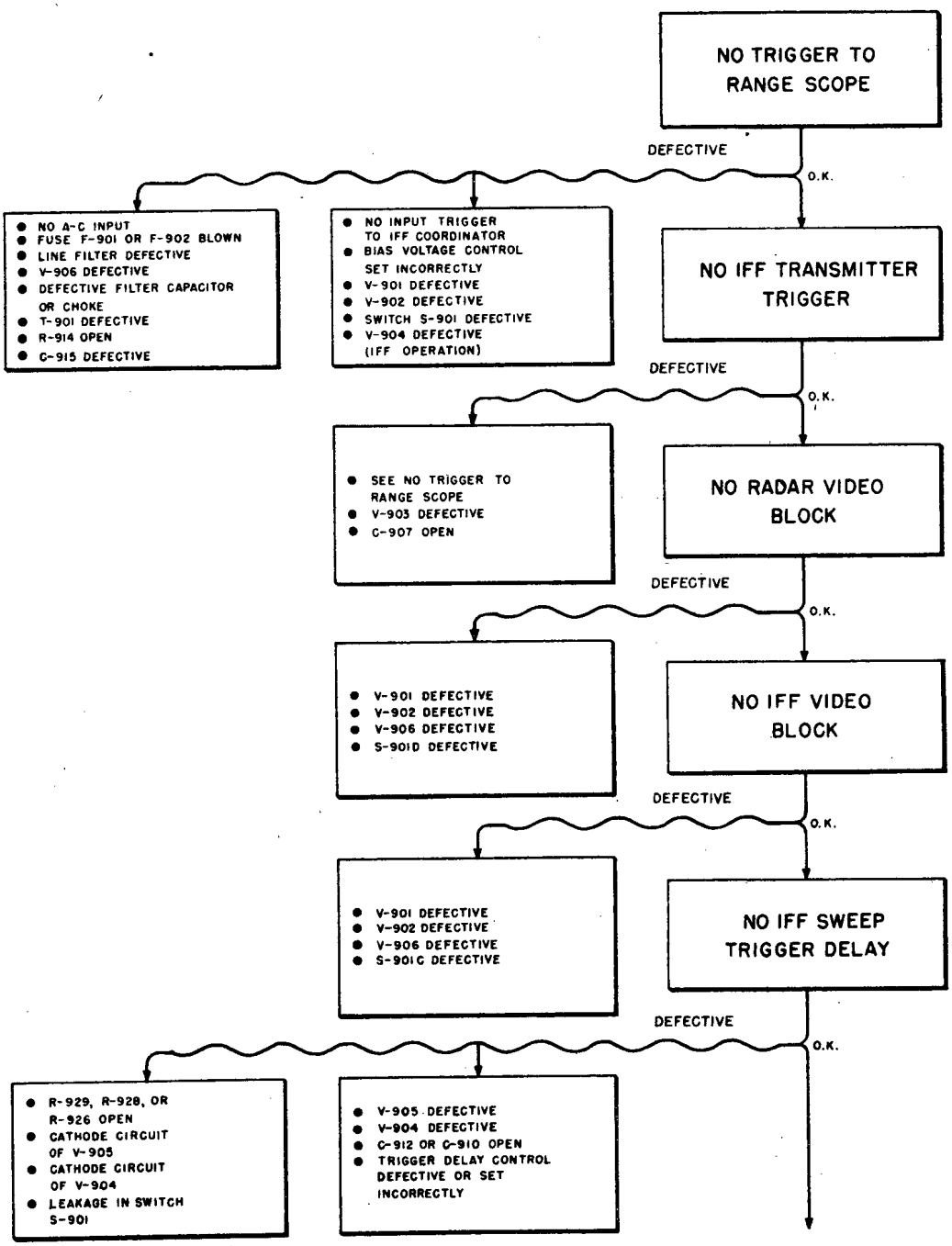


Figure 7-15. IFF Coordinator, Troubleshooting Chart

Figure 7-15. IFF Coordinator, Troubleshooting Chart

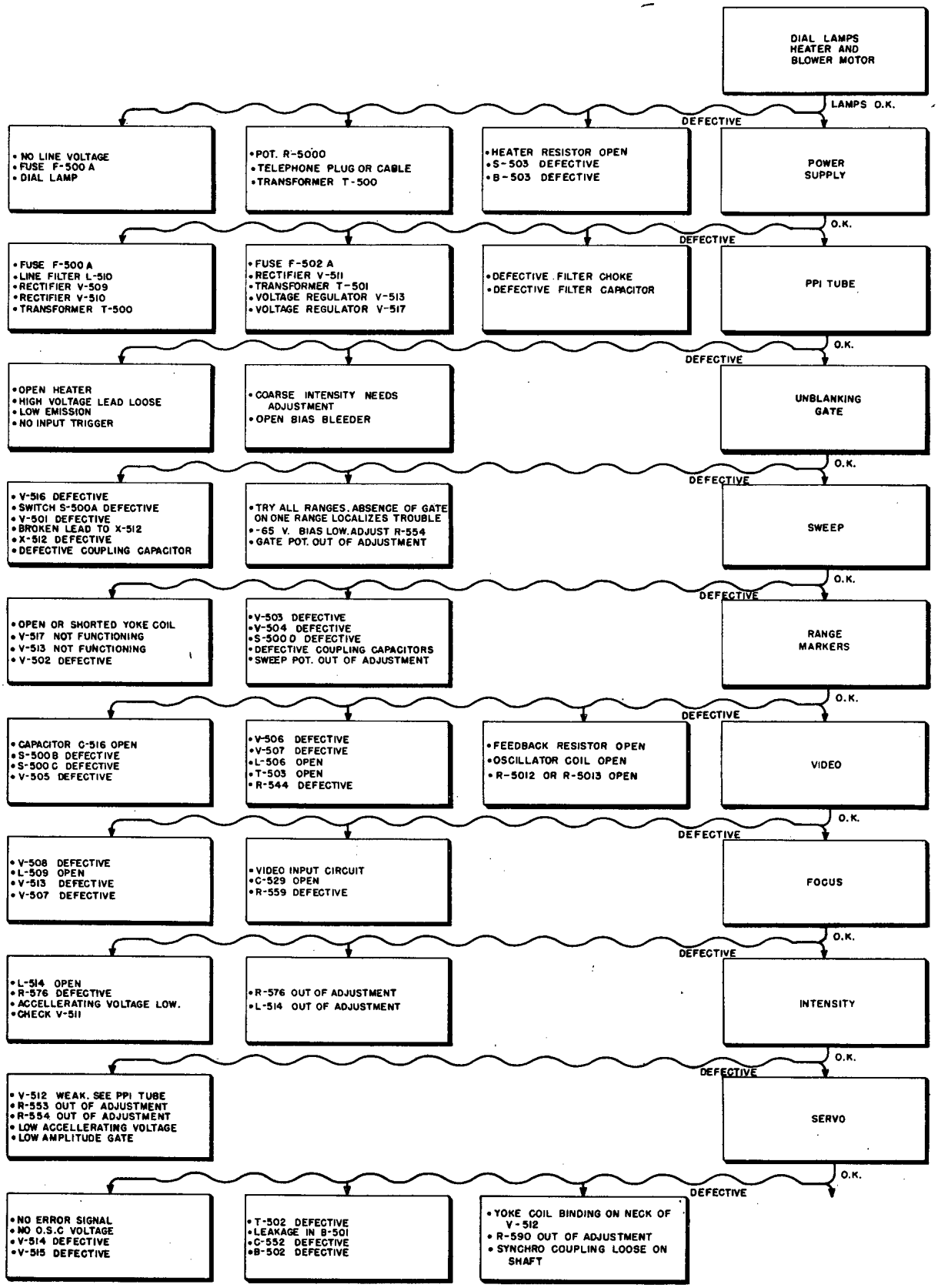


Figure 7-16. PPI Indicator, Troubleshooting Chart

Figure 7-16. PPI Indicator, Troubleshooting Chart

(2) If double markers appear on the radar sweep of the Range Scope, watch the sweep line to see if there isn't a double sweep. A double sweep may be caused by double triggering or the failure of V-606B and V-601 to cut off properly. Observe the output of the multivibrator at TP-609 and also the input trigger at test point TP-607. If no sweep is present, check the tube clamp of V-601 making sure it is isolated from ground.

(3) If the range step appears even when the RANGE STEP control has been pushed in, check resistors R-620, R-6011, and R-622 for correct value. The tolerance ratings on these resistors is given in the Parts and Spare Parts List. If the range step comes and goes intermittently, check resistor R-643. If Range Step fails to appear, check tube clamp of V-602 making sure it is isolated from ground.

(4) If the target pips grow to an abnormal size, check transformer T-601 for shorted turns. Check the actual resistance of the windings against the resistance listed in the winding data tables elsewhere in this section. If the sweep line turns up at the end of the sweep, check the secondary resistance of transformer T-601. It should be 7000 ohms.

(5) A certain amount of instability on narrow trigger pulse widths may be expected on the 200-mile sweep. If any of the sweeps are intermittent or unstable during IFF operation, check the contacts and soldered connections of the CHALLENGE switch S-901 in the IFF Coordinator.

(6) In some cases it may be found that the range step on the 80-mile sweep cannot be made to coincide with the veeder counters. This trouble may be eliminated by paralleling capacitor C-650 with a 100 mmf silver mica capacitor.

(7) If it is impossible to get the radar sweep above the IFF sweep, check the type of tube used as V-613. If the tube in use is a 6AG7, it will cause this type of trouble. Replace the tube with type 6AC7 which is the correct type of tube to be used.

10. TROUBLES IN IFF COORDINATOR.

a. GENERAL.

(1) Test points are provided in practically every stage of the IFF Coordinator. See Fig. 7-3. A test oscilloscope should be used to compare the waveforms at these jacks with the waveforms on the instruction plate or in Fig. 7-3. An Oscilloscope TS-34()/AP or its equivalent, should be used to observe the waveforms. The oscilloscope can be used to isolate the trouble down to one or two tubes. These tubes, and their associated components can then be checked with a volt-ohmmeter such as Navy Model OCK or OBQ (Series) or equivalent to locate the trouble. Representative troubles are shown in Fig. 7-15. The schematic diagram and wiring diagram are shown in Figs. 7-159 and 7-160. Voltages and resistances are shown in Fig. 7-158.

(2) Changing the two tubes in the Eccles-Jordan circuit will usually vary the characteristics of this circuit since its performance depends upon the transconductance of the tubes. This characteristic varies widely between tubes of the same type. It will sometimes be necessary to readjust the TRIGGER DELAY and BIAS VOLTAGE potentiometers when these tubes are changed. It might also be necessary to readjust the potentiometers when resistors or capacitors have been replaced. Most of the troubles experienced in the IFF Coordinator are tube troubles. Check the trigger voltage amplitude. This should be from 45-65 volts for proper Eccles-Jordan operation.

b. LOCATION OF TROUBLES.

(1) If trigger voltage is not available to the Range Scope when the CHALLENGE switch is in the OFF position and a check shows that trigger voltage is available to the IFF Coordinator, check the CHALLENGE switch S-901. If trigger voltage is not available in the ON or MOMENTARY positions of the CHALLENGE switch, insert the test prod of an oscilloscope in test jacks J-912 and J-913. If there is no trigger voltage at these points the trouble lies in the input and grid circuits of the flip-flop multivibrator. If there is voltage present at the points just mentioned, check test points J-905 and J-907. If there is no square wave voltage present at these points, note whether there is a trigger output from V-901. If there is not, replace the tube. If there is an output, replace V-902. If the replacement of tubes does not clear the trouble, check the socket voltages and resistances. Carefully check all coupling capacitors. The only sure way to check for open coupling capacitors with small capacities is to replace the suspected capacitor with one known to be good. Very good results may be obtained by checking the trigger voltage with the oscilloscope at each terminal of the capacitor under test. If there is any noticeable attenuation below that normally expected, replace the capacitor. If the flip-flop multivibrator delivers an output but there is no sweep on the Range Scope, check sections C and D of switch S-901. If these circuits are all right, check V-904 and its circuits.

(2) If the IFF echo cannot be made to coincide in time with the radar echo on the Range Scope, check the potentiometer R-917 and V-905 and its circuits. Connect the test oscilloscope to test points J-911 and J-910. If the correct waveforms are present, adjust potentiometer R-917 over its range and note whether it is spotty in its operation. If it is, replace it. If the IFF Coordinator is inoperative, check the output of the power supply at test point J-909. The d-c voltage at this point should be 270 to 330 volts. If the voltage is low, check V-906 for low emission and if it is all right, check for an open filter capacitor or a partially open winding in the filter choke. These tests assume

that the line voltage is adjusted to the proper level. If the line fuses blow repeatedly, check for a shorted filter capacitor, a shorted rectifier tube, a short circuit in the power transformer, or an overload in the plate supply circuit. Low resistance at test point J-909 will establish the existence of this type of trouble. If there is no IFF transmitter trigger output, but the other circuits function normally, check the output of V-903 at test point J-906 and terminal 785.

11. TROUBLES IN PPI INDICATOR.

a. GENERAL.

(1) Some of the troubles that might be encountered in the PPI Indicator are shown in Fig. 7-16. The schematic diagram is shown in Fig. 7-150 and the wiring diagram is shown in Fig. 7-151. Voltage and resistance charts are shown in Figs. 7-146 to 7-149 inclusive. Since the voltage and resistance values vary with the range, separate charts are necessary for each range.

b. LOCATION OF TROUBLES.

(1) Make a visual inspection to see that the fuses are not blown and that the tubes are in their proper places and their plate caps connected. Check filament continuity by turning on the PPI Indicator and noting whether all of the tubes light. Next check the voltage at TP-531 and measure the bias at TP-518. See Fig. 7-17. If it is not —65 volts, adjust potentiometer R-564 until —65 volts is read on the meter. Observe the trigger sync pulse by connecting a test oscilloscope between terminal 514 and the frame of the set. Measure the trigger voltage from the transmitter. If it is found to be at least 10 volts peak, not more than 79 volts, and at the proper repetition rate, adjust the INTENSITY control on the front panel in an attempt to get a spot on the cathode ray tube. If no spot or trace appears, adjust the coarse intensity control, R-553. See Par. 41*b* of this section. If a spot appears at the center of the PPI tube, the gate may be operating satisfactorily, but the sweep circuits may be inoperative. Notice if the same conditions exist on all positions of the RANGE SELECTOR switch.

(2) Check to see whether the gate circuits are functioning by observing the pattern on the test oscilloscope when it is connected to TP-514. See Fig. 7-17. The waveform should agree with that shown in Fig. 7-13. If the previous adjustment of the INTENSITY controls did not cause the tube to light, and the above procedure proved that the gate *was* functioning, remove the socket from the cathode ray tube and place the test scope probe in the gate pin of the socket and observe whether the unblanking pulse is reaching the socket. Check the bias on the cathode ray tube by reading the voltage from the cathode pin of the socket to ground, at the same time rotating intensity potentiometer R-553. If the voltage is not present, or does not vary with rotation of the potentiometer, an open circuit in the biasing bleeder, comprised of resistors R-5014, R-555, R-552, and potentiometers R-554 and R-553, is indicated. If the bias is satisfactory, check the high voltage power supply. See that 5000 volts exist between the anode connector and ground. This requires the use of a well insulated voltage divider with a step-down ratio of 50 to 1. A 100-volt reading on the voltmeter indicates 5000 volts. If a voltage divider is not available do not attempt any voltage measurements. Use resistance measurements only. Be sure that the high voltage filter capacitors are discharged before attempting to make resistance measurements. If the high voltage is all right, check the cathode ray tube and replace if necessary.

WARNING

5000 VOLTS CAN CAUSE DEATH. USE EXTREME CARE AND PROPER INSTRUMENTS TO MAKE THIS MEASUREMENT. DO NOT TOUCH ANY PART OF THE EQUIPMENT WHILE POWER IS ON. DISCHARGE CAPACITORS BEFORE TOUCHING ANYTHING AFTER POWER HAS BEEN TURNED OFF.

If the trouble is in the gate circuits as indicated by the absence of the proper waveforms at TP-514 (this may be the case for only one position of the RANGE SELECTOR switch) the bright spot at the center may still be present. This is true because the trigger alone may get through to the gate tube V-501 and the video gain may be high enough to allow the transmitter's video pulse from the receiver to unblank the tube.

(3) To discover why the proper waveform was not present at TP-514, try replacing the tube. If the proper waveform still is not seen, make resistance and voltage measurements from the tube socket to ground. If no trouble is evident, proceed to TP-513 and make similar observations. No gate (and hence no sweep) on one particular range may mean that one of the wires has been broken in the RANGE SELECTOR switch circuit or one of the resistors open-circuited. The voltage and resistance from socket terminals to ground on V-516B should also be investigated. If the voltages in general are all too low, check the +275-volt power supply and bleeders for a possible short or open circuit. Voltages and resistances are given in Fig. 7-146 to 7-149 inclusive.

(4) If the gate waveform is unstable on the trailing edge, the sweep will be blurred and jumpy at the end of the PPI sweep. This could be caused by a low bias. Adjust potentiometer R-564 so that the bias is —70 volts if necessary. Remember that too much bias will stop the gate entirely. The gate may shorten excessively if the repetition rate is too high. This may cause the sweep to jump. Adjustment of the gate potentiometer will help obtain a desired gate time constant for extremely high repetition rates.

(5) Sweep circuit trouble usually results in causing a bright spot to appear at the center of the tube, with little or no trace visible. The sweep circuit depends upon proper functioning of the gate circuits. The gate circuits should be investigated but may be assumed to be working if proper waveforms are found up to and including TP-515. See Fig. 7-3, 7-13 and 7-17. If the gate circuits are working properly, connect the oscilloscope to TP-516 and see if the waveform is correct. Replace the sweep tube, V-502, should there be any doubt about its condition. See that the switch section, S-500D, is functioning properly and there is continuity in the wiring. Proceed down the line of sweep circuit test points in an attempt to localize the trouble. If the proper waveform is found on TP-519, but the sweep is not reaching maximum deflection, with the gate open wide, the sweep output tube should be replaced. Also, if the sweep is absent, and everything is normal at TP-519, check for yoke coil continuity. Examine the brushes on the yoke and see that the slip rings are clean. If the sweep intensity increases near the end of the sweep, replace the yoke coil L-515. If the sweep is not a radial straight line, one side of the yoke coil winding may be open. If the speed of the sweep seems to vary, as indicated by the marker dots moving in and out along the trace, the servo voltage regulator V-517 may not be functioning. Check voltages and resistances to see why V-517 does not light. Replace the tube if necessary. If V-517 is not functioning, the servo load will kick back to the power supply and will particularly affect the sweep on the 4-mile range. To secure a stable sweep, the sweep voltage regulator tube V-513 should also be lighted. Check voltage and series resistance for trouble. Sweep linearity difficulties are found most often on the 4-mile range. If the first marker dot is not reasonably spaced on the sweep, check the values of resistor R-5015 and capacitor C-518. Check coupling capacitors C-514 and C-515. Any exceedingly large stray capacity between the sweep circuit components and ground will cause the sweep to start slowly. If the sweep flashes, check the clamp on V-511 to see if it is arcing to ground. Bend it further away from ground if necessary.

(6) The marker circuit is triggered by a negative gate pulse derived from the plate circuit of gate tube V-516B through a coupling capacitor C-516. Hence the waveform at TP-520 will be found correct only if the gate circuits are functioning. Check a convenient +225 volts point in the marker circuit to make certain proper plate voltage is present. At TP-521 a block of sine waves should be present, its length depending upon the gate width. Check the sine wave block for each position of the RANGE SELECTOR switch. If the pattern on the test scope at TP-520 is as it should be, and no sine waves are found at TP-521 for any position of the switch, the tube V-505 and its associated circuits should be checked, particularly switch S-500B. If one particular range only, does not show a proper pattern, check the continuity of the coil feedback resistor and the resistor in series with the coil and ground. If the waveforms are normal at TP-521, check to see whether the multivibrator circuit is functioning. This check is made by viewing the waveforms of TP-523 and TP-522 on the test scope. If waveforms are not present, check voltages and resistances to ground. Replace V-506 if necessary. Proceed to the next test point, TP-524, and make similar investigations. Next, connect the test oscilloscope to the arm of MARKERS control, R-544, located on the front panel and turn the knob clockwise. Check to see if range markers appear on the test scope. If the marks still are not present on the sweep, the lead to the cathode ray tube V-512 must be checked. Remember that even if the marker circuit is operating satisfactorily, the marks will not appear on the PPI if the sweep is not functioning. When the required number of markers do not appear (two appear instead of four) but the gate circuits are functioning, check the feedback circuit of the marker coil in question. If the second marker appears near the edge of the tube, check resistor R-5010 or R-535 in the cathode circuit of V-504. Secondary markers that appear approximately half-way between the main marks (usually on one range only) are caused by an open circuit in the marker coil for that particular range. Several secondary markers appearing immediately after the main markers may be caused by defective biasing resistors R-5012 and R-5013 on V-507.

(7) If the video amplifier V-508 fails to respond to signals, check the tube by replacing it. If this does not correct the troubles, make voltage and resistance measurements from the socket pins to ground in order to isolate the trouble.

(8) Intermittent focusing can be detected by a resistance measurement of coil L-514 and potentiometer R-576. Make certain that the coil is not open. If the sweep spokes excessively, the trouble may be in the Synchro Amplifier, or due to excessive vibration of the ship.

(9) If the servo system fails to operate, first make certain that the error signal is being received by placing the test scope between any two of the 3 synchro input terminals on the terminal board. If the antenna binds, the waveform will vary in amplitude, reversing phase after going through a zero voltage position. Check the waveform at TP-528 and see if the error signal responds to rotation of the antenna. Next see that the O.S.C. fixed phase voltage is applied to the fixed phase motor winding of drive motor B-501. If the trouble continues, make systematic checks on the tubes and components of the servo system, making certain that the proper voltages are present. If the sweep is

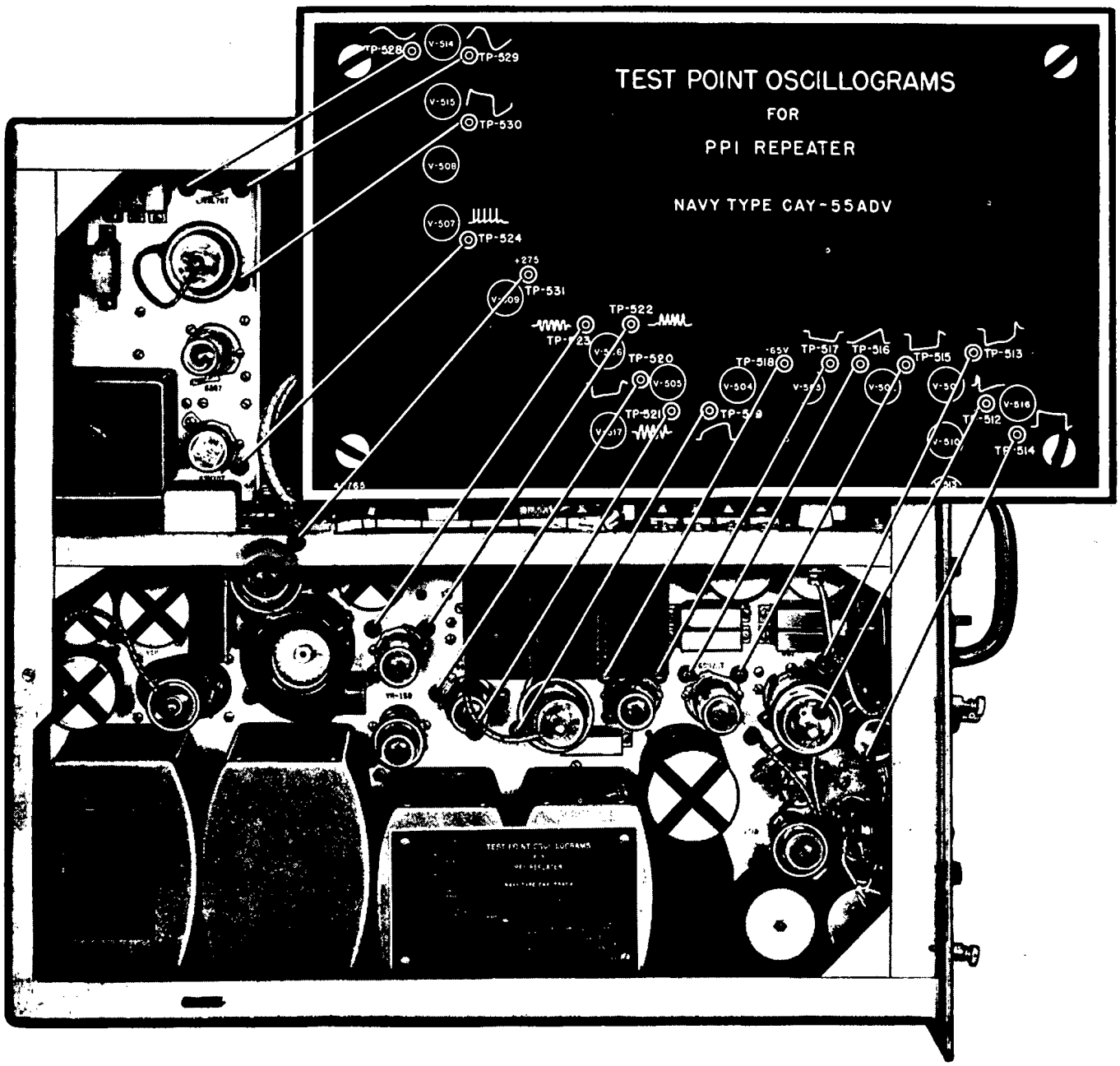


Figure 7-17. PPI Indicator Test Points

erratic or will not follow the antenna at all, check for low resistance leakage between the windings of drive motor B-501. If a condition of rapid small-angle hunting persists in the system, check the anti-hunt control and see if it is properly set. Violent hunting, and even 180° sector scanning, which occurs even with the antenna turning smoothly in one direction, can usually be traced to an open synchro line, possibly inside the equipment or in the ship's lines. If a sudden stop, or reversal of the antenna, causes the servo system to develop a large error, or if the system has a tendency to hunt at low frequencies, the 5 CT synchro transformer B-502 may have become unpinned from its gear coupling. This may be checked by rotating the yoke by hand with the antenna stationary, and noticing whether the error signal, as viewed on a test scope, follows smoothly when the yoke is rotated slightly either side of the zero error signal position. If the PPI sweep follows the antenna erratically, check for leakage between the windings on the servo drive motor.

(10) If a fuse blows, the cause may have been a line transient. Turn the PPI Indicator off, replace the fuse, and see if the condition reoccurs. If the main line fuse F-500 burns out repeatedly, the trouble lies in the low voltage power supply. If the high voltage supply was at fault, fuse F-502 would have blown first, as it has a lower current rating. Check for short circuits in the B+ lines, by checking the resistance from TP-531 to ground, *with the power off.* Also check heater wiring, when the tubes are removed, and the wiring of the dial light circuit. If the O.S.C. excitation fuse F-501 blows, check the grounded capacitor, C-552, and the motor terminals. A short circuit in the high voltage supply may be traced by making resistance to ground measurements. If the power supply does not deliver the proper voltage, or if there is no output at all, check for a defective rectifier tube or for defective components and wiring.

12. TROUBLES IN BEARING INDICATOR.

a. GENERAL.

(1) Any electrical troubles which may occur in the Bearing Indicator will usually be limited to the slewing motor and its power supply. The output of this supply will be the best check on its condition. When both voltages are missing, failure of the power transformer primary is usually indicated. When one voltage is missing and the other is present, this will indicate the failure of one of the rectifiers, or the SLEWING MOTOR switch. The rectifier circuits may be circuit-checked to locate the trouble, following the data given on the schematic diagram in Fig. 7-161. The wiring diagram is shown in Fig. 7-162. When the slewing motor is burned out, it should be replaced with a spare motor from the spare parts. The servicing block diagram in Fig. 7-4 shows the Bearing Indicator in relation to the other components in the antenna positioning system.

13. TROUBLES IN GENERAL CONTROL UNIT.

a. GENERAL.

(1) The troubles most likely to occur in the General Control Unit will be due to a burned out meter, sticking push-buttons, or a defective switch. The meter should be replaced, if burned out, by a new meter from the spare parts. In the event of sticking push-buttons, the button may usually be freed by taking it apart and lightly greasing its rectangular shaft. Springs may be stretched somewhat in order to increase their tension, if necessary. Neither of these practices is recommended if a new push-button is available for replacement. If push-button contacts become pitted, they should be cleaned with a fine piece of sand-paper until smooth. The circuits of the General Control Unit are shown in Fig. 7-163. The wiring diagram is shown in Fig. 7-164.

14. TROUBLES IN THE ROTATION CONTROL UNIT.

a. GENERAL.

(1) The Rotation Control Unit contains the Servo Amplifier and the Rectifier Power Unit. The circuits in these units are combined in the complete schematic diagram in Fig. 7-165. Representative troubles are shown in Fig. 7-18. Fig. 7-4 shows a servicing block diagram of the antenna positioning system of which the Rotation Control Unit is a part. When servicing the Rotation Control Unit, check the circuits against the Navy Field Changes in the supplement at the end of this section. Many of these changes clear up the most frequently occurring troubles.

b. LOCATION OF TROUBLES.

(1) The Rotation Control Unit is the source of excitation for the Servo Generator and, when the rectox unit is used, it supplies power directly to the antenna drive motor. If the Antenna Pedestal fails to rotate in Servo operation, switch to the rectox unit. If the Antenna Pedestal rotates, the trouble is in the servo system of which the Servo Amplifier is a part. This test is accomplished in unmodified SR Equipments by placing the ROTATION switch on the Bearing Indicator in its NORMAL position for servo operation and placing the SLEWING MOTOR switch in one of its operating positions. For rectox operation, the ROTATION switch is placed in its PPI or EMERGENCY position. In equipments modified by Navy Field Change No. 28, normal operation is obtained with the rectox system, which is controlled from the front panel of the Bearing Indicator. Servo or emergency operation is controlled by a switch mounted on a bracket behind the control panel. If the rectox system does not operate but the servo system does, the trouble is in the Rectifier Power Unit. If the rectox system operates but the servo system does not, the trouble may be in the Servo Generator, the

Servo Amplifier, the Bearing Indicator, or the remainder of the synchro circuits. The possibility of defective tubes in the Servo Amplifier makes it a likely source of trouble. To isolate the trouble, it is necessary to measure voltages at various parts of the circuit. First, measure the output from the Servo Amplifier between terminals 65 and 66, then measure between terminals 66 and 67. Take measurements with the SLEWING MOTOR switch OFF and in one of its operating positions. If there is no output, there is trouble in the Servo Amplifier. If an output voltage can be measured, but it does not change when the SLEWING MOTOR switch is operated, check the input to the Servo Amplifier at terminals 63 and 64. If there is no input, the trouble is not in the Servo Amplifier. If an input voltage can be measured, look for trouble in the Servo Amplifier.

c. SERVO AMPLIFIER.

(1) The principal source of trouble in the Servo Amplifier is the tubes. If the bias control tube V-1101 is defective, the input voltage from the synchro system has no control over the output voltage and the Antenna Pedestal will not rotate. If the emission is low in one side of this tube, the Antenna Pedestal will rotate much better in one direction than it will in the other. If either V-1102 or V-1103 is defective, the Antenna Pedestal will rotate continuously in one direction. If the Antenna Pedestal creeps continuously in one direction or tends to hunt constantly, the BALANCE CONTROL R-1112 may require adjustment or the emission may be low in one section of the 6SL7 tube, V-1101, or one of the 807 tubes, V-1102 and V-1103. Low tube emission is indicated whenever creeping cannot be stopped by adjusting the BALANCE CONTROL R-1112. Other sources of trouble are the capacitors and resistors in the circuit. Defects in these parts may be found by making voltage and resistance measurements and comparing them with the measurements given in Fig. 7-167. Representative troubles are listed in Fig. 7-18.

(2) Another source of trouble is the electronic rectifier that supplies power to the field of the Antenna Drive Motor during servo operation. The output of the rectifier can be measured between terminal 70 and test point J-1106. Since this circuit employs no filter, the only possible source of trouble, other than the primary power circuits, is the tube V-1104 and the transformer T-1105. The operation of the Servo Amplifier depends upon the correct functioning of relay K-1106. If this relay is inoperative, primary power is not available to operate the Servo Amplifier. See Fig. 7-1 and 7-2.

d. RECTIFIER POWER UNIT.

(1) Troubles in the Rectifier Power Unit are usually of a simple nature. Most of the troubles are confined to the relays. The relays require preventive maintenance and should be kept clean and the contacts should be polished and adjusted so that they make positive contact and break without sticking. If the Antenna Pedestal rotates in a clockwise direction but will not rotate in a counterclockwise direction in rectox operation, listen to the sound of the Servo Generator. If the Servo Generator runs quietly when the Antenna is rotating in a clockwise direction but groans under a heavy load when the SLEWING MOTOR switch is placed in a counter clockwise position, check relay K-1102. If this relay sticks, one of the dry disc rectifiers is connected across the output of the Servo Generator. The rectifier presents a low shunt resistance to the output circuit of the Servo Generator for one direction of rotation and a high resistance for the other direction of rotation.

(2) Another source of trouble in unmodified equipment is the possibility of relays K-1105 and K-1106 being closed simultaneously. This trouble is due to the time lag of the opening relay that permits it to remain closed for a brief instant after the other relay has closed. If the SR is installed without the Synchro Amplifier, this trouble will blow the fuses in the ship's gyro compass installation. If the Synchro Amplifier is used but the correct polarity has not been observed in connecting the 02 and 03 leads to terminals 25 and 26 on the Amplifier, the main power circuit will be short circuited. Navy Field Change No. 21 describes a mechanical interlock to eliminate this trouble. As the dry disc rectifiers age, their resistance increases with a resulting drop in their output voltage. This condition requires that the leads from the rectifiers to the transformer terminal be set to higher voltage taps. When the rectifiers age to the point where their resistance is very high or where the front resistance is nearly the same as the back resistance, they should be replaced as described in Par. 30*b* of this section. The schematic diagram of the Rectifier Power Unit is shown in Fig. 7-165. Its wiring diagram is shown in Fig. 7-169.

(3) If the Antenna does not rotate at all, check the operation with the Rectifier Power unit. Since rotation can be obtained from either unit, each one may be used as a check on the other and to establish the fact that trouble does or does not exist in the Servo Generator or Antenna Pedestal. If the Pedestal does not rotate in servo operation, check the input and output voltages of the Servo Amplifier. If there is no input, it is obvious that the trouble is in the cabling between the Servo Amplifier and the Bearing Indicator, the Bearing Indicator itself, or in the circuits that supply it. Refer to the troubleshooting chart in Fig. 7-18 and to the schematic diagrams of the suspected units. If error voltage is present at the input to the Servo Amplifier, check the output. If there is no output, check the tubes in the Servo Amplifier,

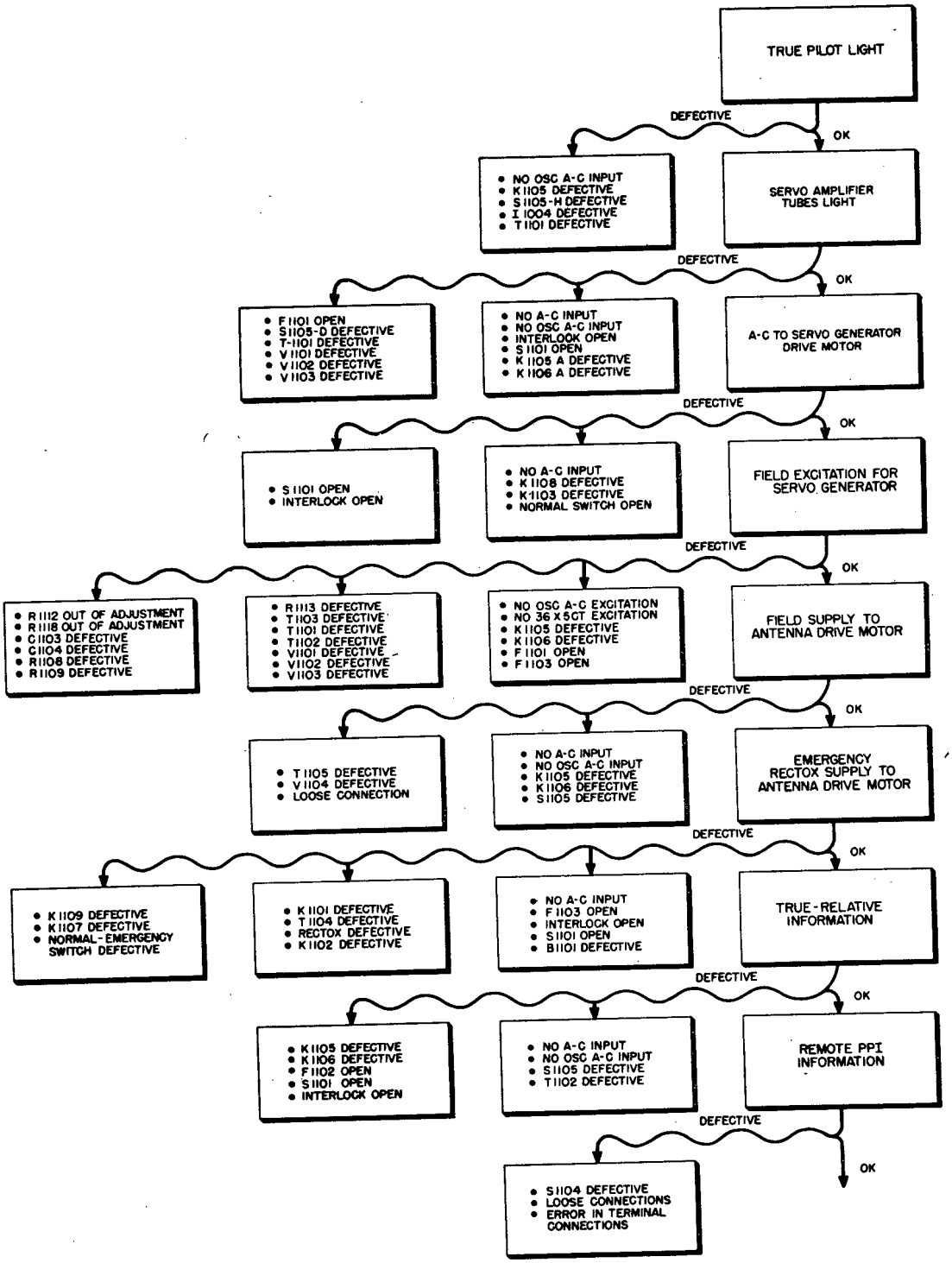


Figure 7-18. Rotation Control Unit, Troubleshooting Chart

Figure 7-18. Rotation Control Unit, Troubleshooting Chart

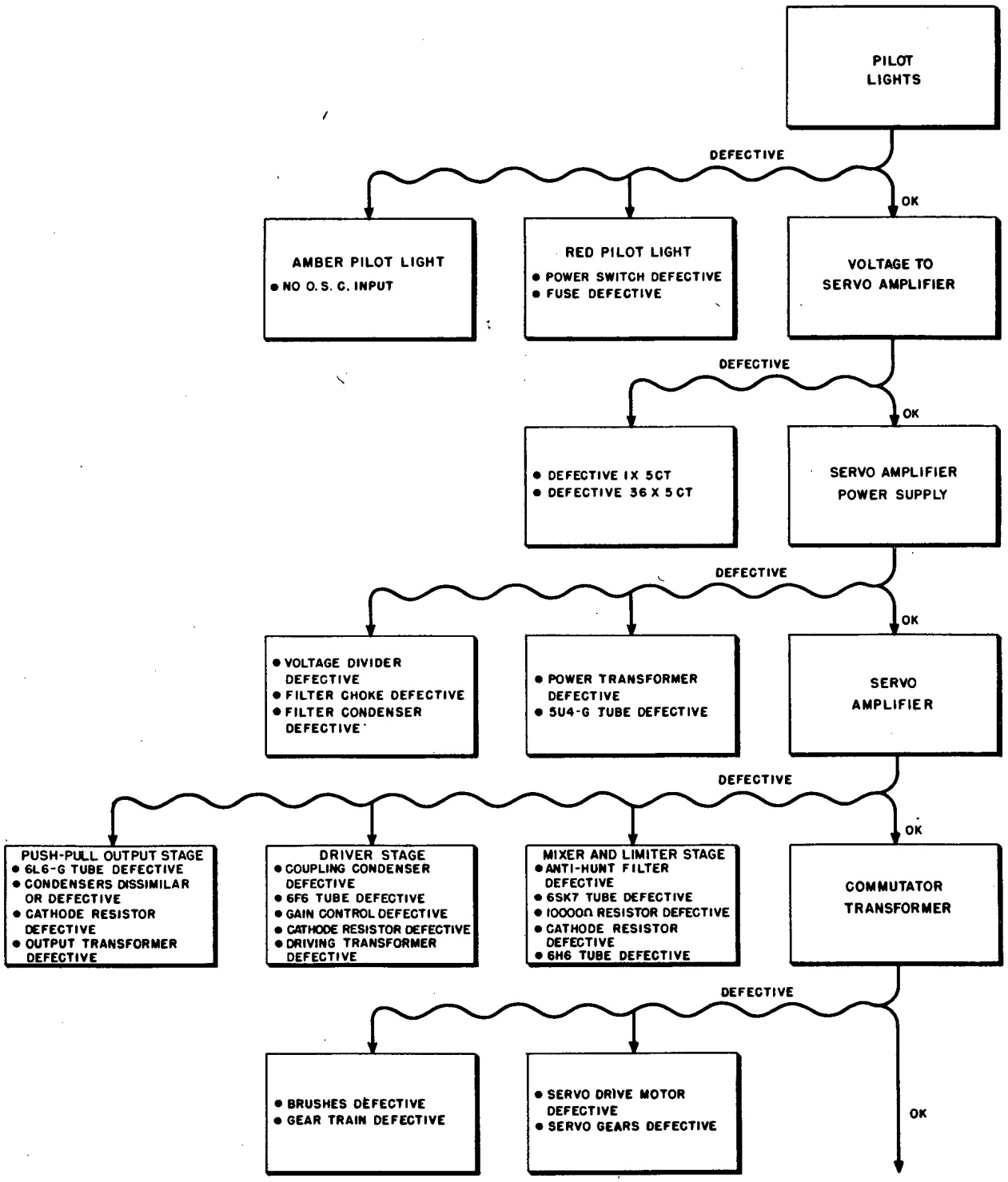


Figure 7-19. Synchro Amplifier, Troubleshooting Chart

Figure 7-19. Synchro Amplifier, Troubleshooting Chart

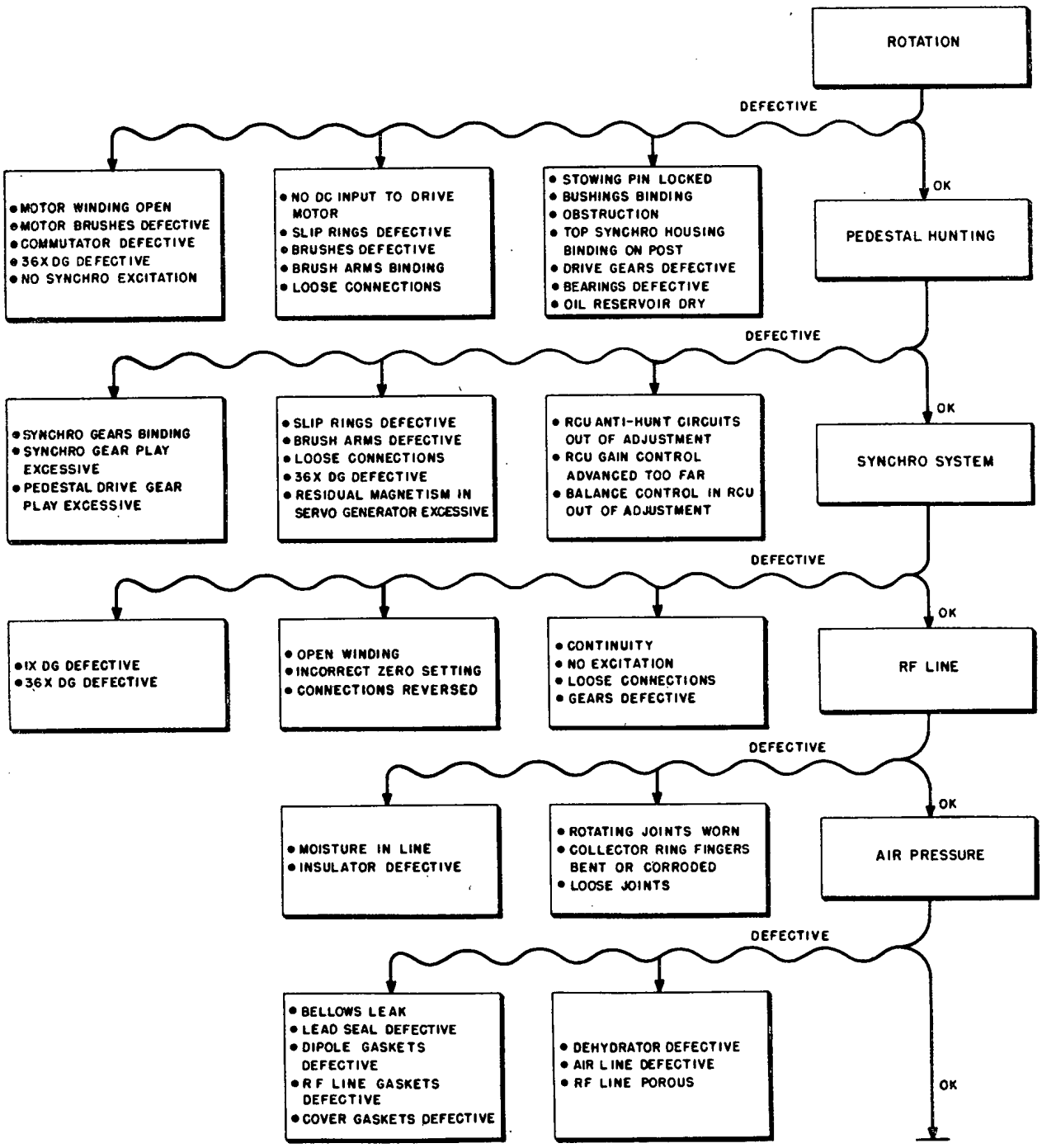


Figure 7-20. Antenna Pedestal, Troubleshooting Chart

Figure 7-20. Antenna Pedestal, Troubleshooting Chart

transformers T-1101 and T-1103, potentiometer R-1113, and capacitors C-1105 and C-1106.

(4) If the output from the Servo Amplifier to the Servo Generator is normal, check the output from the low voltage rectifier V-1104. This voltage can be measured between test point J-1106 and terminal 70. This circuit is very simple and the only points at which trouble can occur is in the rectifier tube V-1104, relays K-1105 and K-1106, or the transformer T-1105. Short circuits in the transformer will open up fuse F-1101.

(5) Most of the troubles encountered in the Rectifier Power Unit are relay troubles. Check the relay action and their contacts if there is no output. As the dry disc rectifiers age, the output voltage decreases. Taps are provided on transformer T-1104 to allow for increased resistance in the rectifiers. When the voltage becomes too low, move the connection to a higher tap to increase the voltage applied to the rectifier. Select the tap that gives the desired voltage.

15. TROUBLES IN SERVO GENERATOR.

a. Very few troubles will be experienced in the Servo Generator. The ones that might occur are of such a simple nature as to make a troubleshooting chart unnecessary. The wiring diagram of the Servo Generator is shown in Fig. 7-175. If it is noticed that the Servo Generator has a tendency to chatter as it slows to a stop, there is nothing wrong. When the centrifugal starting switch opens as the motor picks up speed, the starting capacitor is left with a charge on it. When the motor slows to a stop, the switch closes and the capacitor discharges through the starting winding. This sets up a field that causes the chattering noise. This is a normal condition.

b. If the centrifugal starting switch fails to close when the motor stops, the motor will not start when power is again applied. This condition may be remedied by placing small smooth washers under the micarta block supporting the switch. If this treatment does not eliminate the trouble, the thrust bearing should be replaced.

16. TROUBLES IN SYNCHRO AMPLIFIER.

a. GENERAL.

(1) The troubles in the Synchro Amplifier may be divided into two types of troubles. One type is the troubles that might be experienced in the Amplifier Unit, and the other type is the troubles that may occur in the Synchro Unit. One indication of trouble in the Amplifier Unit is the appearance of a fixed reference voltage in true bearing operation. If the Amplifier is inoperative, no driving voltage is supplied to the servo motor in the Synchro Unit and the commutator brush assemblies do not rotate when the ship changes course. This condition can be detected by watching the Antenna when the ship turns. Fig. 7-19 shows some of the common troubles that might occur in the Synchro Amplifier Unit. The schematic diagram is shown in Fig. 7-172 and the wiring diagram is shown in Fig. 7-174. Voltages and resistances are shown in Fig. 7-171.

b. AMPLIFIER UNIT.

(1) One trouble commonly experienced is hunting. This trouble is manifested throughout the system. If it is located in the Synchro Amplifier Unit, the commutator brush assemblies in the Synchro Unit can be observed to hunt continuously. This condition can be usually corrected by adjusting the anti-hunt circuits as directed in Par. 46*b* of this section. If this adjustment does not eliminate the trouble, check the L1 and L2 leads between the Amplifier and the Synchro Unit to see if they are coupling 60-cps voltage back into the Amplifier. This trouble can be corrected by using a separate cable for this circuit. If the output from the Synchro Unit indicates that it is running erratically or if the sense of direction becomes reversed, check the type 6H6 tube used as a mixer diode in the Amplifier. If the servo motor tends to run continuously in one direction, one of the push-pull final amplifiers is defective and should be replaced. The failure of any one of the remainder of the tubes renders the unit inoperative.

c. SYNCHRO UNIT.

(1) Most of the troubles in the Synchro Unit are of a simple mechanical nature and are covered in preventive maintenance. The brushes on the synchro units are accessible when the small aluminum cover on the end of the synchro is removed. The cover is held in place with two countersunk screws. These brushes should require very little attention. The slip rings on which the brushes ride are pure silver, and the brush action should keep them free of tarnish. A small amount of tarnish on silver does not reduce its conductivity and no attempt should be made to clean the slip rings unless they have been exposed to unusual conditions that would cause them to be very dirty. The slip rings are highly polished and no cleaning process should be used that will injure the polished surface. In the rare cases where cleaning is required, it can usually be done with a clean cloth.

(2) The pressure of the brushes on the commutator transformer should be carefully adjusted. It is very important that the brushes should be adjusted to make good contact without loading the servo drive motor. If fine spoking appears on the PPI Indicator, try increasing the commutator brush pressure very slightly. The surface on which the brushes ride must be kept clean. A negligible amount of high frequency PPI spoking may be noticed under optimum conditions, which is due to the brushes moving over the individual turns on the commutator transformer. This condition is normal. If low frequency hunting appears, check the 30-30-30 mf power factor correction capacitor in the 36-speed circuit to the Antenna Pedes-

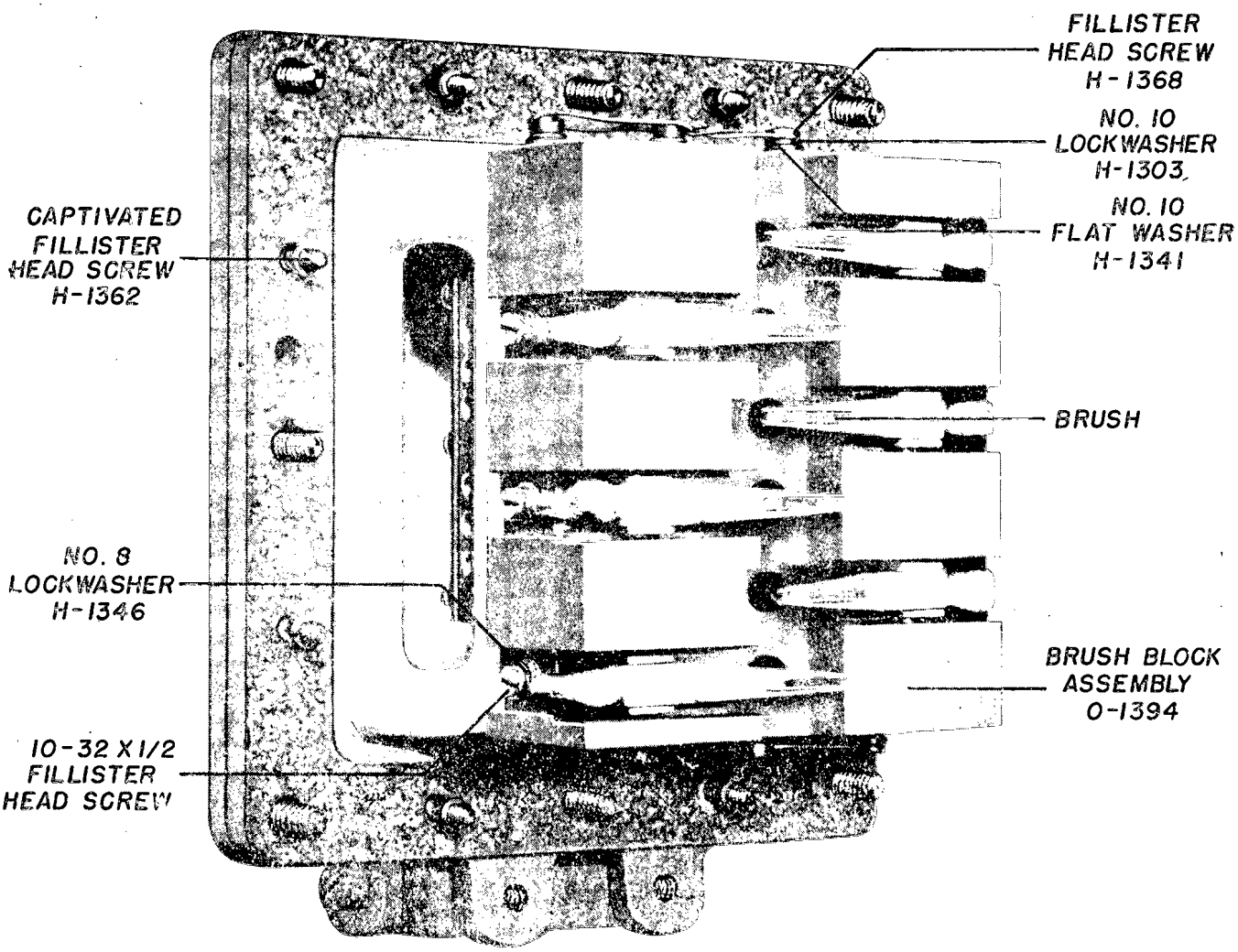


Figure 7-21. Brush Block Assembly in Antenna Pedestal

tal. If this capacitor is not used, or if it shows leakage, hunting will result.

(3) It is important that mechanical action of the Synchro Unit be as frictionless as possible. The gearing should be kept clean and the synchro units should be checked periodically to see that their shafts run freely without binding.

17. TROUBLES IN ANTENNA PEDESTAL.

a. GENERAL.

(1) The troubles encountered in the Antenna Pedestal may be mechanical or electrical. The electrical troubles may be simple circuit troubles or troubles in the r-f transmission lines that pass upward through the Pedestal. For convenience, the trouble shooting chart in Fig. 7-20 lists some of the most common troubles. A schematic diagram of the Pedestal is shown in Fig. 7-178. For the correction of mechanical troubles, refer to Par. 33 of this section and the accompanying illustrations.

b. LOCATION OF TROUBLES.

(1) Mechanical troubles are readily apparent. If the Pedestal fails to rotate, the output from the Servo Generator and the Rotation Control Unit can be checked. If it is normal, the trouble is located in the cabling, slip rings, antenna drive motor, or in the gear train. The condition of the cabling can be checked by measuring the voltage at the terminal boards in the base of the Pedestal. If the Antenna stops at definite points when rotating, the brushes may not be making a good contact with the slip rings at these points. This trouble can be corrected by removing the drive motor brush block and freeing the sticking brush holder arm so that the brushes make contact all the way around the slip rings. See Fig. 7-21. Check the brush arms to see if they are bent or loose and riding on the edge of the micarta insulator.

(2) If the Antenna Pedestal binds and refuses to rotate after several hours of operation, check the clearance between the stationary post and the top of the synchro housing at the bellows section. See Fig. 7-68. To check this, it is necessary to remove the T-section from the top of the Pedestal and insert a

feeler gauge between the post and the housing. Also open the synchro compartment cover and measure clearance between dome and ring at top of post. The clearance should be 0.0625 inches. If the clearance is insufficient, ream out the hole to the proper size. The disassembly of the T-section is described in Par. 33*p* of this section.

(3) If the bearing indication shows a varying error as the Antenna Pedestal is rotated through 360 degrees, check the capacitor that corrects the power factor in the DG synchro circuits. When this capacitor is replaced, the trouble should be eliminated. If the PPI Indicator and the Bearing Indicator show bearing errors of 180 degrees, check the synchro leads and reverse if necessary. These leads are shown in Fig. 7-179. If the PPI sweep and the Bearing Indicator dials rotate in a direction opposite from the direction of the Antenna Pedestal, reverse the leads to terminals 151 and 153 on terminal board E-1008 in the top of the Indicator Console case. If the Ship's Head Marker sweep is absent from the PPI Indicator, check the 01 and 101 leads to see if they are reversed. These leads may be found on terminal board E-1304 in the base of the Pedestal. Also check the marker pin on the ring gear in the Pedestal and check the arm of the microswitch S-109. This condition might be caused by a sheared pin or a bent switch arm.

(4) If the Antenna hunts and the adjustments in the servo system are normal, check the slip rings in the Antenna. If the rings are dirty, they may cause the antenna to hunt. Another possible source would be sticking brushes and poor contact between the brushes and the slip rings.

(5) Another source of trouble that should be checked each time the Antenna Pedestal is inspected, is the pin that secures the large spur gear on the one-speed 6DG synchro unit. If this pin works out, there is a possibility of damage to the 180-30 idler gear. Loose pins can be tightened by driving the pin into place and peening the small end. When peening the pin, be sure to support the back of the spindle with a heavy block or something rigid to prevent bending the hollow shaft.

(6) Troubles in the antenna drive motor usually consist of sticking brushes, or a worn and dirty commutator. In case of damage to the motor windings, it is necessary to replace the motor. Damage or excessive wear to the gear train requires the replacement of the defective parts. The disassembly of the Antenna Pedestal is described in Par. 33 of this section. The antenna should be cleaned periodically. Deposits of soot on the dipoles, transmission line, and insulators cause losses that materially reduce the efficiency of the antennas.

18. TROUBLES IN POWER EQUIPMENT.

a. GENERAL.

(1) The power equipment consists of the components required to convert the ship's d-c power into a-c power for the SR equipments. Since the action of these components is so closely related, they are considered together. The principal component is the Motor-Generator. The Magnetic Controller is used to start the Motor-Generator, and the voltage regulator controls the level of the output voltage. A Voltage Stabilizer is employed to further regulate the voltage applied to certain components in the SR equipment. The troubles encountered in the power equipment are of such a simple nature that it is unnecessary to list them in troubleshooting charts. The schematic and wiring diagram of the Motor Generator is shown in Fig. 7-180. The schematic diagrams of the Magnetic Controllers are shown in Figs. 7-181 and 7-183. The schematic diagram of the Voltage Regulators is shown in Fig. 7-185.

b. LOCATION OF TROUBLES.

(1) Most of the troubles in the power equipment will be blown fuses, dirty commutators, worn brushes, and dirty or worn relay contacts. These troubles have been generally covered in Section 6 as items of preventive maintenance. The first indication of trouble is the failure of the equipment to start or to stop when running. The first point to check in this case is the fuses in the Line Disconnect Switch if the Magnetic Controller has automatic reset circuits. If it does not, operate the reset push-button and attempt to start the equipment. If the equipment does not start, check the fuses as previously suggested. If the fuses are all right, check the over-speed switch on the d-c drive motor of the Motor Generator. This switch has contacts that open to remove power from the motor if the load is suddenly removed for any reason. The switch also opens in case open circuits develop in the exciter or the alternator. If this switch becomes defective and remains in an open position, the circuit to the motor is open. The switch is accessible when the cover at the end of the motor is removed. The cover is held in place by means of small studs. Another source of trouble is the Pushbutton Station. The stop section of the Pushbutton Station may be stuck in an open position. Another source of trouble is the starting resistances and the relays that switch them in and out of the circuit. These parts are located in the Magnetic Controller. If the relay contacts are badly burned or worn, if a relay coil is open, or if a relay is stuck, the Motor Generator will fail to start. With the exception of open circuits in the d-c drive motor, the only other electrical failure that will prevent starting, is open armature resistors in the Magnetic Controller. These resistors can be readily checked with an ohmmeter. It might be added that the door of the Line Disconnect Switch can be closed with the switch either open or closed. The door contacts must be all the way over to the right for the switch to close when the door is closed.

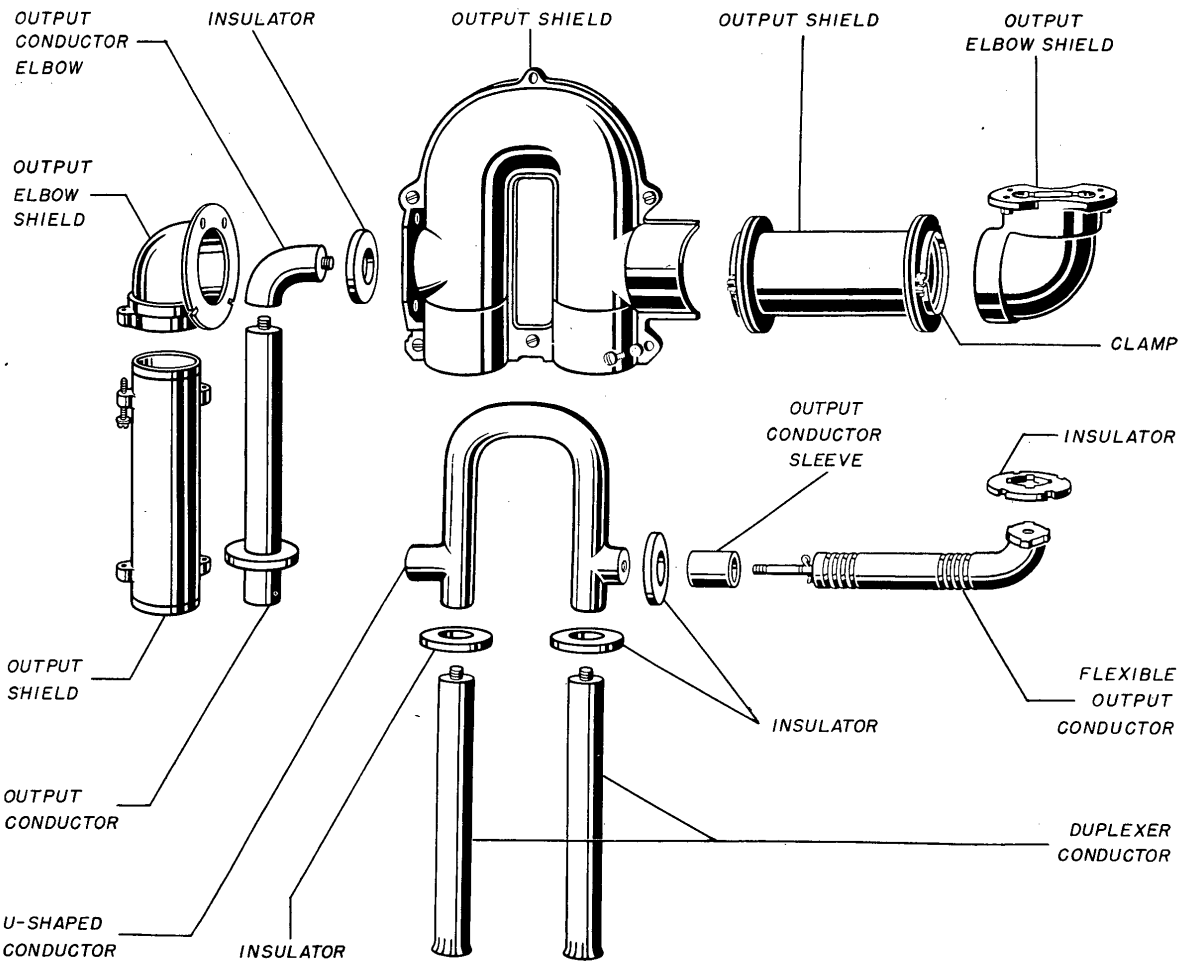


Figure 7-22. Transceiver R-F Line, Exploded View

(2) If the bearings of the Motor Generator should run hot, and the equipment is turned off while they are hot, the shaft will freeze in the bearings and it will be impossible to start the Motor Generator again. In fact it will be very difficult to disassemble the Motor Generator. If a Motor Generator with hot bearings is encountered, cool the bearings with water applied externally and with oil applied to the grease cups, followed by the grease recommended in the lubrication chart. After the bearings have cooled down to normal temperature, the Motor Generator may be stopped and the bearings inspected for damage.

(3) If for any reason, the speed of the Motor Generator drops below the rated speed of 1800 rpm, the frequency of the line voltage drops below 60 cps. The low line frequency will permit the current in the Voltage Stabilizer to rise to proportions high enough to burn out the windings and an excessively high voltage that may be as high as 165 volts, will be applied to the SR equipment unless the Voltage Stabilizer becomes completely open circuited. The normal stabilized line voltage should be 115 volts when the voltmeter on the Voltage Regulator is indicating 120 volts. The speed of the Motor Generator is accurately set by the adjustment of a resistor in series with the second shunt field of the d-c motor. The taps on this resistor should not be changed. It is possible to get speed as low as 1200 rpm with this adjustment. At this speed the Voltage Stabilizer does not last any time at all. If the line frequency is high or low, the antenna positioning system will hunt badly and it will be impossible to stop it until the frequency is properly adjusted. Hunting is caused by the inability of the anti-hunt filters to suppress voltages with frequencies very far removed from 60 cps.

(4) If the Motor Generator runs but does not deliver an output voltage, check the brushes and commutator on the exciter and the alternator. If this does not locate the trouble, switch from automatic to manual operation at the Voltage Regulator. If there is still no output voltage, check the fields of the exciter and the alternator. If there is an output voltage, check resistor R-1463 in the Voltage Regulator. It may be open, preventing the circulation of current in the exciter field. If there is no voltage regulation in automatic operation, check the solenoid K-1461. Other points to check are potentiometers R-1461 and R-1462 and transformer T-1461. If the other winding of transformer T-1461 is open, there will be no voltage output in either type of operation.

19. MECHANICAL ADJUSTMENTS IN TRANSCEIVER.

a. GENERAL.

(1) Some of the mechanical adjustments in the Transceiver are so closely identified with the electrical adjustments that they are included in the electrical adjustment procedure. An example is the cams that operate the limit switches that control the drive motor

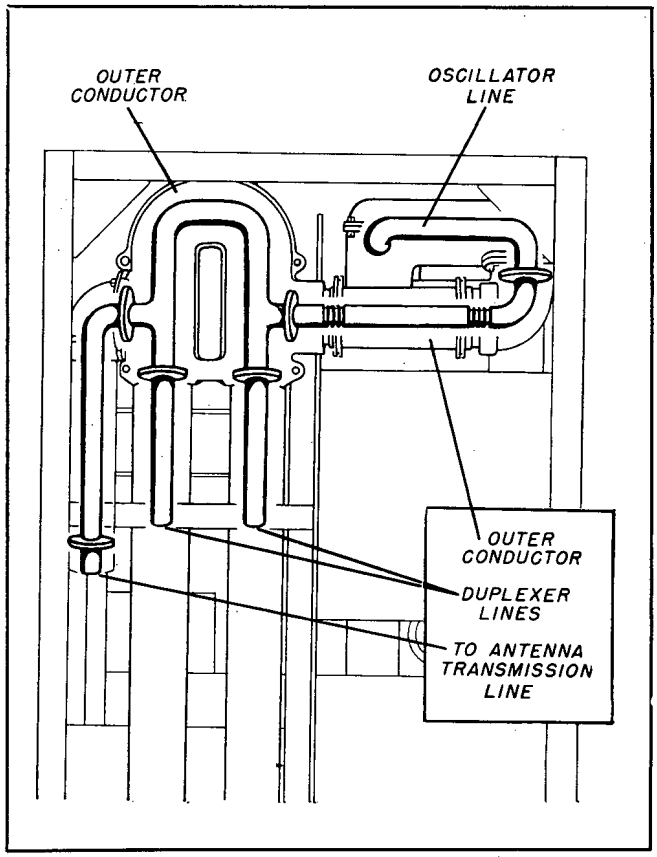


Figure 7-23. R-F Line Assembly in Transceiver

of the variable high voltage transformer. Therefore the procedures given in this paragraph are limited to the assembly and disassembly procedures required to remove some of the more complicated parts.

b. R-F LINES.

(1) With the exception of the duplexers and tuning stubs, all of the parts in the r-f line assembly in the Transceiver are shown in the exploded view in Fig. 7-22. This figure may be used to identify parts and to convey an idea of how they are assembled. A schematic diagram of these same parts is shown in Fig. 7-23. This figure shows the location of the assembled parts in the Transceiver. These parts are the ones most likely to require removal. The duplexers and tuning stubs require little attention beyond an occasional drop of oil on the tuning mechanisms. The replacement of spark gap points in the duplexers is described in a separate paragraph. The section of the r-f lines that is treated in this paragraph contains insulators that may require occasional replacement.

(2) To remove the r-f lines shown in Fig. 7-23, it is necessary to remove the rear panel of the Transceiver as a preliminary step. The next step which is the first real step in disassembly, is shown in Fig. 7-24. This step is the removal of the U-shaped shield or outer conductor shown in Step 1. This part is held in place with the assembly screws shown exploded out from it in Fig. 7-24. Step 2 consists of loosening the

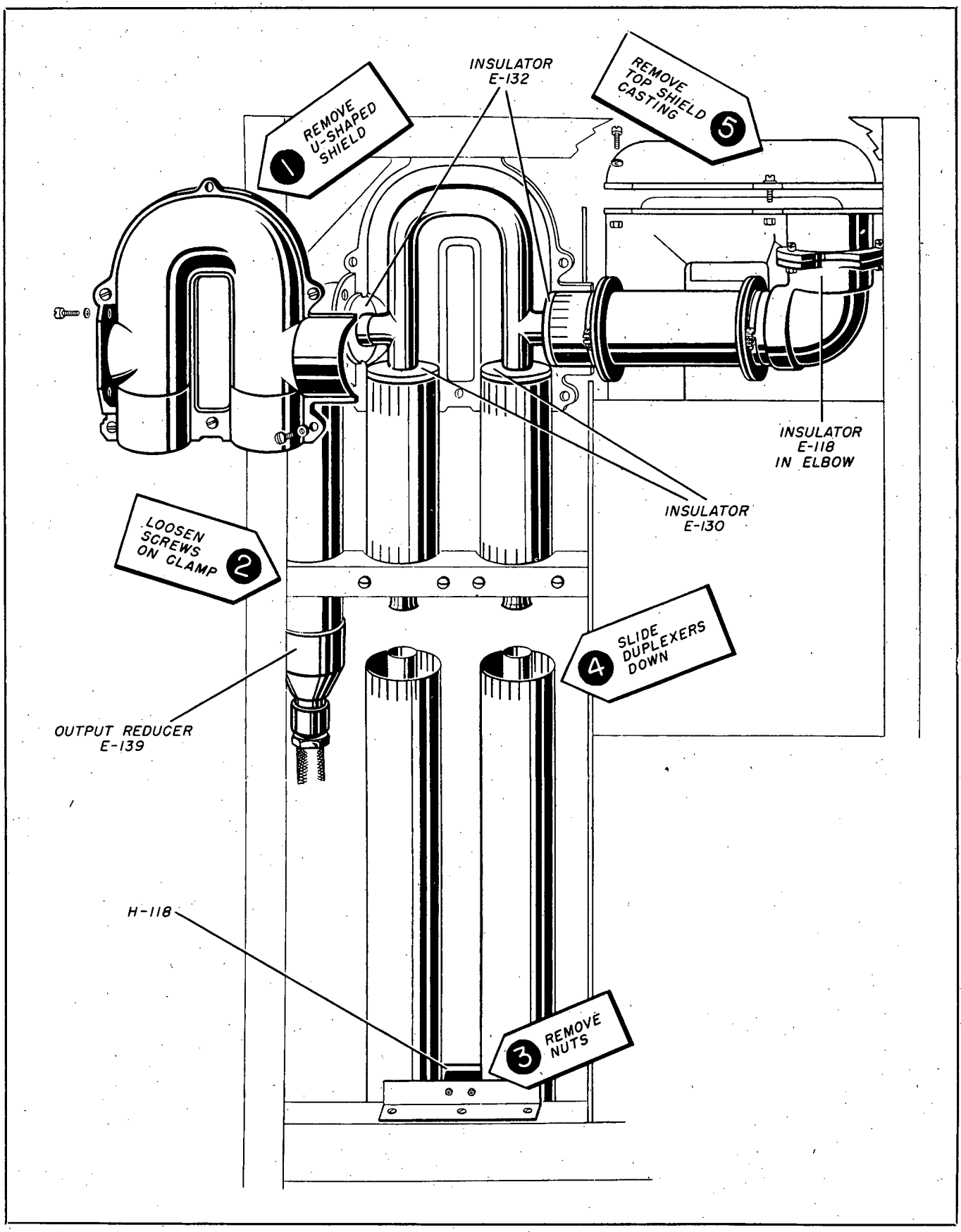


Figure 7-24. Disassembly of Duplexers and U-Section

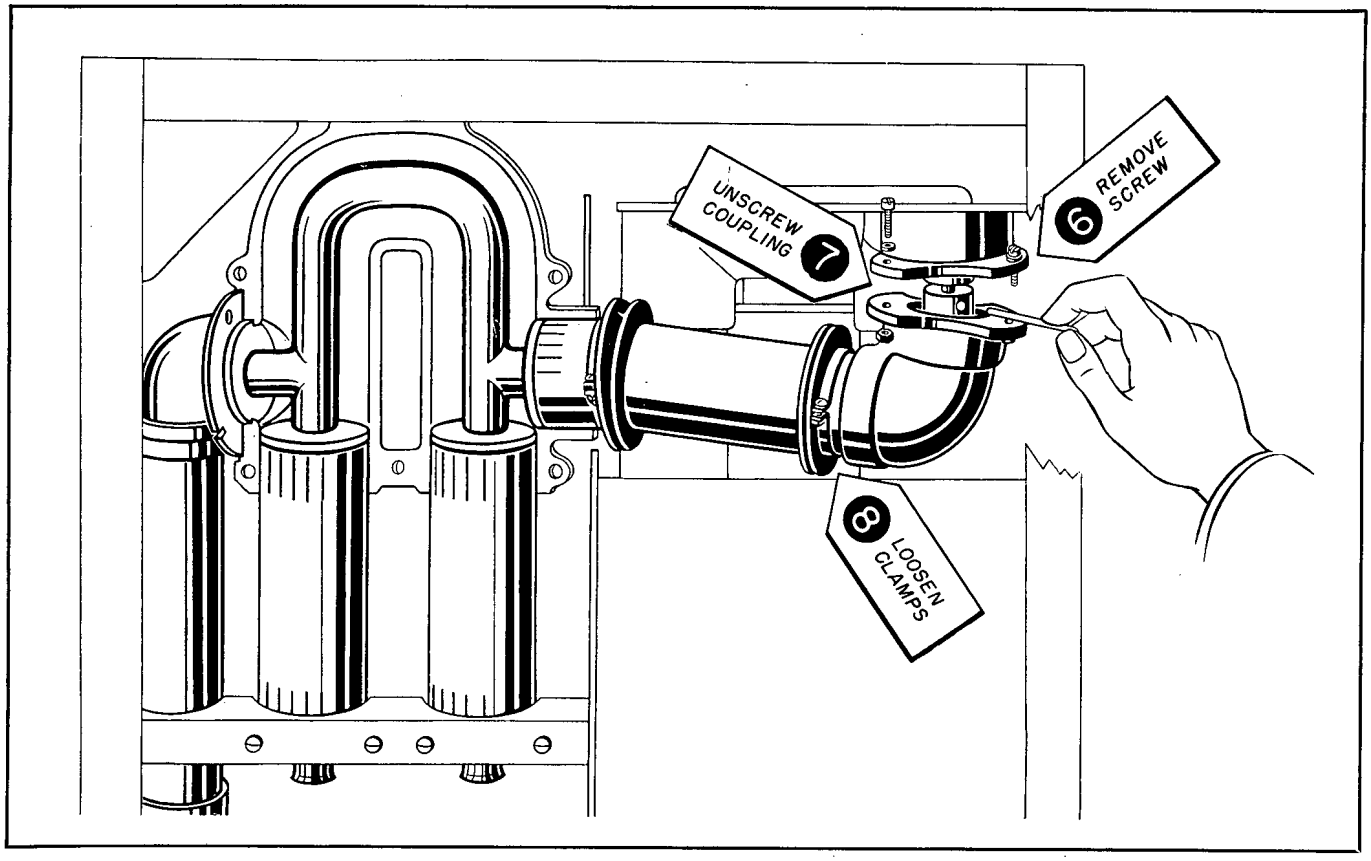


Figure 7-25. Disassembly of Oscillator Line

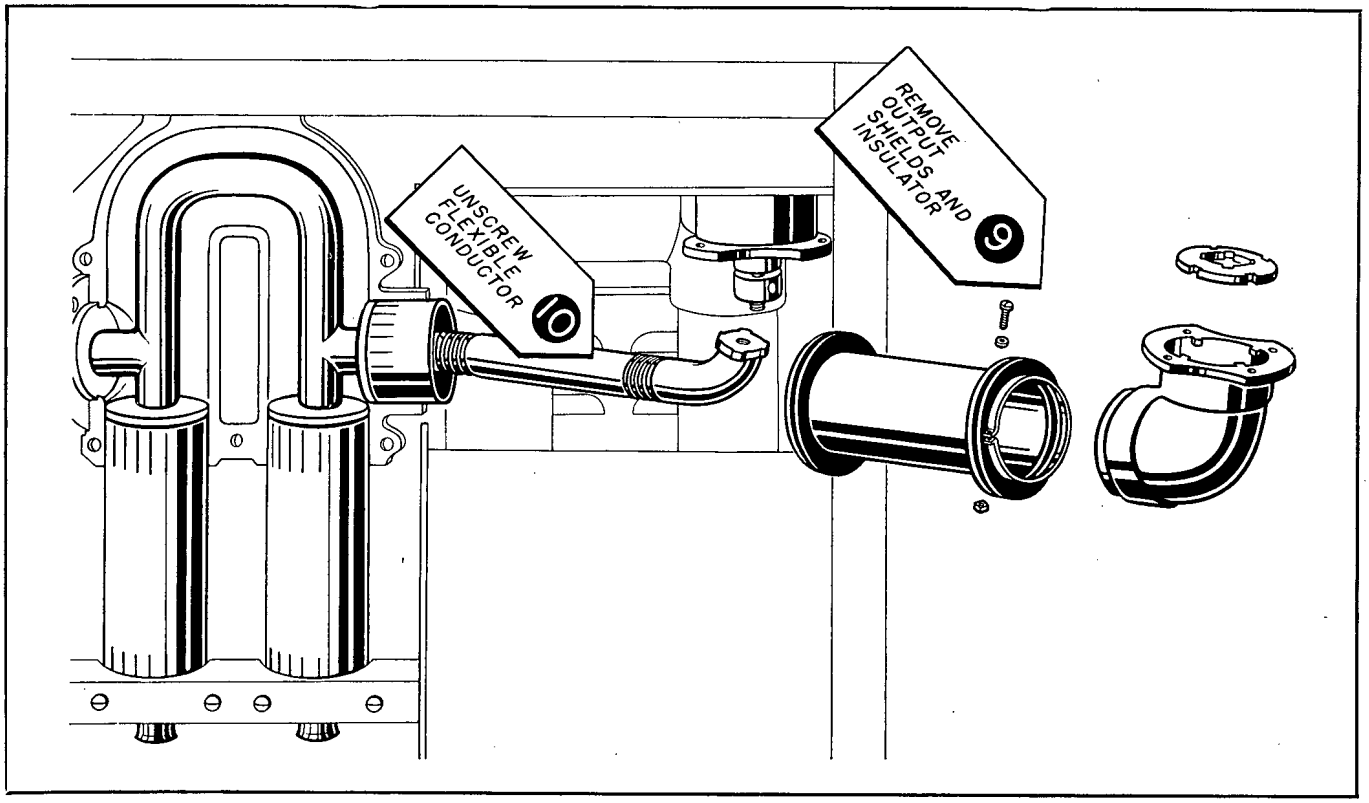


Figure 7-26. Removal of Oscillator Line

screws that hold the horizontal member that hold the duplexers in place. Then, to release the duplexers, remove the nuts at the bottom as shown in step 3 of Fig. 7-24. The duplexer stubs may now be disengaged from the upper section of the line and lowered to the position shown in step 4. Now proceed to the top of the Transceiver and remove the top cover. This exposes the top shield casting shown in step 5 in Fig. 7-24. Remove this casting as directed. Step 6 in Fig. 7-25 shows the removal of the screws that secure the elbow of the flexible coupling to the casting from which the top shield casting was removed in step 5. This exposes the coupling on the inner conductor. This coupling is disconnected by inserting a small rod, such as a nail or an Allen wrench, through the hole in the nut and turning it counterclockwise until the coupling comes apart. See step 7 in Fig. 7-25. The clearance here is very close and the rod will have to be slipped back and forth to permit a complete revolution of the coupling nut. Once the coupling has been disengaged, the clamps on each end of the flexible coupling should be loosened as shown in step 8 of Fig. 7-25.

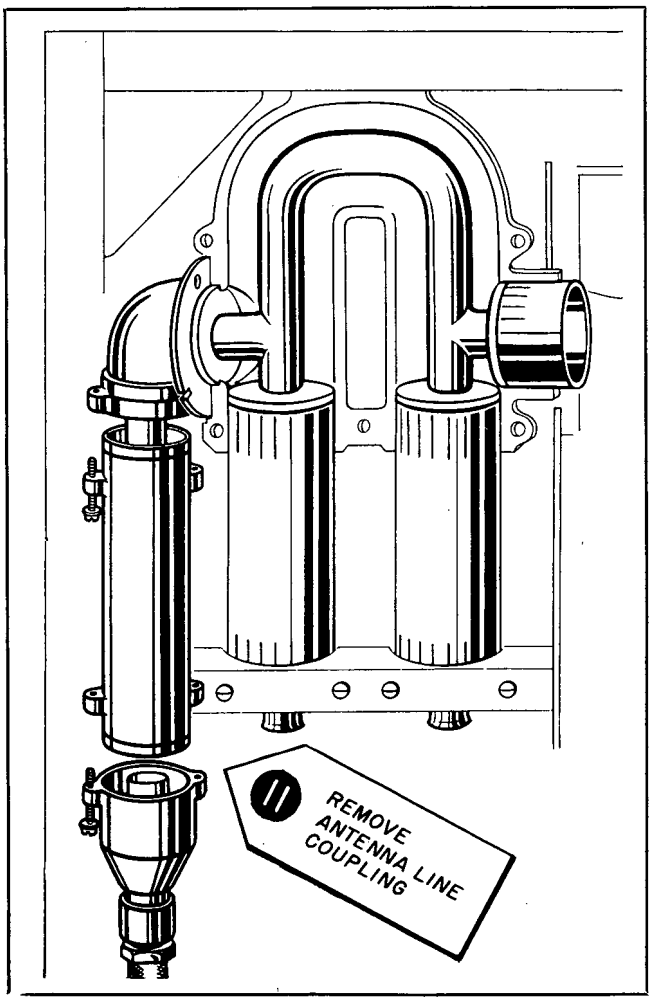


Figure 7-27. Disassembly of Antenna Line and Cable

(3) The flexible coupling is now ready for removal. Gently pry the insulator out as shown in step 9 in Fig. 7-26, and take the elbow off. Then slide the shield or outer conductor off over the inner conductor. Since the flexible conductor has two flexible bellows-type joints, it should be supported during this operation. Step 10 in Fig. 7-26 shows the removal of the flexible inner conductor. The part screws into the

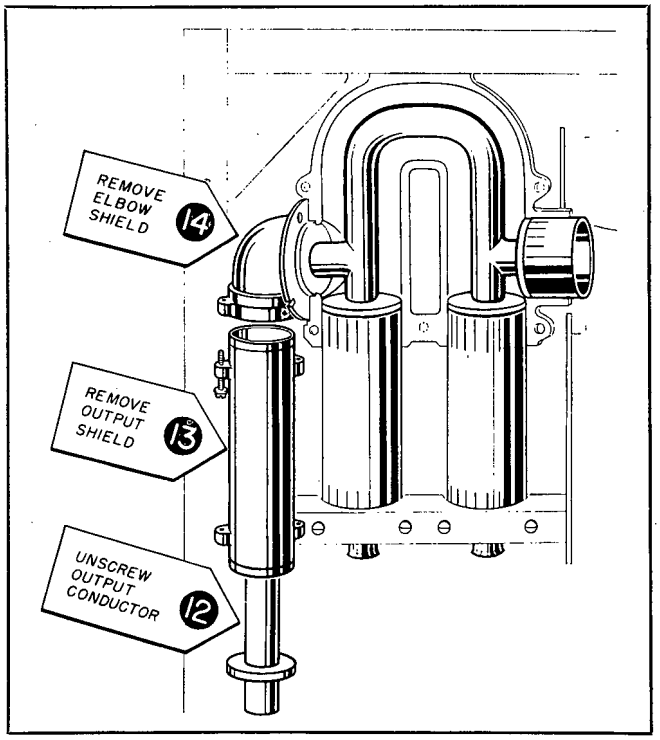


Figure 7-28. Removal of Antenna Line

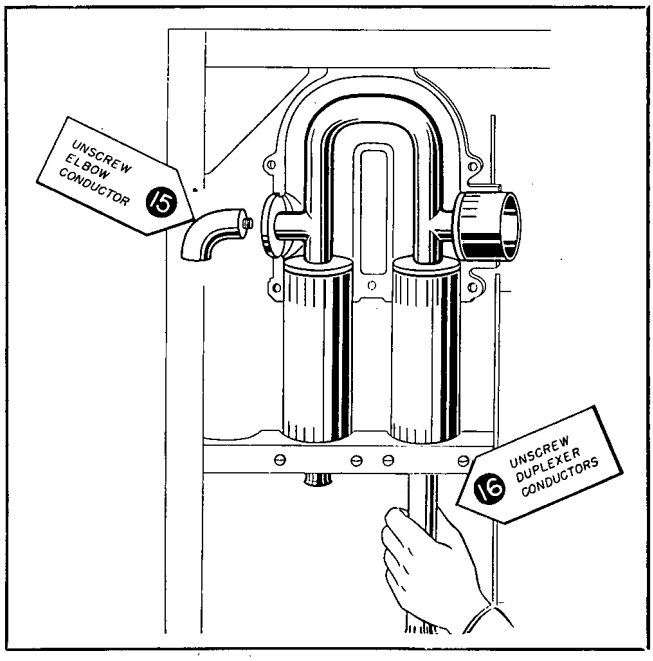


Figure 7-29. Removal of Upper Duplexer Conductors and Elbow Conductor

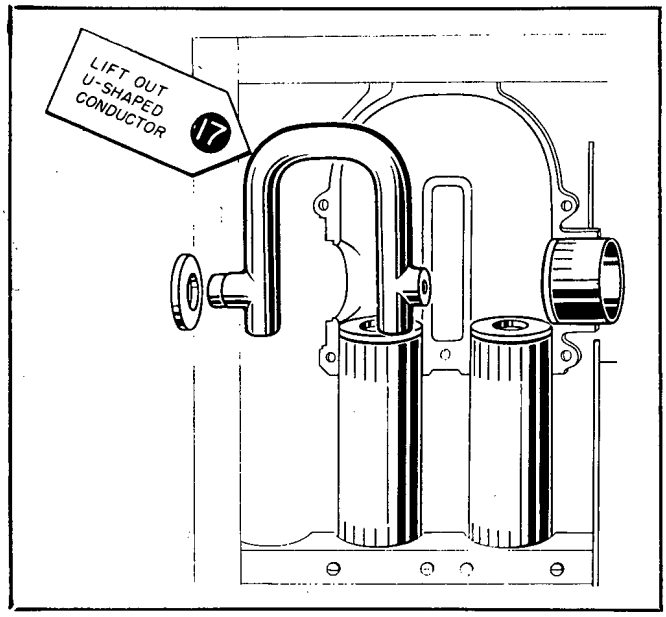


Figure 7-30. Removal of U-Shaped Conductor

U-shaped section and is removed by turning it counterclockwise until it is free.

(4) Step 11 in Fig. 7-27, shows the removal of the antenna line coupling. As shown in the figure, the assembly screws are accessible beneath the coupling flanges. A long screwdriver is required for this operation. After the antenna line coupling has been removed, unscrew the center output conductor as shown in step 12 of Fig. 7-28. Then remove the output shield as shown in step 13. To remove the elbow shield shown in step 14 of Fig. 7-28 loosen the bottom screws that secure the bottom of the flange and completely remove the top screws. This permits the elbow shield to be removed. Since the inner conductor in the shield is still attached, the elbow shield must be correctly positioned in order for it to slide over the inner conductor.

(5) The next step in the operation is shown in step 15 of Fig. 7-29. This consists of unscrewing the elbow conductor from the U-shaped section. The next step in disassembly is the removal of the upper sections of the inner conductors in the duplexers as shown in step 16 of Fig. 7-29. The ends of these sections are fitted with a threaded stud that screws into the U-shaped section.

(6) The final step in disassembly is the removal of the U-shaped conductor as shown in step 17 of Fig. 7-30. This part lifts out of its position as soon as the inner conductors of the duplexers are removed.

(7) To reassemble the r-f lines, reverse the above procedure. Place the insulators in position as shown after first brushing their edges with glyptol or some other suitable cement.

c. FILAMENT TRANSFORMERS.

(1) The filament transformers are located behind the lower right hand door on the front of the Transceiver. When this door is opened, be sure that the

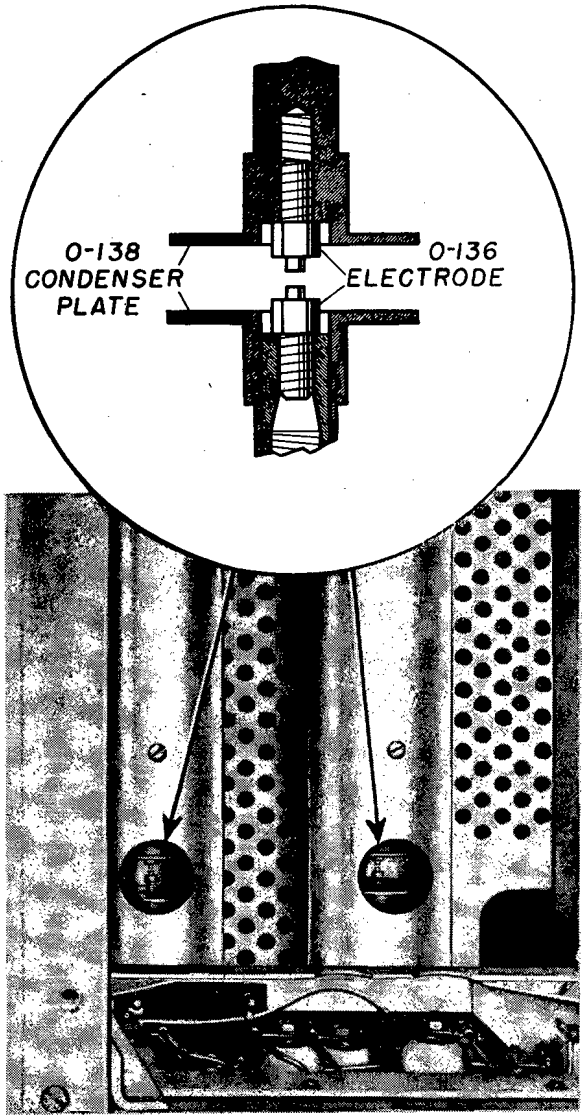


Figure 7-31. Duplexer Spark Gaps

toggle switch immediately above the door interlock switch is in the position farthest from the observer.

WARNING

GROUND PLATE CAPS AND CHECK INTERLOCK SWITCH BEFORE TOUCHING ANY PART OF THE EQUIPMENT. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN SEVERE SHOCKS THAT CAN EASILY CAUSE DEATH.

(2) After grounding the tube caps remove the tubes. Then remove the bracket inside the door that holds the door check. Swing the door check out of the way.

(3) Disconnect the defective transformer and use a socket wrench to remove the nuts from the four mounting bolts that secure the transformer base to the mounting plate. Lift the assembly up and tilt it backward so that the base of the transformer can clear the gusset and come through the door first.

(4) Replace the transformer by reversing the above procedure.

d. VOLTAGE REGULATOR ASSEMBLY.

(1) The voltage regulator assembly is located in the lower lefthand corner of the Transceiver cabinet. It is shown in Fig. 7-7. The instructions in this paragraph should be read carefully before attempting to remove the assembly. As the instructions are read, the assembly itself should be carefully examined in order to accurately determine the correct procedure. Sufficient space for a man to work in a crouched position must be available at the rear and on the left-hand side of the Transceiver. If there is not, the Transceiver must be moved from its location to a position where sufficient space is available.

(2) Remove the lower panels from the left side and rear of the Transceiver.

(3) Open the lower compartment door and remove the plate from the microswitch assembly. This assembly is shown in Fig. 7-7. Do not remove the microswitches.

(4) Mark the positions of the cams on the variac shaft and with the Allen wrench provided, loosen their set screws and remove them from the shaft.

(5) Remove the fillister head screws that hold the worm assembly. Force the wires above the assembly out of the way and carefully work the assembly out of position and remove it.

(6) Using a small punch, drive out the pin in the worm gear assembly, loosen the set screws and remove the worm gear from the variac shaft.

(7) Remove the cover from the circuit breaker S-118 which is located above the worm assembly as shown in Fig. 7-7. Remove the mounting screws that hold the switch in position and push the switch to one side. This exposes the top mounting screw of the variac.

(8) Remove the bolts holding the cross member in front of capacitor C-107. This capacitor is located in the rear of the Transceiver and is accessible when the rear panel is removed.

(9) Disconnect and tag the leads to capacitor C-107, remove the holding clamps, and lift the capacitor out.

(10) Remove the air filter and the canvas boot from the blower motor. The removal of the air filter is described in Section 6.

(11) Remove the bolts holding the lower cross member that supports the air filter assembly.

(12) Disconnect and tag the leads to the terminal blocks on the variac.

(13) Remove the screws that hold the variac in place. There are three of these screws and they are located on the vertical panel on which the assembly is mounted and are accessible through the door to the lower compartment. The removal of the parts in the first part of this procedure made them accessible.

(14) In the event that the nuts holding the supporting screws for the variac are loose, it will be necessary to remove the screws holding the perforated cover on the variac and bend the cover so that the nuts can be reached and removed.

(15) Turn the variac so that one of its sides is at the bottom lying parallel with the supporting plate. Then lift upward to clear the plate and pull the variac out of its position and remove it from the Transceiver.

(16) When installing the new variac, note the position of the shaft of the old variac and the location of the hole in the shaft through which the pin passes. Place the shaft of the replacement in exactly the same position and drill the same size hole in exactly the same position.

(17) Note whether the holes for the mounting screws are threaded in the replacement variac. If they are not, the perforated cover will have to be removed so that the nuts can be started on the mounting screws. After the variac has been mounted in position, the cover can be replaced. The remainder of the assembly is the reverse of the above steps.

(18) When the assembly is complete to the point where the cams are to be replaced, put each cam back in the position it occupied originally and set according to the markings, so that they open and close the microswitches at the same point in variac rotation that they originally did. If this point cannot be definitely established, refer to paragraph 36*c* of this section for the procedure to use in correctly positioning the cams.

20. MECHANICAL ADJUSTMENTS IN THE KEYER UNIT.

a. The only moving parts in the Keyer Unit are the switch assembly and the switch drive motor. The drive motor is held in place with four fillister head screws and its removal and replacement is a very simple procedure. The contact arms of the switch may require tensioning on rare occasions. This is accomplished by bowing the arms with a pair of pliers in the direction in which tension is desired. If the switch motor runs continuously, the microswitch used as a limit switch is not functioning. This is often due to insufficient tension in the spring arm that actuates the switch. Bend this arm with a pair of pliers so that it operates each time the cam reaches the open position. The replacement of all other parts is a simple mechanical procedure. It is intended that the modulator will replace the Keyer in all equipments.

21. MECHANICAL ADJUSTMENTS IN THE MONITOR RECEIVER.

a. GENERAL.

(1) The mechanical construction is not complicated and none of the parts are difficult to remove. All actual adjustments in the Monitor Receiver are electrical. Whenever a potentiometer is removed, the control knob should be replaced, pointing all the way clockwise or counterclockwise with the potentiometer pointing in the same direction. When replacing the R-F control knob, rotate the rotor plates of the capa-

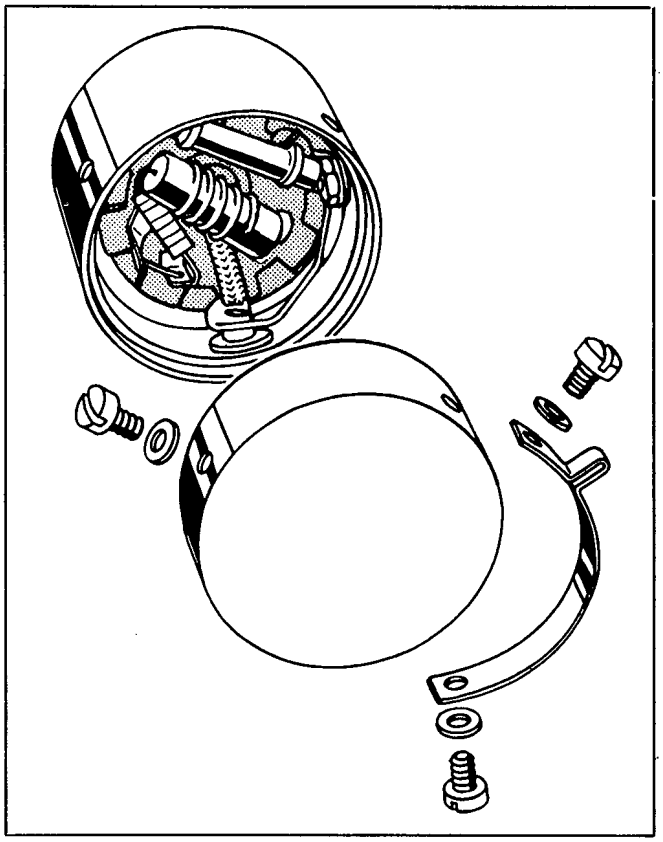


Figure 7-32. Disassembly of Lighthouse Tube Sockets in Monitor Receiver

citor until they are completely meshed with the stators for maximum capacity and tighten coupling on the flexible shaft so that the knob is turned fully clockwise.

b. ECHO BOX.

(1) If the plating inside the Echo Box becomes defective it will be necessary to replace it. Before removing the Echo Box, turn the control all the way clockwise or counterclockwise. Unscrew the r-f connector on top of the Echo Box and, with a soldering iron, remove and tag all other connections. The Echo Box is secured to the chassis with four fillister head screws held by nuts located beneath the chassis. Remove these screws and lift the Echo Box out of the chassis.

(2) Before installing the new Echo Box, turn the small spur gear on its control shaft until it is adjusted to exactly the same position as the old one. Then place it in position, meshing the gears and being careful not to disturb the position of either the knob or the Echo Box. Replace the mounting screws and reconnect the Echo Box.

c. LIGHT HOUSE TUBE SOCKETS.

(1) Fig. 7-32 shows the disassembly of the light house tube sockets to permit the testing and replacement of parts in the socket. The socket should be reassembled with the parts in the same relative positions shown in the figure.

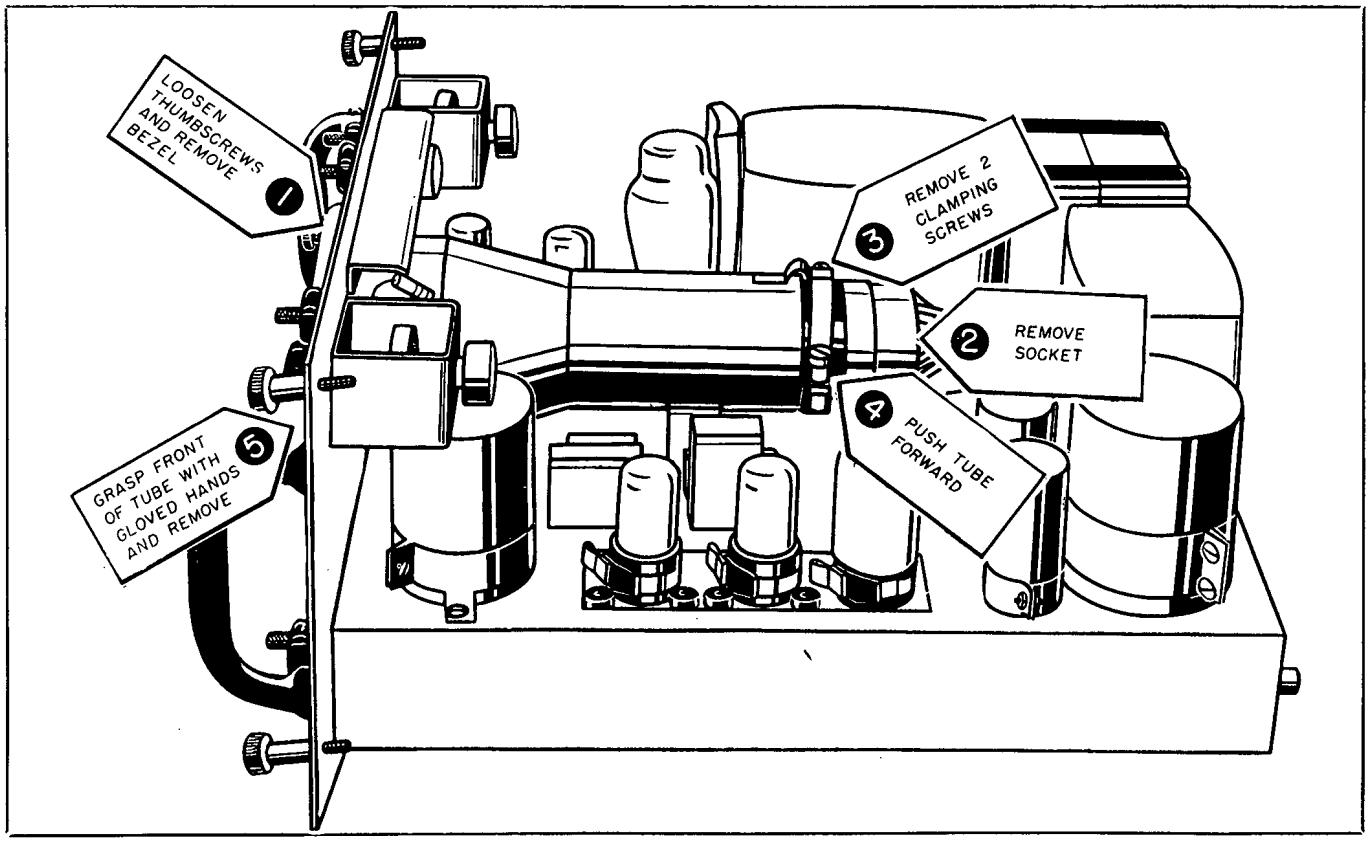


Figure 7-33. Removal of Cathode Ray Tube in Monitor Scope

22. MECHANICAL ADJUSTMENTS IN THE MONITOR SCOPE.

a. GENERAL.

(1) The only part in the Monitor Scope that is difficult to remove is the cathode ray tube. There are no mechanical adjustments that must be made to maintain accuracy or efficient operation. The removal of the cathode ray tube is described in the following paragraph.

b. CATHODE RAY TUBE.

(1) As a preliminary step, the Monitor Scope must be pulled out from the Transceiver case until the locks engage. Then the thumbscrews that hold the bezel should be removed as directed in step 1 of Fig. 7-33. Carefully remove the tube socket as directed in step 2 of Fig. 7-33. Then remove the two clamping screws as shown in step 3 of Fig. 7-33. The tube is now in position to be pushed forward as directed in step 4. Grasp the front end of the tube with gloved hands and pull the tube out as directed in step 5 of Fig. 7-33.

(2) Install the new tube by reversing the above procedure.

23. MECHANICAL ADJUSTMENTS IN THE MODULATOR.

a. GENERAL.

(1) The parts in the Modulator are mounted on decks and are all easily accessible. There are no mechanically moving parts and with the exception of the time delay relay in the early models, none of the parts are difficult to remove. In the early models, it is impossible to remove the cover over the time delay relay when it is mounted in position. To remove the cover, it is necessary to disconnect and remove the relay from the Modulator. This condition was corrected in the later models by removing a gusset on the frame that prevented the cover from being removed with the relay in its assembled position. The replacement of tubes and fuses is described in Section 5.

24. MECHANICAL ADJUSTMENTS IN THE CONSOLE RECEIVER.

a. There are no complicated mechanical parts or assemblies in the Console Receiver. Therefore no special instructions for the removal of any parts are required. The principal difficulty encountered in making repairs on the Console Receiver lies in the

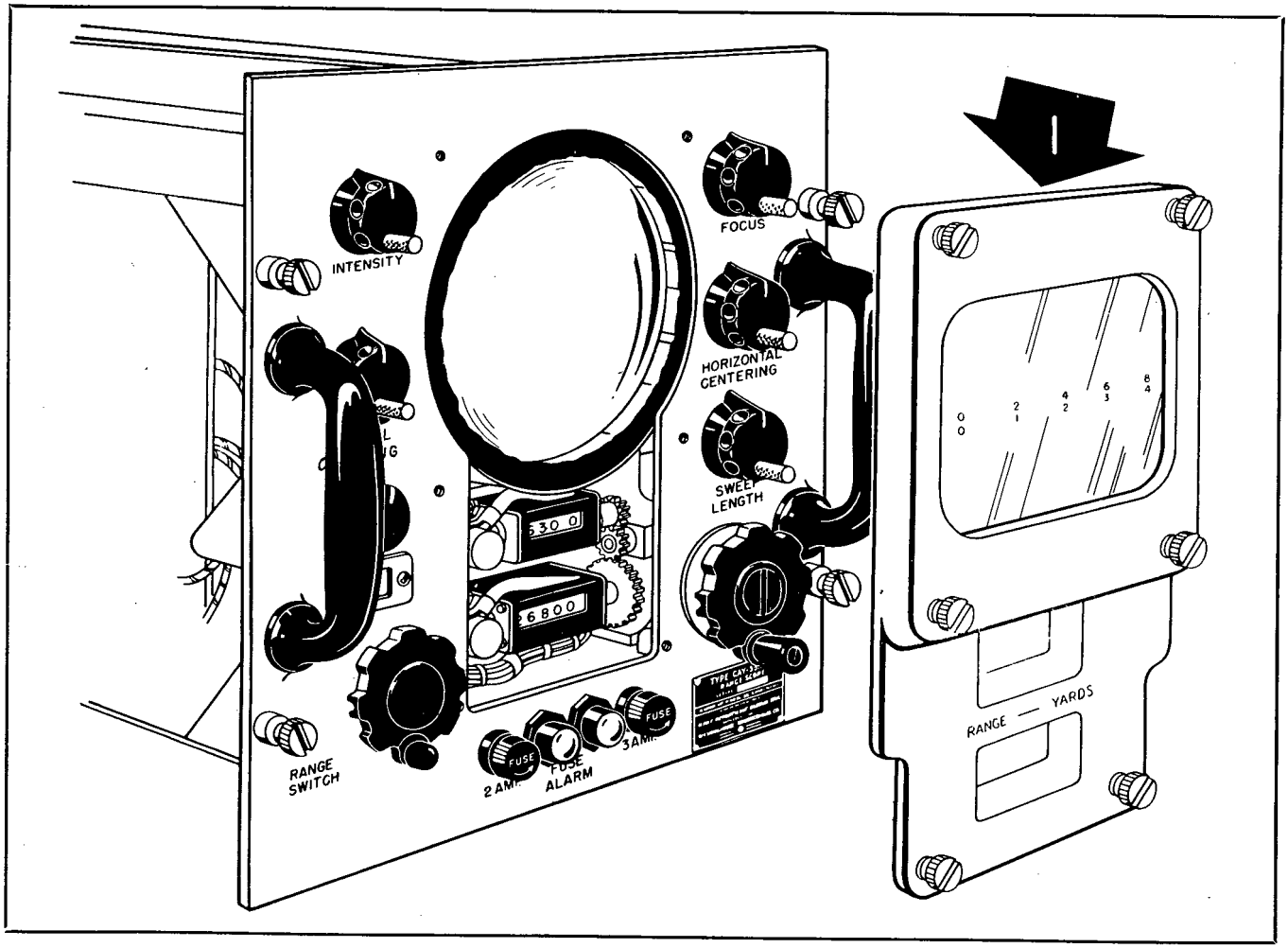


Figure 7-34. Removing Bezel from Range Scope

wiring. Before removing any part, observe the position of the leads and replace them in exactly the same way. Particular attention should be paid to grounds, especially grounds made with screw connections. A poor ground connection will result in oscillation in the i-f amplifiers of the Receiver. A good positive contact between the shield cans and the chassis must be maintained for the same reason.

25. MECHANICAL ADJUSTMENTS IN THE RANGE SCOPE.

a. GENERAL.

(1) The only moving parts in the Range Scope that require particular attention are the counters and the helipot. There are no mechanical adjustments that must normally be made during alignment or when setting up the equipment. The removal and replacement of the cathode ray tube and the counters and helipot are described in the following paragraphs.

b. CHANGING CATHODE RAY TUBE.

(1) Turn off all power to the Indicator Console and wait 30 seconds for the high voltage capacitors to discharge.

(2) Unscrew the captive screws that hold the front panel of the Range Scope to the Indicator Console case. Pull the chassis forward until it is stopped by the locks.

(3) Remove the bezel as shown in Fig. 7-34 by unscrewing the captive screws that hold it to the front panel.

(4) Grasp the high voltage connector to the tube by its rubber cover and squeeze it together so that it can be removed from the connector. DO NOT PULL THE CONNECTOR OFF WITHOUT SQUEEZING IT. THE TUBE MAY BE DAMAGED. After the high voltage lead has been disconnected, GROUND IT TO THE CHASSIS BEFORE PROCEEDING FURTHER. The high voltage lead is shown in Fig. 7-35.

(5) Gently remove the socket from the base of the tube. See Fig. 7-35. Then unscrew the knurled screw on the base clamp.

(6) Use the gloved hand to support the front of the tube and use the other hand to apply pressure against the base of the tube and carefully force the tube out. See Fig. 7-36.

(7) When the tube has been pushed forward far enough to free it in the tube shield, use gloved hands to remove it as shown in Fig. 7-37.

(8) To install the new tube, insert it in the shield using the technique shown in Fig 7-37. Insert the tube just far enough to allow it to be connected.

(9) Turn the equipment on and observe the sweep on the tube. It should be perfectly horizontal. If it is not, turn off the equipment, remove and ground the high voltage lead and rotate the tube in the direction that will bring the sweep into a horizontal position. If the tube binds, push it forward out of the shield until it can be turned. DO NOT PUT ANY STRESS OR STRAIN ON THE GLASS OR THE TUBE ENVELOPE WILL BREAK. After the sweep has been properly positioned, the tube should be pushed back into its proper position. The proper

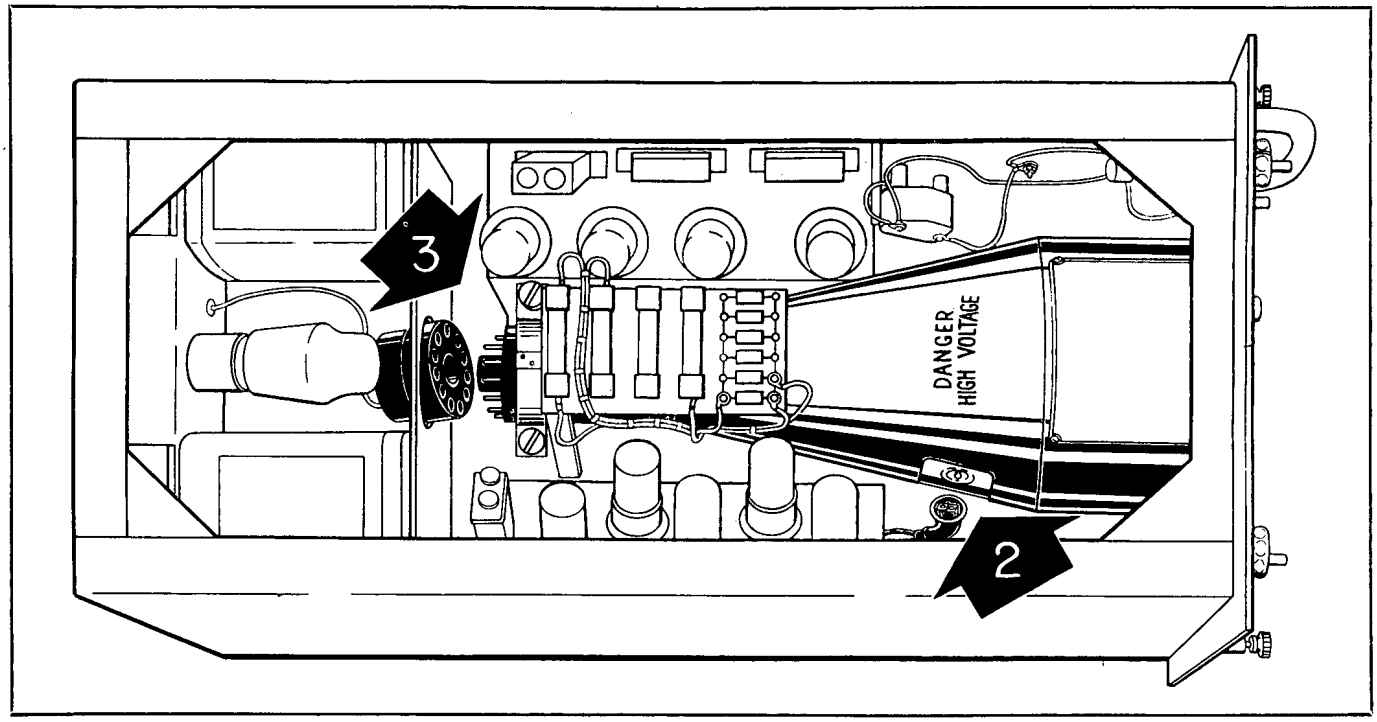


Figure 7-35. Disconnecting Cathode Ray Tube in Range Scope

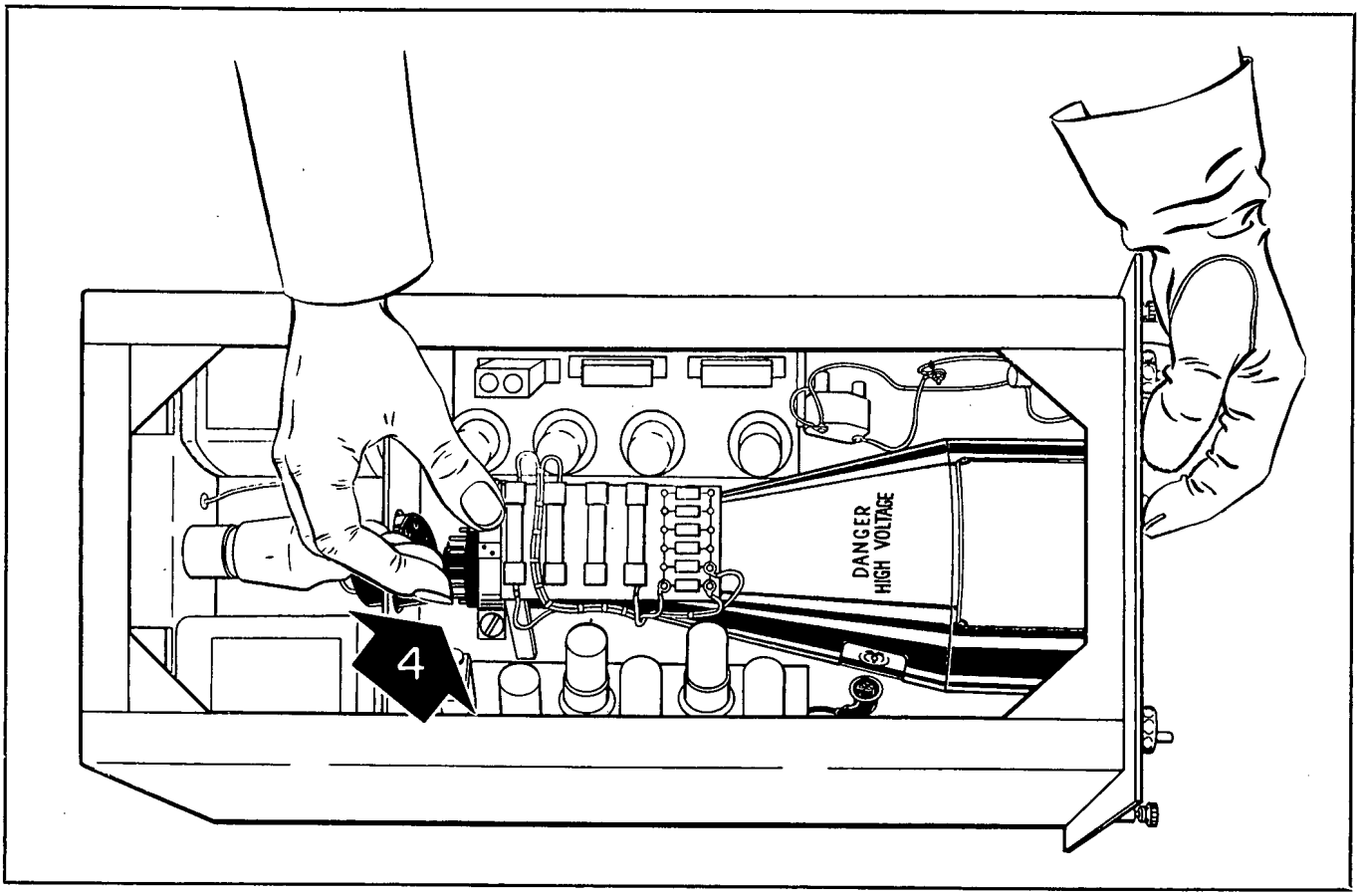


Figure 7-36. Pushing Cathode Ray Tube Forward in Range Scope

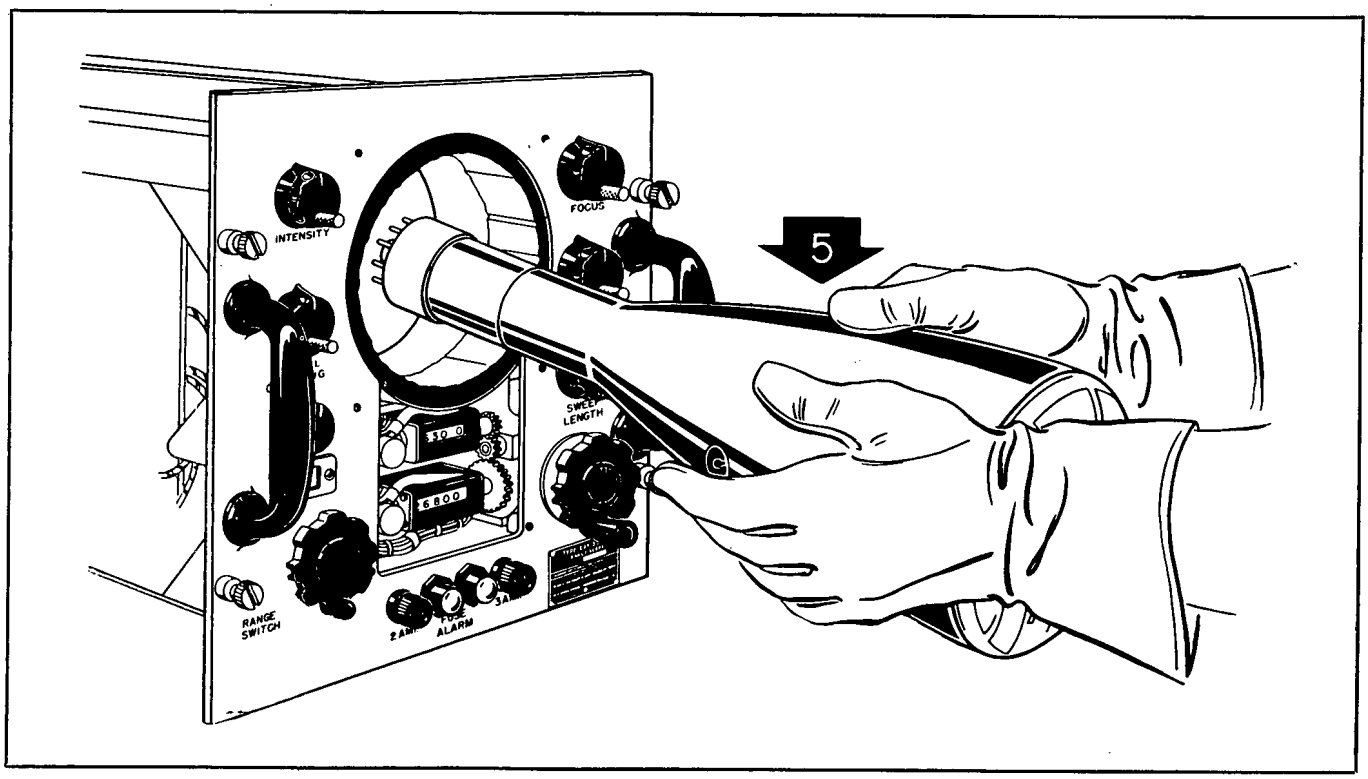


Figure 7-37. Removing Cathode Ray Tube from Range Scope

position is where the face of the tube is lightly touched by the rubber bumper on the bezel when it is put into place.

c. REPLACING HELIPOT.

(1) The linearity required of the helipot cannot be adjusted very readily in the field. Consequently, if the alignment procedure discloses that the helipot is out of adjustment, it should be replaced. This is comparatively easy and is described in the following steps.

(2) Unscrew the captive screws that hold the front panel of the Range Scope to the Indicator Console case. Pull the chassis out until it locks. It is possible to replace the helipot with the chassis in this position. While it is a little awkward, it is necessary to remove the cable connections before the chassis can be completely removed. If it is desired to remove the chassis, press on the lock releases on each side of the opening into which the chassis slides. This releases the locks and allows the chassis to be completely removed. The cable must be disconnected before the locks are released. Two men should remove the chassis to avoid dropping it.

(3) The removal of the helipot is shown in Fig. 7-38. The first step is to remove the three leads. Next remove the three screws that hold the dust cover in place over the helipot, and remove the cover.

(4) Rotate the RANGE STEP control until the arm of the helipot reaches the end of its travel as shown in Fig. 7-38. While the figure shows the arm in one position, either extreme position is satisfactory.

(5) Remove the three screws that hold the helipot to the frame casting. The helipot can now be lifted off.

(6) To install the new helipot, rotate its arm to the same position occupied by the old one. Then carefully place the helipot in position so that the pins on the top of the helipot engage in the holes on the split worm gear assembly. See Fig. 7-38.

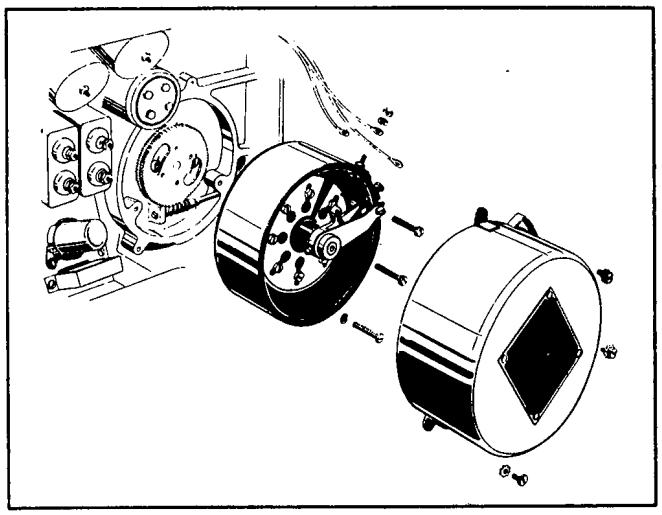


Figure 7-38. Removing Helipot from Range Scope

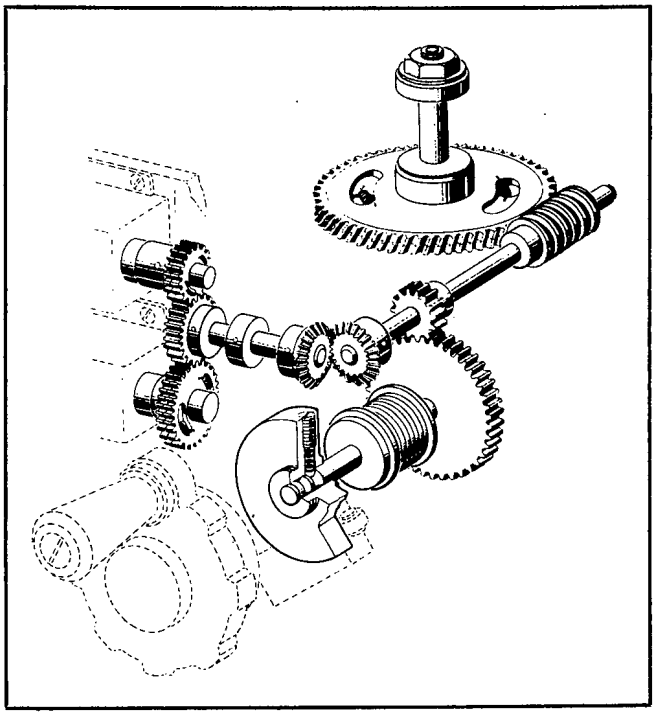


Figure 7-39. Counter Gear Train, Schematic Diagram

(7) Secure the helipot in position with the three mounting screws.

(8) Replace the dust cover with the leads coming up inside the guard over the lead opening in the dust cover. Fasten the cover in place with the three mounting screws. Connect the leads in the original sequence.

d. SERVICING COUNTER GEAR TRAIN.

(1) The counter gear train is operated by the RANGE STEP control to drive the helipot and the counters. The counters register a range that is dependent upon the setting of the helipot and consequently, the position of the range step. The mechanical principle of the gear train is simple. It is illustrated in Fig. 7-39. It is not likely that the gears and other parts should ever have to be replaced unless they suffer damage in battle or due to carelessness. The procedure for removing the gear train is given in the following paragraphs.

(2) Pull the chassis from the case until it locks.

(3) Disconnect the helipot, fuses, pilot lamps and the microswitch S-601. Pull the cables back out of the way.

(4) Remove the bezel by unscrewing the thumbscrews that hold it to the front panel.

(5) Unscrew the large slotted screw that holds the RANGE STEP control in place and remove the control.

(6) Remove the two countersunk screws at the left side of the panel opening. These screws are near the pilot lights.

(7) Remove the three screws around the RANGE STEP control. One of these screws is on the left and the other two are on the right of the control.

(8) Support the assembly with one hand and remove the two screws on the right-hand side of the chassis below the terminal strips.

(9) Let the rear of the counter assembly drop down. Then slide it back toward the rear of the chassis. This allows the front of the assembly to be pulled downward between the rails of the chassis frame.

(10) The disassembly of the counter assembly is shown in Fig. 7-40. This figure shows the location of all of the parts and the screws and taper pins that hold them in place. A study of this illustration will enable the technician to completely disassemble the gear train. The gears on the counter shafts are split-sprung gears. The gear on the upper counter gear should be sprung one tooth. The lower counter gear should be sprung two teeth. The worm gear assembly on the shaft of the helipot is also a split-sprung gear. It should be sprung two teeth.

(11) The range step switch is a micro-switch mounted at the bottom of the chassis behind the front panel. Its removal is shown in Fig. 7-41. To remove it, disconnect the leads from the lug connectors and remove the two mounting screws. When installing the new switch, be sure to connect the switch leads to the two lugs on one end of the switch.

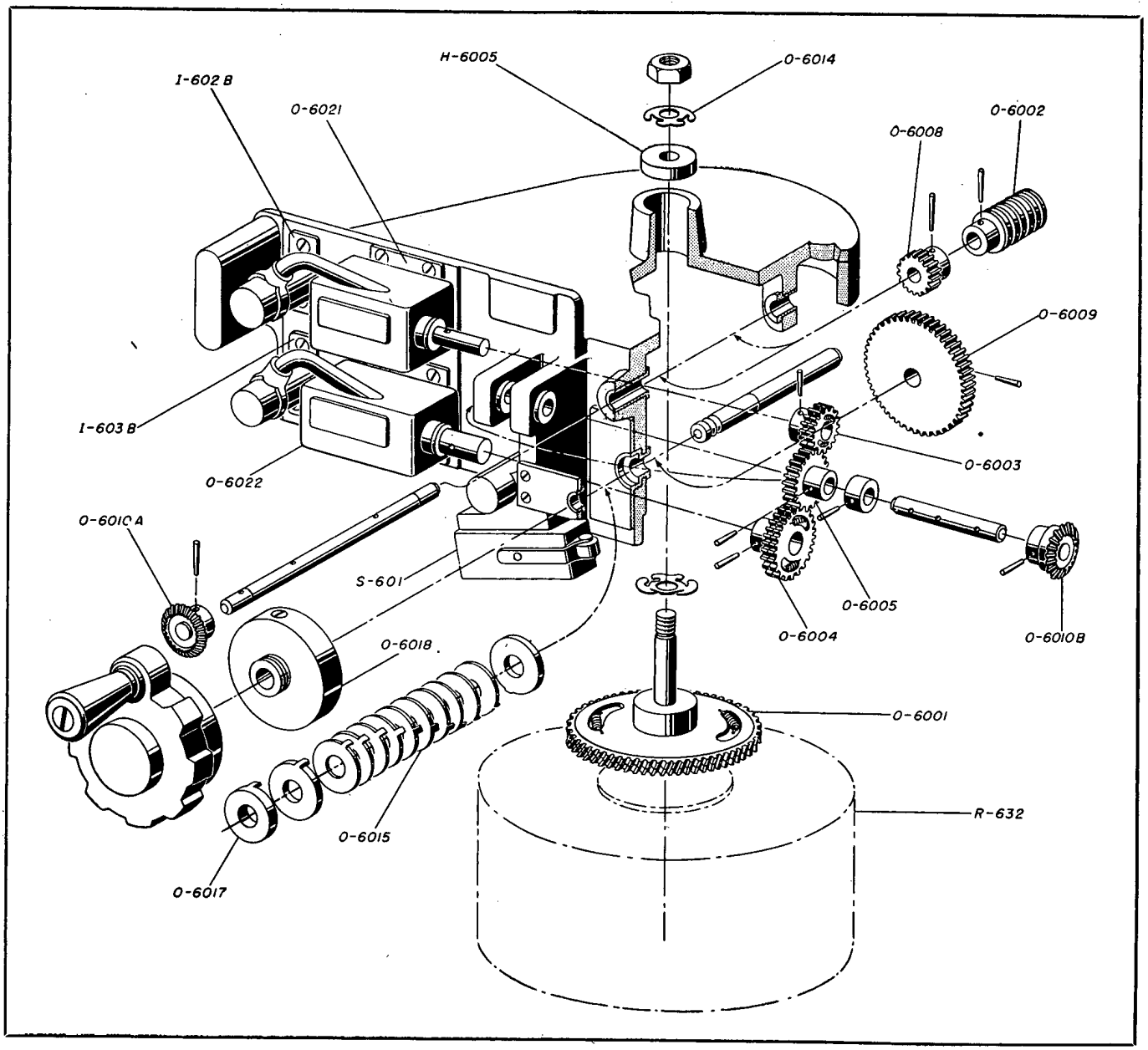


Figure 7-40. Counter Gear Train, Exploded

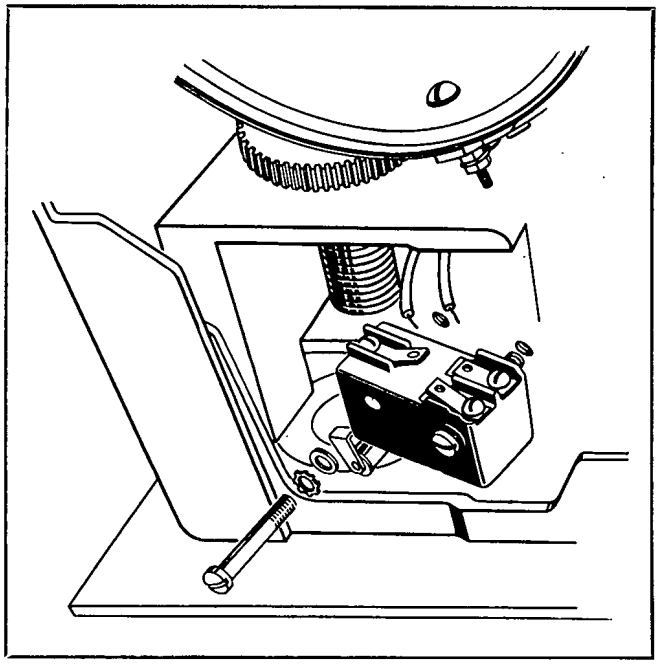


Figure 7-41. Removing Range Step Switch from Range Scope

26. MECHANICAL ADJUSTMENTS IN THE IFF COORDINATOR.

a. GENERAL.

(1) There are no mechanical adjustments to be made in the IFF Coordinator except tensioning the contact springs on the CHALLENGE switch. This is a standard type of key switch. It is properly adjusted at the factory and should require little or no attention other than cleaning. The contacts should be cleaned with an approved solvent if they are very dirty. They should then be wiped clean with a cloth free from lint. If the contacts are very dirty or rough, they should be cleaned with a standard relay burnishing tool. When cleaning contacts in this manner, be sure to clean as much of the entire surface as possible, preserving the original contour of the contact.

(2) If it is necessary to adjust the spring tension, use a tool designed for this purpose if at all possible. If such a tool is not available, use a pair of small duck-billed pliers. Grasp the spring with the pliers as near to the pile-up as possible. Put a slight torque on the pliers in the direction tension is required and slide the pliers along the spring to the other end of it. This will put a slight bow in the spring. Do not kink the spring. Next, grasp the spring again at the pile-up and bend it in the direction tension is required. This will bring the contact together and the increased contact pressure will straighten out the bow in the spring and leave it straight. The springs should be tensioned so that the back springs should follow the *breaking* contact spring a perceptible amount as the contacts open. The *making* contact springs and their back springs should be tensioned so that the back spring is perceptibly forced backward as the contacts come together.

27. MECHANICAL ADJUSTMENTS IN PPI INDICATOR.

a. REPLACING CATHODE RAY TUBE.

(1) Turn off the power and pull the set out of the case about two-thirds of the way. Disconnect the octal socket from the base of the tube. Remove the high voltage anode connector from the bowl of the tube. See Fig. 7-42. *Momentarily ground this snap connector to remove any charge remaining on the power supply capacitors.* Remove the three slotted thumb screws that fasten the molded bezel to the casting. If the tube is being removed from an Indicator with a manually operated Cursor, disconnect the bezel lights plug P-501 from its jack J-506, located on the horizontal shelf to the left of the casting, just in back of the front panel. If the cursor is manually operated, remove it by unscrewing the thumbscrews that hold it in place. See Fig. 7-43. If the cursor is gear driven, unscrew the two thumb-screws on the right-hand side and swing the hinged Cursor back out of the way. See Fig. 7-44.

(2) Loosen the three thumbscrews holding the retaining ring on the front edge of the PPI tube and remove the ring.

(3) Loosen the slotted thumbscrew that holds the clamp around the neck of the tube near its base as

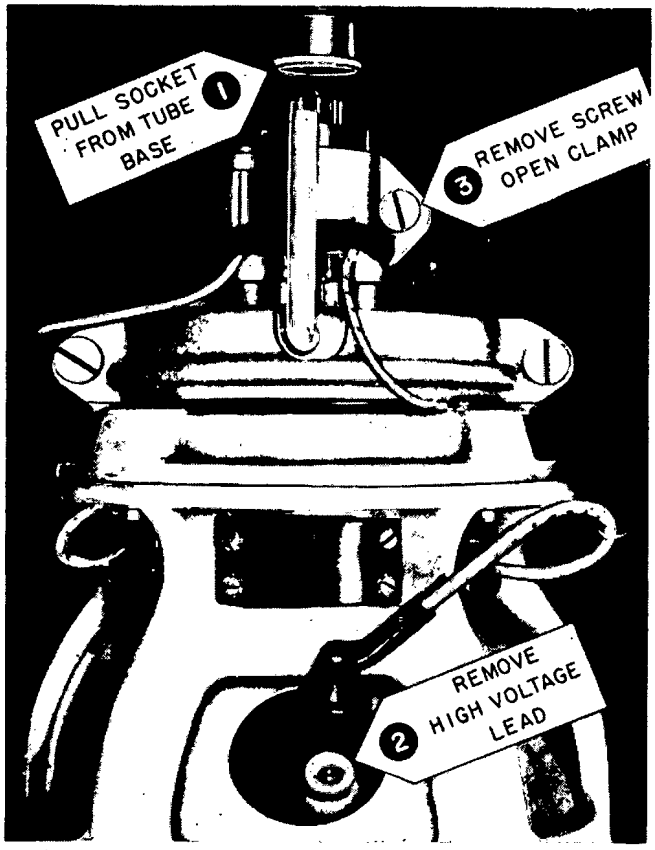


Figure 7-42. Disconnecting Cathode Ray Tube in PPI Indicator

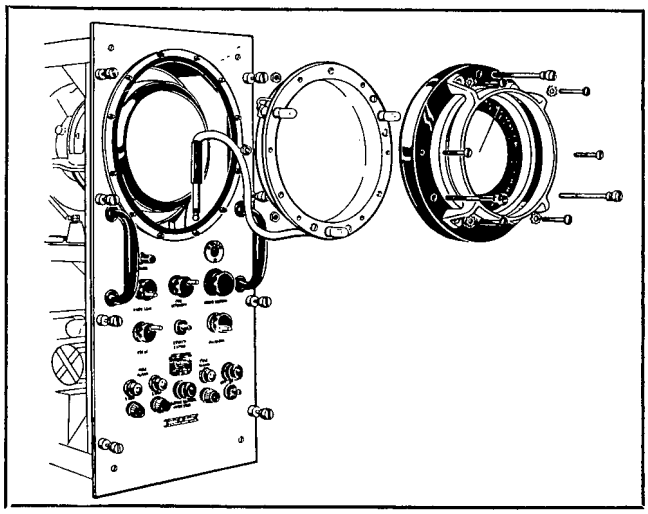


Figure 7-43. Removing Manually Operated Cursor

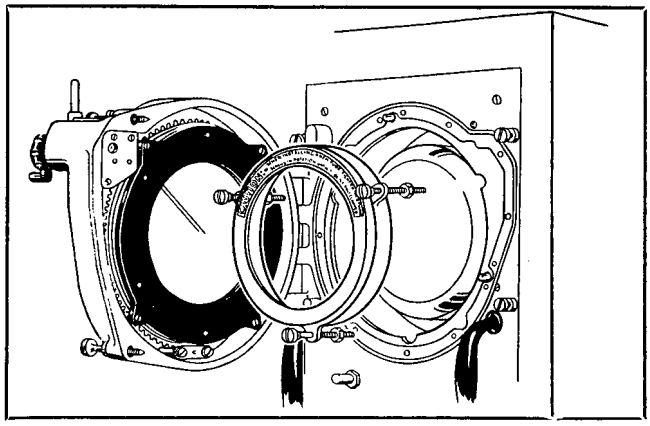


Figure 7-44. Geared Cursor in Position to Permit Removal of Cathode Ray Tube

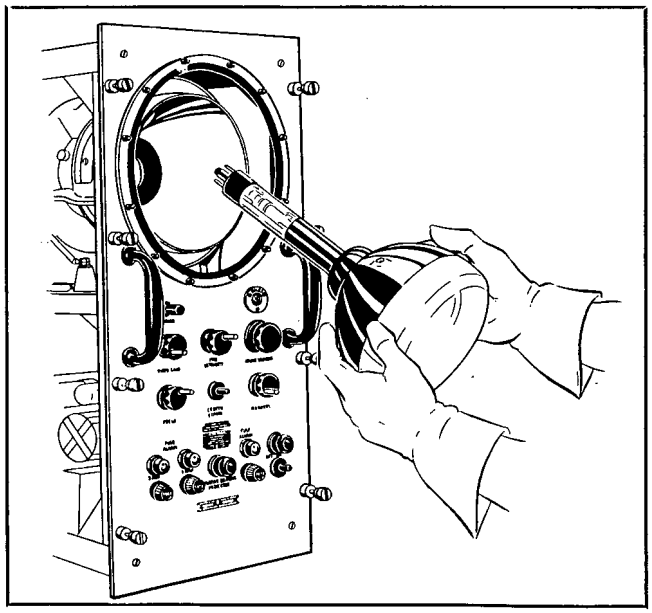


Figure 7-45. Removing Cathode Ray Tube from PPI Indicator

shown in Fig. 7-42. Hold the face of the tube firmly, and open the hinged clamp. The tube can now be removed from the set. The tube must be removed with gloved hands as shown in Fig. 7-45, since there is danger of breakage.

(4) To insert the new tube, use gloved hands. Slide it into the chassis until the bowl of the tube is in contact with the large rubber grommet in the center of the tube shield. Make certain that the high voltage anode pin is accessible through the hole in the top of the tube shield. Push the tube firmly against the grommet and, at the same time, close the hinged clamp on the rear of the tube. Tentatively fasten this clamp tight enough to hold the tube in place while replacing the Cursor. The manually operated Cursor is then pushed back into its rubber retaining ring, and the three slotted thumbscrews tightened until the bezel is back into its normal position and the rubber ring in the bezel is compressed firmly against the rim of the tube face. Tighten the hinged clamp thumbscrews further, being careful not to cause an unreasonable amount of pressure to be placed on the tube neck. If the Indicator has a geared Cursor, replace the retaining rings and then tighten the three thumbscrews firmly but not too tightly; then swing the geared Cursor back into place and tighten the two thumbscrews that hold it. Replace the octal socket on the tube base, the high voltage anode snap connector on the tube bowl, and the dial light plug in the jack from which it was removed.

b. SERVICING THE PPI ASSEMBLY.

(1) The following items may be replaced without unbolting the tube mount assembly from the chassis. Fig. 7-50 shows an exploded view of the PPI Assembly that locates each part in it and shows how they may be removed.

(a) Yoke coil brushes.
(b) Focus coil.
(c) Synchro drive gear.
(d) Yoke coil.
(e) Yoke coil bearing front.
(f) Yoke coil bearing back.
(g) Drive motor.

(2) CHANGING YOKE COIL BRUSHES.

(a) The brush holders are located in recesses at the rear of front casting, one on each side. Unscrew

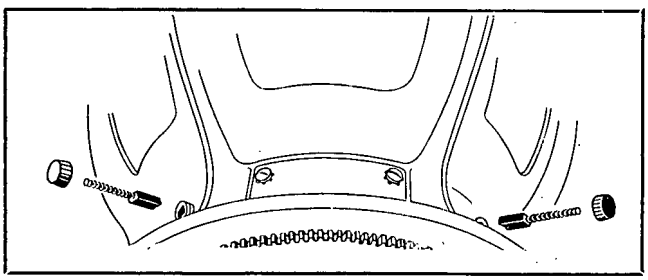


Figure 7-46. Replacing Yoke Coil Brushes

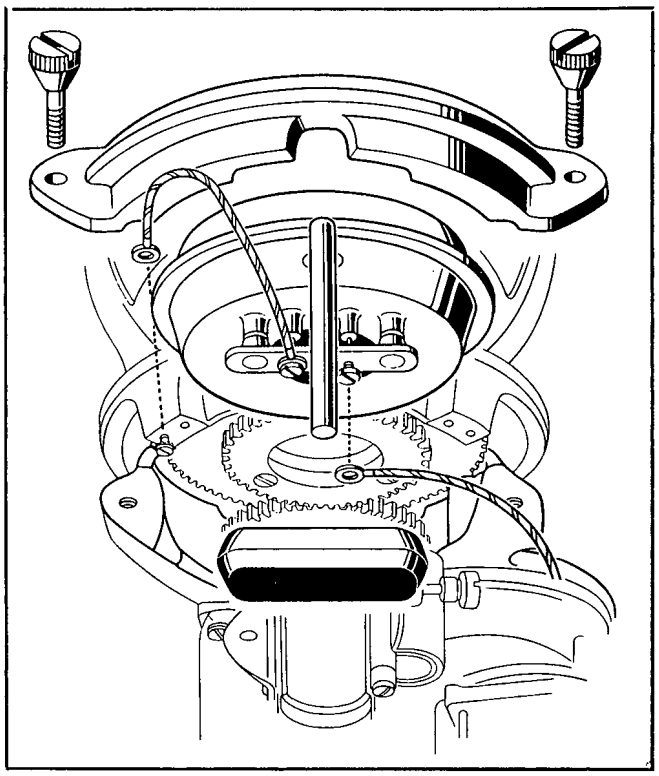


Figure 7-47. Removing Focus Coil

the molded caps and remove the brushes. Replace with new brushes and screw on the caps. See Fig. 7-46.

(3) CHANGING FOCUS COIL.

(a) To remove focus coil, first remove the cathode ray tube. See Par. 27*a* of this section. Loosen the focus coil clamp screws, shown in inset in Fig. 7-113 and remove the two screws that hold each clamp to center casting. Remove clamps. Lift out focus coil. Replace by reversing this procedure. Later models incorporate a single cap clamp held by two thumbscrews as shown in Fig. 7-47. After the focus coil is replaced, it must be adjusted as described in Par. 41*c* of this section.

(4) REMOVING SYNCHRO DRIVE GEAR.

(a) First remove the focus coil. See previous paragraph. Reach into the assembly from the rear and remove the three flat head screws that secure the gear. See Fig. 7-48. Grasp the yoke coil to prevent rotation and turn the gear on coil, pulling lightly on gear. The gear will slide off. Replace by reversing this procedure.

(5) REMOVING YOKE COIL.

(a) Remove the focus coil and synchro drive gear as previously described. Remove the brushes as shown in Fig. 7-48. Unbolt the tube shield and remove it through the front panel as shown in Fig. 7-49. Unbolt bearing retaining ring and remove. Slide the yoke coil forward out of the casting. The front bearing will come out and the coil may be removed by lifting

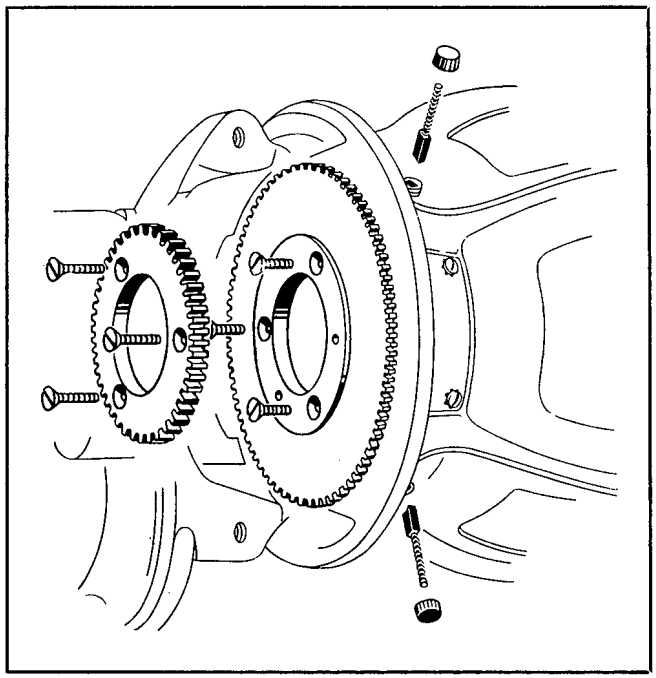


Figure 7-48. Removing Synchro Drive Gear

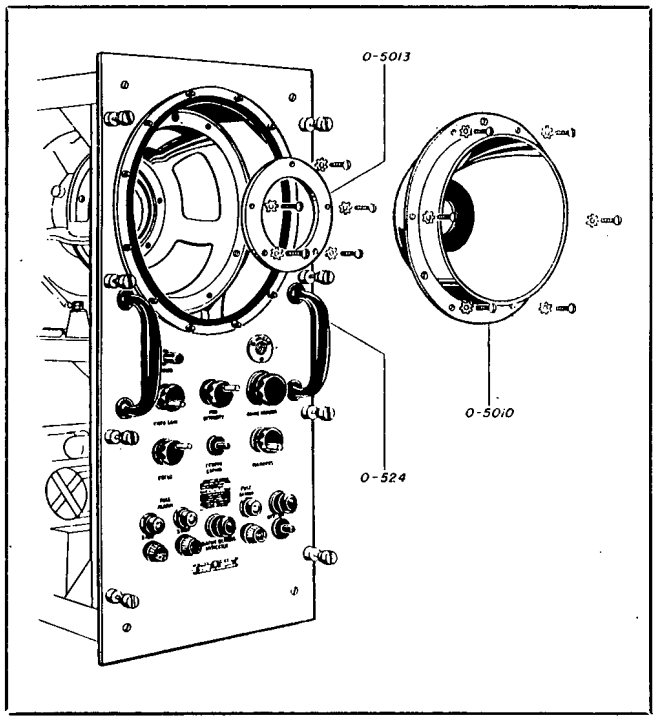


Figure 7-49. Removing PPI Tube Shield and Retaining Ring

the snap ring out of the groove. Slide the bearing off the coil. The rear yoke coil bearing may be removed after the yoke coil is taken out. Place the fingers inside of the bearing and slide it out of the casting. Be careful not to pull unevenly, as this will bind the bearing in the housing. The removal of the yoke coil and its bearings is shown in Fig. 7-51. The coil and bearings are replaced by reversing the above procedure.

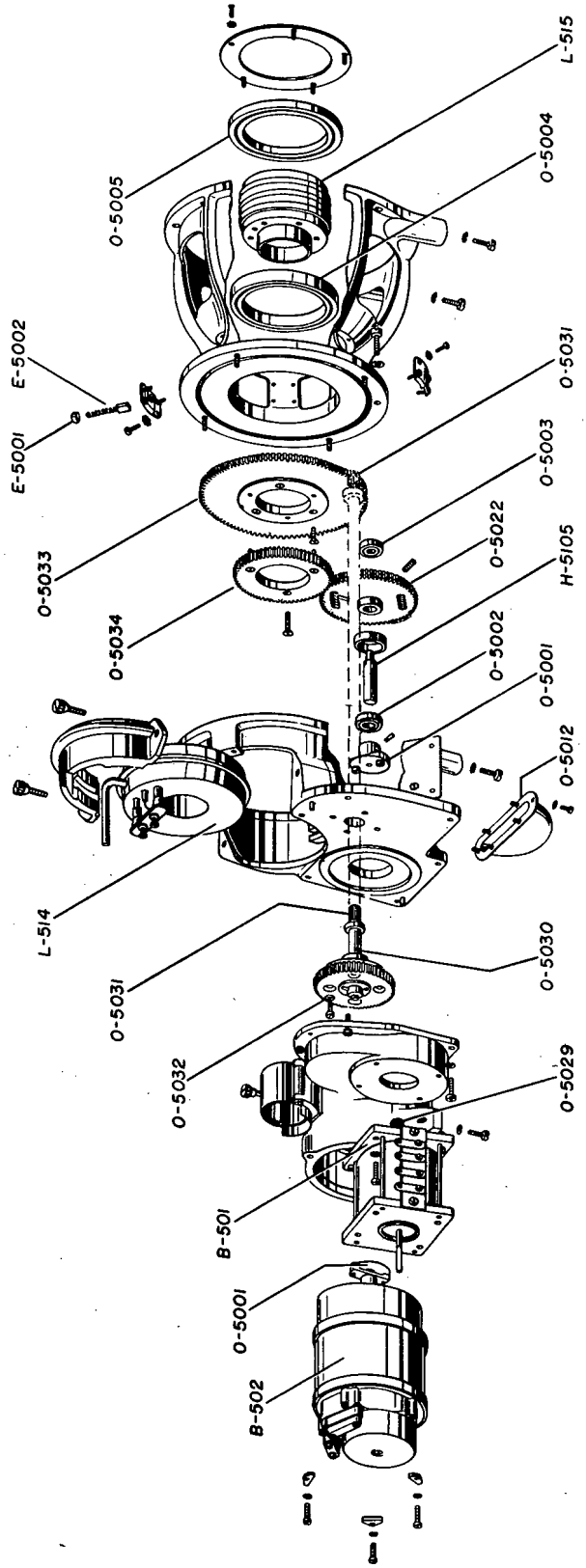


Figure 7-50. PPI Assembly, Exploded View

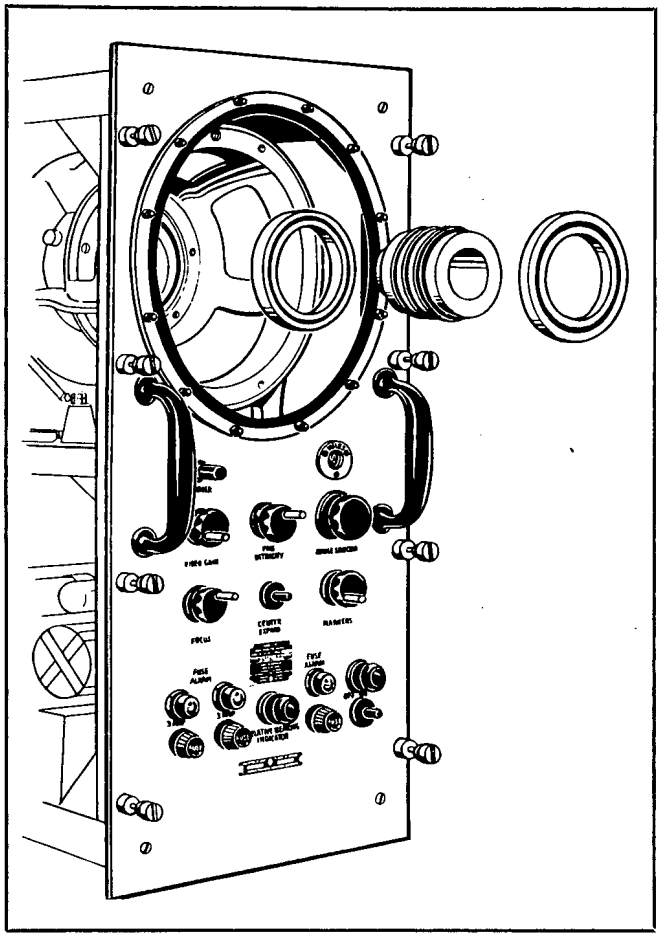


Figure 7-51. Removing Yoke Coil and Bearings

(6) REMOVING DRIVE MOTOR.

(a) To remove the drive motor, disconnect the four connecting leads. Then remove the four screws that mount it to the casting and pull it out of its mounting position. When replacing the drive motor, rock the shaft back and forth with one hand to mesh the pinion on the motor drive shaft with the large spur gear with which it mates.

(7) DISASSEMBLY OF PPI ASSEMBLY.

(a) Complete lubrication requires disassembly of the PPI assembly. The drive motor and Synchro-transformer require no lubrication. To remove any items not listed specifically in the preceding paragraphs, the following procedure which is illustrated in Fig. 7-50 should be employed.

1. Remove the chassis from the case. To do this, unscrew the panel thumbscrews and slide the chassis out as far as it will go. Remove the cable from the terminal board on the right-hand side; press the lock releases; and completely remove the chassis.

2. Remove the cathode ray tube from the assembly as directed in Paragraph 27*a* of this section.

3. Remove the insulated lead as indicated by step A in Fig. 7-52.

4. Remove the thermostat. See step B in Fig. 7-52.

5. Remove brush holders. See step C in Fig. 7-52.

6. Remove the drive motor connections as shown by step D in Fig. 7-52.

7. Remove synchro connections. See step E in Fig. 7-52.

8. Remove the six screws that hold assembly to the chassis. Three of these screws are shown in step F in Fig. 7-52.

9. Lift the assembly out through the left side of the chassis, being careful not to break the high voltage bushing.

10. Loosen the two hex-head cap screws between the plates of the synchro-to-synchro drive gear coupling and remove the nuts, screws, and spacers. See Fig. 7-53.

11. Remove the three fillister head screws and clamps on the back ring of the synchro-transformer. See Fig. 7-50.

12. Slide synchro-transformer out of casting. See Fig. 7-50.

13. Unbolt drive motor from rear casting and remove drive motor and drive motor pinion. See Fig. 7-50.

14. Remove the six fillister head screws holding the rear casting to the center casting. Remove rear casting. See Fig. 7-50.

15. Remove the four binding head screws that secure the jackshaft assembly, through the holes in the web of the 79 tooth micarta gear. See Fig. 7-50.

16. Lift out the jackshaft assembly.

17. Remove the plastic gear guard cover screws and remove the gear guard cover. See Fig. 7-50.

18. Loosen the focus coil clamps and remove clamps and focus coil. See Fig. 7-47.

19. Turn the split synchro drive gear so that the taper pin may be driven out of the gear hub. See Fig. 7-50. Use a punch to recover taper pin.

20. Loosen set screw.

21. Slide split gear shaft out of the assembly and remove the gear. When re-assembling, spring the split gear one tooth to load the springs before engaging with the synchro drive gear mounted on yoke assembly.

22. Remove the four fillister head screws that bolt the front casting to the center casting. See Fig. 7-50.

23. Remove the center casting.

24. Remove the three screws in the synchro drive gear and remove the gear. See Fig. 7-48.

25. Remove the three screws in the yoke-driven gear and remove gear. See Fig. 7-48.

26. Rest the front casting on its feet on the table.

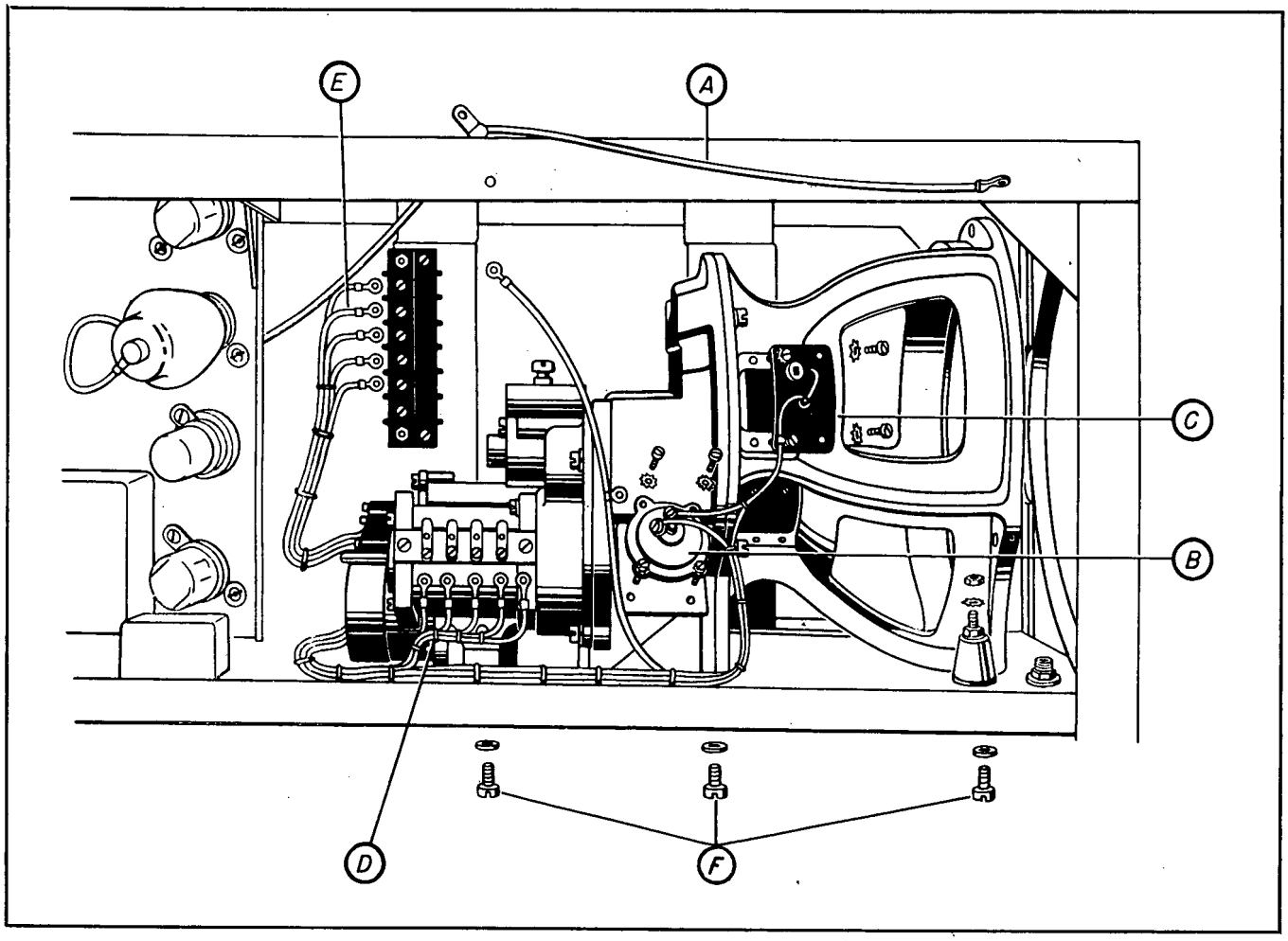


Figure 7-52. Removing PPI Assembly from Chassis

27. Take out the screws securing the tube shield to the front end of the casting and remove the shield. See Fig. 7-49.

28. Take out the five binding head screws from the front yoke bearing retainer ring and remove the ring. See Fig. 7-49.

29. Take off the brush holder caps and remove the brushes. See Fig. 7-46.

30. Slide the yoke toward the large end of the front casting, and remove. This will also remove the front yoke bearing and the dust cover. See Fig. 7-51.

31. Slide out the rear yoke bearing. See Fig. 7-51.

32. Lift the snap ring out of the groove on the front end of the yoke assembly and slide the front yoke bearing and dust cover off the assembly.

33. To dismantle the jack shaft assembly, drive the taper pin out of the 79-tooth micarta gear hub and slide the parts off the pinion shaft.

34. To remove the drive motor pinion from drive motor shaft, hold the pinion and remove the screw from the outer end.

35. To re-assemble the PPI Mount, reverse the procedure given in steps 1 to 34 inclusive. Lubricate the parts as directed in Section 6 before reassembling them.

(8) DISASSEMBLY OF CURSORS.

(a) The manually operated cursor is easily removed as described in the preceding paragraph. The dis-assembly is completed by removing the nuts that hold the dial lamp assembly captive to the cursor casting. The geared cursor disassembly is shown in Figs. 7-54 and 7-55. These figures are self-explanatory. The removal of the filter from the cursor and the removal of the cursor assembly from the front panel are shown in Fig. 7-54. The disassembly of the cursor is shown in Fig. 7-55.

c. CARE OF THE PPI ASSEMBLY.

(1) To assure proper functioning of this assembly the yoke and its drive must rotate freely at all times. The backlash between the drive motor and the yoke must be held to a minimum, as excessive backlash will cause hunting.

(2) The two micarta gears on the jack shaft should be replaced after 10,000 hours of service. All

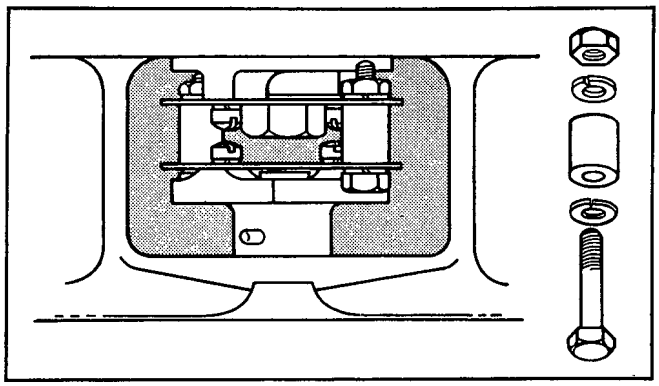


Figure 7-53. Disassembly of Universal Coupling

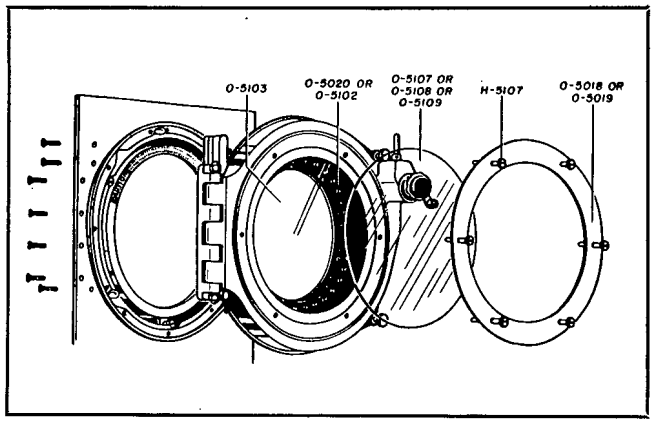


Figure 7-54. Removing Geared Cursor from PPI Indicator

other gearing should last the natural life of the equipment unless damaged.

(3) The yoke coil bearings should be cleaned and lubricated semi-annually, or each time the PPI mount is dis-assembled for any reason. All of the bearings should also be cleaned and lubricated if it is known that they have been subjected to salt water or salt spray. The other bearings should be cleaned and lubricated annually. Use the following method for cleaning and lubrication.

(a) Wash the bearing in a clean bath of grease solvent. This solvent may be carbon tetrachloride, gasoline, or a good grade of kerosene. After the bearing is washed, grasp it so that it cannot rotate and blow it dry with compressed air. If the compressed air is allowed to rotate the bearing at high speed, the bearing races will become scored. Lubricate each bearing with a 1/16 inch diameter drop of Gulf Petrolatum B. There is no Navy Type number assigned to this lubricant. If this lubricant is not available, use Navy Type 2110 oil. However, the bearings should be disassembled, cleaned and lubricated again as soon as the proper lubricant can be obtained.

(b) All of the bearings are lubricated in the same way. The only difference being that the yoke coil bearings are lubricated semi-annually instead of annually. Extreme care must be used when removing and replacing the bearings since they are all hand-press fitted and it is easy to cock the races and cause them to bind. When the bearing has been replaced, test it to see that it turns freely.

(c) The yoke coil is cleaned every three months during preventive maintenance. When the yoke coil is dis-assembled, it should be cleaned with carbon tetrachloride and wiped clean with a dry cloth. Do not leave any of the white deposit that appears when carbon tetrachloride dries. If the rings are rough or dirty after the washing, clean them with a piece of

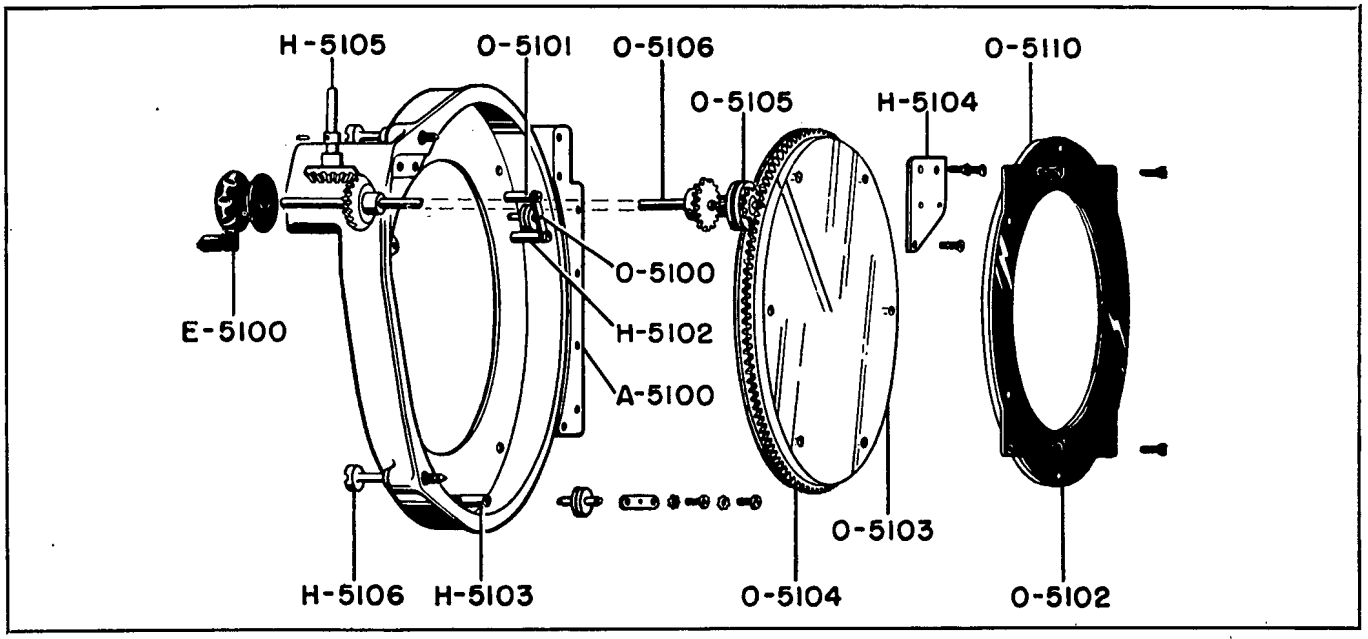


Figure 7-55. Geared Cursor, Exploded View

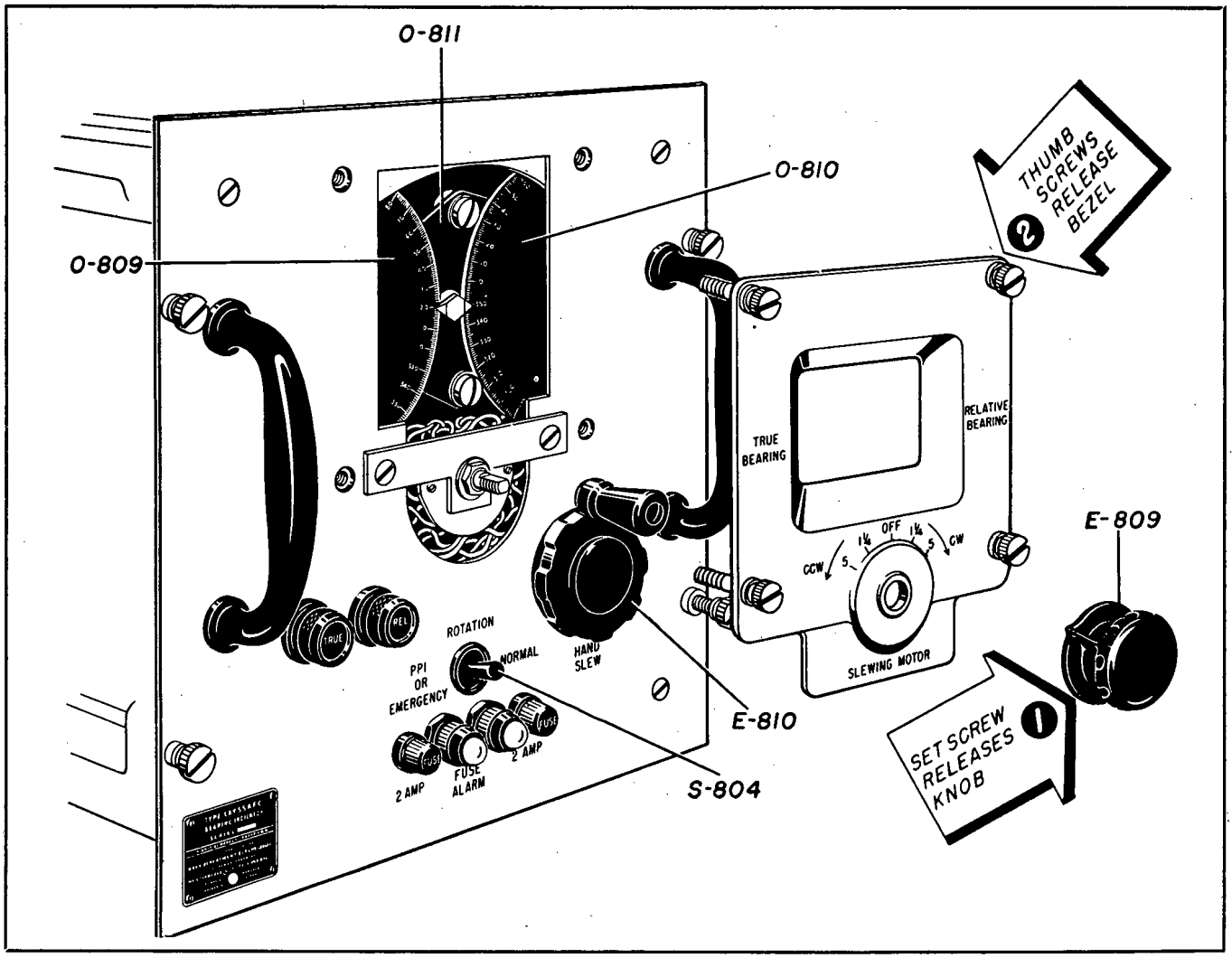


Figure 7-56. Bearing Indicator, Bezel Removed

crocus cloth. Do not use carbon tetrachloride in preventive maintenance since its residue cannot be readily cleaned away.

28. MECHANICAL ADJUSTMENTS IN THE BEARING INDICATOR.

a. REMOVAL OF SYNCHRO UNITS.

(1) The Bearing Indicator is an electro-mechanical device and it requires very little service beyond lubrication and cleaning. If it is necessary to remove one of the synchro units, the method described in the following paragraphs is recommended.

(a) Unscrew the captive thumbscrews that hold the front panel to the Indicator Console case. Pull the chassis out as far as it will go and remove the cable connections.

(b) Push the lock releases and pull the chassis all of the way out of the case, using two men to carry it. Place the chassis on a suitable work bench.

(c) Use an Allen wrench to loosen the two set screws that hold the SLEWING MOTOR knob to its shaft. Remove the knob.

(d) Unscrew the four thumbscrews that hold the bezel to the front panel and remove the bezel. See Fig. 7-56.

(e) Unscrew the two screws that hold the dial index and lift the index assembly straight up and out of the chassis. The index cannot be removed through the opening in the front panel. See Fig. 7-57.

(f) Grasp the dial of the synchro unit to be removed with one hand and use a three-eighths inch, 12 point wrench to loosen and remove the hex nut that holds the dial to the synchro shaft. Remove the key washer. See Fig. 7-58.

(g) Slide the dial forward on the shaft and then lift it up and out from behind the panel. Fig. 7-58 shows the front panel broken away to show the detail of the dial assembly. The dial assemblies cannot be removed through the opening in the panel.

(h) Unlace the cable containing the synchro leads and separate the leads from it. Follow the leads away from the synchro unit to their respective terminals and disconnect them. The leads cannot be disconnected at the synchro units. See Fig. 7-59.

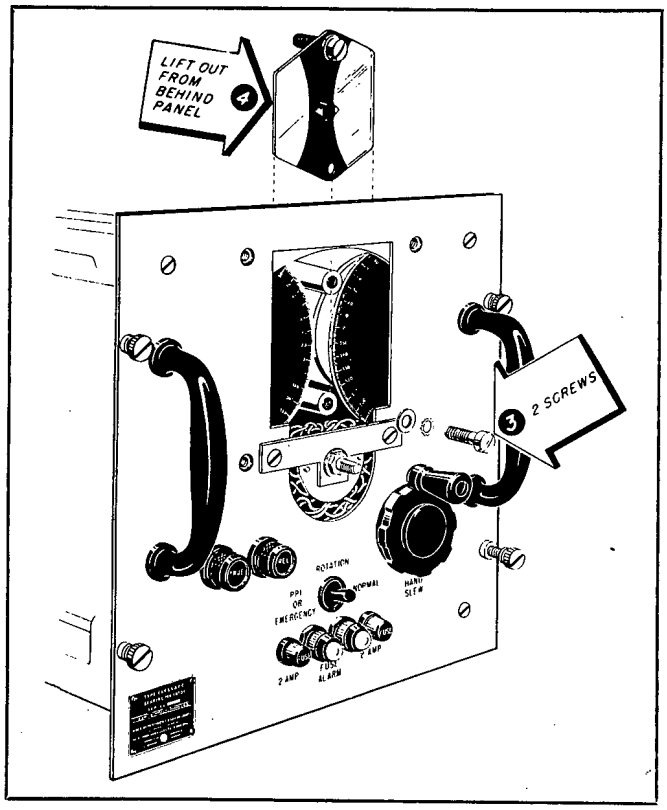


Figure 7-57. Bearing Indicator, Dial Index Removed

(i) Remove the screws and lugs that hold the synchro unit to the plate it butts against and remove the unit. See Fig. 7-59.

(j) Install the new synchro unit by reversing the above procedure.

(2) To remove synchro unit B-803, it is necessary to dis-assemble the universal coupling between the unit and the shaft of the HAND SLEW wheel. This disassembly of this coupling is shown in Fig. 7-53. The synchro unit is then removed from its supporting casting in the manner described in the immediately preceding paragraph.

b. REMOVAL OF SLEWING MECHANISM.

(1) Whenever it is necessary to remove any part of the slewing mechanism, it is easier to remove the entire assembly first and then remove the defective part. The reason for this is the delicate construction of the gears in the gear box. If the drive shaft is bent, the gears in the gear box will be sprung out of alignment and will damage very rapidly as the shaft is rotated. To remove the assembly, refer to Fig. 7-60 and the following procedure.

(a) Remove the chassis from the Indicator Console case and place it on a work bench.

(b) Remove the connections to the motor terminal board by the side of the gear box. Mark each

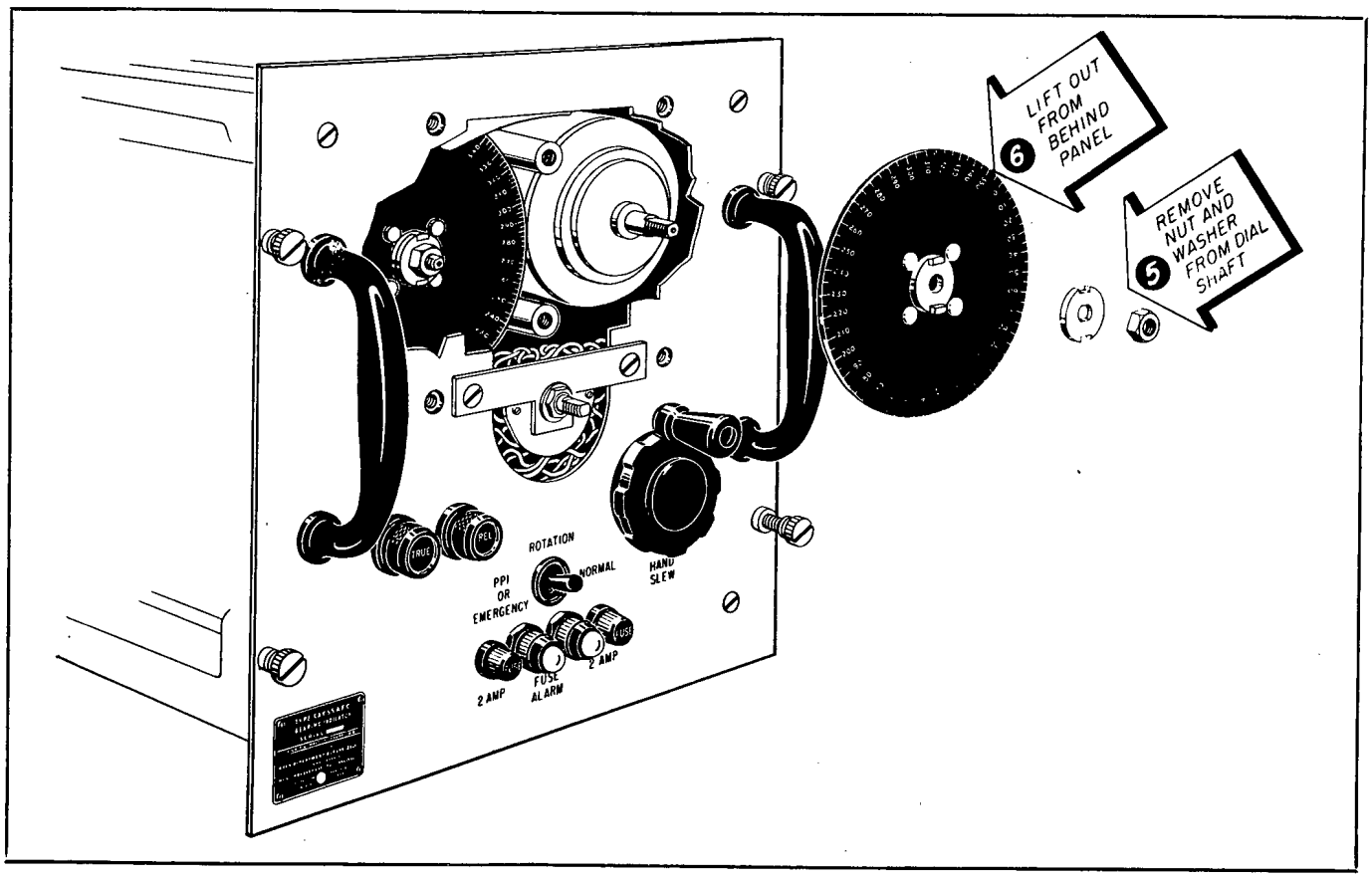


Figure 7-58. Removing Bearing Indicator Dial

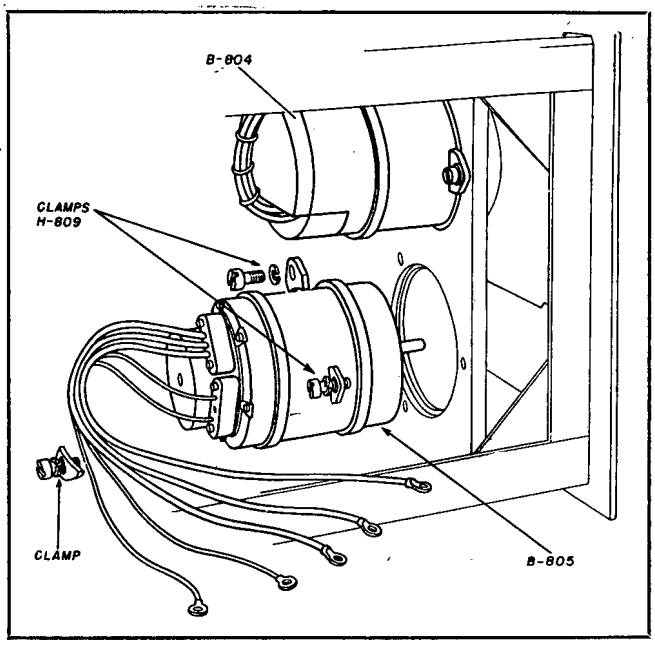


Figure 7-59. Bearing Indicator, Synchro Unit Removed

lead and terminal in some way so that the leads can be reconnected in the correct way.

(c) Turn the chassis over so that it rests on its right hand side, and block it up about one inch from the surface of the table.

(d) Remove the cable clamp inside what is now the top rail of the frame.

(e) Loosen the screws that hold the bedplate, on which the gear box and motor are mounted, to the frame. Do not take the screws out.

(f) Carefully remove and count the shims under each screw. Mark the number of shims counted near each screw. Finish removing the screws.

(g) Remove the three large screws that hold the gear assembly to the plate behind the front panel. Support the shaft with one hand.

(h) Push the bottom of the bedplate toward the center of the chassis allowing it to drop down to the surface of the table. This permits the top of the bedplate to clear the rail so that it can be swung outward. Next, lift the entire assembly out and away from the chassis. The steps just described are illustrated in Fig. 7-60.

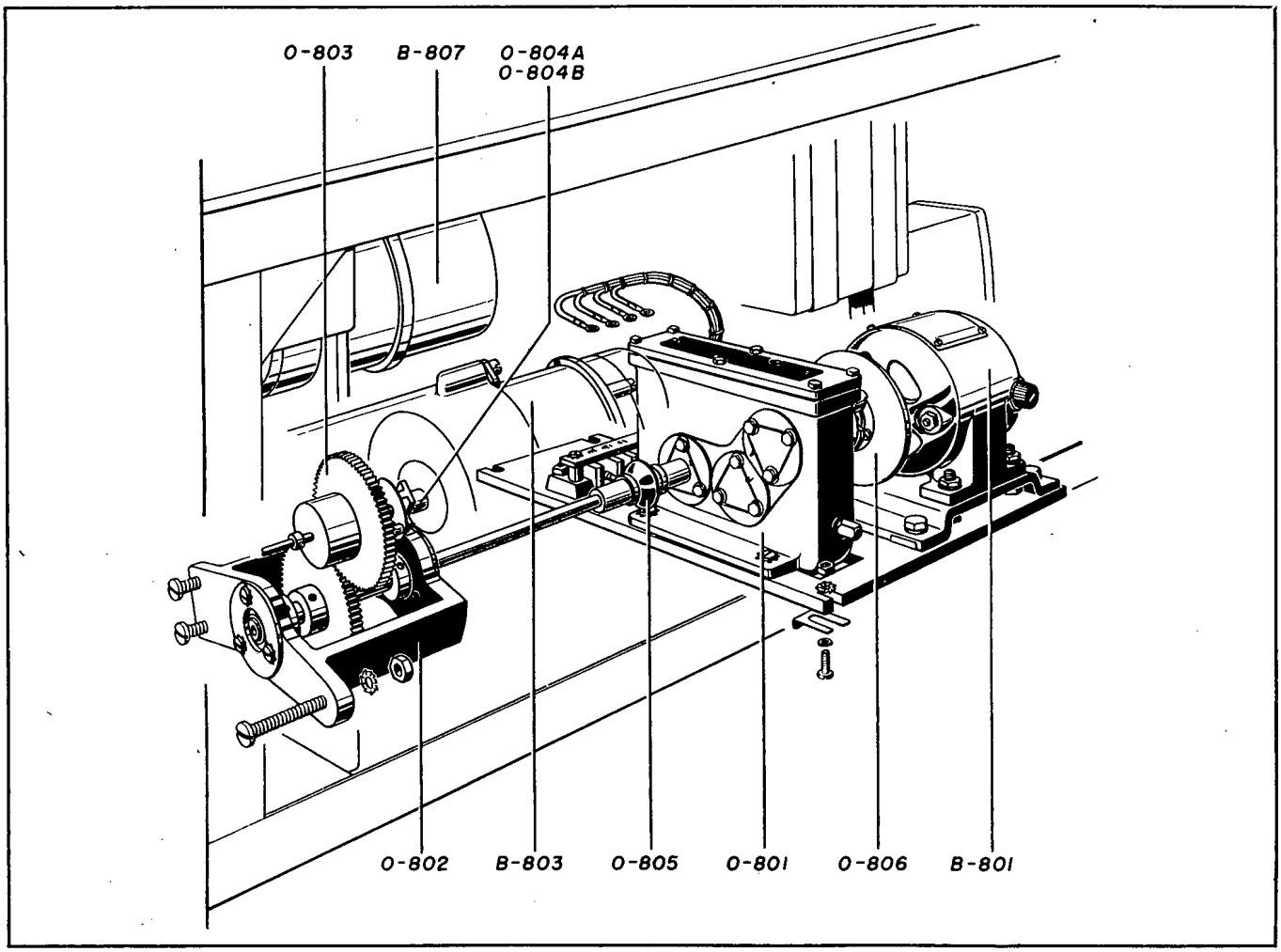


Figure 7-60. Removing Slewing Mechanism from Bearing Indicator

(i) Place the assembly on a flat surface with the gear bracket resting on a block so as not to bend the shaft or spring the gears in the gear box.

(j) The component parts can now be removed as shown in Fig. 7-61. This figure is an exploded view. Note that most of the parts are fastened to the shafts with taper pins. The shafts should rest on something solid so that they will lie perfectly straight and in alignment when the pins are to be driven out. The pins should be removed carefully with a suitable punch so as not to bend or damage any of the parts.

(k) It is not advisable to attempt to replace any of the gears in the gear box. Defective gear boxes should be replaced with new gear boxes from spare parts. It is difficult to replace the gears in the gear box and obtain the precision alignment necessary without special tools and equipment.

c. SERVICING OF SLEWING MECHANISM.

(1) When the assembly is reassembled, it should be lubricated. Lubrication is described in Section 6. Briefly, the gear box should be lubricated with three drops of Navy Type 2110 oil in each hole on top of the box. The gear in the bracket should be wiped with light Navy grease. Do not leave any surplus on the gear. The drive motor should be lubricated with ANDOK-C grease or its equivalent. To do this, remove the set screws over the bearings and force grease into the bearings until they are full.

(2) The brushes on the drive motor should be inspected before the assembly is replaced unless it is known that they have just recently been inspected. To do this, unscrew the caps on the brush holders and remove the brush springs and brushes. If there is not more than one quarter of an inch of the active brush material remaining, it will be necessary to replace the brush. If the old brush is replaced, be sure to install the brush back in the holder in the same way that it came out.

(3) Replace the slewing assembly, reversing the procedure used to remove it. Be sure to replace the correct number of shims under each bolt in the bedplate. This insures that the assembly is correctly aligned. Carefully check the alignment if a new gear box has been installed. Watch the rubber covered universal joint to see whether any unusual amount of wobble appears. Listen to the gear box and also see if any evidence of binding can be felt in the shaft when it is turned. It may be necessary to change the arrangement of the shims in order to align the assembly properly. The slewing mechanism is shown in exploded form in Fig. 7-61. This figure shows each moving part in its relation to the other parts.

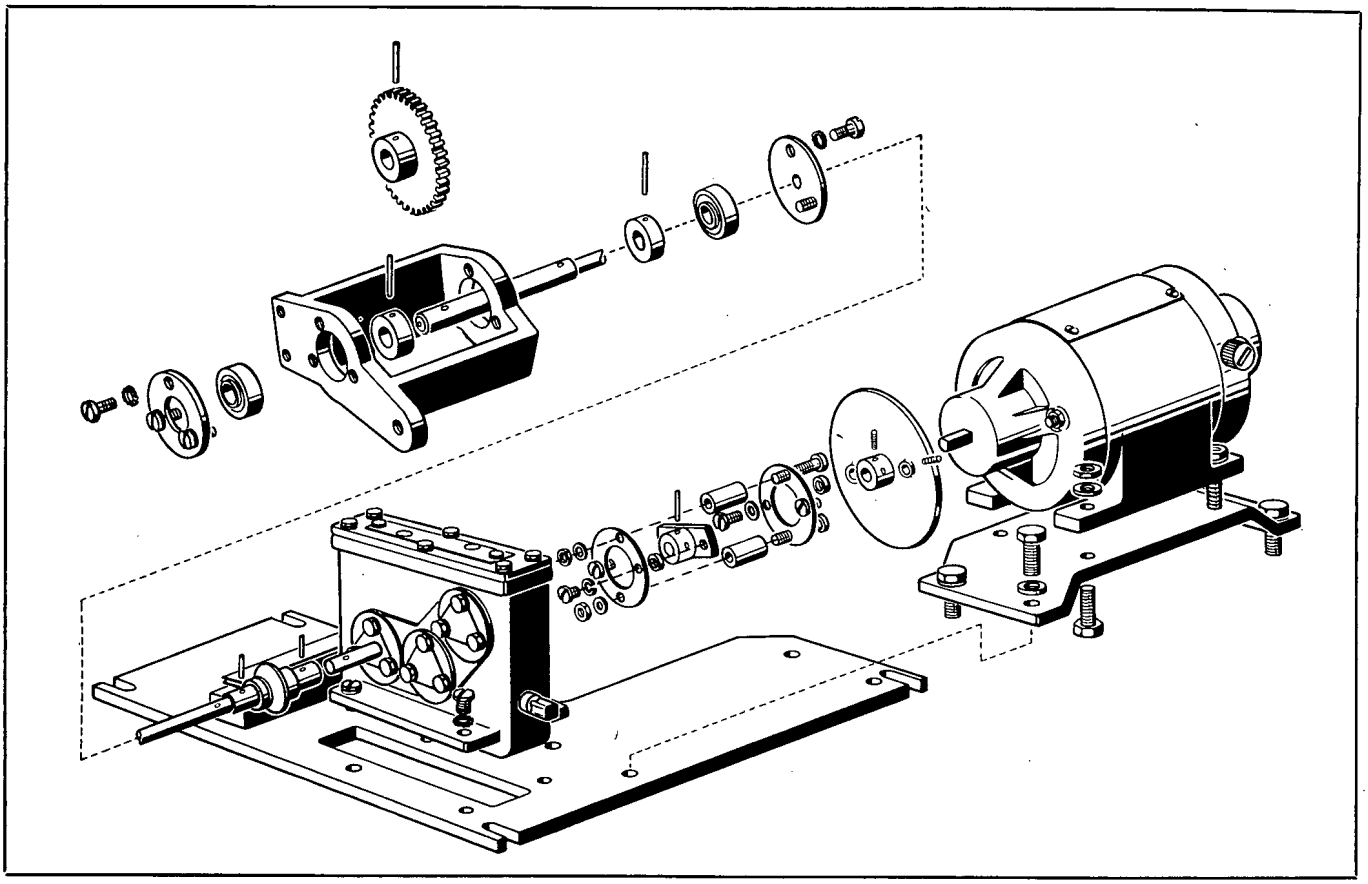


Figure 7-61. Slewing Mechanism, Exploded View

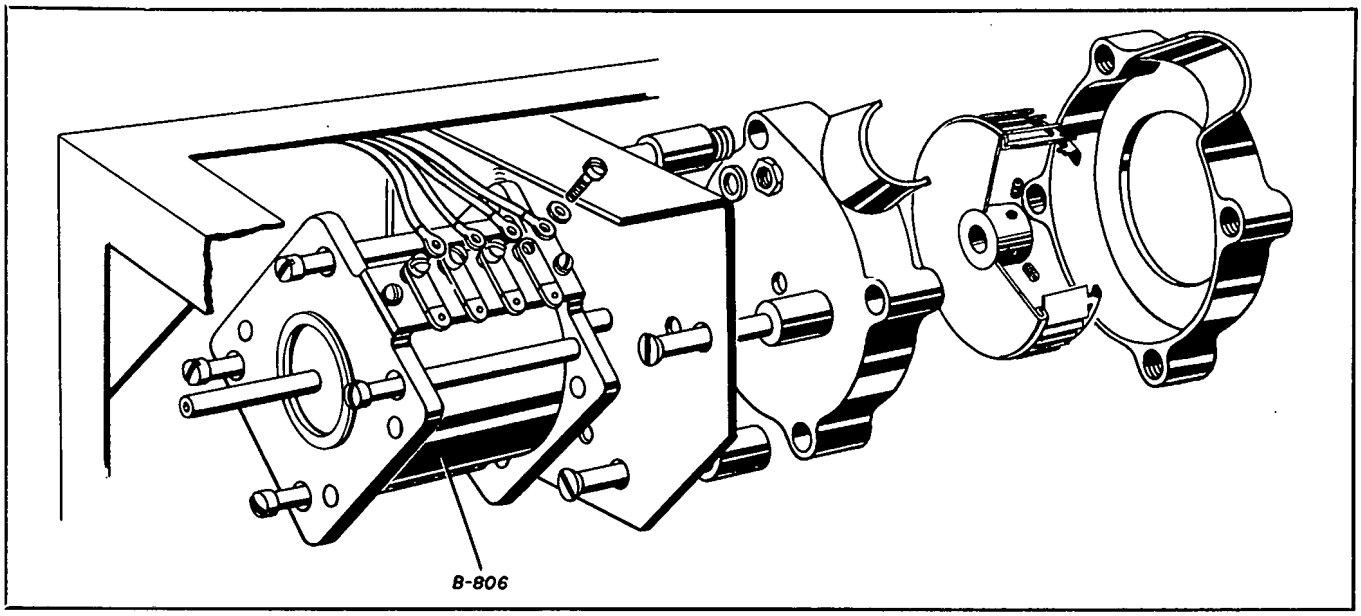


*Figure 7-62. Fan and Fan Motor, Exploded View

(4) The fan motor and fan are mounted in the rear of the Bearing Indicator. The fan motor contains no brushes and is permanently lubricated. To remove the motor, it is first necessary to remove the fan housing and fan. The recommended procedure is given as follows:

(a) Loosen the motor mounting screws. See Fig. 7-62. These screws are held by hex nuts. One of these nuts is visible between the fan housing and the gusset in the figure.

(b) Unscrew and remove the fan housing mounting screws. When these screws are removed, the outside portion of the fan housing can be removed.

(c) Use an Allen wrench to loosen the set screws that hold the fan to the motor shaft. Remove the fan.

(d) The motor and the other half of the fan housing may now be lifted out.

(e) Reassemble the fan assembly by reversing the above procedure.

29. MECHANICAL ADJUSTMENTS IN THE GENERAL CONTROL UNIT.

a. The only mechanical adjustments in the General Control Unit are those that may be required by the fan and fan motor. The fan and fan motor are similar to the fan in the Bearing Indicator. The disassembly of this fan was described in Paragraph 28*c*(4) of this section. It is illustrated in Fig. 7-62.

30. MECHANICAL ADJUSTMENTS IN THE ROTATION CONTROL UNIT.

a. GENERAL.

(1) The Rotation Control Unit consists of the Servo Amplifier and the Rectifier Power Unit in one case. The Servo Amplifier is constructed with a vertically placed chassis and all parts are accessible when it is removed from the case. Most of the parts are accessible without completely removing it from the chassis. There are no complicated mechanical assemblies in the Servo Amplifier. The relays are readily accessible and are easily removed.

b. REMOVAL OF DRY DISC RECTIFIERS.

(1) The Rectifier Power Unit has two assemblies that are not easily removed unless the correct procedure is followed. One of these assemblies is the dry disc rectifiers mounted on the rear of the unit as shown in Fig. 7-63. To remove any or all of the rectifiers it is necessary to completely remove the Rectifier Power Unit from the Rotation Control Unit case. The con-

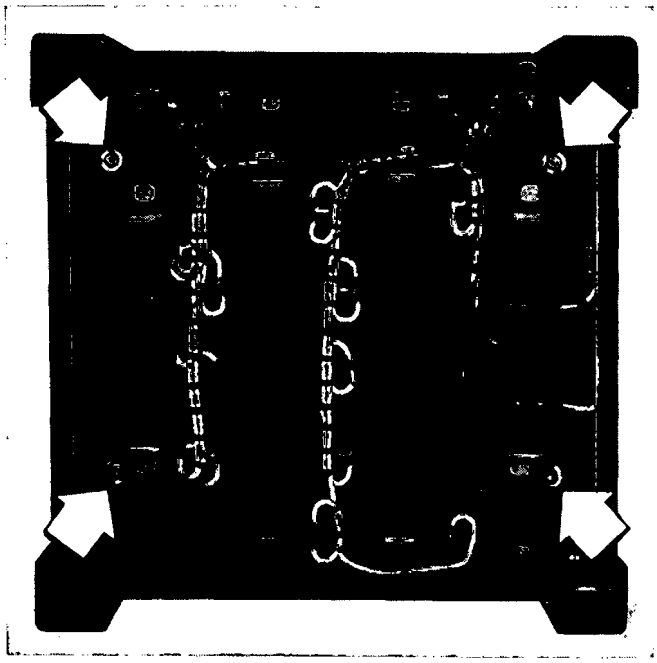


Figure 7-63. Dry Disc Rectifier in Rectifier Power Unit

necting cable must be removed from the side of the chassis and the small access plate in the front of the case on the cable side must be removed to permit sufficient clearance for the cable when the unit is pulled all the way out. After removing the Rectifier Power Unit, place it in some convenient position, disconnect the connecting leads behind the assembly, and remove the four assembly nuts shown in Fig. 7-63. Then pull the entire assembly straight out from the rear of the chassis. It is recommended that all four rectifiers be changed at the same time. However, it is permissible to change the two small rectifiers or the two large rectifiers. Never change a rectifier without also changing its mate. When it is necessary to disconnect leads from rectifiers, mark the leads carefully, identifying them so that they may be connected to the new rectifiers in the same way that they were originally connected. There is no occasion to disassemble a rectifier. If the assembly nuts that hold them together are loosened, the rectifiers may be irreparably damaged. After the assembly is removed, remove the top outside nuts on the rectifiers. These nuts are the ones visible in Fig. 7-63 at the top of the unit. Then remove the fillister head screws that hold the terminal strip to the metal side of the frame and remove the terminal strip. Next remove the bottom outside nuts from the rectifiers to be removed. This permits the defective rectifiers to be removed. The replacements are installed in the reverse order.

c. REMOVAL OF FAN AND MOTOR ASSEMBLY.

(1) The fan and fan motor assembly is located directly behind the rectifier assembly. When the nuts on the four motor mounting bolts are removed, the fan and motor assembly can be lifted out through the top of the chassis. To remove the fan and motor, disconnect the motor leads at relay L-1101. Then remove the cable clamp mounted on the terminal board of transformer T-1104, and unlace the cord that holds the vinylite sheet around the laced cable. Remove the vinylite sheet and free the motor leads from the laced cable. The motor leads are held to the cable with two laces. Next remove the nuts from the mounting bolts. The motor may now be lifted out. When replacing the fan motor, be sure that the fan is properly mounted on the shaft and that the set screws are tight enough not to come loose. Place the fan in position, tighten the nuts on the mounting bolts to finger tightness and rotate the fan by hand to see that it is properly centered in the fan housing. Adjust the position of the fan until the fan is properly centered. Then tighten the assembly nuts and recheck the position of the fan. Finally, replace the motor leads and replace the vinylite sheet, lace it, and replace the cable clamp.

31. MECHANICAL ADJUSTMENTS IN THE SERVO GENERATOR.

a. There are no adjustments in the Servo Generator. The a-c drive motor and the generator-exciter unit are assembled together in such a way that either unit may be replaced. To replace one of the units or to repair a defective coupling between them, remove the cover to the junction box and disconnect the leads to the unit being removed. Then remove the four mounting screws that hold the terminal board in place and pull it forward so that the mounting screws that hold the junction box casting may be removed. Next use a socket wrench to remove the assembly bolts that hold the two units together. Then remove the nuts on the base mounting bolts in the base of the unit to be removed. Lift the unit out of position. The new unit can now be installed by reversing the above procedure. When installing the new unit or when repairing or replacing the coupling between the units, be sure that the shafts of the units are positioned properly for the coupling to go together when the unit is pushed into position.

32. MECHANICAL ADJUSTMENTS IN THE SYNCHRO AMPLIFIER.

a. GENERAL.

(1) The Synchro Amplifier consists of two units. The only unit requiring mechanical adjustments and containing parts difficult to remove, is the Synchro Unit. The adjustment of the synchro control transformers in the Synchro Unit is a mechanical adjustment but, since it involves voltage measurements and is closely related with the alignment of the antenna positioning system, this adjustment must be performed as a part of the general orientation. Access to the Synchro unit is gained by removing the lower cover over the commutator-transformer and gear train.

b. ADJUSTMENTS IN LOWER COMPARTMENT.

(1) There should be no occasion to perform any service in the lower compartment except to lubricate the gear train, change or adjust the brushes, and in extreme cases to zero the synchro units. The gear train includes the one- and 36-speed speed control transformers and the commutator brush assemblies. Electrical zero for both the control transformers and the commutator brushes has been set at the factory, after which the gear train was pinned so as to maintain the relative position between the one- and 36-speed control transformers and brushes. If the gear train has been disturbed for some reason, the brushes can be reset by removing the idler gear and zeroing the gear train. After the idler gear has been removed, clamp the 36-speed brush assembly on electrical zero. In this position the #2 brush is at the top of the commutator transformer and is nearest the potential of that end

of the transformer. The voltage between the #1 and #3 brushes should read zero. Turn the one-speed brush assembly to its zero position, replace the idler gear, and remove the clamp from the 36-speed brush assembly.

(2) If it is necessary to zero the synchro control transformers, clamp the 36-speed brush assembly in its zero position as directed in the preceding paragraph. Connect the R2, S1 and S3 leads of each synchro to one side of a 78-volt source. Then connect the S2 lead to the other side of the 78-volt source. Connect a voltmeter to the R1 and S2 leads and rotate the stator of the synchro to the point where the highest voltage reading is obtained. Then rotate the stator 90 degrees counterclockwise. Disconnect the voltmeter and disconnect the R2 lead from the 78-volt source. Reconnect the voltmeter to the R1 and R2 terminals on the 36-speed synchro. Rotate the stator until minimum voltage is obtained on the meter. Clamp the stator in this position.

(3) To accurately zero the one-speed synchro, disconnect the LR2 terminal from the 78-volt source and connect a voltmeter between terminals LR1 and LR2. Connect a 115-volt source to terminals M3 and M4 on the terminal board in the Synchro Unit. Connect terminal M3 to terminal LS2. Rotate the stator until a minimum voltage reading is obtained and clamp the stator in this position. Remove the clamp on the 36-speed brush assembly. The synchro adjustments are shown in Fig. 7-64.

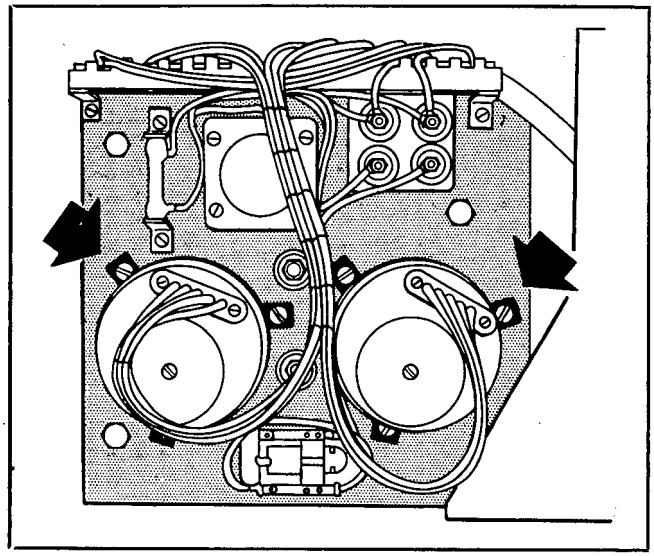


Figure 7-64. Synchro Adjustments in Synchro Amplifier

33. MECHANICAL ADJUSTMENTS IN ANTENNA PEDESTAL.

a. GENERAL.--

(1) There are no periodic adjustments to be made in the Antenna Pedestal. Once the DG synchro units have been properly zeroed, there should be no occasion to change the adjustment unless one of them is replaced. Aside from lubrication and care of the brushes, all service is of a nature that requires mechanical disassembly of some portion of the Antenna Pedestal. Since the disassembly is complicated in some instances, detailed mechanical procedures are given. The tools required to service the Pedestal are shown in Fig. 7-65. It must be emphasized, that before any service is performed, the quick access door shown in Fig. 7-66 must be opened and the motor disconnect plug shown in Fig. 7-67 must be removed. This prevents accidental application of power to the drive motor circuits from suddenly rotating the Antenna Pedestal.

b. SYNCHROTIE ASSEMBLY.

(1) To remove a synchrotie assembly, remove the plug from the rear end of the drive motor and insert the handcrank shown in Fig. 7-68, making sure that the tongue on the crankshaft engages the groove in the motor shaft.

(2) Loosen the captive fillister head screws in the end of the synchrotie inspection door Fig. 7-68, pull the door away from the housing until all screws are clear and lower the door on its hinges.

(3) Rotate the handcrank until the desired synchrotie is directly below the domed recess in the synchrotie cover. The dome may be seen on top of this cover in Fig. 7-66.

(4) Disconnect the six lead wires from the terminal block, and coil the wires around the synchrotie. The terminal block is shown in Fig. 7-69.

(5) Remove the three screws which hold the synchrotie clamp ring, shown in Fig. 7-69, in place and lift the clamp ring until the screws are free.

(6) Lift the synchrotie straight up until its top is in the domed recess, tilt the bottom end forward and remove the synchrotie through the inspection door.

(7) To replace a synchrotie from which the driving arm (see Fig. 7-69) has been removed, or to install a new synchrotie, remove the hex nut from the synchrotie shaft. With the woodruff key in place, slide the driving arm assembly on the shaft.

(8) Place the lockwasher and hex nut on the shaft. Hold the shaft to keep it from turning and tighten the nut.

(9) Place the clamp ring retainer (Fig. 7-69) over the upper flange on the synchrotie and lay the two halves of the clamp ring (see Fig. 7-69) in the ring retainer. Place the screws and lockwashers through the retainer and clamp rings and close the three rings around each screw.

(10) Replace the synchrotie in the synchrotie bracket. Make sure that the driving pin enters the slot in the lower half of the coupling and is between the button and plunger. (See Fig. 7-70.) Be sure the pilot diameter of the synchrotie is registered in the bore of the synchrotie bracket.

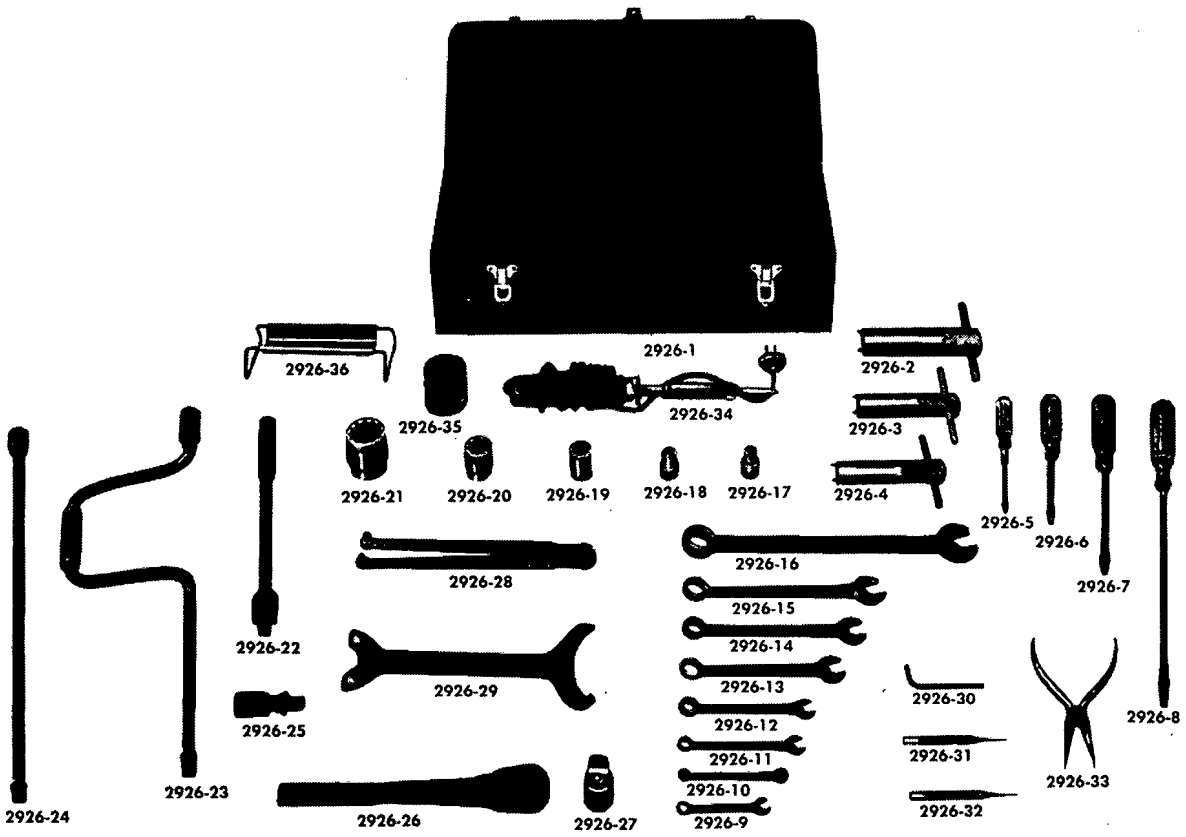


Figure 7-65. Antenna Pedestal Tools

(11) Have the lead wires long enough to reach the terminal block when the synchrotie is turned 360°. Cut the wires to length, strip the insulation and solder a terminal lug to each wire. Lace the wires into braided form and connect to the terminal block (shown in Fig. 7-69) according to the wiring diagram in Fig. 7-179.

(12) Remove the handcrank from the motor shaft and replace the motor plug. Replace disconnect plug in the pedestal base and close the access door.

c. SYNCHROTIE BRACKET ASSEMBLY.

(1) After removing the disconnect plug in the pedestal base, remove the plug from the rear end of the drive motor and insert the handcrank. Make sure that the tongue on the crankshaft engages the groove in the motor shaft. The disconnect plug is shown in Fig. 7-67. The plug on the motor, and the handcrank are shown in Fig. 7-68.

(2) Loosen the captive fillister head screws in the edge of the synchrotie inspection door, pull the door away from the housing until all screws are clear, and lower the door on its hinges. This door is shown in Fig. 7-68.

(3) Turn the unit with the handcrank until the inspection door is in line with the front of the synchroties. The antenna faces forward in this position.

(4) Disconnect the five wires on each terminal block, which lead to the rear of the synchrotie bracket. These leads are shown in Fig. 7-69. Then loosen the wire clamp strips on each side of the bracket so the leads can be pulled out.

(5) Rotate the unit 180 degrees with the handcrank so the inspection door lines up with the rear of the synchrotie bracket.

(6) Remove the safety wires from the hex head captive screws on each side of the synchrotie bracket cap. Loosen the screws as far as possible.

(7) Rotate the unit 180 degrees with the handcrank so the inspection door is again in line with the synchroties.

(8) Remove the square headed positioning dowel in the center of the bracket. The positioning dowel is shown in Fig. 7-69. Hold the assembly against the post and loosen as far as possible the captive hex head screw immediately above the positioning dowel.

(9) Grasp the synchrotie assembly firmly in both

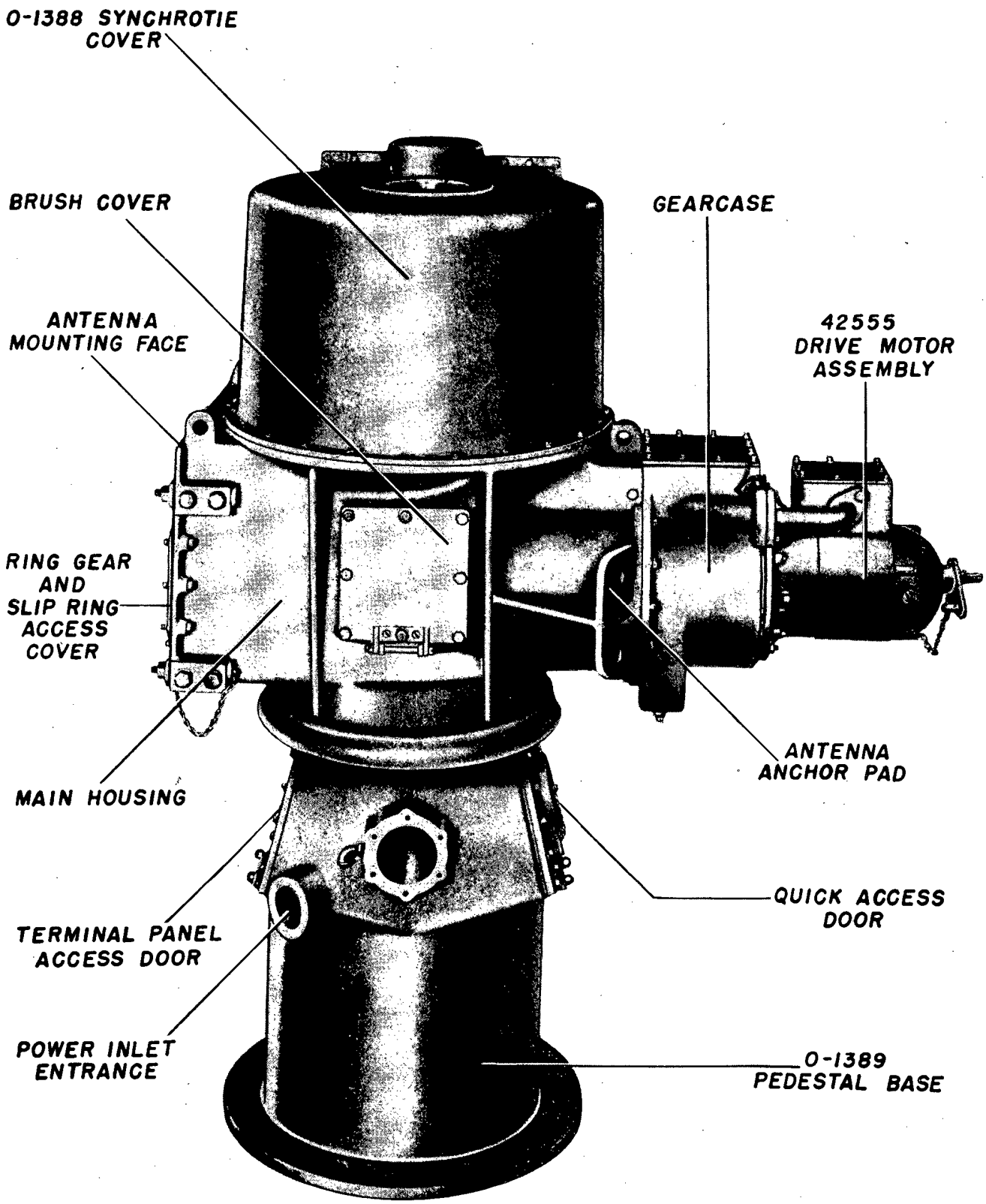


Figure 7-66. Antenna Pedestal, Right Side View

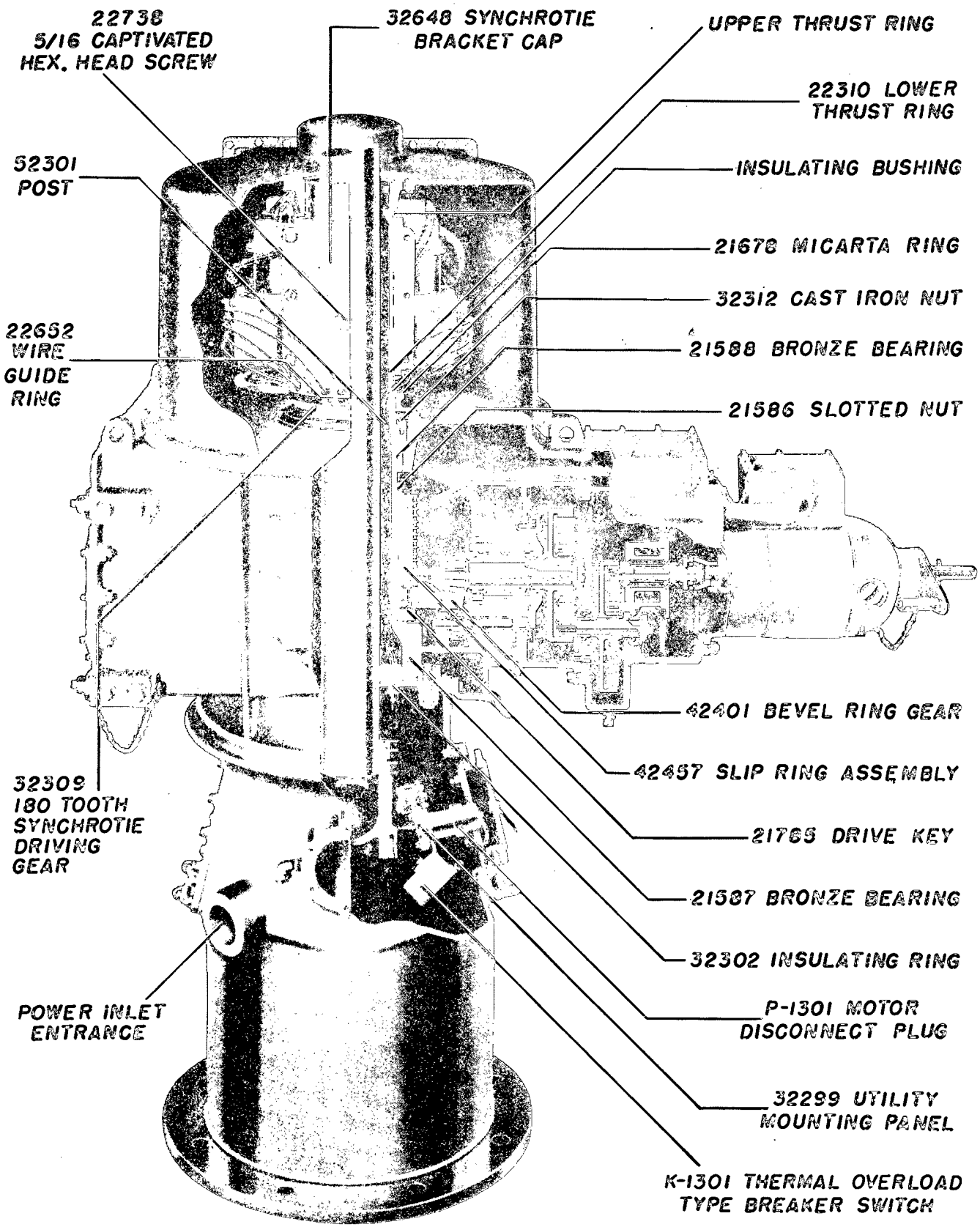


Figure 7-67. Antenna Pedestal, Cut-away View of Right Side

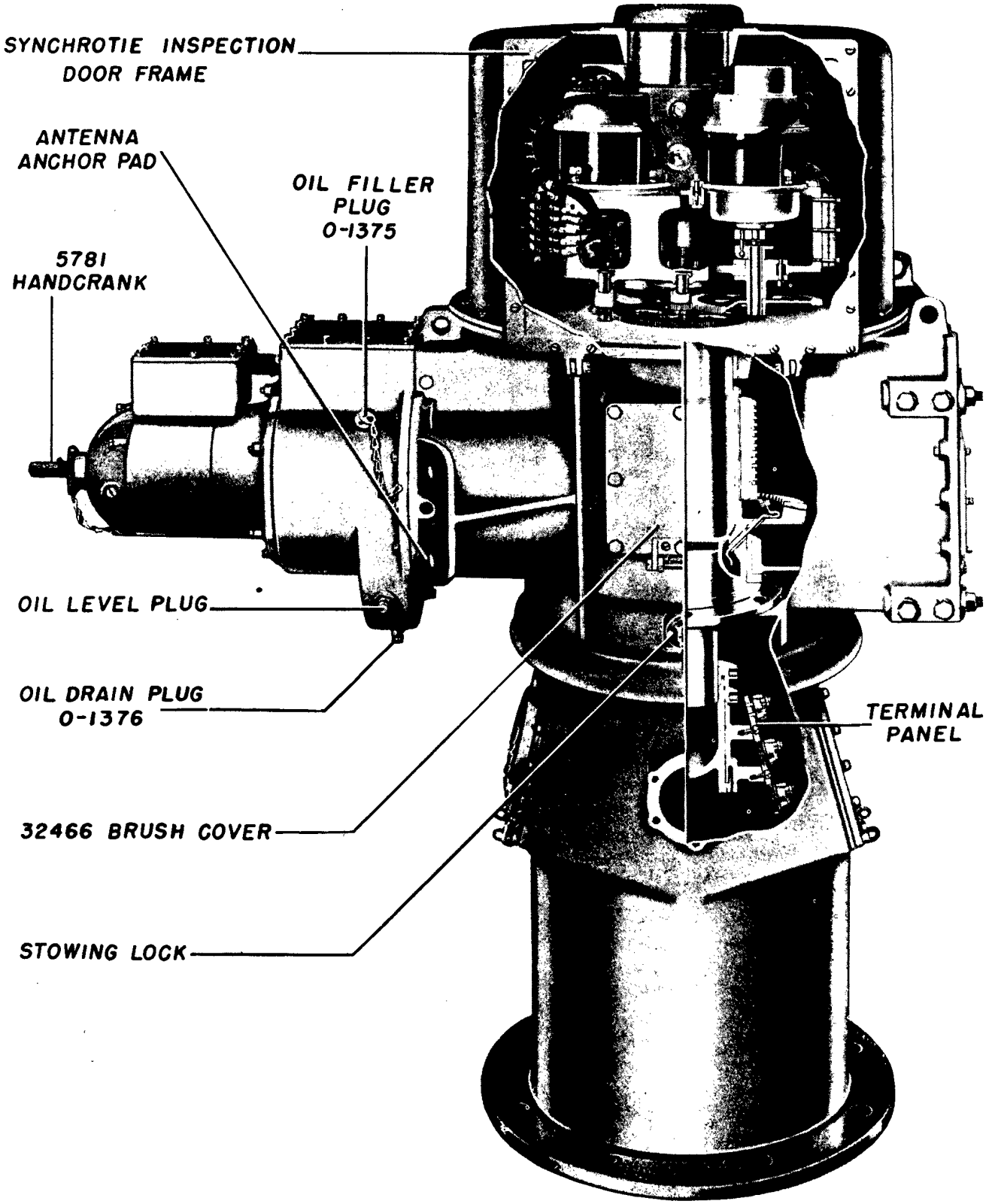


Figure 7-68. Antenna Pedestal, Cut-away View of Left Side

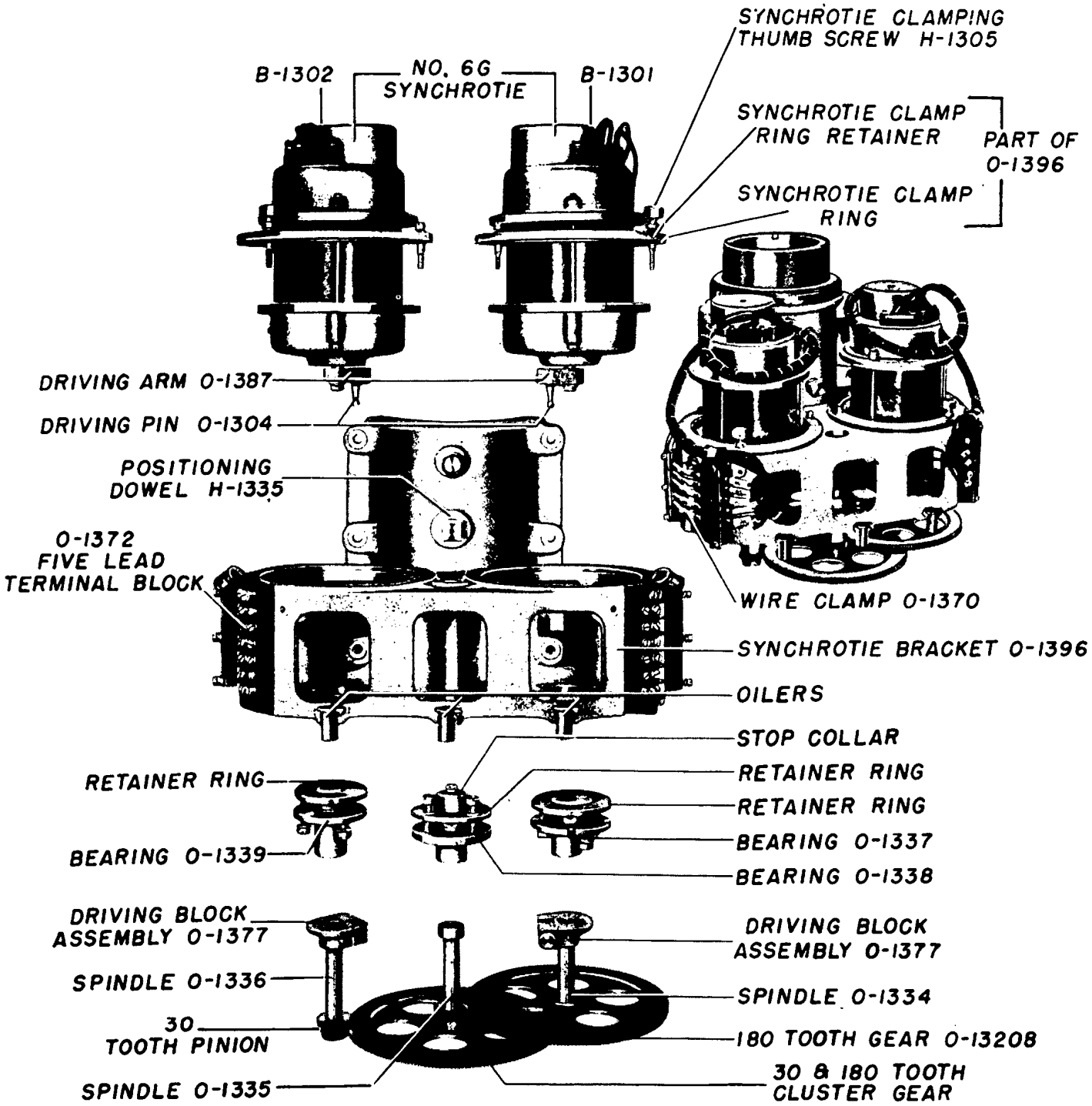


Figure 7-69. Synchrotie Bracket Assembly, Disassembled View

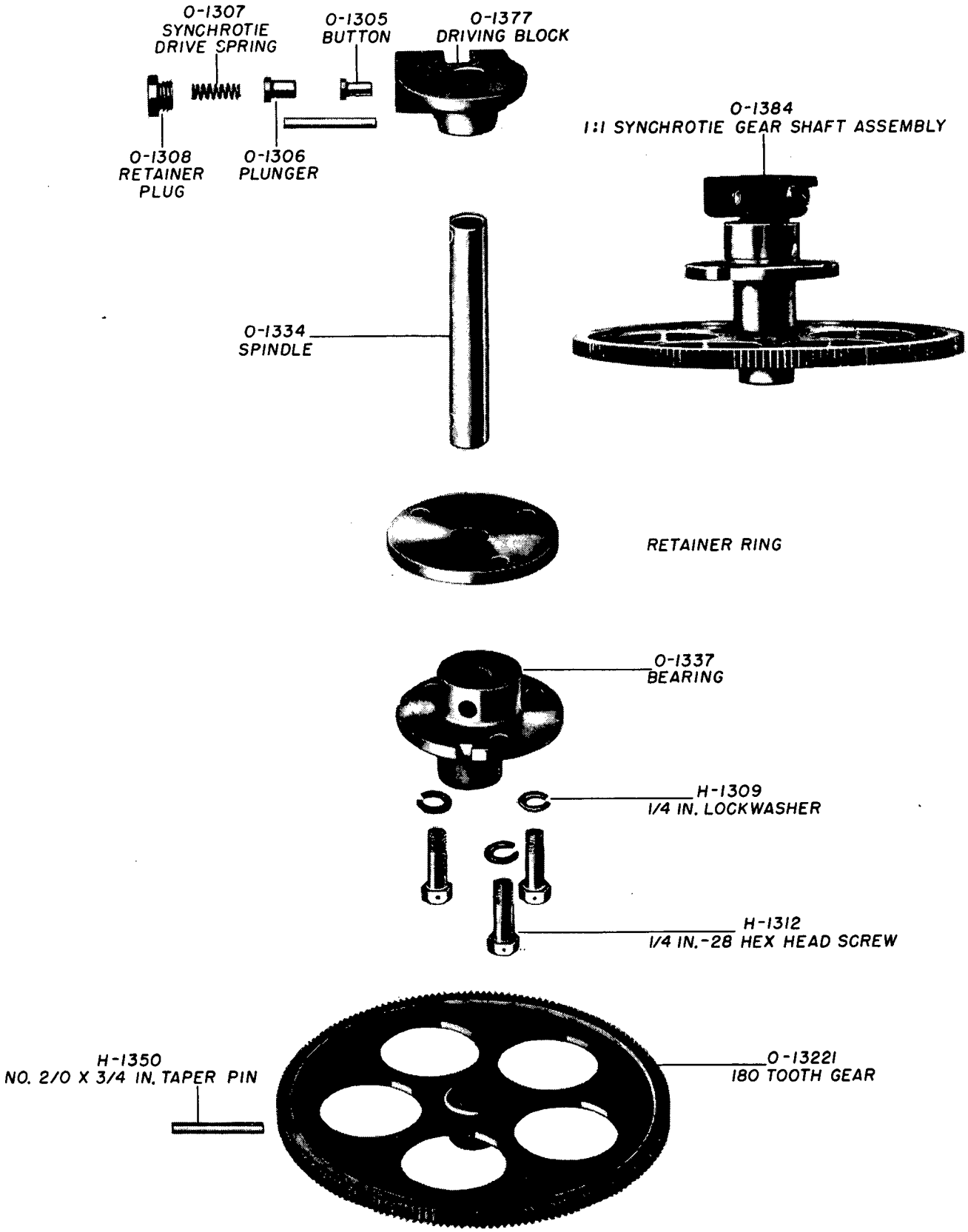


Figure 7-70. One-to-One Synchrotie Gear Shaft Assembly O-1384

hands and gently draw it forward until clear of the post and the thrust rings above and below the bracket. The thrust rings are shown in Fig. 7-67. Be very careful not to bump the synchrotie driving gear teeth on the spur gear bolted to the main housing.

(10) The synchrotie bracket can be removed without removing the bracket cap, unless conditions indicate that the cap needs replacing. If this is the case, rotate the unit until the bracket cap faces the inspection door. Remove the wire guide ring from the bottom of the bracket cap by taking out the fillister head screws. The guide ring is shown in Fig. 7-67. Remove the safety wire and loosen the captive hex head screw in the center of the bracket cap. Then, making sure that the wires are out of the way, pull the bracket cap straight back and out through the inspection door.

(11) When the necessary repairs or replacements have been made, check to see that the synchrotie wires are properly attached to the terminal blocks on each side of the bracket. Then grasp the assembly firmly in both hands and guide it through the inspection door in an upright position. Be careful not to damage the gears or wiring against the sides of the door.

(12) Guide the bracket assembly into its approximate position making sure that the 180 tooth spur gear under the 1 to 1 synchrotie is properly meshed with the 180 tooth gear bolted to the main housing. The gear under the synchrotie is shown in Fig. 7-69. The other gear is shown in Fig. 7-67. Holding the unit firmly, start the positioning dowel in place, moving the bracket slightly so that the dowel seats properly. Start the captive hex head screw immediately above the dowel and draw it snug but not too tight. Tighten the dowel firmly in place. Then draw up and tighten the hex head screw.

(13) If the synchrotie bracket cap has been removed, rotate the unit with the handcrank until the rear of the synchrotie bracket faces the inspection door. Position the bracket cap and, holding it in place, start each of the seven hex head captivated screws on the bracket cap. Tighten and safety wire these screws.

(14) Replace the wire guide ring at the bottom of the bracket cap and tighten the five screws holding it in place. Feed the wires through the wire clamping strips on each side of the bracket and attach to the terminal blocks according to the wiring diagram in Fig. 7-179. Tighten the screws on the wire clamping strips.

(15) Set backlash in the driving gear train as directed in paragraph 33*b* of this section.

(16) Check to see that all screws are tight and that no scraps of wire, drops of solder or other loose parts are inside the cover. Then close the cover door, remove the handcrank from motor, replace the motor plug and the disconnect plug in the pedestal base, and cover the quick opening access hole.

d. ONE-TO-ONE SYNCHROTIE GEAR ASSEMBLY.

(1) Remove the complete synchrotie bracket assembly and then remove the one-to-one synchrotie from the bracket as directed in paragraph 33*c* of this section. Remove the oiler for the one-to-one bearing from the synchrotie bracket.

(2) Remove taper pin in the hub of the 180-tooth gear. This pin is shown in Fig. 7-70. Lift the driving block assembly with the spindle attached, out through the top of the synchrotie bracket and remove the 180 tooth gear from the bottom of the bracket. See Fig. 7-70. Remove the hex head screws which hold the retainer ring and the bearing in place in the synchrotie bracket and remove the retainer ring and bearing from the bracket. Remove taper pin from the driving block assembly and the driving block from the spindle. These parts are all shown in Figs. 7-69 and 7-70.

(3) When the necessary repairs or replacements have been completed, the one-to-one synchrotie drive assembly may be replaced as follows.

(4) Slip the bearing shown in Fig. 7-70 into the synchrotie bracket from the bottom and place the retainer ring over the hub of the bearing extending up through the bracket. Start the hex head screws, with lock washers, through the holes in the bearing flange, the holes in the bottom of the brackets and into the tapped holes in the retainer ring.

(5) Screw the oiler lightly into place and check to see that the oil wick extends into the shaft bore of the bearing approximately one-eighth of an inch. Remove the oiler, being careful not to change the amount of wick extending out the end of the tube.

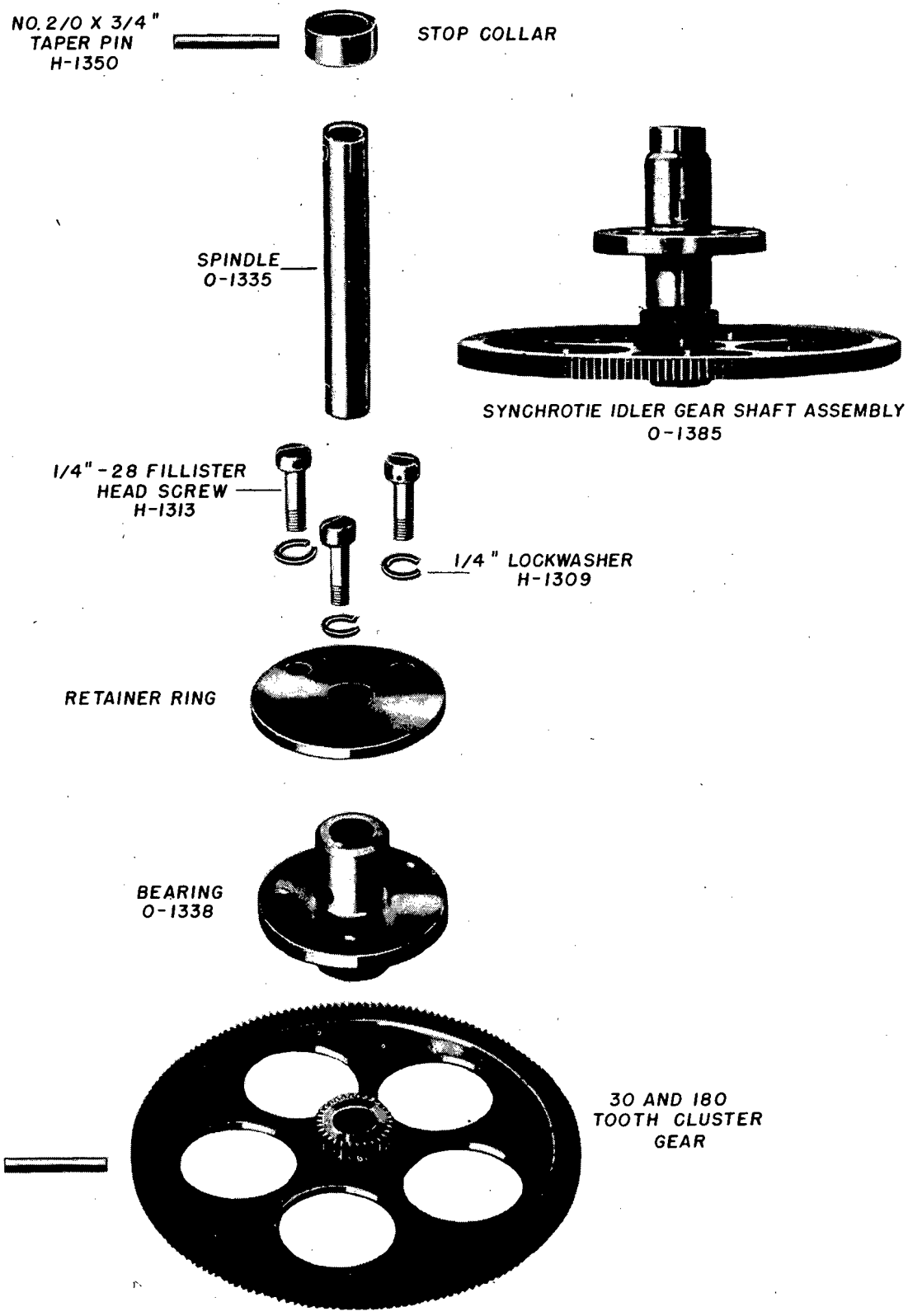
(6) Rotate the bearing counterclockwise as far as possible (looking down from above) and holding the 180-tooth gear in mesh with the 30 tooth pinion of the cluster gear (see Fig. 7-69), push the spindle through the bearing and into the gear. Place the driving block assembly on the spindle, line up the taper reamed holes in the gear hub and spindle, insert the taper pin and tap it firmly in place. See Fig. 7-70.

(7) Insert oiler and tube into the bracket again. If this is the only gear assembly being replaced, proceed with the backlash adjustment as outlined in paragraph 33*b*. Then, replace synchrotie bracket assembly in the unit according to paragraph 33*c* of this section.

e. IDLER GEAR ASSEMBLY.

(1) Remove complete synchrotie bracket assembly as outlined in par. 33*c* of this section. Then remove the center oiler from the synchrotie bracket.

(2) Remove the fillister head screws holding the idler bearing in place. See Fig. 7-71. The complete bearing and spindle assembly can then be removed from the bottom of the synchrotie bracket. Remove



ALL PARTS SHOWN ABOVE ARE PART OF SUBASSEMBLY O-1385

Figure 7-71. Idler Gear Shaft Assembly O-1385

the taper pin holding the stop collar to the top of the spindle and pull the cluster gear, with spindle attached, out of the bearing. Remove the taper pin from the cluster gear hub and slide the cluster gear from the spindle.

(3) When the necessary repairs or replacements have been made, place the spindle through the bore in the cluster gear, line up the taper reamed holes, insert the taper pin and tap it firmly in place. Hold the bearing in the synchrotie bracket and screw the oiler in place, making certain that the wick extends into the bearing bore approximately one-eighth of an inch. Then remove the oiler using care not to change the amount of wick extending out the end of the tube. If a stop collar or spindle is being installed which has not been taper reamed, take the bearing out of the synchrotie bracket and slip the spindle and cluster gear through the bearing. Place a .003 inch shim of paper or similar material between the top of the bearing and the stop collar. See Fig. 7-71. Hold the gear against the bottom of the bearing, and hold the stop collar against the shim. With the gear and collar in this position, taper ream a hole through the collar and spindle. Remove the shim, insert the taper pin through the stop collar and spindle and tap it firmly in place.

(4) Slip the bearing into the bottom of the synchrotie bracket, meshing the cluster gear with its mating gears. Place the retainer ring over the hub of the bearing extending up through the synchrotie bracket. Thread the fillister head screws through the retainer ring, the bottom of the synchrotie bracket and into the bearing flange, screwing them loosely in place. After setting the backlash of the gear train, as described in paragraph 33*b*, tighten these screws and assemble the complete synchrotie bracket into the unit in accordance with paragraph 33*c* of this section.

f. 36 TO 1 SYNCHROTIE GEAR ASSEMBLY.

(1) Remove the complete synchrotie bracket assembly, and remove the 36-to-1 synchrotie from the bracket in accordance with paragraph 33*c* of this section.

(2) Remove the taper pin from the hub of the driving block assembly and the driving block from the top of the spindle. See Fig. 7-72. Slip the 30-tooth pinion with spindle attached out of the bearing. Remove the oiler that extends into the 36-to-1 synchrotie bearing and the fillister head screws which hold the bearing and its retainer ring in place. See Fig. 7-69. The bearing can then be pressed out of the bottom of the synchrotie bracket, and the retainer ring can be lifted out of the top of the bracket. Remove the taper pin from the hub of the 30 tooth pinion and spindle and remove the pinion from the spindle.

(3) After completing the necessary repairs or replacements, place the 30-tooth pinion on the bottom of the spindle, line up the taper reamed holes, insert the taper pin and tap it firmly in place. If the top end of the spindle or driving block has not been taper reamed, slip the spindle, with pinion attached, through the bearing and place a .003 inch shim of paper (or similar material) between the bearing and driving block on the top of the spindle. Press the pinion against the bottom of the bearing and the driving block against the shim, and taper ream a hole through the hub of the driving block and the spindle.

(4) Remove the driving block assembly and shim from the spindle and pull the pinion and spindle from the bottom of the bearing. Hold the bearing in position in the synchrotie bracket and screw the oiler in place. Check the amount of wick extending into the bearing bore. There should be approximately one-eighth of an inch in view. Remove the oiler from the bracket, being careful not to change the amount of wick extending from the end of the tube.

(5) Slip the retainer ring over the hub of the bearing. See Fig. 7-72. Insert the fillister head screws, with lock washers in place, through the holes in the bearing flange and thread them into the retainer ring. Tighten and safety wire the screws. Push the spindle, with pinion attached, up through the bore of the bearing, meshing the pinion with the idler gear. Press the driving block assembly on the top of the spindle and pin it in place.

(6) After adjusting the gear train for backlash as directed in par. 33*b*, assemble the complete synchrotie assembly to the post in the unit. See par. 33*c* of this section.

g. 180-TOOTH SYNCHROTIE GEAR ON MAIN HOUSING.

(1) To remove the 180 tooth synchrotie drive gear from the main housing, remove the antenna connections above the synchrotie assembly cover.

(2) Open the quick opening access door in the pedestal base and remove the motor disconnect plug. See Figs. 7-66 and 7-67. Remove the plug from the rear end of the drive motor and insert the handcrank in the drive motor shaft, making sure that the tongue on the crank engages the slot in the motor shaft. These parts are shown in Fig. 7-68.

(3) Remove the antenna seal joint at the top of the synchrotie cover (see Fig. 7-87), and remove the concentric line. Open the synchrotie inspection door by loosening the captive fillister head screws and swinging the door down on its hinges. Remove the safety wires from the fillister head screws holding the cover on the main housing, five of which are inside the inspection door, and remove the screws. Close the inspection door, holding it in place with two or three screws at the top, and lift the synchrotie cover off the main housing.

(4) Remove the synchotie bracket as directed in

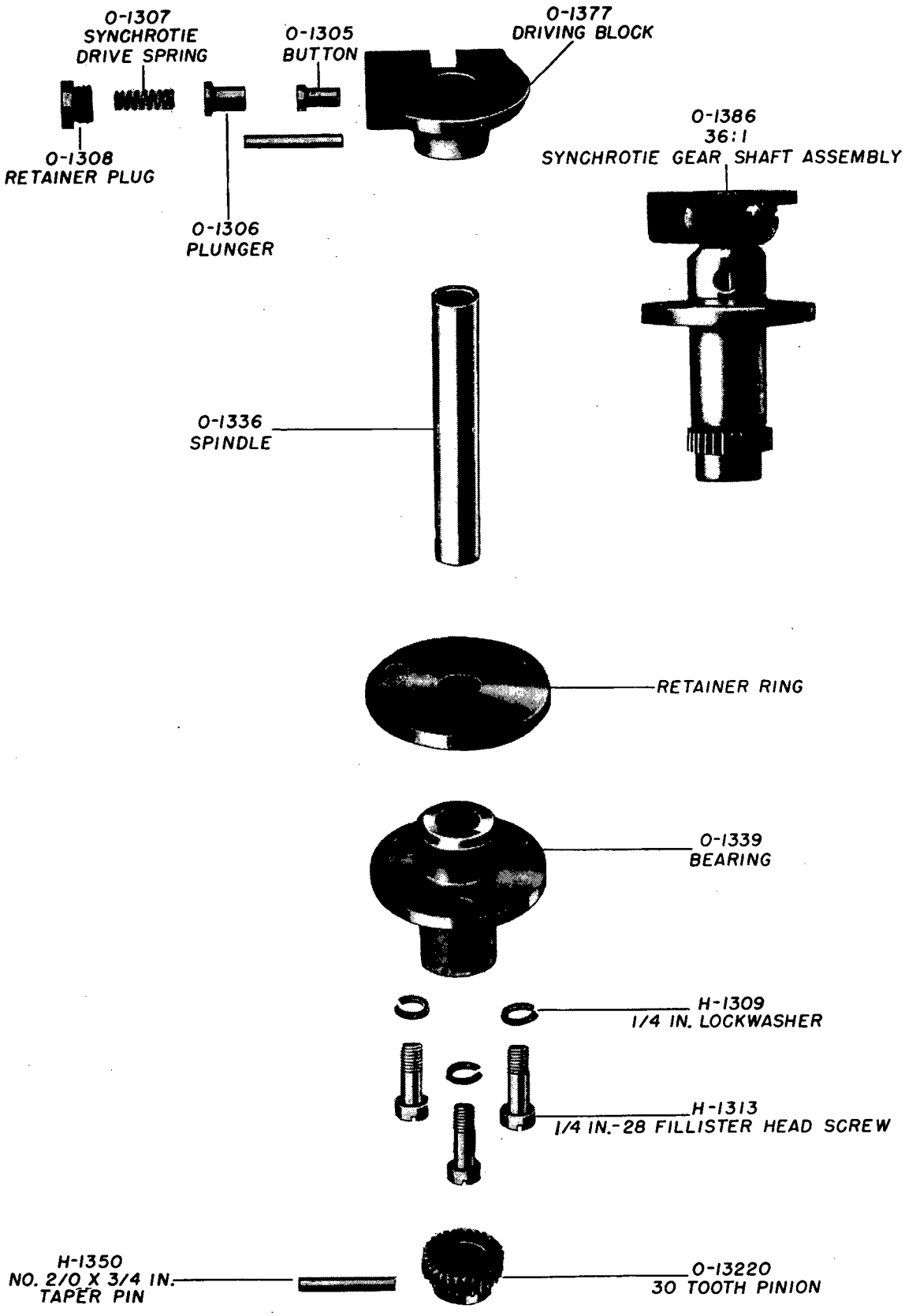


Figure 7-72. 36-to-1 Synchrotie Gear Shaft Assembly O-1386

paragraph 33*c* of this section and remove the upper and lower thrust ring. See Fig. 7-67. Unsolder the terminal lugs from the synchrotie lead wires which come out of the post. Push the wires back into the post, tieing them in a group so they will not fall to the bottom of the post. Then remove the micarta ring from the post.

(5) Remove the safety wires from the six socket head cap screws that hold the 180-tooth synchrotie drive gear to the main housing and remove the screws. The gear can then be lifted from the post.

(6) After making all necessary repairs or replacements, slip the 180-tooth gear down over the post until its flange rests on the main housing. Screw the six socket head cap screws loosely through the gear into the main housing. Place three .002 inch feelers between the post and bore of the gear, approximately 120 degrees apart. Adjust the gear until each feeler can be removed with the others in place. This will center the gear about the post, leaving .002 inch clearance on all sides. Draw all of the screws up tight and recheck with the feelers to see that the proper clearance is still obtained. If the clearance has changed after tightening the screws, loosen them and repeat the adjustment until the gear is centered about the post. Then safety wire the screws in pairs.

(7) Slip the micarta ring down over the post until it rests on the gear. Feed the synchrotie wires out through the insulating bushings in the post according to the wiring diagram, Fig. 7-179. Slip the lower thrust ring down over the post, replace the synchrotie bracket assembly on the post as directed in paragraph 33*c* of this section, and place the top thrust ring in position.

(8) Adjust the synchrotie gears as directed in paragraph 33*b* of this section. Replace the synchrotie cover, the concentric line, the antenna seal joint and reconnect the antenna connections above the synchrotie assembly cover.

b. BACKLASH ADJUSTMENT OF SYNCHROTIE GEAR TRAIN.

(1) Loosen the fillister head screws holding the idler gear assembly in place in the synchrotie bracket. See Fig. 7-71. Move the assembly toward the front of the bracket on a line at right angles to a line passing through the two synchroties. Loosen the hex head screws holding the one-to-one synchrotie gear assembly in place. See Fig. 7-70.

(2) With a spanner wrench, turn the one-to-one synchrotie gear assembly counterclockwise, looking down from the top, as far as it will go and note the position of the wrench. Turn the assembly clockwise as far as it will go, and again note the position of the wrench. Using the positions noted as a guide, turn the assembly counterclockwise to a point midway between the two extremes.

(3) Tighten the hex head screws on the one-to-one synchrotie gear assembly until it is held firmly in place and can be turned only slightly by the spanner wrench. Tighten the fillister head screws on the idler gear assembly until the assembly is held firmly in place but can still be moved by tapping the bearing flange lightly with a block of wood or fiber. This flange may be seen in Fig. 7-69. Hold the 30-tooth pinion on the 36-to-1 synchrotie gear assembly, and tap the idler gear bearing until a minimum amount of backlash can be felt by hand. See Fig. 7-72. Then hold the 180-tooth gear on the one-to-one synchrotie gear assembly, and tap the idler gear bearing until a minimum amount of backlash can be felt by hand. These parts are shown in Figs. 7-69 and 7-70. Continue to adjust the idler gear bearing until a minimum amount of backlash can be detected between the idler gear and both of the synchrotie drive gears, making certain that in moving the idler gear into mesh with one gear it does not bind in the other.

(4) When adjustment of the idler gear assembly has been completed, there should be a very slight amount of backlash in the whole train and it should not bind at any point. The gears should turn freely by hand in either direction using any gear as a driver.

(5) Tighten the three fillister head screws holding the idler gear assembly in place and check, as in the preceding paragraph, to see that the adjustment has not been disturbed.

(6) If these steps have been performed before installation of the synchrotie bracket assembly on the unit, proceed to assemble the bracket to the post, as described in paragraph 33*c* of this section, before continuing with the adjustment.

(7) Check the backlash between the 180-tooth gear on the one-to-one synchrotie drive assembly and the 180-tooth synchrotie drive gear bolted to the main housing. See Figs. 7-67 and 7-70. Using a spanner wrench, turn the one-to-one synchrotie gear assembly counterclockwise to increase the backlash or clockwise to decrease the backlash, looking down from above. Adjust the one-to-one synchrotie gear assembly until minimum backlash can be detected by hand. By grasping the gear teeth lightly in the finger tips, as little as .0002 inch backlash can be felt.

(8) Tighten the three hex head screws that hold the one-to-one synchrotie gear assembly in place and recheck to see that the backlash has not been changed. See Fig. 7-70.

(9) In any pair of the gears, the amount of backlash permissible, as measured at a four inch radius with the mating gear held stationary, is .000388 inch.

(10) As a final check on the synchrotie gear train backlash, lock the housing stationary and attach an arm, four inches or longer, to the hub of the 30-tooth gear on the 36 to 1 synchrotie bearing assembly. This gear is shown in Fig. 7-72.

(11) If an indicator is available, attach it to the synchrotie bracket so the plunger of the indicator bears against the arm on the hub of the 30-tooth gear. Set the indicator dial to zero with all the backlash taken out by holding the gear train tight in one direction. Then turn the 30-tooth pinion until the backlash has been completely taken out in the other direction. The amount shown on the indicator should be less than .0035 inch at a four inch radius. This is a three minute backlash, or .00087 inches per inch radius.

(12) In the event no indicator is available, the above check can be made by attaching a block to the synchrotie bracket in such a manner that when the 30-tooth gear is turned to remove all backlash in one direction, the arm and block are touching. Turn the 30 tooth gear in the opposite direction until all the backlash is taken out and measure the opening between the arm on the gear hub and the block. Measure the distance from the center of the 30-tooth gear hub to the point of contact between the block and the arm and multiply the distance in inches by .00087. This gives the maximum allowable opening between the block and arm. Check the opening and if it is larger than allowed, as shown by the above multiplication, reset the gears as outlined in the preceding instructions.

i. BRUSH BLOCK ASSEMBLY.

(1) To remove the brush housing from the main housing assembly, first remove the motor disconnect plug from the pedestal base. This plug is shown in Fig. 7-67. Then loosen the eight hex head captive screws that hold the brush cover in place. See Fig. 7-68 for the location of the brush cover. Open the brush cover and hang it down on its hinges.

(2) Remove the eight captive fillister head screws which hold the brush housing in place. The brush block assembly is shown in Fig. 7-21. Hold the sides of the brush housing firmly and pull it straight out from the main housing.

(3) If only one brush is to be removed, disconnect the wire from the terminal of the brush being removed and bend it back out of the way. Remove the hex nut and flat washer from the outer end of the brush assembly bolt shown in Fig. 7-73. Pressing on the threaded end of the bolt, push the brush holder assembly out of the brush block.

(4) To reassemble, press the threaded end of the brush assembly bolt through the hole in the brush block, being sure that the square shank is registered in the slot in the brush holder. Connect the wire to the brush terminal. Place the No. 10 hex nut and flat washer on the brush assembly bolt, remembering that if the new type brush assembly is used, the brush connecting bracket must go on the bolt first.

(5) Take out the three fillister head screws holding the wire clamping strip and remove the strip. Disconnect the wire terminals, push the wires back through the brush housing, and remove the housing assembly from the unit. Remove the six safety wired fillister head screws, three above and three below, which hold the brush block assembly in the brush housing. Then remove the brush block assembly from the brush housing.

(6) To reassemble, press the brush block into the brush housing with the thin section of the block in the lower left hand corner, looking at the block from the brush side. See Fig. 7-21. Insert the six fillister head screws, with the necessary flat washers and lock washers, three at the top and three at the bottom. Tighten the screws and secure them with safety wires.

(7) Place the brush housing assembly in the brush cover opening and feed the wires through to the outside of the brush block. Connect the wires to the proper brush terminals, and replace the wire clamping strip, holding it in place with three fillister head screws.

(8) Place the brush housing in the main housing and draw up the eight captive fillister head screws. Make sure that the gasket is smooth and in position, and close the brush cover door and bolt it in place.

(9) Replace the motor disconnect plug in the pedestal base and close the quick access opening.

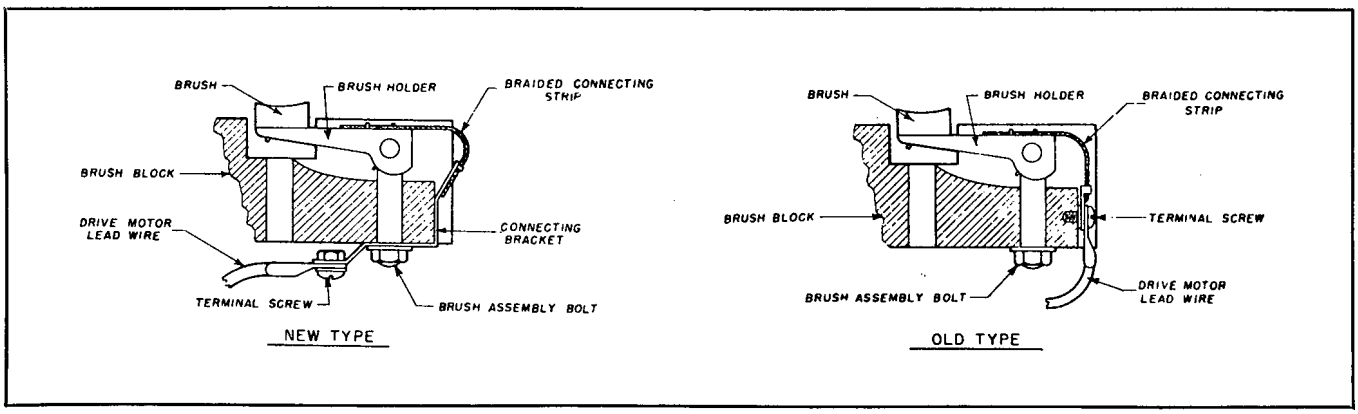


Figure 7-73. Brush Assemblies

j. REMOVING ANTENNA ASSEMBLY.

(1) Any major repairs to the Antenna Pedestal require its removal from the mast. After the Antenna and Pedestal Assembly has been lowered to the deck, the antennas must be removed if work is to be done on the lower part of the Pedestal. Usually the antennas can be repaired without removing them from the Pedestal.

(2) To remove the antenna assembly, first engage the stowing lock shown in Fig. 7-68. Then remove the studs that hold the transmission line flange to the top of the Antenna Pedestal. The next step is to remove the bolts that hold the diagonal struts to the anchor pad shown in Fig. 7-66.

(3) Remove the studs on the side of the antenna mounting face shown in Fig. 7-66. There are eight of the studs, four on each side. At least four men should support the antenna assembly while the nuts are removed from the four bolts that pass through the antenna mounting face. These bolts are the ones through which the studs on the side pass. See Fig. 7-66. After the nuts are removed from these bolts, lift the antenna assembly off the Pedestal.

k. REMOVING DRIVE UNIT.

(1) The drive unit consists of four sub-assemblies. The sub-assemblies are the electric motor assembly, the high speed pinion shaft assembly which is connected to the motor by an Oldham coupling, the intermediate pinion shaft assembly located in the lower part of the gearcase, and the low speed or bevel pinion and ring gear assembly mounted in the main housing. See Fig. 7-74.

(2) Before starting to disassemble the drive unit, remove the wire terminal cover from the top of the gearcase by loosening 12 captive screws and disconnect all the wires exposed in the terminal box. See Fig. 7-74.

(3) To remove the drive motor assembly from the gearcase, loosen the two captive hex head screws holding the wire manifold to the gearcase and remove the six nuts and lockwashers from the cone pointed motor mounting studs. See Fig. 7-75. Ease the motor carefully away from the studs, holding it firmly level to prevent it from twisting or damaging the threads on the studs.

(4) The high speed pinion shaft assembly is now exposed for inspection, adjustment or disassembly. It is important to note that it is not necessary to take this assembly from the gearcase in order to remove the complete gearcase from the main housing.

(5) If it is desired to remove the high speed pinion shaft assembly from the gear case, remove the five safety wired hex head screws from the flange of the eccentric bearing cage (shown in Fig. 7-76). Pull gently with a firm grip on the shaft and Oldham coupling, and the entire assembly may be removed.

(6) Before removing the intermediate pinion shaft assembly, which is mounted in the gearcase, drain the oil from the oil reservoir by loosening the captive oil drain plug in the bottom of the gearcase. This plug is shown in Fig. 7-68. Remove the hex head screws holding the gearcase to the main housing. Eight of these are in the flange of the gearcase, four in the flange of the main housing and two inside the wire terminal box. Pull the gearcase straight out from the main housing, being careful not to twist or turn the assembly. The entire intermediate pinion shaft assembly is now removed and the low speed or bevel pinion assembly is exposed.

(7) To remove the low speed or bevel pinion assembly, insert a socket wrench through the web of the 101-tooth internal gear, shown in Fig. 7-74, and remove the six hex head screws that hold the bearing cage. These screws are safety wired. Exert an even pull on the internal gear and the assembly will come free from its seat in the housing. Extreme care should be taken during removal not to damage the shims on the bearing cage hub.

CAUTION

THE FINE ADJUSTMENTS AND CLOSE LIMITS NECESSARY TO THE PROPER FUNCTIONING OF THE UNIT DEMAND EXPERT HANDLING AND EXACTING CARE IN THE METHOD USED IN DISASSEMBLING AND REASSEMBLING TO PREVENT GALLING, DISTORTING OR OTHERWISE DAMAGING THE PARTS. NEVER USE MORE FORCE THAN COMMON SENSE DICTATES IN REMOVING OR INSTALLING SMALL PARTS. NEVER HAMMER A PART WITH MATERIAL AS HARD AS THE PART ITSELF. DO NOT HIT TOO HARD. USE PULLERS WHEN REMOVING GEARS. DO NOT TAP PRESS FIT PARTS INTO OR OUT OF AN ASSEMBLY WITH BAR AND HAMMER EXCEPT WHEN NO OTHER METHOD IS AVAILABLE.

(8) To disassemble the drive motor, remove the terminal box cover shown in Fig. 7-75 by loosening the eight captive screws. Loosen the two hex head captive screws on the side of the terminal box to remove the wire manifold. The driving member of the Oldham coupling, shown in Fig. 7-75, is removed by bending the locking ears of the lockwasher away from the cone pointed locking screw and removing the screw. See Fig. 7-76. The driving member can then be pulled off the motor shaft.

(9) Using a screwdriver, pry the ears of the lockwasher from the slots in the locknut on the threaded end of the shaft. Remove the locknut, lockwasher, coupling retainer washer, coupling spacer, Oldham coupling floating member and the driven member from the shaft. Unlock the lockwasher from the next locknut and remove the nut and washer from the shaft. Remove the woodruff key which is used to hold the

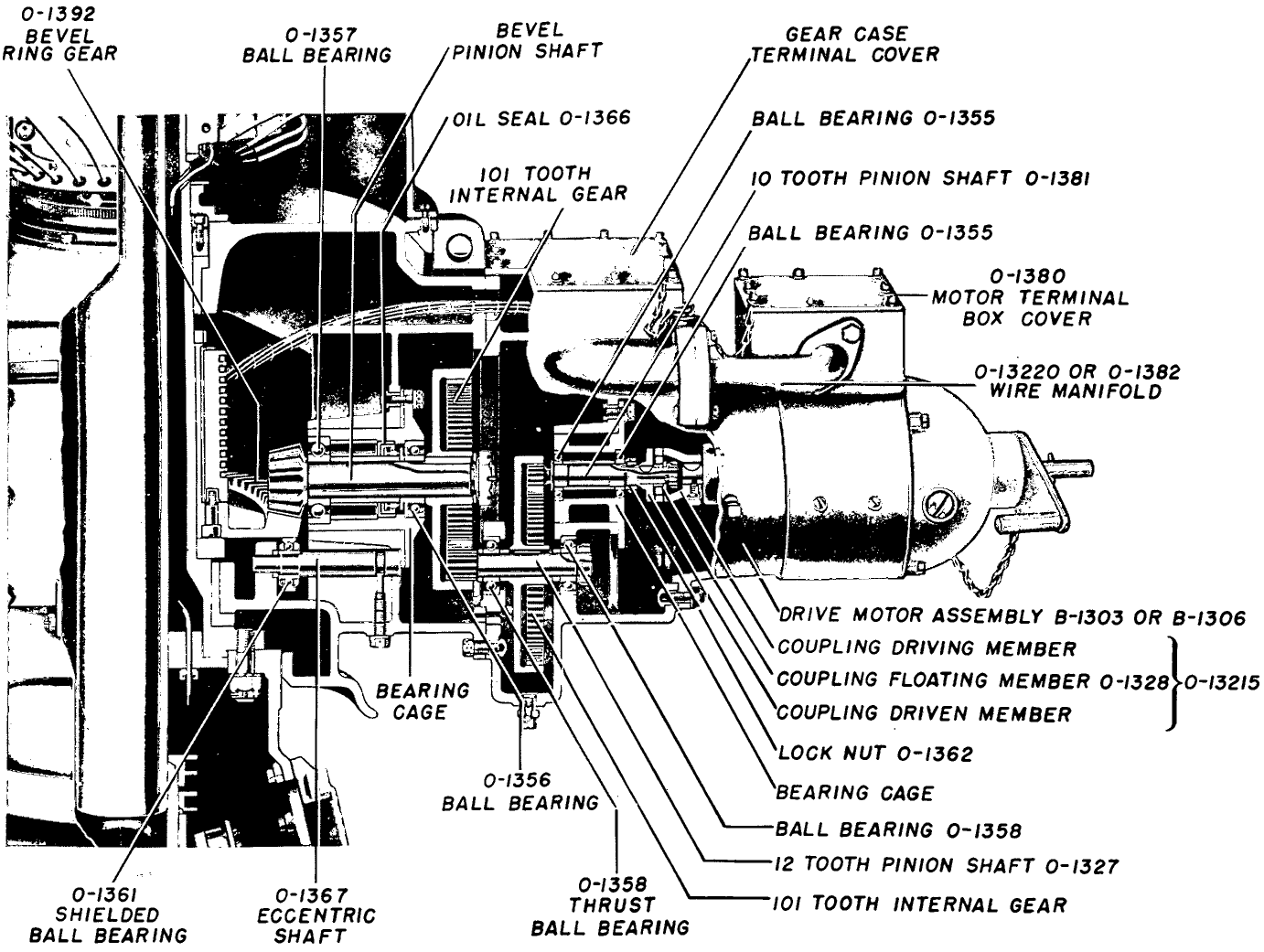


Figure 7-74. Drive Gear Train, Sectional View

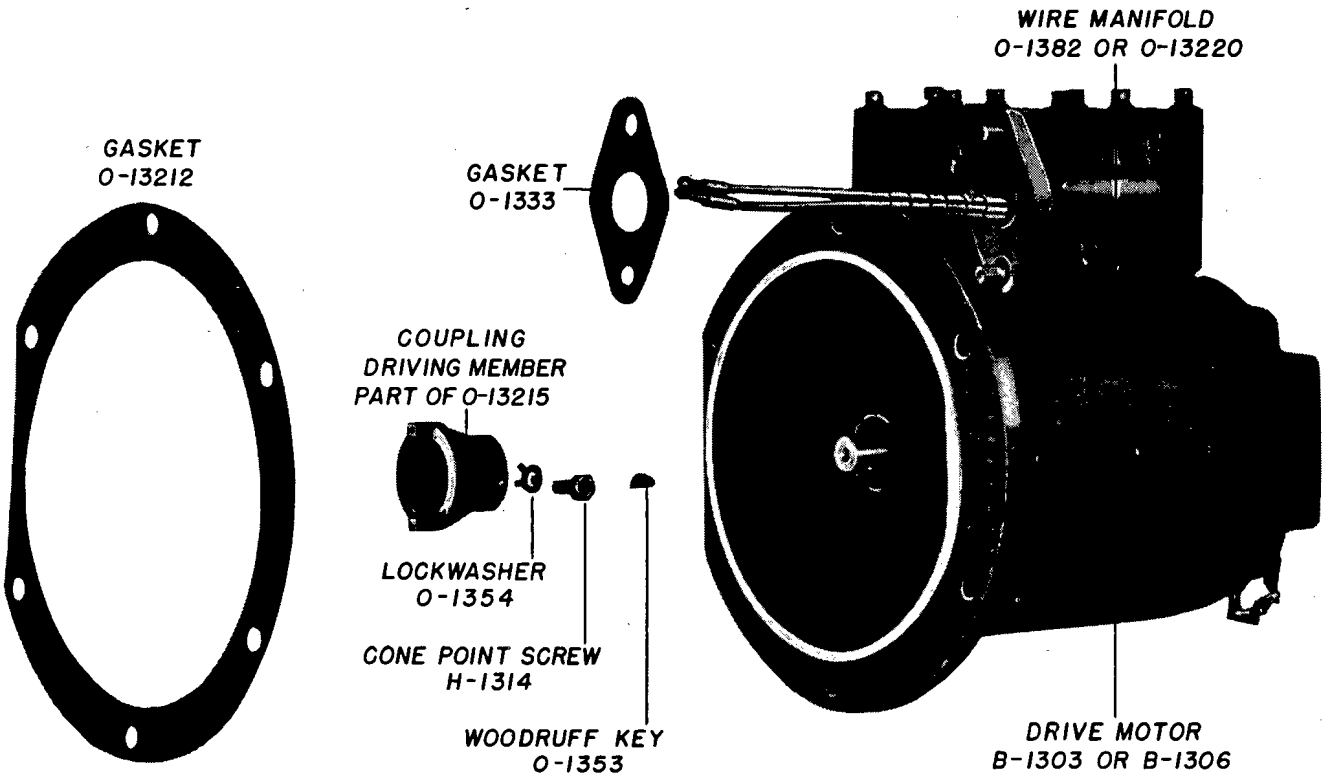


Figure 7-75. Drive Motor Assembly

driven member of the coupling to the shaft. These parts are all shown in Figs. 7-74 and 7-76.

(10) Hold the eccentric cage firmly and with even, light pressure on the end of the shaft, the pinion end ball bearing, inner sleeve bearing and shaft should slide from the cage. If more pressure is required up-end the cage on two blocks leaving an opening with sufficient clearance for both pinion and bearing to push through and tap lightly on the threaded end of the shaft. The bearing in the front face of the cage may then be removed by light, even pressure around its periphery, applied through the counterbore of the cage. Place the shaft in an arbor press, pinion end down and resting on the face of the bearing, and press the shaft until free of the bearing.

(11) To remove the intermediate pinion shaft assembly, pry the lockwasher ears from the retaining slots in the lock nut on the end of the shaft with a screwdriver, back off the lock nut and remove the washer. See Fig. 7-77.

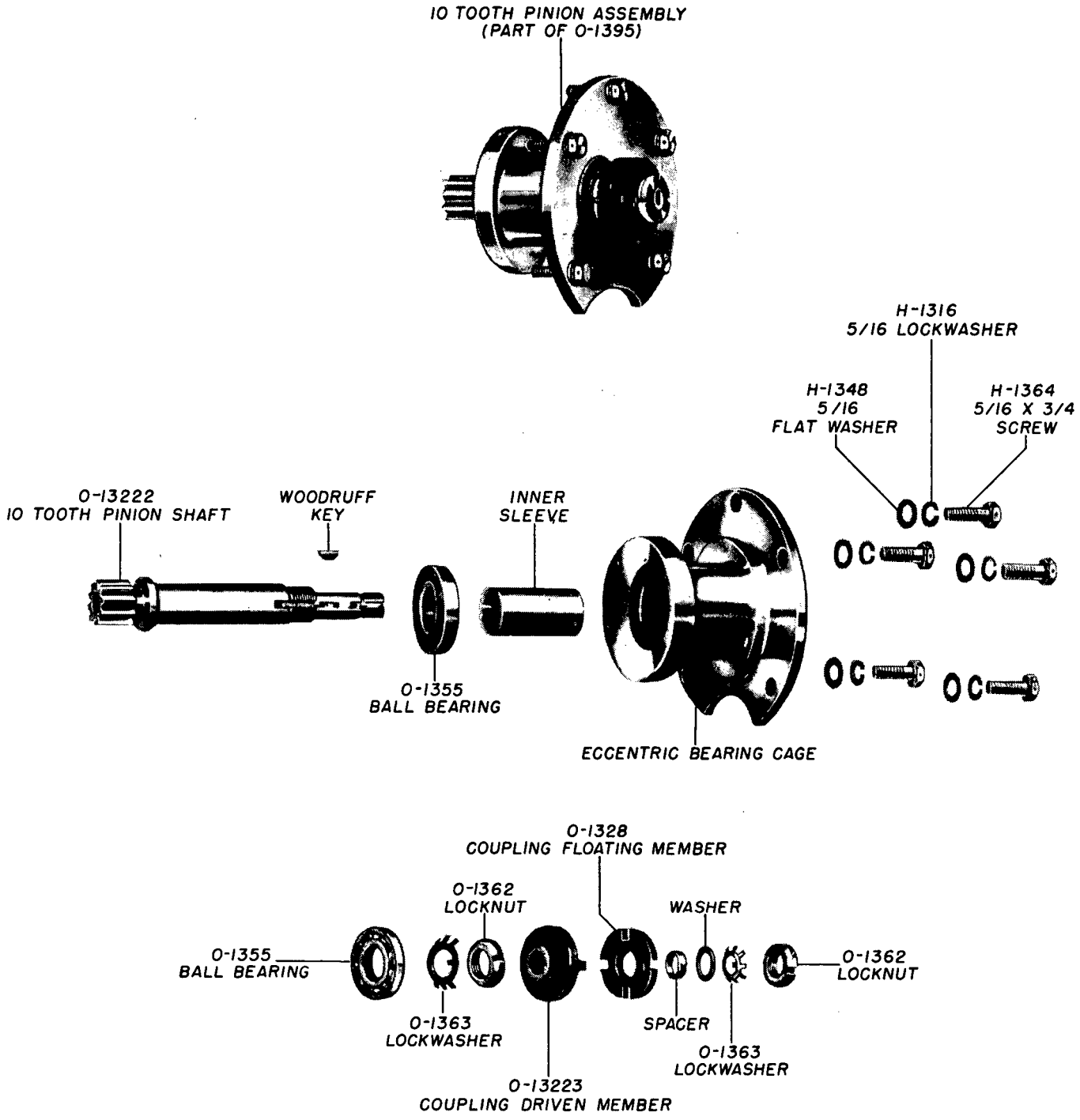
(12) Place the gearcase on parallels no less than 6 inches high and resting on the flange that fits against the main housing. With the housing in a flat horizontal position, press the 12 tooth pinion shaft downward using a round bar of soft material. When the pinion shaft is pressed out of the gearcase, the radial thrust ball bearing at the pinion end of the shaft and two spacers should come out with it. These parts are shown in Figs. 7-74 and 7-77.

(13) Remove the third spacer, shims and 101-tooth internal gear from the gearcase. Turn the gearcase over so it rests on the motor mounting face. Using a round bar of soft material and a hammer, tap evenly around the periphery of the outside race until the remaining radial thrust ball bearing comes out.

(14) The first spacer remaining on the shaft will slide off freely and the drive key should then be removed from the shaft. To remove the ball bearing, and the spacer between it and the pinion, place the assembly in an arbor press resting on the face of the spacer. Press the shaft downward until the bearing is free.

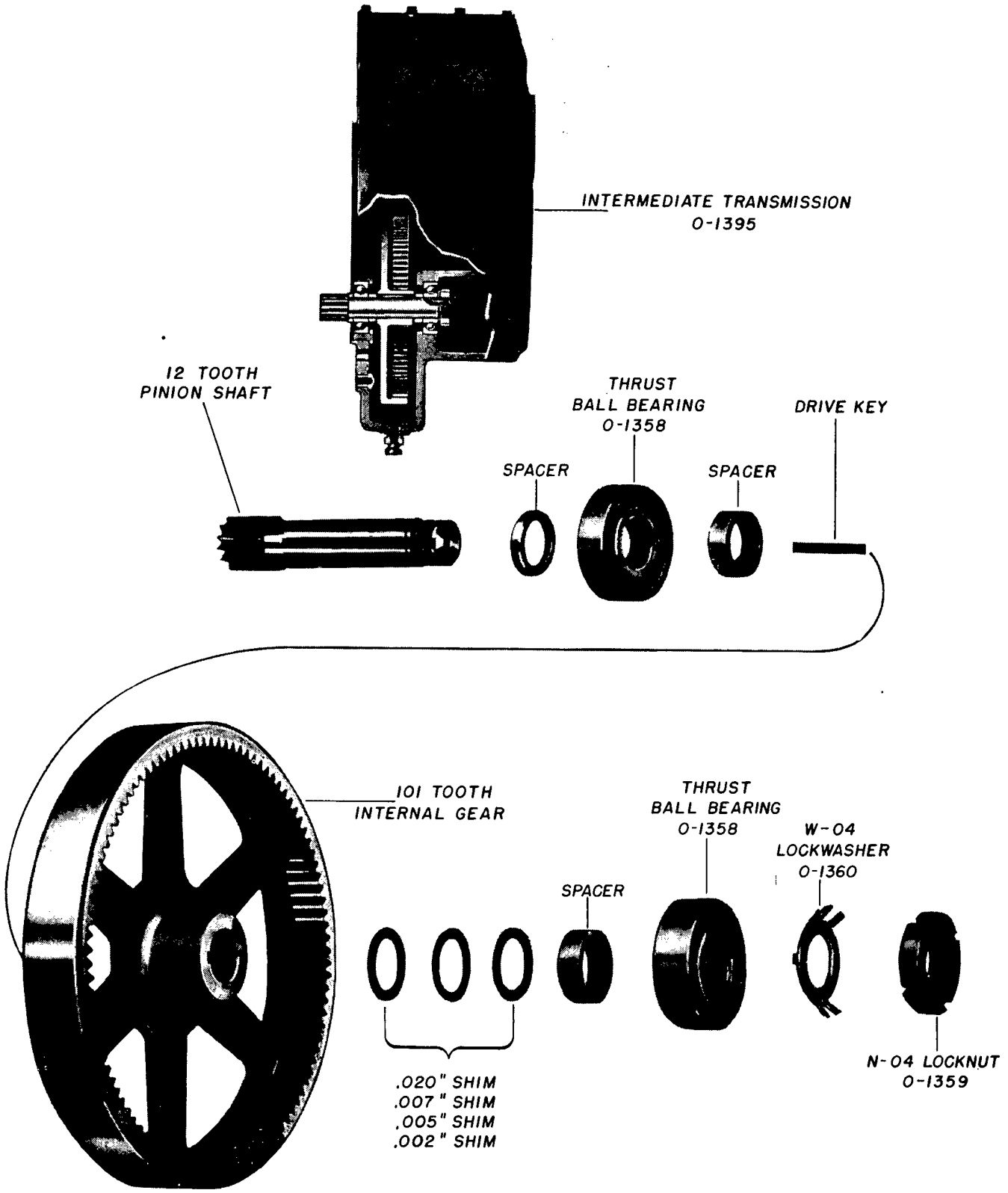
(15) To remove the low speed or bevel pinion assembly, remove the shims which fit against the inside of the bearing cage flange and tie them together as a pack so they will not become damaged or lost. See Fig. 7-78.

(16) Remove the cotter pin, slotted shear nut and washer, and pull the 101-tooth internal gear from the shaft with a gear puller. This gear is shown in Fig. 7-74 and 7-78. After removing the drive key from the shaft, set the bearing cage in an upright position, with the bevel pinion down. Using an arbor press, push the bevel pinion shaft out of the bearing cage. The radial thrust ball bearing and one spacer will come with the pinion shaft when it is pressed out of the cage. Slide the larger, oil seal retaining spacer from the bearing cage.



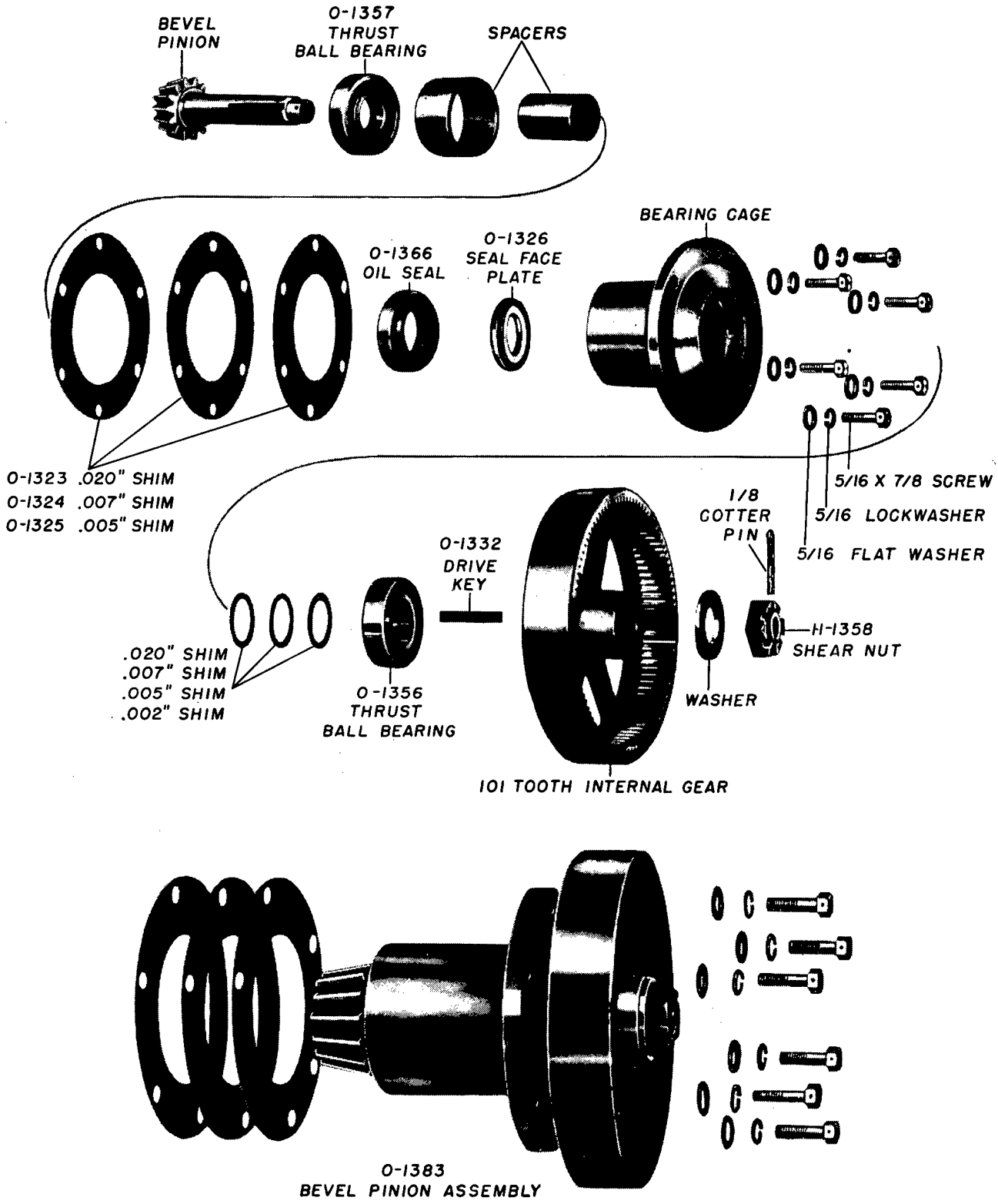
PARTS SHOWN ABOVE MAY BE OBTAINED AS PART OF INTERMEDIATE TRANSMISSION SECTION O-1395.

Figure 7-76. Motor Shaft and Coupling Assembly



ALL PARTS NOT IDENTIFIED BY SYMBOL NUMBER MAY BE OBTAINED ONLY BY ORDERING COMPLETE SUBASSEMBLY

Figure 7-77. Internal Transmission Section O-1395



ALL PARTS NOT IDENTIFIED BY SYMBOL NUMBER ARE AVAILABLE ONLY AS PART OF BEVEL PINION ASSEMBLY.

Figure 7-78. Pedestal Drive Assembly O-1383

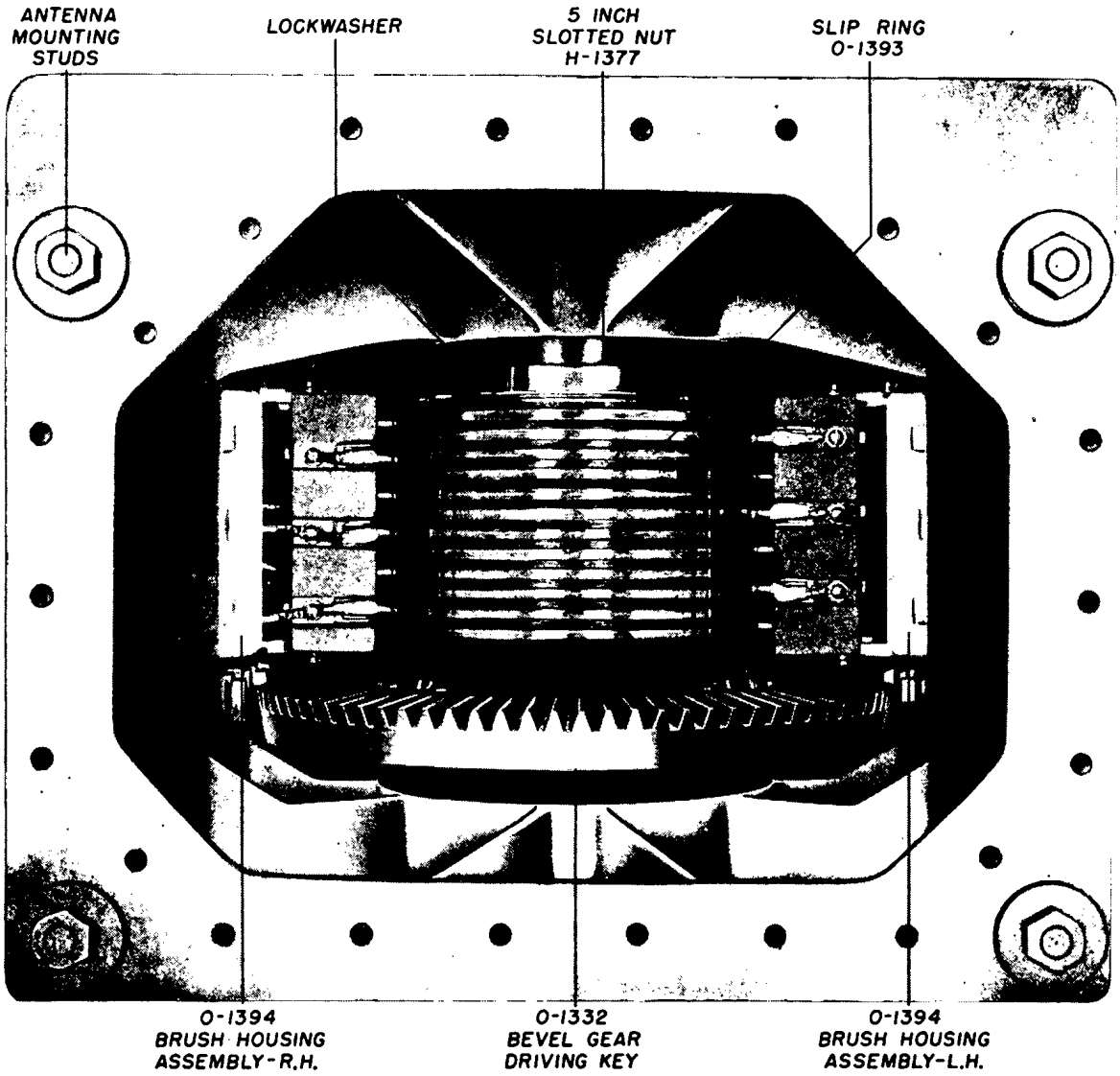


Figure 7-79. Slip Ring Assembly O-1393

(17) Rest the bearing cage on the face at the flange end, and place a round soft bar approximately 6 inches long with a squared flat end, down through the oil seal against the oil seal face plate. Press the radial thrust ball bearing, the shims, and the face plate out of the bearing cage.

(18) Set the bearing cage, with the pinion end down, on a clean surface. Using a round bar of soft material, not over one-quarter of an inch in diameter, tap the oil seal out, being careful not to tap on the bronze sealing ring.

(19) The small spacer will slide freely off the pinion shaft. Remove the ball bearing by placing the assembly in an arbor press, resting on the face of the inner race with the pinion end down, and pressing the shaft until the bearing is free.

l. REMOVING RING GEAR AND SLIP RING ASSEMBLY.

(1) If more than six of the slip rings are not in a usable condition or if the ring gear is damaged the Antenna and Antenna Pedestal must be removed from the mast before any repairs or replacements can be made.

(2) After the Pedestal has been removed from the mast, remove the synchrotie cover, the complete synchrotie bracket assembly, the 180-tooth synchrotie driving gear, and the brush housing assemblies. See paragraphs 33*b* to 33*i* inclusive. Remove the drive motor assembly shown in Fig. 7-66, the gearcase and the bevel pinion assembly, as described in paragraph 33*k*. Remove the captive fillister head screws which hold the slip ring and ring gear access door cover on

the front face of the main housing, and remove the cover. See Fig. 7-66. Remove the ship's head marker microswitch (not shown in illustrations) from the bracket mounted on the main housing floor, to the right, inside this door.

(3) Remove the one-quarter inch socket head screw from the cast iron thrust nut in the top of the main housing and, using a spanner wrench, remove the thrust nut from the post. See Figs. 7-67 and 7-81. Turn the post in the main housing until the tab on the lock washer of the 5 inch slotted nut that holds the gear and slip ring assembly in place, can be seen through the large opening in the front face. See Fig. 7-80. Bend the locking tab out of the slot, leaving the nut free to turn. Unscrew the nut until it is clear of the threads and rests on the upper main bearing. Push the ring gear and slip ring assembly down against this nut.

(4) Remove the screws connecting the wires at the bottom of the slip ring assembly and unsolder the terminal lug from each wire. Some of these connections are shown in Fig. 7-79. Push the wires down through the ring gear as far as possible. Turn the main housing so the driving keys are at the sides, pull six wires completely out of the gear and push them as far as possible into the post. Turn the main housing 180 degrees and repeat the above procedure with the remaining six wires.

(5) Secure two benches or supports of the same height, at least 24 inches high, and so constructed that they can be placed side by side with a space of approximately 10 inches between them. Turn the unit upside down and place the upper flange on the supports with the post extending down between them.

(6) Remove the screws holding the circular cover plate in the bottom of the pedestal base and remove the cover from the base. Remove six 5/16 inch hex head screws holding the insulating ring to the bottom of the post. See Fig. 7-67. Pull the insulating ring and all wires out of the post and fold the wires down out of the way.

(7) Remove the cotter pins and castle nuts from the six studs holding the post to the pedestal base and lift the base off the post and out of the main housing. See Figs. 7-67 and 7-80.

(8) Grasp the studs extending from the bottom end of the post and pull the post straight up out of the bearings. The ring gear may come up against the bottom main bearing as the post is first raised, indicating that the bore is quite snug on the post. A helper is needed to reach through the front opening in the main housing and guide the gear off the post. Avoid touching the threaded sections of the post against the bore in the gear or the main bearings.

(9) Lift the ring gear and slip ring assembly out through the front of the main housing and take out the slotted nut and washer which are left inside the housing.

(10) Cover the post with a film of oil or similar rust resisting material while the post is out of position and remove this protection only immediately before reassembling the post in the unit.

(11) To remove the slip rings from the ring gear, turn the gear so the drive keys are facing up. See Figs. 7-67 and 7-81. Remove the two slotted head screws holding the slip rings to the ring gear and press the complete slip ring assembly off the hub of the gear.

(12) Unless an emergency necessitates the salvaging of drive keys, do not remove them from a ring gear that is being replaced. The keys are doweled to the gear and reamed to fit the post so the old keys would have to be reamed over the standard size and special oversize dowels would be required. If it is necessary to salvage dowels for use with a new ring gear remove the three 3/8-inch socket head screws holding each key to the ring gear. Press the dowels out of the ring gear and out of the drive keys.

(13) To assemble the drive keys to a new ring gear place two keys on the bottom face of the gear with the side that is relieved for its full length toward the center of the gear and the chamfered edge away from the back face of the gear. Thread the six 3/8-inch socket head screws, three to each key, and tighten until the keys are held firmly in place but can still be moved by tapping lightly with a wood block or rawhide hammer.

(14) With the keys as far from the center of the gear as the screws will permit, slide the gear down on the post until the keys rest on the corresponding ground flats on the post. Tap the keys against the flats until both are snug against the post for the full length of the key, with no opening at either end. Then tighten the six socket head screws securely.

(15) Remove the ring gear from the post and ream four holes, two in each key and the ring gear, to a press fit for the dowels. Press the dowels into place.

(16) It should then be possible to press the gear onto the post. The gear should be absolutely free from any angular motion relative to the post.

(17) To assemble the ring gear and slip ring assembly, set the gear on a smooth surface with the hub upward. Start the slip ring assembly on the hub of the ring gear lining up the threaded inserts on the bottom of the slip ring assembly with the two holes where the hold-down screws come through the ring gear. Place wooden blocks on top of the slip ring assembly and press it down on the hub of the ring gear. Insert the hold-down screws from the bottom of the gear and tighten them.

(18) Remove the protective coating of grease from the post and cover it with a very light film of oil, using the same oil as in the crankcase. The oil film

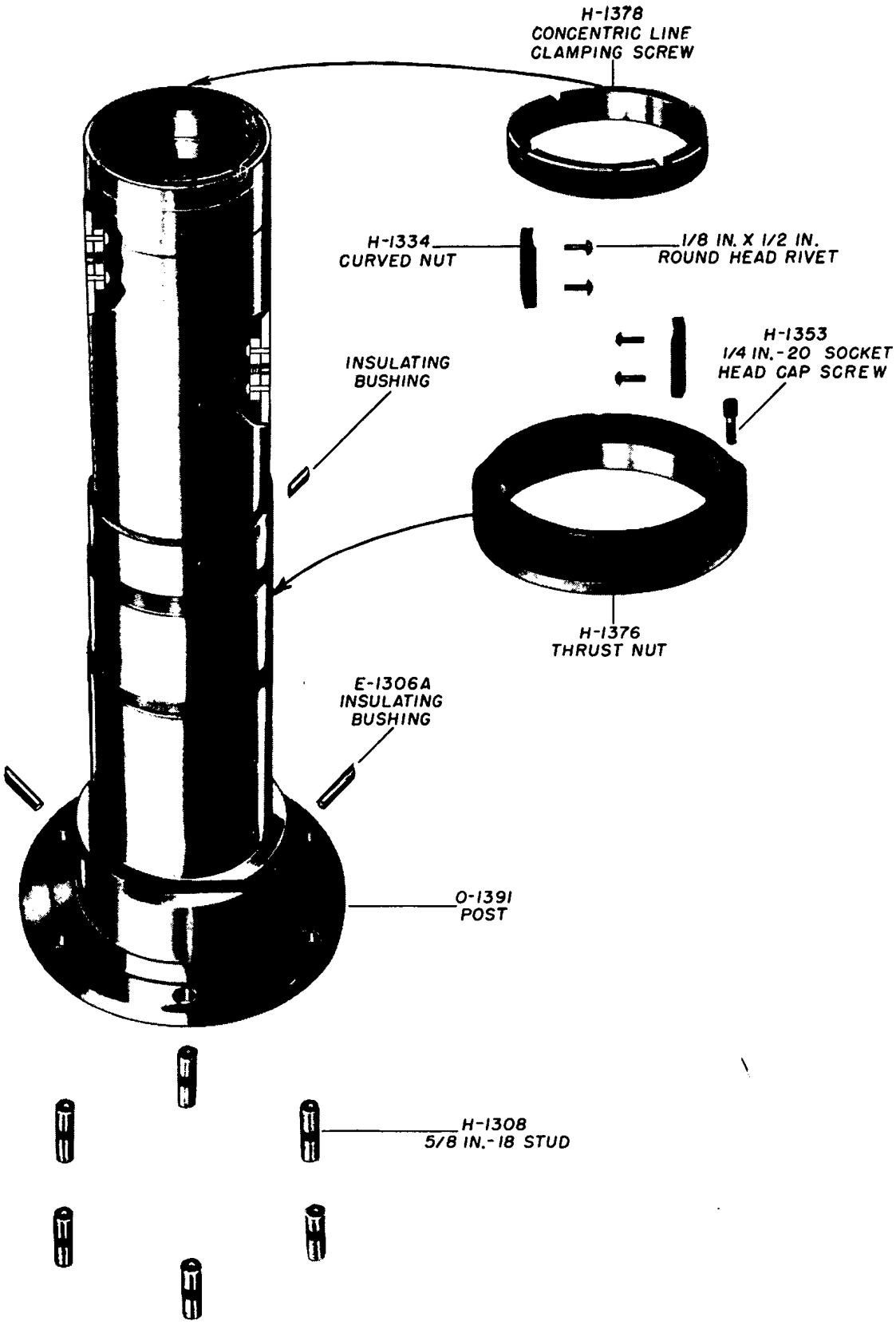
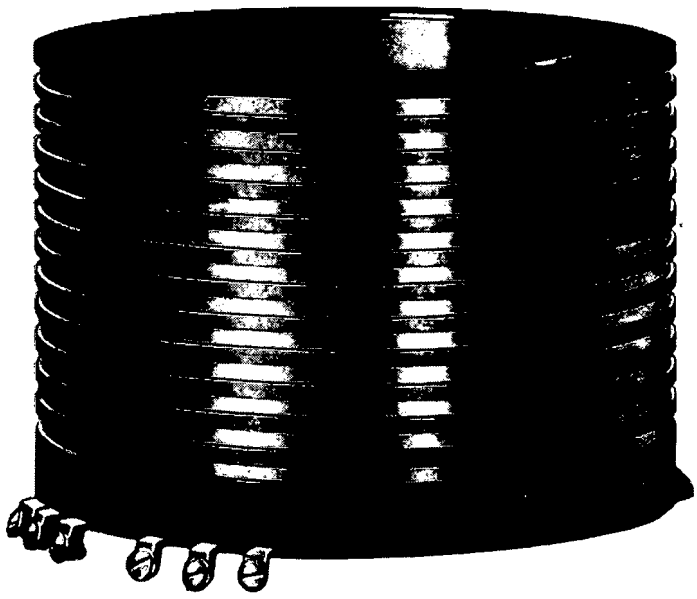


Figure 7-80. Pivot Post Assembly O-1391



O-1393
SLIP RING ASSEMBLY

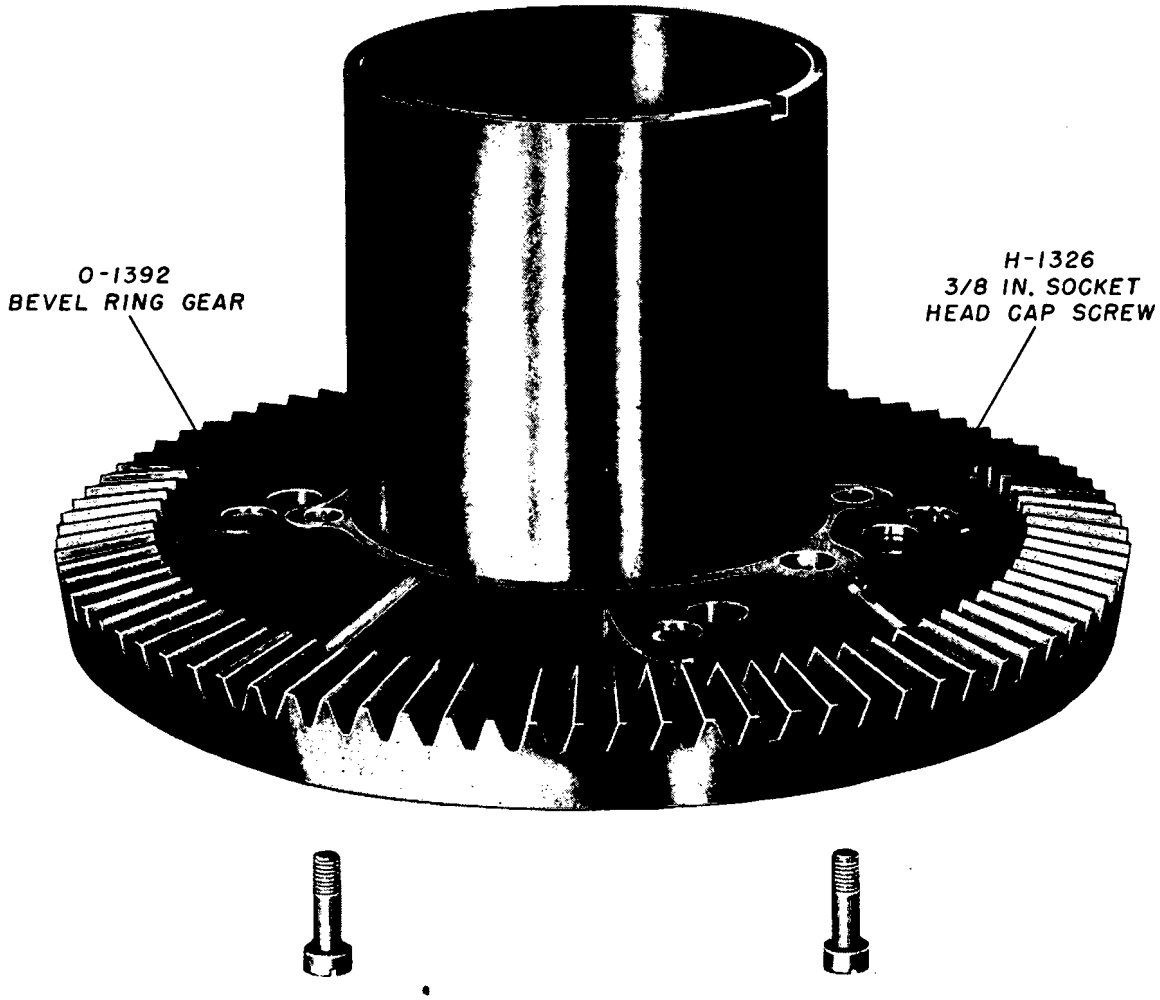


Figure 7-81. Ring Gear O-1392 and Slip Ring Assembly O-1393

should be light enough to prevent running, after assembly of the post in the main housing.

(19) With the main housing resting on two supports, as in disassembly, remove the hex head screw from the bottom of the housing near the gearcase mounting face. Remove the socket head set screw under this hex screw and loosen the next socket head set screw one and one-half turns. This releases the eccentric shaft, the end of which is flattened on the side in line with the high point of the eccentric and slotted to permit rotation. This shaft and the back-up bearing are shown in Figs. 7-74 and 7-82. Rotate this shaft until the flat is toward the bottom of the main housing, thus moving the ring gear back-up bearing away from the ring gear position, where it will not interfere with seating the gear on the post.

(20) Lay the five inch slotted nut in the main housing, concentric with the main bearing in the top of the housing. Lay the lockwasher on top of the slotted nut with the tab on its inside diameter facing the bottom main bearing. See Fig. 7-80. Set the ring gear and slip ring assembly on top of the lockwasher with the locking tab extending into the slot on the ring gear hub. With one person holding the gear in position, hold the post by the studs and lower it carefully into the main housing, lining up the flats on the post with the driving keys on the bottom of the gear. Place the cast iron thrust nut, shown in Figs. 7-67 and 7-80, over the top of the post and tighten against the bearing in the top of the main housing.

(21) Replace the cover and the holding screws in the bottom of the Pedestal base. Turn the main housing over and set it in position on the base with the studs on the bottom of the post through the holes in the top of the base. Place the lockwashers and the castle nuts on the six studs, draw them up tight and insert cotter pins. Push the ring gear assembly down on the flats of the post as far as possible and place the lockwasher on top of the gear hub with the tab in the slot of the hub. Thread the five-inch slotted nut on the post and against the lock-washer. See Fig. 7-67.

(22) Place a spanner wrench in the slots of the five inch nut and have one person hold it against the inside of the main housing while another turns the housing and tightens the nut. Lock the tab of the lockwasher in the slot of the nut.

(23) Loosen the cast iron thrust nut shown in Figs. 7-67 and 7-80, about two and one-half degrees. This should give the main housing .004 inch of vertical movement on the post. Check this play by attaching an indicator to the top of the main housing and resting the plunger of the indicator on a shoulder of the post in such a manner as to give an indication of any vertical movement. The movement should be between .004 and .0045 inch. This vertical clearance is provided to allow for the difference in expansion of the steel post and the aluminum main housing. With this adjustment completed, lock the cast iron thrust nut by tightening the socket head screw in the nut.

(24) Feed the slip ring lead wires through the post and ring gear in accordance with wiring diagram Fig. 7-179. Slip tubular cable markers over the wires and solder on the terminal lugs. Connect the terminal lugs to the terminals at the bottom of the slip ring assembly.

(25) Push the insulating ring shown in Fig. 7-67, into the bottom end of the post and bolt in place with six 5/16-inch hex head screws and lockwashers. Push the neoprene ring and metal wire clamping ring up on the wires and against the insulating ring. Start the hex head screws holding the wire clamping ring in place, but do not tighten them.

(26) Assemble the 180-tooth synchrotie driving gear to the top of the main housing as described in Paragraph 33*g*. Slip the micarta ring, shown in Fig. 7-67, down over the post and allow it to rest on top of the 180-tooth gear. Cover the synchrotie wires with flexible plastic tubing if this has been removed for any reason. Feed the synchrotie wires through the insulating bushings. See Fig. 7-67.

(27) Assemble the synchrotie bracket and bracket cap assemblies as in Paragraph 33*c*.

(28) Reach under the rear side of the ring gear and turn the ring gear backup bearing by hand. This bearing is shown in Fig. 7-74.

WARNING

THE BACK-UP BEARING CAN BE REACHED WITH THE TIPS OF THE FINGERS BETWEEN THE BOTTOM REAR RIBS OF THE MAIN HOUSING. BE SURE THAT THE HOUSING IS NOT TURNED WHILE FEELING FOR THE BEARING AND ALSO THAT THE HAND IS CLEAR OF THE GEAR TEETH OR DRIVING GEAR BEFORE ROTATING THE HOUSING.

(29) Turn the main housing slowly, checking the bearing to see that it does not touch the bottom face of the gear. Turn the eccentric bearing shaft clockwise until the bearing lightly touches the gear. There may be only one or two places touching on the gear as this bearing was not intended to support the gear during normal operation. The purpose of the bearing is to prevent the gear from being sprung from an abnormal load. Turn the socket head set screw under the shaft clockwise to lock the eccentric shaft. See Fig. 7-74. Safety lock the set screw by screwing the cup point socket head set screw up under it. Close the opening with the neoprene gasket and hex head screw.

(30) After the drive unit has been reassembled as directed in the next paragraph, replace the synchrotie cover, brush assemblies, and the ship's head marker switch. Draw the wires down through the insulating ring in the bottom of the post, noting that wires inside

the post are to have a slight amount of slack and are not to be stretched tight. The wires through the ring gear should also have a small loop where they attach to the terminals of the slip ring assembly. Be sure this loop is not in a position where it might get caught between the bevel gear and pinion.

(31) With the wiring adjusted properly, tighten the hex head screws on the wire clamp ring and safety wire the screws holding the insulating ring in place in the bottom of the post. Replace the brush block and cover assemblies and connect the brush leads to the terminal block in the gearcase according to the wiring diagram, Fig. 7-179. Then check all electrical circuits.

(32) Check the backlash in the driving gear chain as directed in Par. 33*b* of this section.

m. REASSEMBLING DRIVE UNIT.

(1) The Drive unit cannot be assembled in exactly the reverse order to which it was disassembled. There are certain details to be observed which make it impractical to adhere strictly to this procedure. Before assembly inspect each part to make certain that it is clean and in perfect condition. Lubricate each metal part before reassembly and replace damaged gaskets and shims with new ones. In a few instances where it may be necessary to tap press fits into assembly, always tap evenly all the way around the parts. On starting a press fit, be sure that it starts straight. Oil should always be used. Wash all bearings thoroughly in clean kerosene until they are free of oil, grease and grit, then blow out with compressed air or hand bellows. Use extra care when working with gears so as not to damage teeth.

(2) Too much emphasis cannot be placed on the importance of making major repairs or replacements at a base where a complete set of precision tools is available. This point should be given particular attention when pre-loading ball bearings. To pre-load a bearing means to pinch the inner race against the outer race through the balls. It is necessary to pre-load the bearings to eliminate possibility of end play. The slightest end play in the bevel pinion shaft will create excessive backlash between the bevel gears. As a result, a hunting effect will be introduced making it impossible to operate the unit properly. A most important factor is the position of the open faces of the bearings in the assembly. The open face should be facing away from the bearing cage. The outer race of the bearing is nearly tangent to the top of the balls on the open face, but on the other side the inside diameter of the outer race is much smaller, creating a shoulder for the balls to run against.

(3) The first step in reassembly is to replace the bevel pinion shaft assembly. Several preliminary steps are required before starting on the actual assembly of the bevel pinion shaft in the bearing cage. In addition to the above mentioned close measurements for setting the bearings, there are two others equally exacting. They are dimensions "A" and "B" shown in Fig. 7-83.

(4) With the bearings removed from the bearing cage, use precision measuring instruments and find dimension "C" shown in Fig. 7-83. Set each bearing on parallels and find dimension "F". Adding the dimension "F" found for each bearing and subtracting the total from dimension "C" gives dimension "A".

(5) Use the necessary combination of shims to make dimension "B", the length of the inner spacer plus the oil seal face plate plus the shims, equal to .002 inch less than dimension "A".

(6) Using a hammer and a bar of soft material approximately one-quarter of an inch in diameter, tap the oil seal, shown in Fig. 7-74, into the bearing cage, tapping evenly around the outer edge. Slide the larger, oil seal retainer, spacer into place.

(7) With the open face of the ball bearing nearest to the pinion end, press the bearing on the pinion shaft. See Fig. 7-74. A thin film of oil on the shaft will minimize possibilities of galling.

(8) By pressing or tapping with a soft hammer on the face of the outer race, insert the bearing and shaft into place in the bearing cage.

(9) From the other end of the cage, slide the remaining spacer over the shaft and down through the oil seal. Slide the oil seal, face plate and the combination of shims figured for dimension "B", shown in Fig. 7-83, over the shaft.

(10) Press the ball bearings into place with the face of the outer race tight against the shoulder of the bearing cage, being sure that the open face of the bearing is toward the threaded end of the shaft. When the outer race of the bearing is entering the bearing cage, occasional light taps around the periphery of the outer race will assist in preventing the balls from becoming imbedded in the groove.

(11) Press the drive key into the keyway in the shaft. Press the 101 tooth internal gear into place on the shaft, slide the washer over the shaft and lock the assembly with the slotted shear nut and cotter pin. These parts are shown in Fig 7-74.

(12) The next step in assembly is to mount the bevel pinion assembly in the main housing. Bevel gears have what is known as a cone point, an imaginary point in space where the pitch angles cross the center line of the shaft. See Fig. 7-83. When a bevel gear is in mesh with its mating gear, the cone point lies on the center line of the mating gear. The distance from the cone point to the pitch diameter is known as the cone distance. This distance on the bevel pinion is 6.000 inches.

(13) After a bevel gear is cut, it has a definite cone point. This point cannot be changed except by recutting the teeth on a gear cutting machine. No

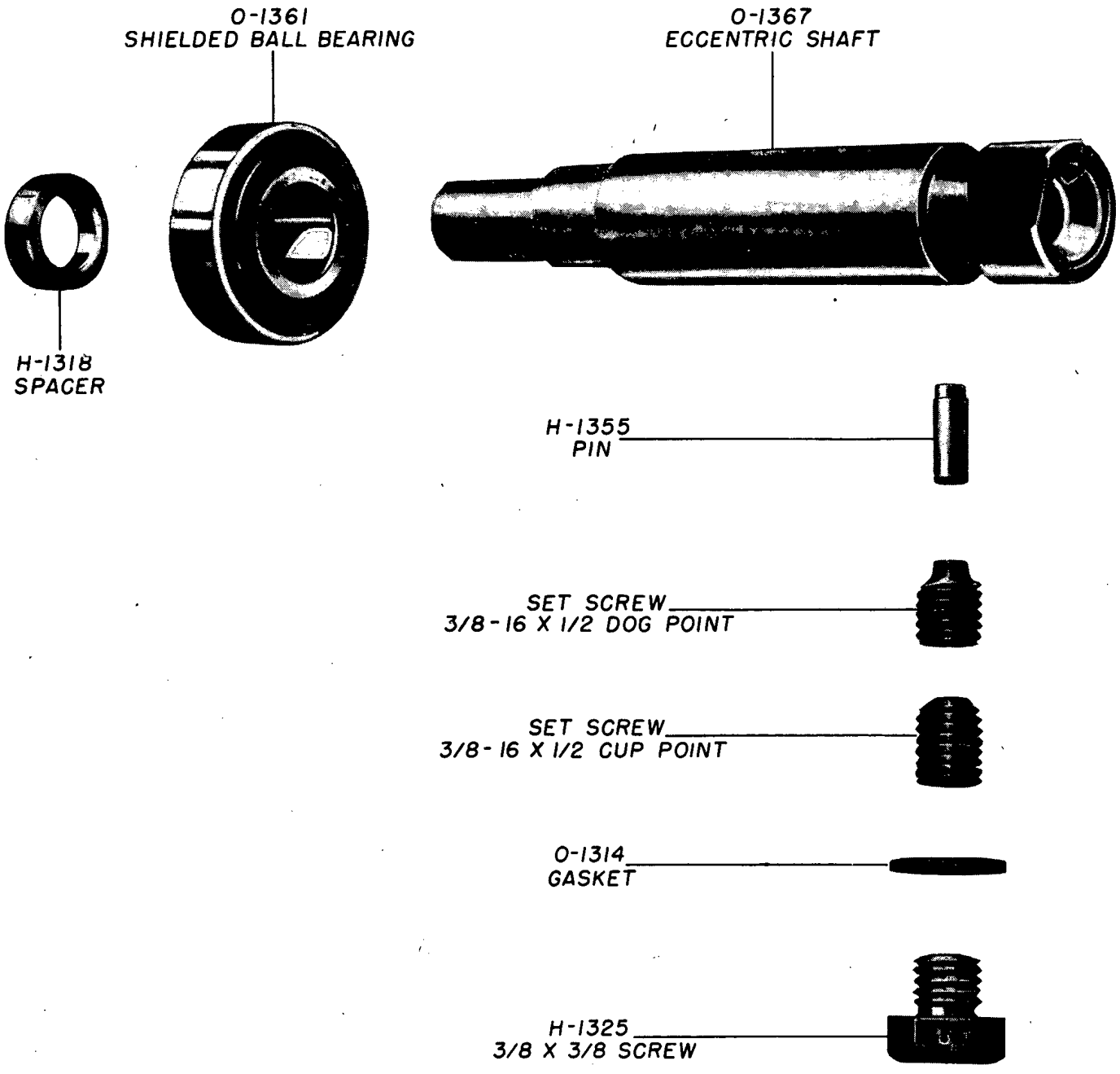


Figure 7-82. Bevel Gear Back-up Bearing Eccentric Shaft

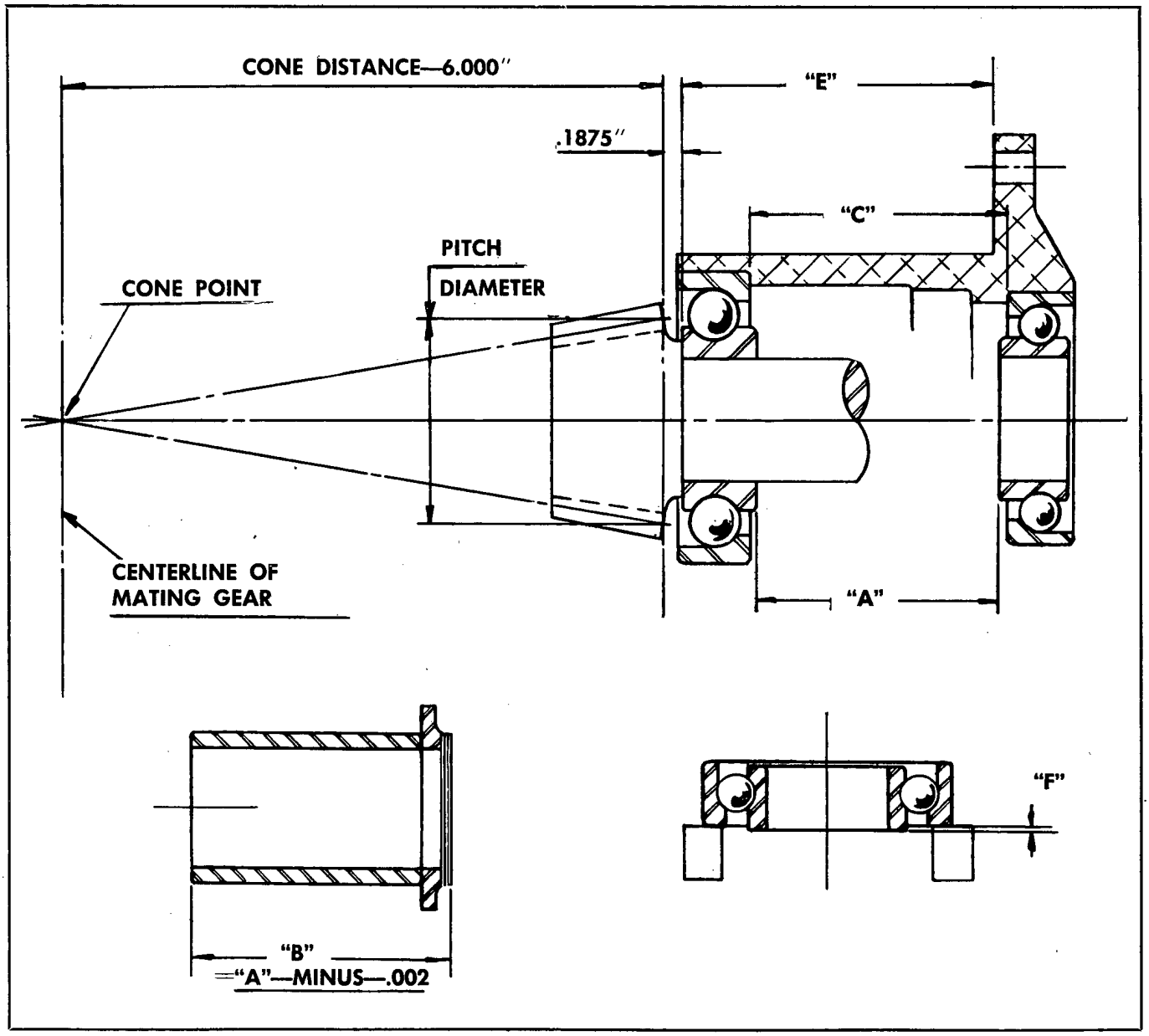


Figure 7-83. Bevel Gear Shaft Assembly Dimensions

change in the cone point can be made by adjustment after the gear is assembled in a unit. In order to function properly, a bevel gear must be assembled so that its cone point lies on the center line of the mating gear.

(14) The foregoing information will clarify the reasons why the following preliminary steps are necessary when mounting the bevel pinion in the main housing. The procedure for mounting the bevel pinion assembly correctly is as follows:

(15) With precision measuring instruments, find dimension "E", see Fig. 7-83, the distance from the inner face of the bearing cage flange to the outer face of the inner race of the ball bearing on the pinion end of the shaft. To dimension "E", add 6.000 inches (the cone distance) and .1875 inches (the distance from the shoulder of the bevel pinion shaft to the pitch diameter). From this sum subtract 9.281 inches. The result of this subtraction gives the thickness of the shim pack to be placed between the flange face of the bearing cage and the mounting face of the main housing when assembling the unit. The required shim pack can be made from the combination of shims supplied with the equipment.

(16) Using shims that are clean and free from burrs, slide the shim pack over the body of the bearing cage and against the face of the flange. Slide the assembly slowly into the main housing, being careful not to damage the ring gear. Use a ½ inch socket wrench and bolt the assembly in place with the six hex head screws, flat washers and lockwashers.

(17) The third step in the assembly is to mount

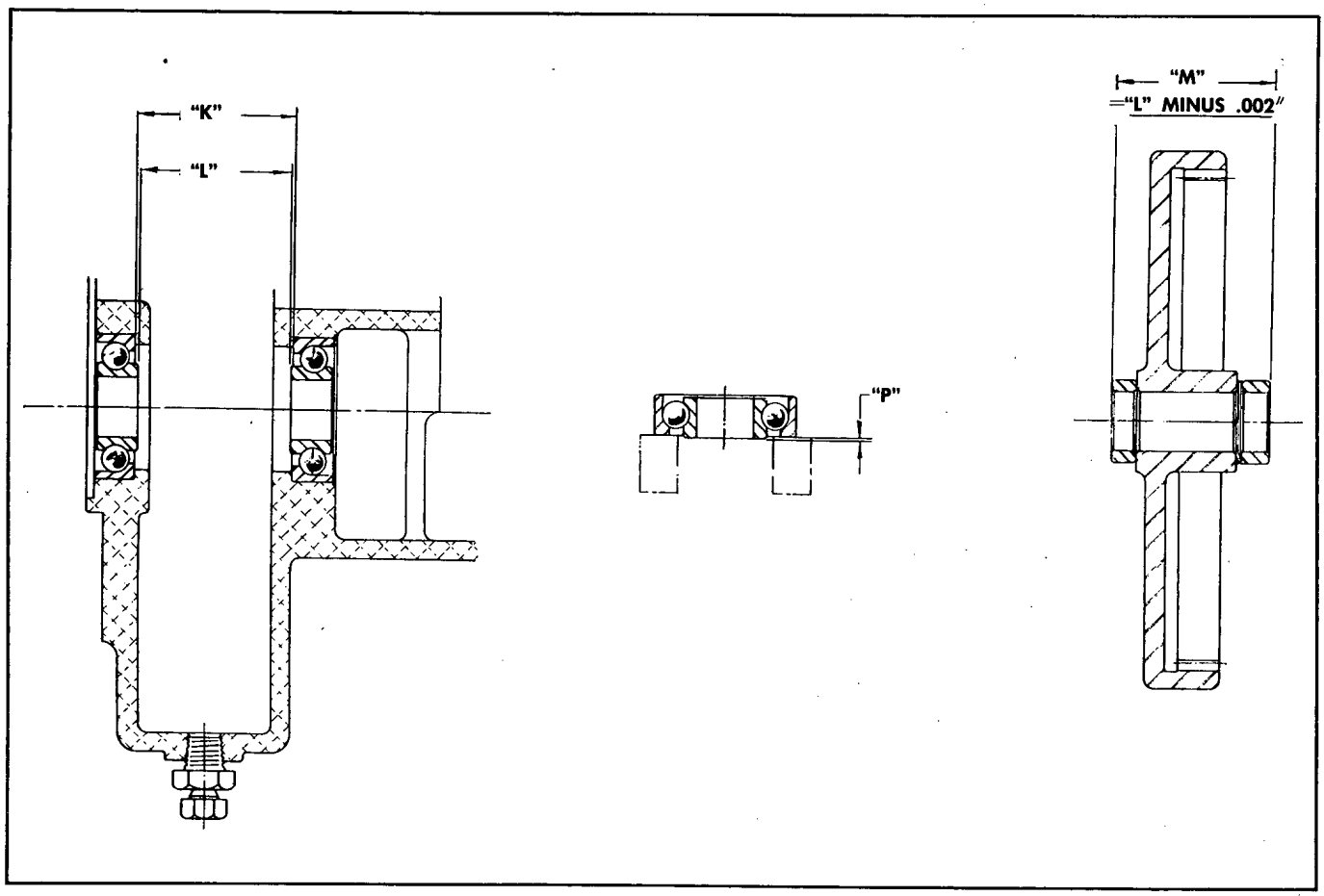


Figure 7-84. Alignment of Reduction Gear Bearings

the intermediate pinion shaft assembly. The two ball bearings in this assembly are of the radial thrust type and consequently must be pre-loaded. The procedure for taking the preliminary measurements for pre-loading the bearings is as follows. See Fig. 7-84.

(18) With bearings removed from the gearcase and using precision measuring instruments, find dimension "K", the distance between the shoulders in the bearing mounts on either side of the lower section of the gearcase. Set the bearings on parallels and find dimension "P" for each bearing. Adding the dimensions "P" found for each bearing and subtracting the sum from dimension "K" will give dimension "L". Select the correct combination of shims to make dimension "M" (the length of the two longer spacers plus the gear hub plus the shims) equal to .002 inch less than dimension "L".

(19) Slide the short spacer over the 12 tooth pinion shaft and press the ball bearing on the shaft until it pinches the spacer tight against the back of the gear teeth. These parts are shown in Fig. 7-74. The open face of the bearing should face the gear teeth. Slide one of the longer spacers on the shaft and press the drive key into the key way. Lay the gearcase on its motor mounting face on a bench and place the 101 tooth internal gear in its approximate location. Press the 12 tooth pinion shaft assembled with bearing, spacers and drive key into the gearcase, lining it up so the key in the shaft fits into the key way in the 101 tooth internal gear. Use care when making this assembly. Do not press or hammer too hard if it seems that the assembly is tighter than necessary.

(20) Slide the shim pack that was determined above in paragraph 33*m*(18) over the shaft and against the hub of the internal gear. Slide the remaining spacer on the shaft and press the ball bearing in place, making sure that the open face of the bearing is out. The locknut which goes on the end of the shaft may be used to press the bearing into place. Lock the assembly together with the lockwasher and locknut.

(21) The fourth step in the assembly is to mount the intermediate pinion assembly to main housing. The gearcase is located on the main housing by a turned pilot on the gearcase which fits into a bored hole in the main housing. The pilot and bored hole are machined to create an eccentric between the 12 tooth pinion shaft and its mating 101 tooth internal gear, shown in Fig. 7-74. This eccentric feature makes it possible to adjust the gear mesh to any backlash requirement, moving the pinion in and out of mesh with the internal gear by turning the whole gearcase

assembly. To tighten the gear mesh, stand at the motor end and turn the gearcase in a clockwise direction.

(22) The procedure for mounting the gearcase to the main housing is as follows. Cement the gasket on the flange with good waterproof gasket cement. Place the gearcase in position on the main housing with the pilot fitting into the bored hole in the main housing, being extremely careful in meshing a tooth of the 12 tooth pinion into a tooth space in the internal gear. Bolt the unit into position using only six screws with the necessary flat washers and lockwashers. Tighten these screws sufficiently to hold the flange of the gearcase firmly against the main housing, but with sufficient play to permit rotating the gearcase by tapping with a piece of wood and a hammer.

(23) Grip the outer ring of the internal gear lightly with the fingers by inserting the hand through the bored hole provided for the 10 tooth pinion assembly. Move the gear back and forth. The vibration or rattle will indicate whether or not backlash exists between the 12 tooth pinion and its mating 101 tooth internal gear, shown in Fig. 7-74. Tap the gearcase in a clockwise direction until no backlash is indicated. Then, tap very lightly in a counterclockwise direction until a slightly perceptible backlash can be felt. Check to note if the backlash is uniform all the way around the internal gear on the bevel pinion shaft. Tighten the gearcase solidly with all fourteen hex head screws and check again to see that this has not changed the backlash adjustment. Then safety wire all screws.

(24) The fifth step is to assemble the high speed pinion shaft in its bearing cage. The plain radial ball bearings in this assembly are not of the thrust type, consequently they do not require pre-loading. The parts of the assembly may, therefore, be dismantled at any base as precise measuring instruments are not necessary when reassembling. The procedure for reassembly is as follows.

(25) Press one of the ball bearings on the 10 tooth pinion shaft and snug against the retaining shoulder at the pinion end. Press the bearing and shaft into the eccentric bearing cage until the face of the outer race is flush with the front face of the bearing cage hub. Slide the inner sleeve on the shaft, followed by the remaining ball bearing and press the bearing into place in the flange end of the bearing cage. A cut-away view of the assembly is shown in Fig. 7-74. The bearing lock nut may be used to press the bearing into place. Intermittent tapping with a soft rod on the face of the outer race is a precaution to prevent balls from damaging the grooves of the outer race.

(26) Lock the parts in place with the lock nut and lockwasher, then press the woodruff key into the keyway in the shaft. Slide the Oldham coupling driven member on the shaft, over the woodruff key and snug against the retaining collar. Slide the spacer on the shaft and the Oldham coupling floating member over the spacer. Place this part so that two of the four slots on the periphery fit over the two tongues on the face of the driven member. Place the coupling washer on the shaft and lock the assembly together with the locknut and lockwasher on the end of the shaft. The coupling assembly may be seen in Figs. 7-74 and 7-85. Test the assembly by spinning the shaft.

(27) The sixth step is to mount the high speed pinion assembly in the gearcase. This assembly should be mounted only after the intermediate pinion and internal gear assembly has been installed in the gearcase.

(28) It will be noted that the 10 tooth pinion shaft is eccentric to the hub of the bearing cage, permitting the pinion to be moved in or out of the mesh with its mating 101 tooth gear for backlash adjustment. The assembler should remember this feature as a means of preventing injury to the gear teeth when mounting.

(29) The procedure for mounting the 10 tooth pinion bearing cage in the gearcase is as follows. Place the pinion assembly into the gearcase, taking care that a tooth on the pinion slides into a tooth space on the mating 101 tooth internal gear. Place the flat washers and the lockwashers on the five hex head screws and thread the screws, tightening them sufficiently to hold the bearing cage flange snugly against the gearcase but permitting a slight turning of the cage when it is tapped. See Figs. 7-85 and 7-86.

(30) Using a piece of fiber or wood, tap the bearing cage in a clockwise direction until no vibration or rattle can be detected between the gear teeth on the pinion and internal gear. A positive means for detecting vibration or rattle is to grip the Oldham coupling driven member lightly with the finger tips. It is possible to detect movement or backlash as fine as .002 inch in this manner.

(31) Tap the bearing cage in a counterclockwise direction until a minimum of backlash is noted. Check to see if backlash is uniform all the way around the 101 tooth gear. Tighten the hex head screws with a ½ inch socket wrench and check again to see that this has not changed the backlash adjustment. Secure the screws with safety wires.

(32) The seventh step is assembly of the drive motor. Press the woodruff key in the key way in the motor shaft. Slide the Oldham coupling driving member, see Fig. 7-74, on the shaft, noting that the tapped hole in the coupling member must line up with a drilled spot in the motor shaft. Lock the driving member on the shaft with the cone pointed hex head screw and lockwasher.

(33) Cement a gasket to the flange on the curved

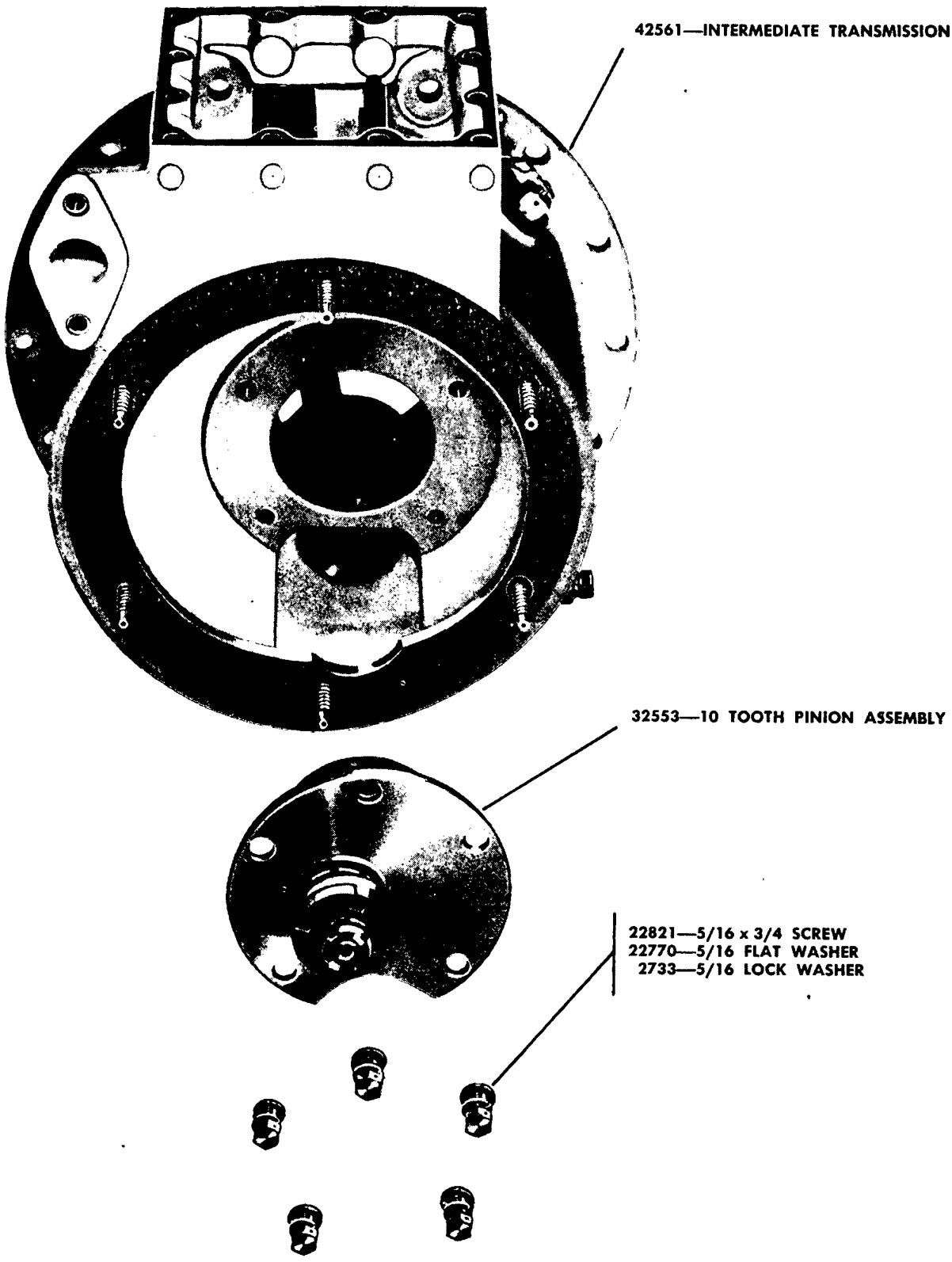


Figure 7-85. Intermediate Transmission Housing, Exploded View

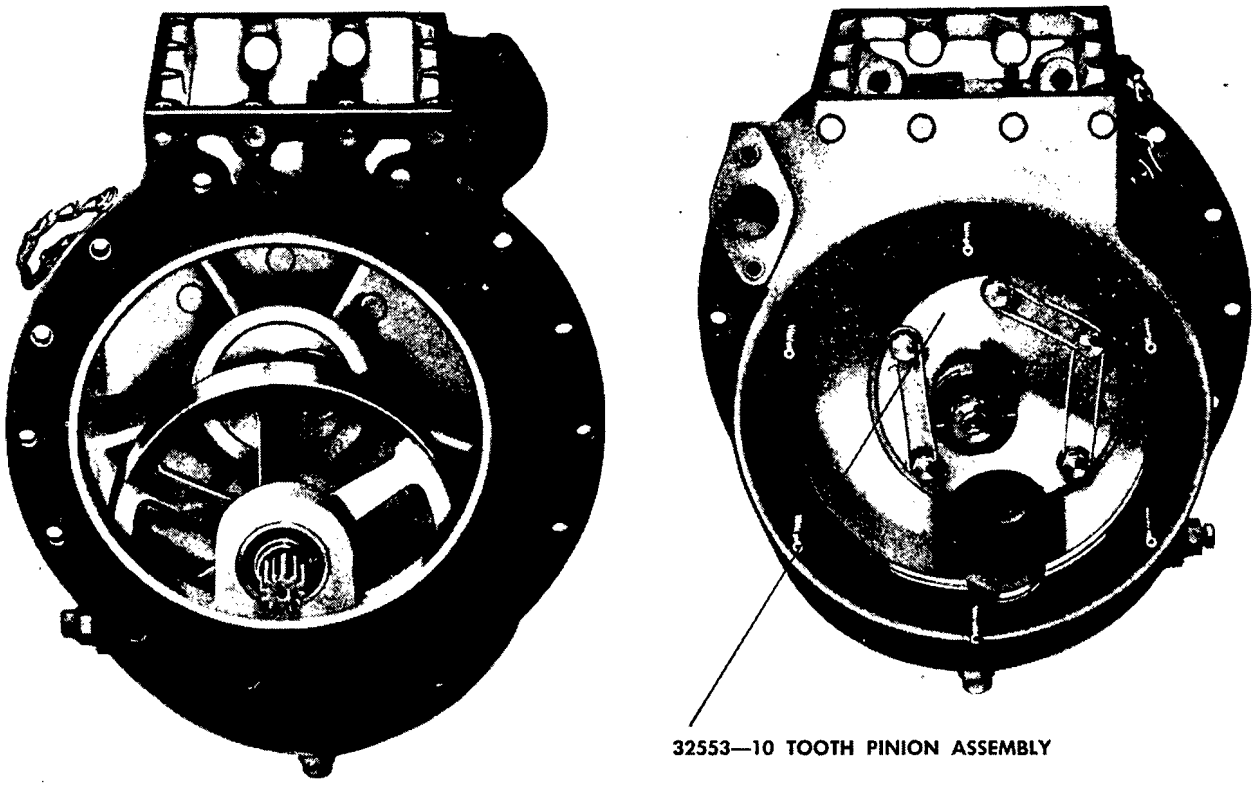


Figure 7-86. Intermediate Transmission Housing Assembly

end of the wiring manifold, using a good waterproof gasket cement. Push the wires from the motor terminal box through the wiring manifold, being careful not to fray the insulation. Bolt the manifold to the boss on the motor terminal box, but do not pull the screws down tight until assembly of the motor to the gearcase.

(34) The final step of the re-assembly is to mount the drive motor assembly on the gearcase. Extra care should be taken when mounting the motor to line up the two tongues of the Oldham coupling driving member with the slots in the floating member. See Fig. 7-74. The floating member is made from micarta and the driving member from steel. It is obvious that care must be exercised when assembling these parts to see that the steel does not damage the micarta. It will be found helpful to line the slots and tongues in a horizontal plane before mounting.

(35) Cement gaskets to the motor flange and the straight end of the wiring manifold, using a good waterproof gasket cement. Lift the motor up to the gearcase and push the motor wires through the opening to the gearcase terminal box. Place the motor slowly into position over the cone pointed mounting studs, using extreme care to prevent damage to the micarta coupling floating member.

(36) Give several turns to the hex head screws which hold the wire manifold to the gearcase. Bolt the motor solidly with six hex head nuts and lockwashers, then tighten the screws on both ends of the wire manifold.

(37) Reconnect the wires in the gearcase terminal box according to the wiring diagram, Fig. 7-179. Replace gearcase terminal box cover.

(38) If the chain captivating the motor terminal box cover to the gearcase has been removed, it should be replaced.

n. CHECKING BACKLASH IN DRIVE UNIT GEAR TRAIN.

(1) With the motor disconnect plug removed from the pedestal base, place a 6 or 7 inch diameter white cardboard disk over the rear end of the motor by cutting out a circle in the center slightly smaller than the boss on the rear of the motor. This card should sit at right angles to the motor shaft center line and be enough of a press fit on the motor boss to prevent it from turning during backlash tests.

(2) Attach a dial indicator to a suitable support

attached to the pedestal base. Adjust the support so the indicator plunger will bear against a smooth surface on the main housing.

(3) Insert the handcrank in the end of the drive motor shaft and rotate the main housing about 10 degrees counterclockwise looking down from above. Then rotate the housing back to its original position, in a clockwise direction only, and move the indicator up so the plunger is inserted approximately half of its total travel.

(4) Mark the position of the handcrank, with no pressure being applied, on the white card. Set the indicator dial to zero. Continue rotation of the housing about 10 degrees in a clockwise direction. This should allow the indicator plunger to move completely out.

(5) Reverse the direction of rotation of the housing and bring it back until the handcrank is again at the point marked, with no pressure on the crank. Note the reading of the dial indicator.

(6) Measure the distance from the center line of the pedestal post to the point of contact of the indicator. Multiply this distance by .00087 radians to find the allowable backlash.

(7) If the backlash noted from the indicator is greater than this allowable backlash, adjust the units of the drive gear chain according to paragraphs 33*m*. (23), (30), and (31).

o. SHIP'S HEAD MARKER MICROSWITCH.

(1) The ship's head marker microswitch (not shown in the illustrations) is mounted on a bracket on the deck of the main housing, inside the access door on the antenna mounting face. It is normally expected that the life of this microswitch (S-1301) will be about one year. To replace it, merely unscrew and remove the old switch from the bracket and screw the new one in place. Align the new switch with the cam on the ring gear so the switch arm closes the switch when riding over the cam, but leaves it open when not on the cam. The switch should also be set under these conditions so its closed time is as short as possible.

p. DISASSEMBLY OF IFF TRANSMISSION LINE.

(1) In any disassembly work on the Antenna Pedestal, the Antenna assembly is removed as one piece. However, it is necessary to remove the IFF Antenna and transmission line separately whenever these parts suffer damage or whenever it is necessary to change the IFF frequency band. The removal of the IFF transmission line is shown in Fig. 7-87. The first step is to remove the clamps that hold the transmission line to the frame as indicated in Step 1 in Fig. 7-87. If only the transmission line is to be removed, loosen the mounting bolts that secure the antenna bazookas to the frame as shown in Step 2. This permits the T-joints on the transmission line to come apart. The disassembly of the T-joints is shown in Step 3. Unscrew the knurled nuts on each side of the T-joints and pull the line apart. Whenever this step is reversed in assembly, be sure that the banana plug on the end of the inner conductor is inserted properly in the T-joint. The plug on the side can be removed if necessary, so that the inner conductor of the T-joint can be seen. Step 4 shows the removal of the transmission line from the dome of the Antenna Pedestal and the top of the bazooka of the radar antenna. After this step is performed, the transmission line may be lifted out of the brackets. The line is installed by reversing the steps shown in Fig. 7-87.

q. DISASSEMBLY OF R-F LINES IN PEDESTAL.

(1) Whenever it is necessary to disassemble the r-f lines in the Antenna Pedestal, it is necessary to remove the antenna assembly from the Pedestal or to remove the IFF transmission line. Since only one person is required to remove the IFF transmission line, this is generally the most logical method to employ. Therefore, the steps shown in the illustrations accompanying this paragraph are numbered as a continuation of the procedure performed in Fig. 7-87. Fig. 7-88 continues the procedure begun in Fig. 7-87, by showing schematically the parts in the r-f line assembly and their location in the Pedestal. Fig 7-89 shows an exploded view of the parts in the r-f line which may be used for parts identification.

(2) After Step 4 in the removal of the IFF transmission line (see Fig. 7-87), remove the elbow assemblies as shown in Fig. 7-90. These parts are located at the base of the Pedestal. They should be removed in the manner shown and when they are replaced, new gaskets should be used.

(3) Step 7 in Fig. 7-91 shows the beginning of the disassembly of the IFF inner conductor. A special Allen wrench is supplied to loosen the set screw at the T-joint. It is not necessary to completely remove the screw.

(4) Step 8 in Fig. 7-92 shows the disassembly of the rotating joint on top of the Pedestal. First, remove the gasket. Then use the special wrench supplied, to remove the ring screw as illustrated. The remainder of the parts may then be lifted out. When removing the splined connector, be careful not to damage the bellows assembly or to scratch its bearing surfaces. If these surfaces become scored, it will be necessary to refinish the bearing surfaces by lapping them with a fine grade of lapping compound. The bearing surfaces should be lapped in against the surfaces that they normally fit against. Badly scored bellows assemblies should be replaced.

(5) The next steps in disassembly are steps 9 and 10 in Fig. 7-93. First, the IFF inner conductor is turned counterclockwise until it is unscrewed from the lower section of the line shown in Fig. 7-91. When replac-

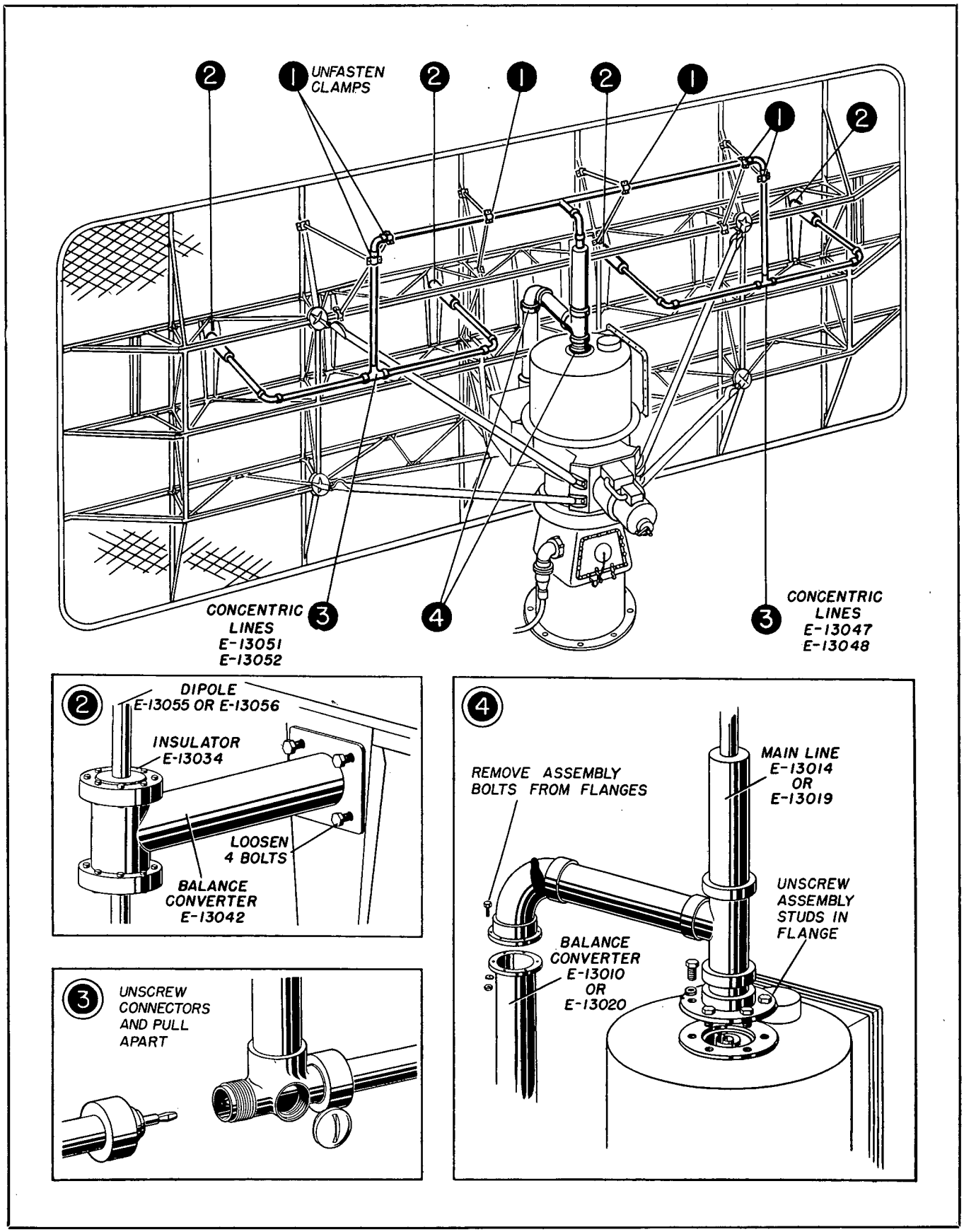


Figure 7-87. Disassembly of IFF Transmission Line

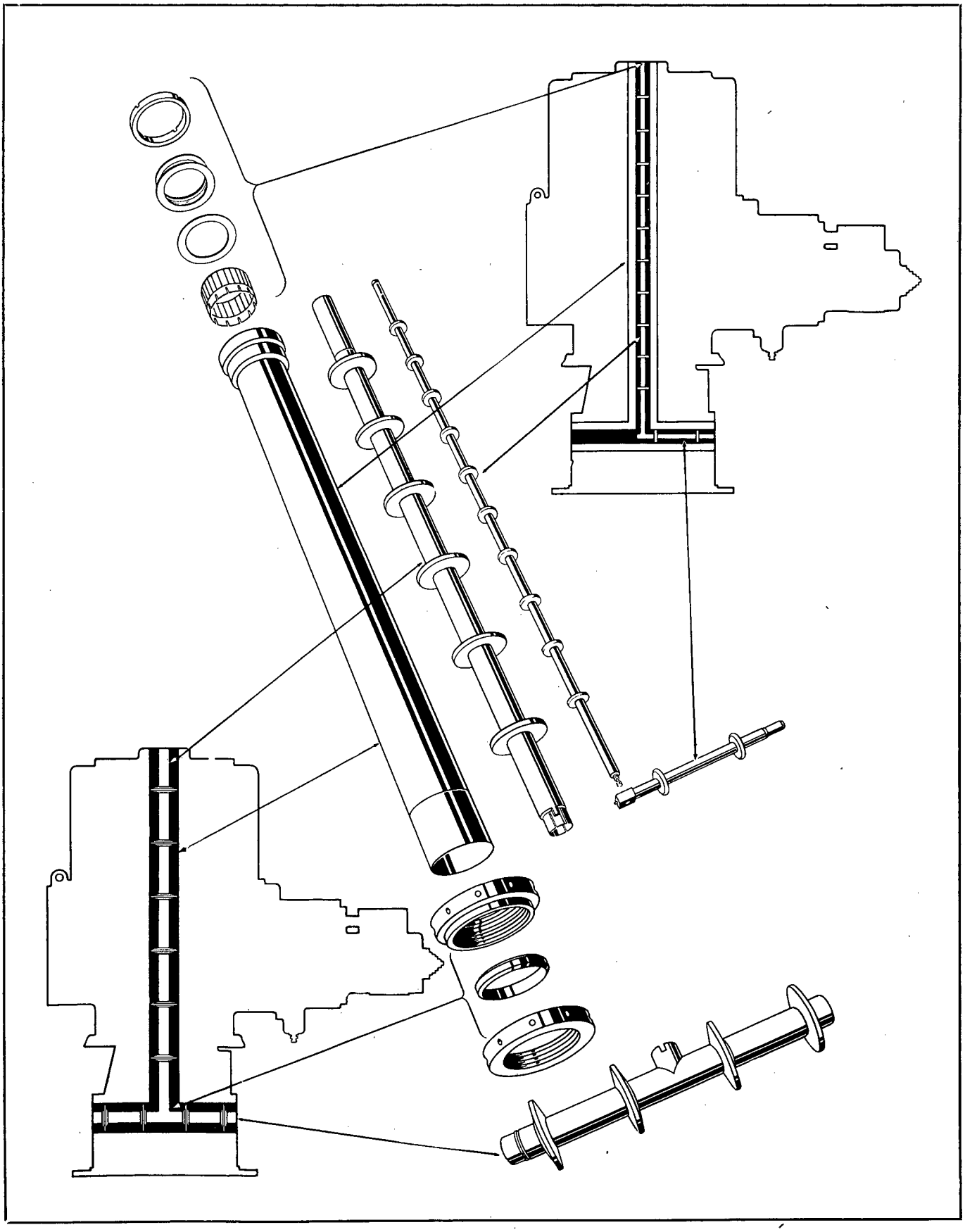


Figure 7-88. R-F Lines in Antenna Pedestal, Schematic Diagram

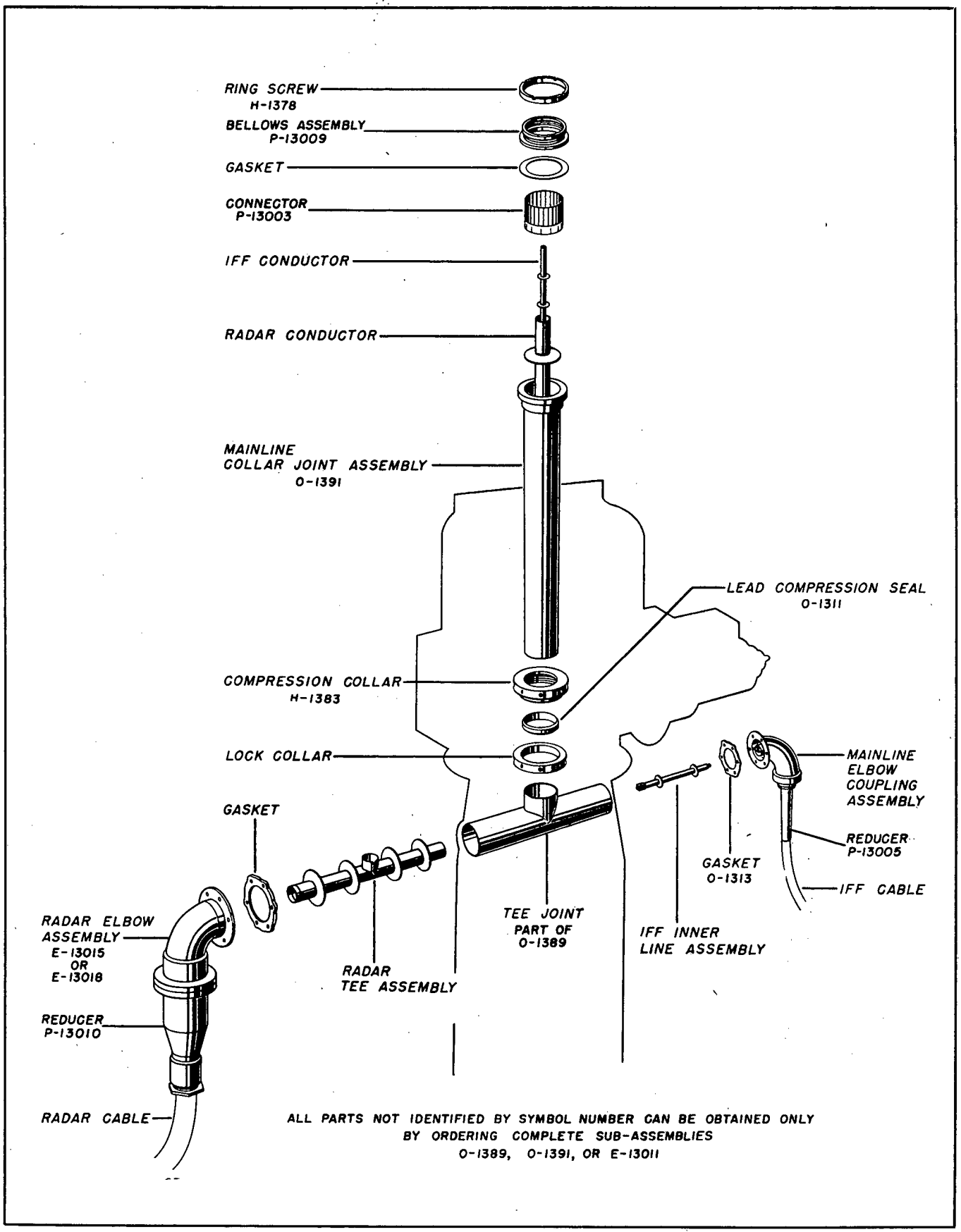


Figure 7-89. R-F Lines in Antenna Pedestal, Exploded View

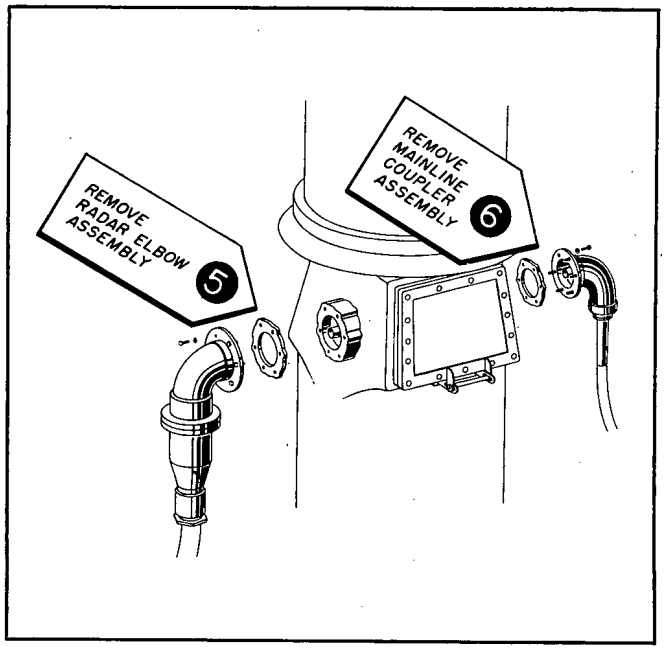


Figure 7-90. Disconnecting R-F Lines at Base of Pedestal

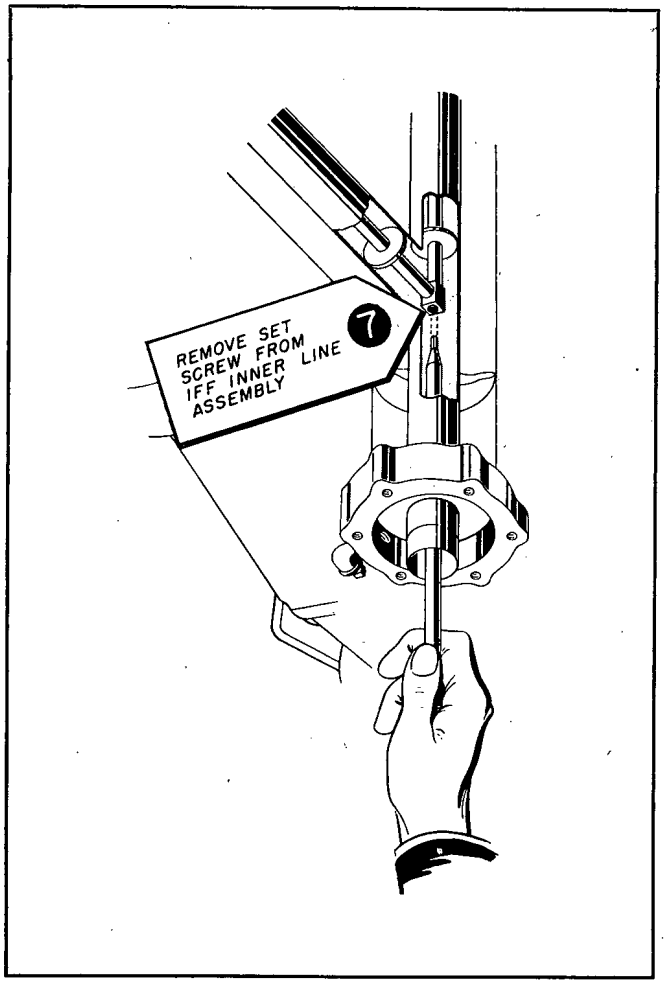


Figure 7-91. Disassembly of R-F Inner Line at T-Joint in Base of Pedestal

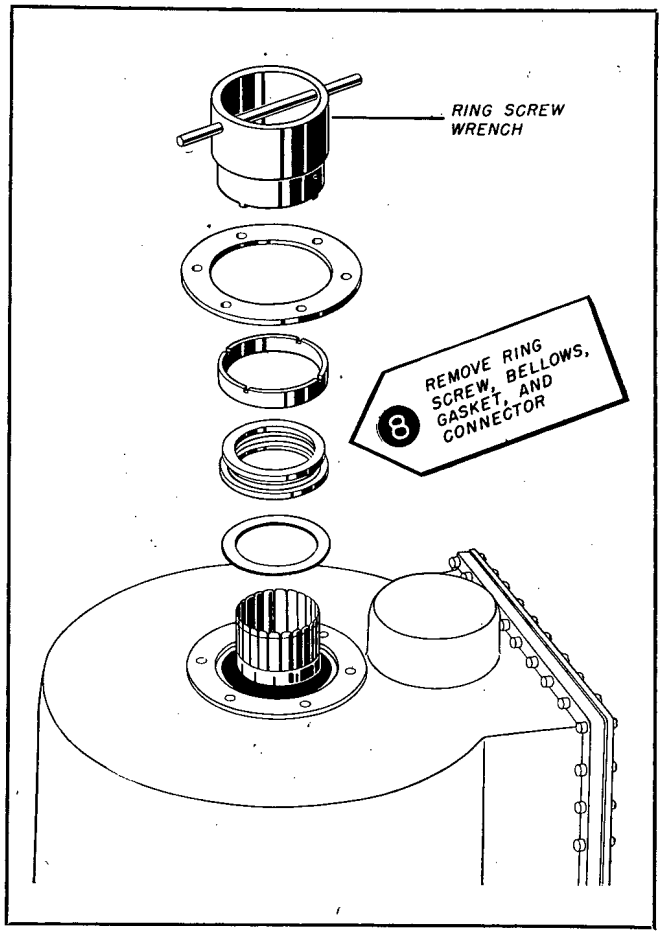


Figure 7-92. Disassembly of Rotating Joint

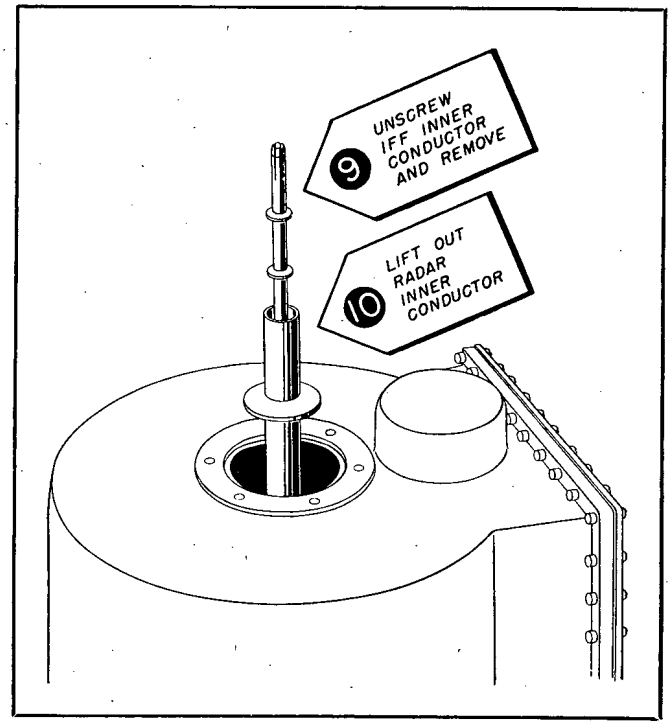


Figure 7-93. Removing Inner Conductors from Pedestal

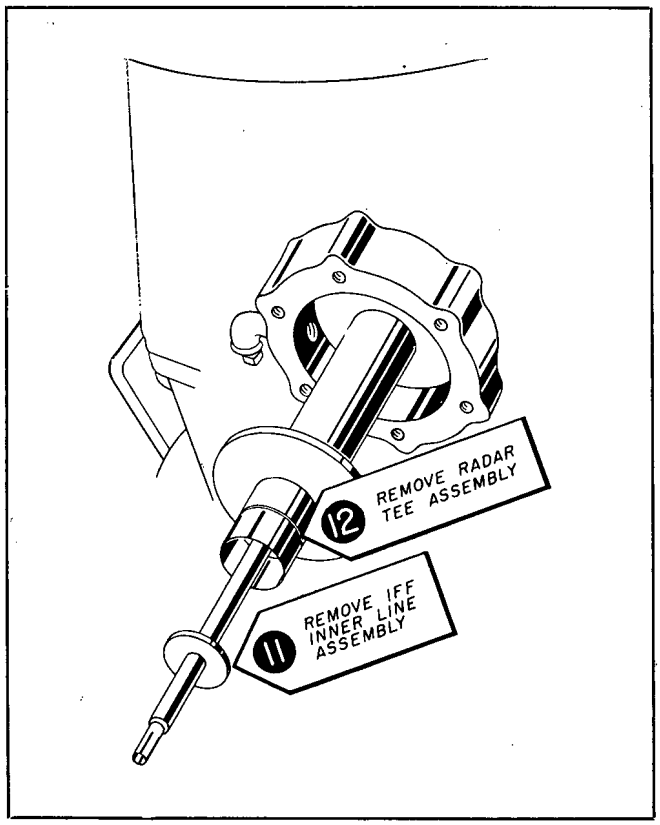


Figure 7-94. Removing Lines from Base of Pedestal

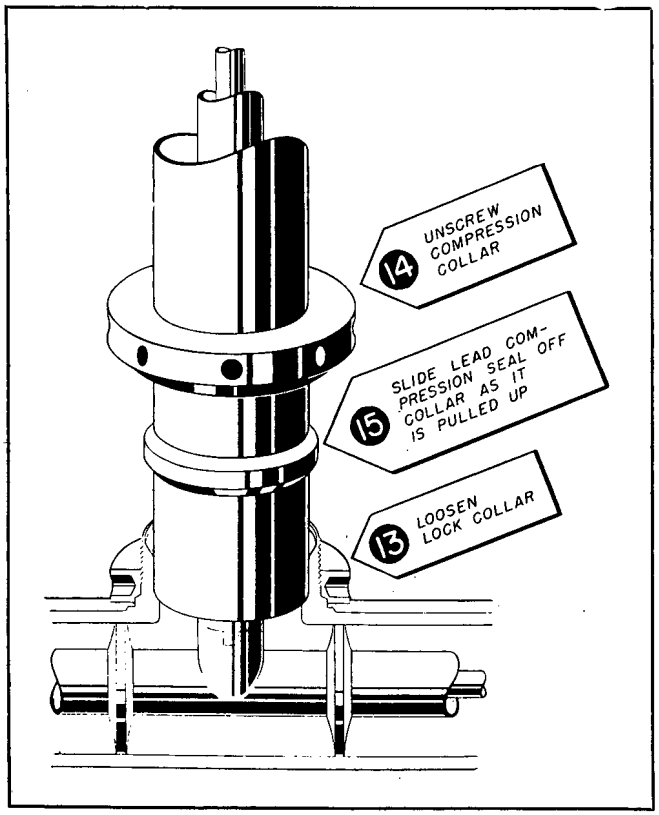


Figure 7-95. Preparation for Removal of Outer Conductor

ing this section of the line be very careful not to start the threaded end of the vertical conductor into the tapped threads on the horizontal conductor in such a way as to cross the threads and damage them. After the IFF inner conductor is removed, the radar inner conductor can be pulled out as shown in step 10. When this section of line is replaced, turn the split section so that the two pieces of line go together and note whether it fits snugly. If it does not, spring the split section at the end of the line so that it makes good contact at the T-joint in the lower section of the line.

(6) Steps 11 and 12 in Fig. 7-94 show the removal of the lower sections of line from the base of the Pedestal. These parts slip out easily after the upper sections of line have been removed. When replacing these sections place the large radar section in place first and then insert the vertical radar section into place. In order to align the lower section so that the upper section will fit into it, it is necessary to shine a flashlight into the side of the Pedestal and look down through the top to see when the lower section is properly centered.

(7) It should not be necessary to remove the outer conductor from the pivot post except in unusual circumstances where the line suffers damage or whenever the Pedestal is completely disassembled for a general overhaul. The steps required to remove the outer conductor are shown in Fig. 7-95. A special spanner wrench is supplied which must be used to remove the compression collar shown in step 14. The parts shown in Fig. 7-95 are located at the T-joint in the base of the Pedestal. The lock collar shown in step 13 must be loosened first. This permits the compression collar to be removed. In order to slide the outer conductor out through the top of the Pedestal, it is necessary to slip the compression seal off the outer

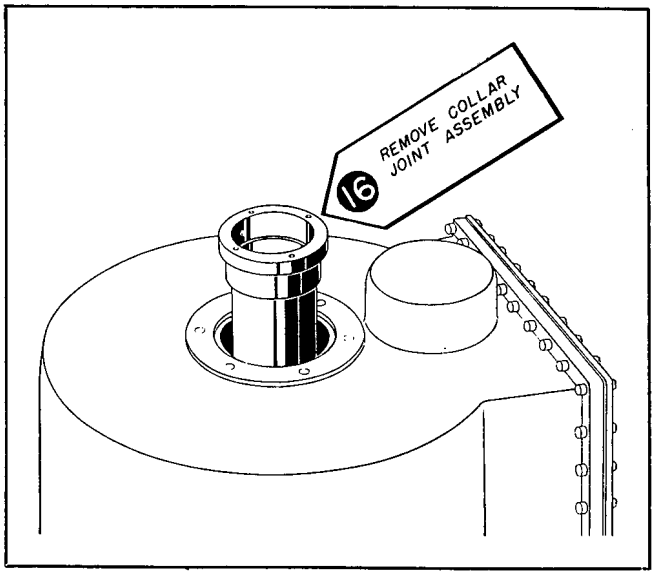


Figure 7-96. Removing Outer Conductor

conductor. The seal fits rather snugly after it has once been compressed, and great care must be exercised in removing it if a replacement is not available. It is not advisable to use the old compression seal when the outer conductor is reassembled, but if a new seal is not available, the old one may be reamed out so that it can be replaced.

(8) The last step in removing the r-f lines in the Antenna Pedestal is shown in Fig. 7-96. The step consists of lifting the outer conductor and pulling it straight up through the Pedestal. If the compression seal cannot be worked off before this step is performed, and a new seal is not available, protect the seal with small blocks of soft wood wired in place and lift the outer conductor up sharply several times to force the seal off.

(9) The r-f lines are reassembled by reversing the steps shown in Figs. 7-87 to 7-96.

34. MECHANICAL ADJUSTMENTS IN POWER EQUIPMENT.

a. GENERAL.

(1) The power equipment consists of several components, most of which are of simple construction and require little adjustment. The disassembly of most of the components is also relatively simple. Since the power equipment performs as a single system, all of its components are treated in one paragraph.

b. LINE DISCONNECT SWITCH.

(1) There are no adjustments on this switch. The only parts requiring replacement other than the fuses are the contacts. The male contacts are mounted on a movable block on the door. If these contacts become badly worn or burned, they may be replaced by removing the countersunk mounting screws that secure them to their mounting block.

(2) To replace the female contacts, it is necessary to remove power from the ship's circuit before touching the contacts. The contacts are covered by a protecting plate that is held in position over the contacts with three countersunk screws. When these screws are removed, the plate may be taken off to expose the mounting of the female contacts. Remove the mounting screws for the contacts and replace the new contacts, being sure to replace the screws securely so that the contacts cannot work loose due to use or vibration.

c. MAGNETIC CONTROLLERS.

(1) The parts in the Magnetic Controllers are mounted on a large insulating panel located on the rear wall of the cabinet. The wiring to the parts is exposed, and it is a simple matter to remove any of the parts after they have been disconnected.

d. PUSHBUTTON STATION.

(1) The Pushbutton station is a simple mechanical device that should require little or no service. The switches are exposed when the front portion of the switch case is removed by taking out the assembly screws. There are two assembly screws in each switch that hold it together. When these screws are removed the switches are easily disassembled.

e. MOTOR GENERATOR.

(1) Repairs on the Motor Generator are usually of such a nature that they cannot be made at the installation because specialized shop equipment is required. Therefore disassembly operations in the field are usually limited to removing one of the components and replacing it with another.

(2) The coupling between the motor and generator may require replacement and must be disassembled whenever it is necessary to remove either the motor or generator. The coupling consists of halves, one for the motor and one for the generator, with a thermoid disc between them. The thermoid disc is attached to each half of the coupling with three bolts, a total of six bolts in all. To remove one of the units it is only necessary to remove the nuts from three of the bolts. The nuts to be removed are the ones on the side of the coupling farthest from the unit to be removed. When replacing a unit be sure to place a washer between the coupling half and the thermoid disc, a washer on the other side of the disc, then a spacer, lock-washer, and finally, the nut. If the disc is to be replaced, all of the bolts must be removed. This can be done without removing either of the units from the bedplate. Access to the coupling is gained when the guard is removed from its mounting on the bedplate.

(3) Do not tamper with the connections to the resistors located in a box on the bedplate beneath the coupling. If these connections are changed, the speed of the Motor-Generator will be changed from its normal speed of 1800 rpm. This will result in permanent damage to the Voltage Stabilizer, and blow out fuses throughout the system. Also the Antenna will hunt badly if any attempt is made to operate the equipment in this condition.

(4) The exciter frame is assembled to the generator bell housing with four mounting studs. To remove the exciter, open the brush covers exposing the mounting studs. Disconnect and remove the brushes. Then remove the mounting studs with a socket wrench and slip the frame assembly off over the armature. To remove the armature, place a wrench on the nut at the end of the armature shaft, block up the armature with pieces of hard wood and then tap the wrench gently until the nut breaks loose. The armature may then be slipped off from the shaft. A better way to loosen the nut would be to grasp the back of the coupling between the motor and generator with a large pipe wrench if one is available. Then while the pipe wrench is held, pressure can be exerted on the wrench that is used to loosen the assembly nut. Be very careful not to spring the armature shaft when removing the exciter armature.

(5) The bearing on the exciter end of the generator may be removed when the exciter armature is removed. To remove a bearing, remove the four studs located in the bearing housing around the shaft. Then remove the studs that hold the bell housing to the frame and pull the bell housing off. The bearing may then be pulled off the shaft if it did not come away with the bell housing. In order to remove the bearings next to the coupling, one of the components must be removed by disassembling the coupling and removing the mounting studs that hold the component to the bedplate. The bearing on the end of the motor with the speed regulator switch cannot be removed until the switch has been disassembled. To disassemble the switch, remove the screws that hold the switch cover in place and take off the cover. The rotating part of the switch is held in place on the shaft with set screws located in the collar on the side of the disc opposite the centrifugal mechanism. Loosen these set screws, disconnect the leads and pull the rotating part off the shaft. Then remove the studs that hold the remainder of the switch to the bell housing. The bell housing may now be removed to expose the bearing.

(6) Periodic inspection should be made of the four pairs of contacts on the rotating part or slip ring assembly. If any of the contacts are pitted or worn, the entire set should be replaced since the gaps between the contacts must all be uniform. To replace the contacts loosen the set screw next to the speed adjusting screw. These screws are located at the center of the brass plate on the slip ring assembly. Counting the number of turns, unscrew the speed adjusting screw until it clears the vibrating part. This is the part with the weight on it. Remove the two screws that hold the vibrating part in place and pull the vibrating part out past the contacts. The contacts can now be replaced. When reassembling the switch, turn the speed adjusting screw clockwise the same number of turns that it was turned in a counterclockwise direction and tighten the set screw. The airgaps between the contacts when open should be 0.025 inch. If the measured gap is more or less than the dimension given, loosen the locknuts on the straight arms of the brass plate and adjust the two gap adjusting screws until the airgaps measure 0.025 inch with a feeler gauge. Tighten the lock nuts and check the gaps to see if the dimension has changed appreciably.

f. VOLTAGE REGULATOR.

(1) The parts in the Voltage Regulators are mounted on a panel in the rear of the cabinet. The panel is secured in place with mounting studs. All wiring is behind the panel and it must be removed to gain access to the wiring, rheostats and switches. None of the parts are difficult to remove. The only adjustable part is the Silverstat relay K-1461. The Silverstat should never require adjustment unless the adjustments have been inadvertently changed. The proper operation of this part is controlled by the adjustment of a tapped resistor and the mechanism of the Silverstat should never be changed to secure the correct voltage output from the Motor Generator.

(2) If for some reason the Silverstat should require adjustment in the field, the method described in this paragraph may be used to restore operation until the Silverstat can be replaced and the old one returned to a base where proper repair facilities are available. Remove the cover from the Silverstat if it is equipped with one. Then with the solenoid deenergized, check to see that all of the contacts on the contact arms are touching. If they do not, adjust the stop screw until they do. This screw is the second screw from the top on the armature arm. The springs should be firmly compressed together. If they are not, adjust the spring tension screw until positive contact is made. Now operate the armature by pushing it as far as it will go into the air gap. The contacts on all of the springs should open. If they do not, back off the screw at the top of the armature until they do. This is the screw that makes contact with the springs. If the screw does not almost touch the spring assembly, adjust it until it does and then repeat the first adjustment of the stop screw. If the mechanism shows a tendency to oscillate too freely during operation, increase the tension on the coil spring until the oscillations are sufficiently damped. Check the output voltage of the Motor Generator after this adjustment to see if it is fluctuating. If it is, reduce the coil spring tension until the voltage fluctuation disappears.

g. VOLTAGE STABILIZER.

(1) There are no mechanical adjustments on the Voltage Stabilizer. To gain access to the interior, it is necessary to remove the bolts around the bottom of the case and lift the case off. The transformers and capacitors are mounted on the base and are easily disconnected and removed.

35. WINDING DATA.

a. Winding data for components of all units is included in Tables 7-2 and 7-3 on pages 7-145 to 7-163 inclusive. Table 7-2 gives coil data for transformers and inductors, and Table 7-3 gives armature and field coil data on the motors and generators.

36. ELECTRICAL ADJUSTMENTS IN TRANSCEIVER.

a. GENERAL.

(1) The electrical adjustment and alignment of both the SR and SR-a Transceivers is described in this paragraph. The procedures given do not include the adjustment of the Monitor Receiver. Its adjustment is described in Paragraph 37 of this section.

b. RELAYS.

(1) Remove the top cover from the SR Transceiver and locate the overload relay K-105. This is the glass covered relay shown in Fig. 7-97. Remove

the cover and disconnect the relay terminal that goes to capacitor C-108. Connect a d-c source of power through a potentiometer connected as a rheostat and a d-c milliammeter to the relay terminal and ground. The milliammeter should have a 250-ma scale. Adjust the current until the meter indicates 200-ma. Then loosen the screw on the pointer shown in Fig. 7-97 and adjust it to the point where the relay trips. Check the adjustment by dropping the current to 150-ma, resetting the relay, and increasing the current until the relay trips. After the relay is properly adjusted, tighten the screw on the pointer, reconnect the relay in the circuit, replace the glass cover and then replace the top cover on the Transceiver.

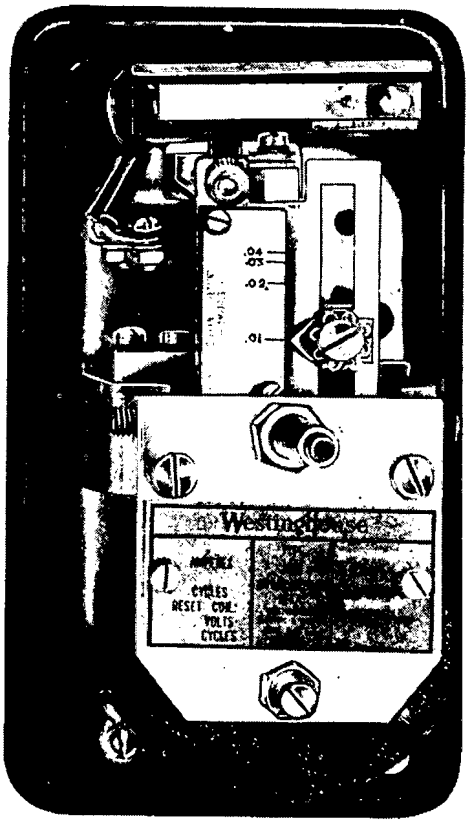


Figure 7-97. Overload Relay in Transceiver

c. LIMIT SWITCHES.

(1) The adjustments given in this paragraph are preliminary to the final adjustments given in the tuning procedure. Remove fuse F-108 from the fuse block behind the left-hand door in the lower compartment. Connect one side of a 110-115 volt source of a-c power to the black lead of drive motor B-101 at terminal board E-110. Touch the other lead from the a-c source to the blue lead on terminal board E-110 for brief intervals and rotate the Variac toward its counterclockwise limit in small steps. Do not drive the Variac against its mechanical stop or damage to the gear train may result.

(2) Rotate the cams that operate switches S-109 and S-111 counterclockwise until the switches click, indicating that the switches are closed. Switches S-109 and S-110 are on the lefthand side of the assembly. See Fig. 7-7. The cams are held on the shaft with set screws which must be loosened during this operation. After the click is heard rotate the cams 25 degrees farther and tighten the set screws. This sets the lower limit switches.

(3) Touch the a-c lead to the red lead on terminal board E-110 and rotate the Variac clockwise toward its upper limit. Adjust the cam that operates switch S-110 until it closes about five degrees before the limit of rotation is reached. This adjustment is not critical.

(4) Carefully tighten all set screws and replace fuse F-108.

d. TUNING THE SR TRANSMITTER.

(1) Connect the grid straps to the type 527 oscillator tubes according to the frequency range of the Antenna in use. If operation is desired in the *blue* or highest frequency band, both grid straps must be used. Connect one of these between the top grid prongs, taking care not to damage the tubes in the process. Connect the other grid strap between the lower grid terminals. If operation is desired in the *yellow-green,* or lower frequency band, place one shorting strap across the *lower* grid terminals of the tubes. Place corona balls on the two upper grid terminals. When installing grid straps be sure that the center lock screw is loose. Tighten the knurled nuts at the grids first and then tighten the center screw.

(2) Check the duplexer length. When operating on the blue band, adjust the duplexer length so that the distance between the lower edge of the flange of the upper U-shaped casting connecting the two duplexers and the center of the spark gap adjustment knob is 9⅞ inches. For the yellow-green band, the distance should be approximately 11⅝ inches. This adjustment is available when the back cover of the Transceiver is removed.

(3) Check the setting of the duplexer spark gaps. The gaps should be between 1/32 and 1/16 of an inch or roughly one turn of the adjustment knob. These gaps may be observed through openings in the duplexer when the Monitor Receiver is removed from the Transceiver, or when it is slipped forward and the right side shield of the Transceiver is removed.

(4) Place the CONTROL switch S-107 in its LOCAL position. See Fig. 7-98.

(5) From the calibration chart on the front of the

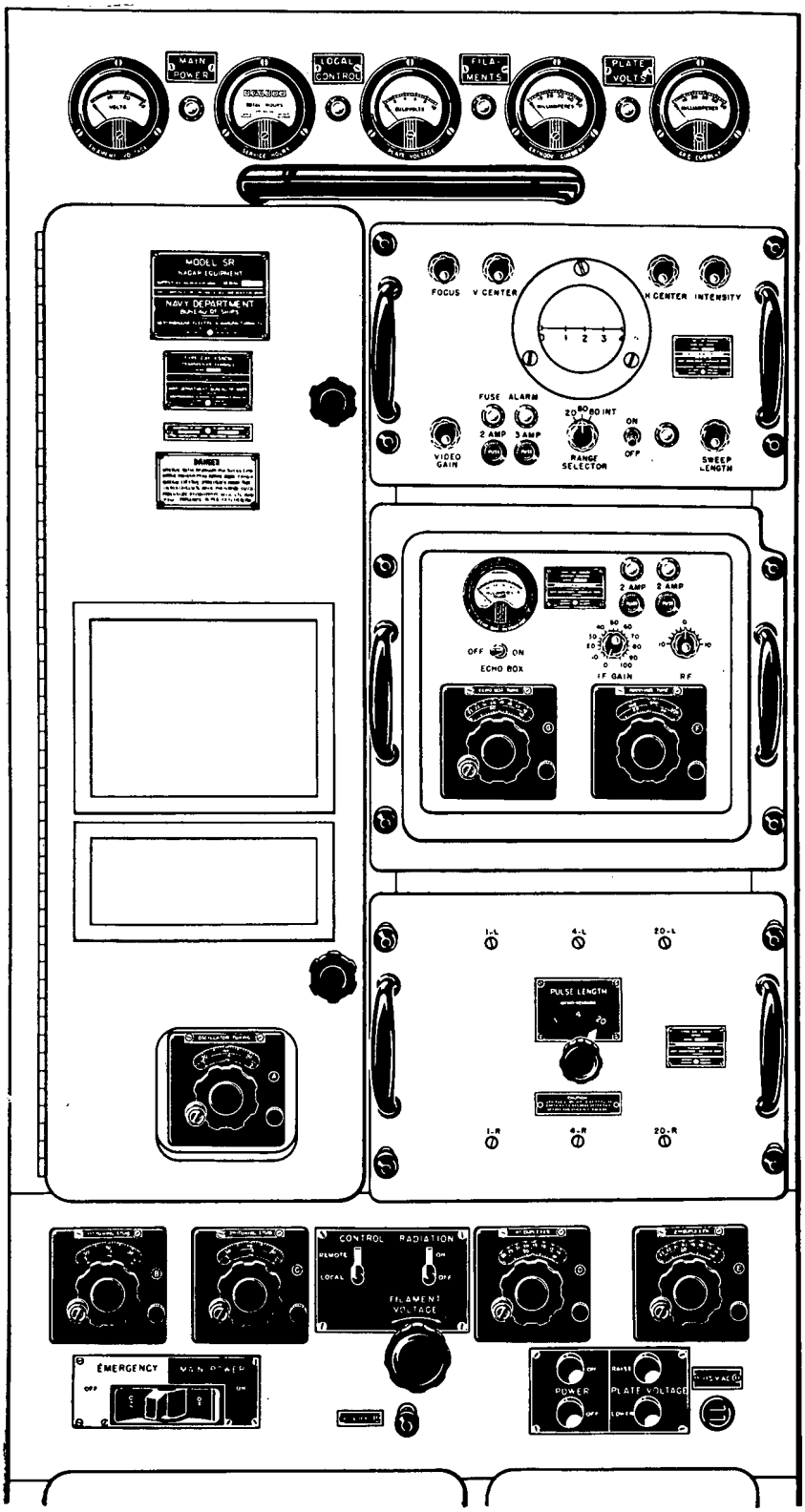


Figure 7-98. Transceiver, Operating Controls

oscillator door of the Transceiver, determine the approximate setting of the controls A, B and C. Place these controls in their approximate positions. Control A is the OSCILLATOR TUNING control, while B and C are the 1st TUNING STUB and the 2nd TUNING STUB controls, respectively. The proper setting of these controls is critical for operation at maximum efficiency. Final adjustment is made after other operations have been completed.

(6) Place the PULSE LENGTH switch S-158 on the panel of the keyer compartment in its 20 microsecond position. This switch is shown in Fig. 7-98.

(7) Place the EMERGENCY-MAIN POWER switch S-101 in its ON position. After five seconds the time delay relay in the Transceiver will operate to permit d-c voltage to be applied to the plates of the oscillator tubes.

(8) Set the filament voltage to 10 volts on the FILAMENT VOLTAGE meter by adjustment of the FILAMENT VOLTAGE control T-106. See Fig. 7-98 for the location of this control.

(9) Press the POWER ON button S-103. The PLATE VOLTAGE meter should indicate 500 volts. If it does not, adjust it to 500 volts with the RAISE and LOWER switches. Then turn off the equipment and adjust the cam controlling microswitch S-109 so that this switch is open for all plate voltages below 500 volts. The cam is fastened by setscrews to the shaft of the variable low-voltage transformer. The location of this cam and those controlling microswitches S-110, S-111, and S-119 is shown in Fig. 7-7.

(10) Adjust the cam controlling microswitch S-111 using the above procedure, so that this switch is open for plate voltages above 700 volts.

(11) Connect an oscilloscope to the grid pulse jack, J-106, on the Transceiver panel. Use the internal horizontal sweep frequency of the oscilloscope and adjust it to approximately the repetition rate of the transmitter which is 60 cps. Make final adjustments of the oscilloscope repetition rate after the signal is applied. Rotate the Antenna until it faces the Echo Box Antenna.

(12) Raise the plate voltage by pushing the RAISE switch S-105 until the PLATE VOLTAGE meter indicates 8 kv with the RADIATION switch in its OFF position.

(13) Place the RADIATION switch ON momentarily and observe the shape of the Keyer wave form on the test oscilloscope. It should be as shown in Figs. 7-99 and 7-100. The plate voltage should increase to 11 kv when the RADIATION switch is operated.

CAUTION

IF THE TUBES ARE ALLOWED TO REMAIN OSCILLATING IN AN IMPROPER OPERATING CONDITION FOR MORE THAN A FEW SECONDS, PERMANENT DAMAGE MAY BE DONE TO THEM.

(14) If the waveform is not correct, adjust the 20-R controls a step at a time and repeat (13) after each adjustment. The 20-L control is a Vernier between steps on the 20-R control. If the overload relay trips, back the 20-R control off one step and find the correct operating point with the 20-L control. See Fig. 7-98 for the location of these controls. The result of proper Keyer adjustments is an increase in the life of the oscillator tubes and an increase in the overall operating efficiency of the Transmitter. Ideal conditions exist when the discharge period of the RC network is equal to the natural period of the synchronizing voltage, as is shown in Fig. 7-99. The positive peak of the resultant waveform should always be at least 15% of the overall waveform amplitude, or excessive oscillator tube heating will occur. Adjust the R and L tap switches until the conditions shown in Fig. 7-99 are satisfied. Distance *D* should never be less than 15 per cent of the total waveform E. The top portion of the waveform should be steep and should not round off where oscillation begins. If R is properly adjusted, it should be possible to vary the L tap switch over three or four positions without causing unstable operation. If the waveform seen when operating on the 20 microsecond pulse has several humps between *a* and *b*, it is not an indication of an abnormal condition. These humps are caused by the 60 cycle external synchronizing voltage used only on the 20 microsecond position. It may be found that changing the operating frequency of the Transmitter from one position of the band to another may cause a change in the Keyer grid pulse waveform. For this reason, a test oscilloscope should be used for observing the grid pulse waveform whenever Transmitter tuning or Keyer adjustments are made. Fig. 7-100 shows actual photographs of typical oscilloscope patterns of the grid pulse waveforms.

(15) Place the Echo Box switch in its ON position. Tune the Echo Box, using the G dial on the Monitor Receiver panel, until a dip in the ECHO BOX

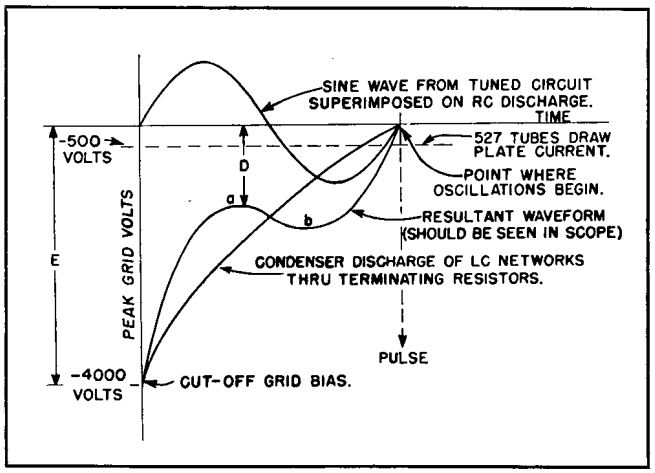


Figure 7-99. Keyer Pulse Waveform Development

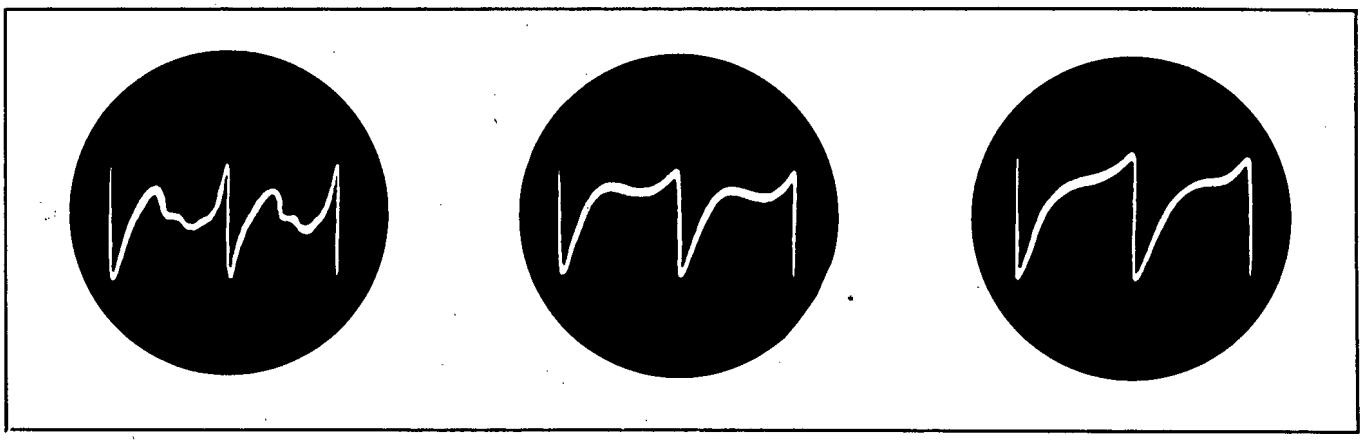


Figure A
Good 20 Microsecond Grid Pulse Shape

Figure B
Good 4 Microsecond Grid Pulse Shape

Figure C
Good 1 Microsecond Grid Pulse Shape

Figures A, B and C illustrate proper shapes of grid pulse patterns; the first hump is sufficiently high to insure a steep rise at the point of oscillation, thus keeping the time of plate current flow just before oscillation to a minimum. The hump itself is well below the level at which it would cause the tube to draw plate current.

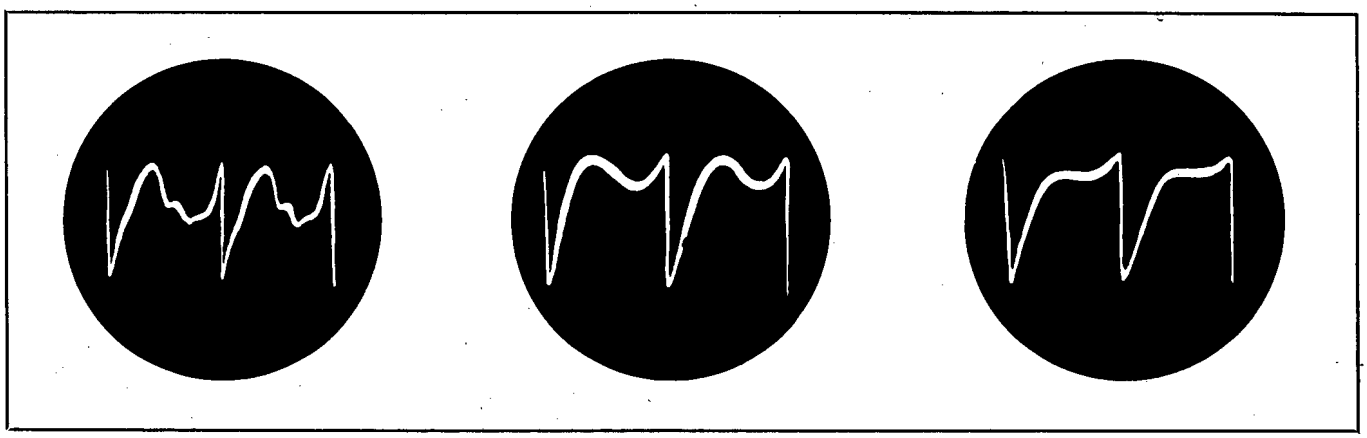


Figure D
Poor 20 Microsecond Grid Pulse Shape

Figure E
Poor 4 Microsecond Grid Pulse Shape

Figure F
Poor 1 Microsecond Grid Pulse Shape

Figures D, E and F illustrate grid pulse shapes in which the hump is too high and is causing plate current to flow at the top. If the hump were to go still higher, it would rise above the level at which the tube oscillates resulting in "multiple pulsing" and erratic patterns on both the grid pulse viewing scope and the indicator scopes.

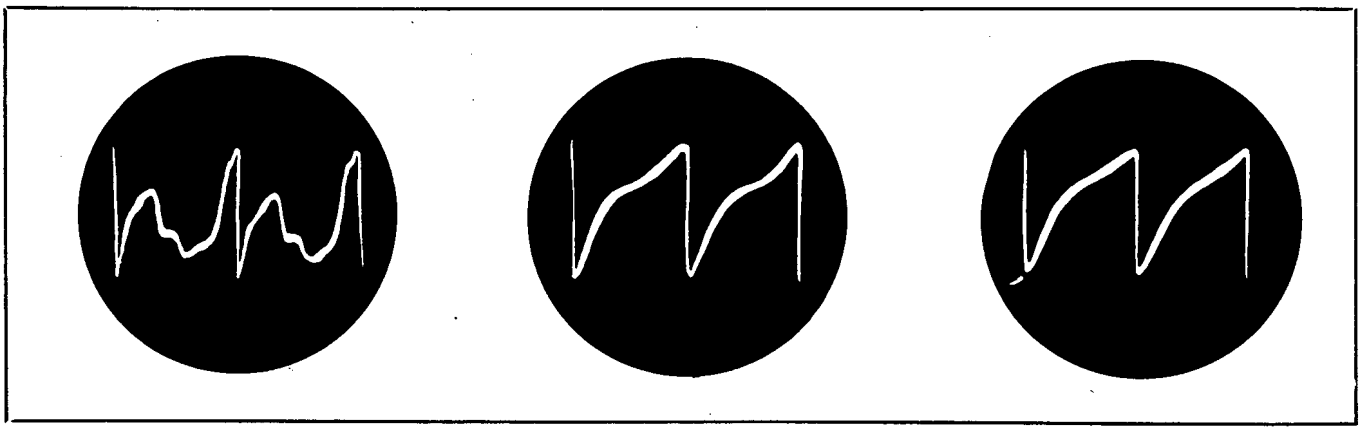


Figure G
Poor 20 Microsecond Grid Pulse Shape

Figure H
Poor 4 Microsecond Grid Pulse Shape

Figure I
Poor 1 Microsecond Grid Pulse Shape

Figures G, H and I illustrate grid pulse shapes in which the hump is too low, causing the rise at the firing level to be too flat, thus resulting in plate current flow for some time before oscillation begins.

Figure 7-100. Keyer Pulse Waveforms

RESONANCE meter indication occurs. This presumes that the Echo Box has been changed as described in Navy Field Change No. 30. If the change has not been made, tune the Echo Box to a peak in the meter reading. Check the G dial (ECHO BOX TUNE) reading against the calibration chart. The frequency should be within the frequency range of the Antenna plus or minus 3 megacycles of the center of the band. If the deviation is too great, correct by tuning the A dial. If it is necessary to retune the A dial, repeat the check on the Keyer grid pulse shape and of the plate and grid currents, as described previously. As a rule, tuning the A dial to higher numbers lowers the frequency and vice versa. Adjust dial A until the peak obtained is the largest that lies in the frequency band of the Antenna.

(16) Adjust the 1st TUNING STUB (B) dial and the ECHO BOX TUNE (G) dial alternately for maximum deflection on the ECHO BOX RESONANCE meter. If the waveform changes during this adjustment, readjust the L and R controls on the Keyer and then continue the adjustment of the B and G dials.

(17) Repeat step (16) using the 2nd TUNING STUB (C) dial and the G dial used in step (16).

(18) Repeat steps (16) and (17).

(19) Place the RADIATION switch in its OFF position and place the PULSE LENGTH switch in its 4 position. Place the RADIATION switch in its MOMENTARY position for a brief period of time and observe the shape of the grid pulse. Compare its shape with the ideal shapes shown in Figs. 7-99 and 7-100.

(20) Adjust the 4-R and 4-L controls shown in Fig. 7-98 using the technique described in step (14). Do not disturb the setting of any other controls during this procedure.

(21) Repeat steps (19) and (20) using the 1-R and 1-L controls and the 1 position of the PULSE LENGTH switch. See Fig. 7-98. Check the waveforms against the 1 microsecond waveforms in Fig. 7-100.

(22) Place the ON-OFF switch on the Monitor Scope in its ON position. See Fig 7-98.

(23) Adjust the V CENTER control (R-324) until the sweep trace coincides with the etched line on the face of the tube.

(24) Adjust the H CENTER control (R-322) until the start of the sweep trace coincides with the O position etched on the face of the tube.

(25) Place the FOCUS control (R-331) in approximately the center of its range of rotation. For the location of this control see Fig. 7-98.

(26) Adjust the FOCUS BALANCING control (R-335) to obtain maximum definition and uniformity of the sweep trace. This control is located on the top rear center of the chassis, and is shown in Fig. 7-101. If necessary, re-adjust the FOCUS BALANCING control after a video signal has been applied to the Monitor Scope in subsequent procedures. After the final re-adjustment, the FOCUS BALANCING control should be in the proper operating position and should require no further attention as the equipment is used. Lock the control.

(27) Adjust the RANGE SELECTOR switch S-301 to the 20 position. Adjust SWEEP LENGTH control R-313 until end of sweep coincides with 4 on the scale.

(28) Place the PULSE LENGTH switch in its 20 position and then place the RADIATION switch in its ON position.

(29) Set the RF control on the Monitor Receiver at 0, and set the IF GAIN control at 100. See Fig. 7-98.

(30) Adjust the RECEIVER TUNE (F) dial until target echoes appear on the Monitor Scope. Reduce the setting of the IF GAIN control through the remainder of this procedure as necessary.

(31) Adjust the 2nd DUPLEXER (E) dial for maximum echo amplitude and then adjust the 1st DUPLEXER (D) dial for maximum echo amplitude.

(32) Adjust the RF control for maximum echo amplitude.

(33) Adjust the knurled knobs that control the spark gap spacing until the amplitude on the Monitor Scope is maximum and the spark is clean and blue. The outer conductors of the r-f lines in the Transceiver are at ground potential and may be handled with safety. DO NOT TOUCH ANYTHING ELSE.

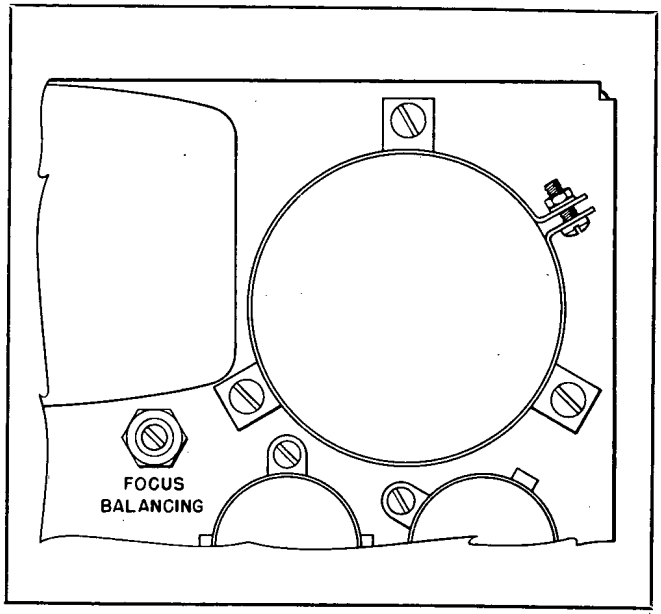


Figure 7-101. Monitor Scope, Focus Balancing Control

(34) Carefully trim the adjustment of the following controls for maximum echo amplitude in the order given:

2nd TUNING STUB (C)
RECEIVER TUNE (F)
2nd DUPLEXER (E)
1st DUPLEXER (D)
RF CONTROL

(35) Measure the frequency again with the Echo Box. If it has shifted during the tuning procedure, readjust the OSCILLATOR TUNING (A) dial and repeat the tuning process. Continue these operations until the frequency is correct at the end of the tuning procedure.

(36) Make a final check to make certain that the Transceiver operates properly on all three pulse lengths. Turn the RADIATION SWITCH to its OFF position while switching from one pulse length to another. The readings which may be expected on the meters of the Transceiver during normal operation are as follows:

PULSE LENGTH (microseconds)	20	4	1
PLATE VOLTS (kv.)	11	11	11
CATHODE CURRENT (ma.)	35-55	30-40	15-25
GRID CURRENT (ma.)	10-13	6- 9	2- 4

Record the readings actually obtained.

e. TUNING THE SR-a TRANSMITTER.

(1) Connect both grid straps for the blue antenna. Use only the lower grid strap and the corona balls for the yellow-green antenna. See step (1) of Par. 36*d*.

(2) Check the duplexer length as directed in step (2) of Par. 36*d* of this section.

(3) Check the duplexer spark gaps as directed in step (3) of Par. 36*d* of this section.

(4) Place the CONTROL switch (S-107) in its LOCAL position.

(5) Adjust the Transmitter A, B, and C controls as described in step (5) of Par. 36*d* of this section.

(6) Remove the dust cover from time delay relay K-2002 in the Modulator. See Fig. 7-102. When the equipment is received, the metal clappers will have supports to protect them during shipment. These supports must be removed before the equipment can be placed in operation. Check the sliding gear to see that it is set on the 5-minute scale. If it is not, move the sliding gear until the large gear is opposite the 5-minute index. Loosen the thumbnut on the discs and rotate them until their index pins are opposite the 5-minute mark. Then tighten the thumbnut and replace the dust cover.

(7) Place the EMERGENCY-MAIN POWER switch S-101, in its ON position. After five seconds, the time delay relay in the Transceiver will operate to permit d-c voltage to be applied to the Modulator permitting the Modulator time delay relay to start its cycle. Five minutes must elapse before the POWER ON switch can be operated.

(8) Set the filament voltage to 10 volts on the FILAMENT VOLTAGE meter by adjustment of the FILAMENT VOLTAGE control T-106.

(9) Press the POWER ON button S-103. After five minutes the time delay relay in the Modulator unit will close. This will be indicated at the Transceiver by the lighting of the PLATE VOLTS indicator.

(10) Place the RADIATION switch in the ON position.

(11) Press the RAISE switch, holding it in until the PLATE VOLTAGE METER indicates approximately 3.5 kv.

(12) Perform steps (13) to (36) inclusive of Par. 36*d* of this section.

(13) Increase the plate voltage until the PLATE VOLTAGE meter indicates 5 kv. If arcing occurs in the oscillator compartment, retune to a different frequency with dial A, and adjust the other controls for optimum operation.

(14) Typical indications for the Transceiver meters in normal operation are as follows:

FILAMENT VOLTAGE	10 volts
PLATE VOLTAGE	5 kv.
PLATE CURRENT	20-30 ma.
GRID CURRENT	4- 8 ma.

Record the actual readings obtained.

(15) Adjust the repetition rate of the Modulator to 120 cps. by means of the REPETITION RATE control (R-2001) located on the panel in the lower center of the front of the unit. This control is shown in

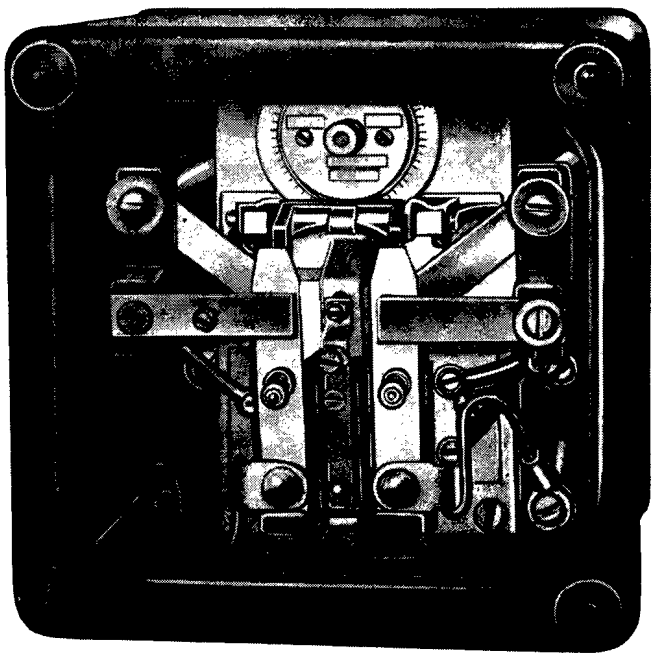


Figure 7-102. Time Delay Relay in Modulator

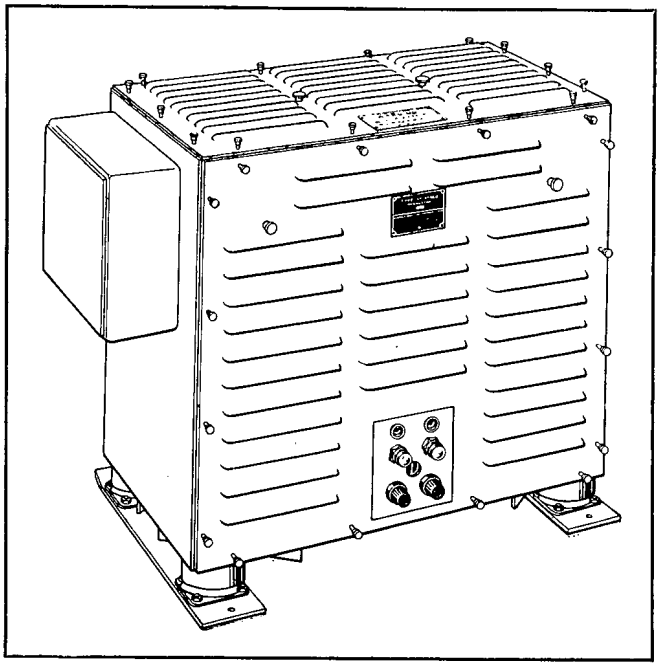


Figure 7-103. Modulator, Front View

Fig. 7-103. The rate should not be set higher than 120 cps. even though slightly better definition may be obtained, because the faster repetition rate will tend to overload the high voltage rectifier in the Transceiver. Connect the 60-cps. line voltage across one set of the plates of an oscilloscope and connect the output between test jack J-2004 and ground to the other set of plates. Adjust the repetition rate control, R-2001 until a two-lobed Lissajou figure is visible on the screen of the test oscilloscope. The repetition rate will then be twice the line frequency, or 120 cycles ± the line frequency variation. Another check on the repetition frequency is to observe targets on the Monitor Scope. The targets jitter at all repetition frequencies except 120 cps.

37. ELECTRICAL ADJUSTMENTS IN MONITOR RECEIVER.

a. GENERAL.

(1) Since the Monitor Receiver does not require alignment very often, its alignment procedure is not given in the tuning procedure for the Transceiver in Par. 36 of this section. The alignment of the Monitor Receiver requires a signal generator with a range of 10 to 240 mc/s such as Model LX (Series) or equivalent. Output measurements may be made with an oscilloscope or with a microammeter with a range of 0-100 micro-amperes in series with a 100,000-ohm resistor. If an oscilloscope is used the signal generator output must be audio modulated. A vacuum tube voltmeter and a pair of 100,000-ohm headphones are also necessary. No attempt should be made to align the Monitor Receiver until it has been thoroughly serviced and it has been determined that all voltages and resistances are normal and that the tubes check satisfactorily on a tube checker. A further check may be made on the performance of the tubes after alignment by measuring the voltage gain per stage.

b. ALIGNMENT.

(1) Remove the Monitor Receiver from the Transceiver and place it on a work bench. Connect a-c power to terminals 102 and 103 on terminal board E-203. Use the shortest length of cord possible and locate it behind the Monitor Receiver. Place the signal generator on one side of the Receiver and the output meter or oscilloscope on the other side to minimize the coupling between the test leads. Ground the test equipment to the chassis of the Monitor Receiver. If the output meter is used, connect the resistor to terminal 41 on terminal board E-202. Then connect the meter to the other end of the resistor and to terminal 01 on terminal board E-202. If the output meter is not used connect the oscilloscope to the output terminals.

(2) Connect a signal generator, adjusted to 15 mc/s to terminal 2 on transformer T-201. This is the plate terminal of the transformer. An alternate method is to disconnect the grid lead between V-203 and inductor L-206, insert a 100,000-ohm resistor in series with the grid and the inductor and connect the signal generator to the end of the resistor nearest the grid of the tube.

(3) With power applied, advance the I.F. GAIN control to 100. Then adjust the attenuator on the signal generator until the output is one volt on the output meter or oscilloscope. Either of these instruments will have to be calibrated against a known voltage to establish this level.

(4) Adjust inductors L-211, L-210, L-209-B, L-209-A, L-208-B, L-208-A, L-207-B, and L-207-A in this order for maximum output. These adjustments are shown in Fig. 7-104. The output should be limited to three volts by adjustment of the attenuator on the signal generator during the alignment procedure. After the adjustment is completed, repeat it to insure accuracy.

(5) Connect the signal generator to connector J-201 and adjust its frequency to 225 mc/s and its output to 50,000 microvolts. Do not use modulation.

(6) Adjust the tuning adjustment of inductor L-205 to a point approximately equal to one-third of its range from the counterclockwise position.

(7) Set the F dial on the control panel of the Monitor Receiver to 800 and adjust the oscillator trimmer C-207-C for maximum output. This adjustment is shown in Fig. 7-104.

(8) Adjust the r-f trimmer C-201 for maximum output.

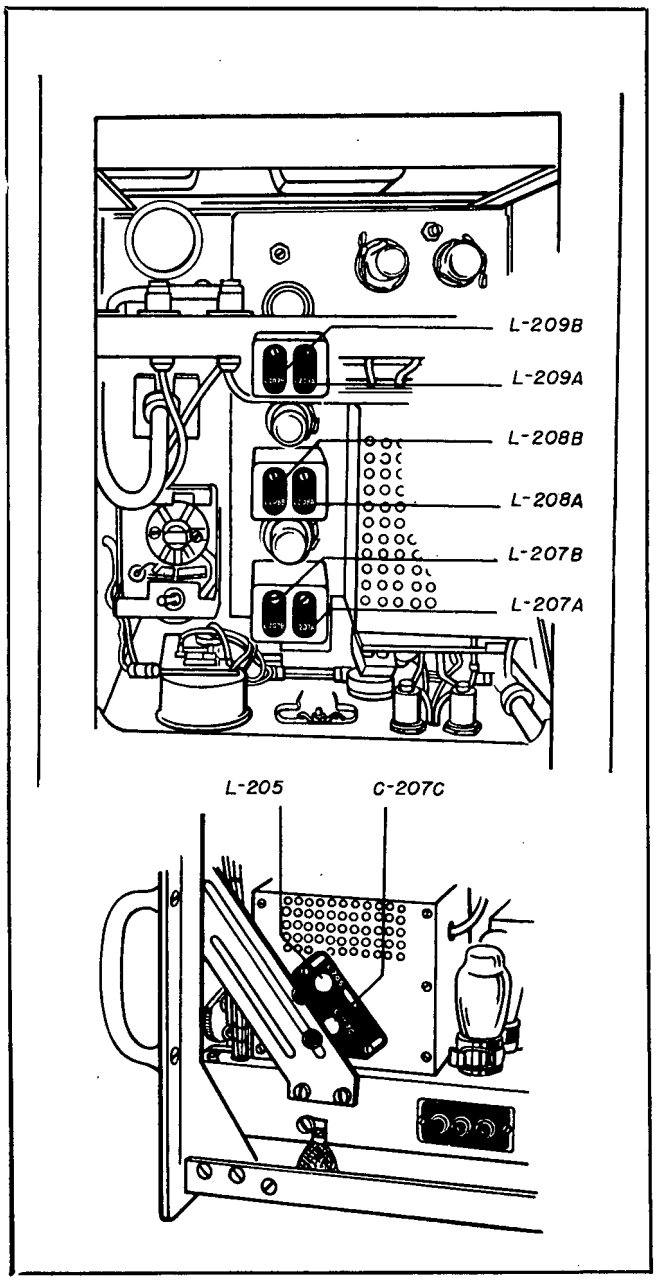


Figure 7-104. Monitor Receiver, Alignment Controls

(9) Rock the F dial and trimmer C-207-C for maximum possible output. As the final adjustment is approached, the action of each of these controls becomes more and more affected by the other's setting.

(10) Adjust the signal generator to 180 mc/s and look for the signal at approximately 300 on the F dial.

(11) Alternately adjust the F dial and the tuning adjustment of inductor L-205 until maximum output is obtained. Adjust the R.F. control for C-201 until maximum output is obtained. This control is on the front panel. The output of the signal generator should be between three and five volts for this adjustment.

(12) Repeat the adjustments for 225 and 180 mc/s alternately until further adjustment produces no noticeable effect.

(13) The final 225 mc/s adjustment must fall at a point between 700 and 850 on the F dial. If the point is below 700, squeeze inductor L-206 closer together and repeat the alignment. If the point is above 850, spread the turns of inductor L-206 and repeat the alignment.

38. ELECTRICAL ADJUSTMENTS IN CONSOLE RECEIVER.

a. GENERAL.

(1) The alignment adjustments of the Console Receiver consist of two operations. One is the alignment of the i-f channels and the rejection or bandwidth filters. The other operation is alignment of the control which varies the bandwidth of the receiver when the BANDWIDTH control is adjusted.

b. I-F AMPLIFIER ALIGNMENT.

(1) Connect a one-inch lead between pin 4 of X-706 and ground. Ground the rear ledge of the chassis with a one-half inch wide, tinned copper braid. Do not use any other ground on either the receiver or signal generator. The receiver should be standing on end during alignment.

(2) Adjust the BANDPASS switch to SHARP, and set the BAL, the I.F. TUNE to 0, and REJ 1 and REJ 2 to 0 positions. These controls are on the front panel of the Console Receiver.

(3) Connect a signal generator (Navy Model LX (Series) or equivalent) with an output adjustable to 25 megacycles to the input of the receiver. Set it to produce an output at exactly 15 megacycles. Adjust the attenuator so that a reading of .30 ma appears on the JAMMING INDICATOR meter. This meter is on the front panel of the receiver.

(4) Adjust inductors L-706B, L-706A, L-705B, L-705A, L-704B, L-704A, and L-703, *in the order named,* for maximum reading on the meter. See Fig. 7-105. The attenuator control on the signal generator should be adjusted as required during the alignment procedure so that the meter deflection does not actually increase. When the meter reading increases, readjust the attenuator on the signal generator so that the output on the meter is reduced to its original value. Work within the range of 0.15 and 0.30 ma. To go over this level may result in overloading some of the stages and give a false meter reading.

(5) Repeat the adjustment once or twice to make certain that the alignment of the i-f channel is correct and maximum gain is shown on the meter. This indicates that *both* the i-f channels and the circuits are aligned.

c. ALIGNMENT OF REJECTION FILTERS.

(1) Connect the signal generator as described in step (3) of Par. 38*b* and adjust it to 15.2 megacycles.

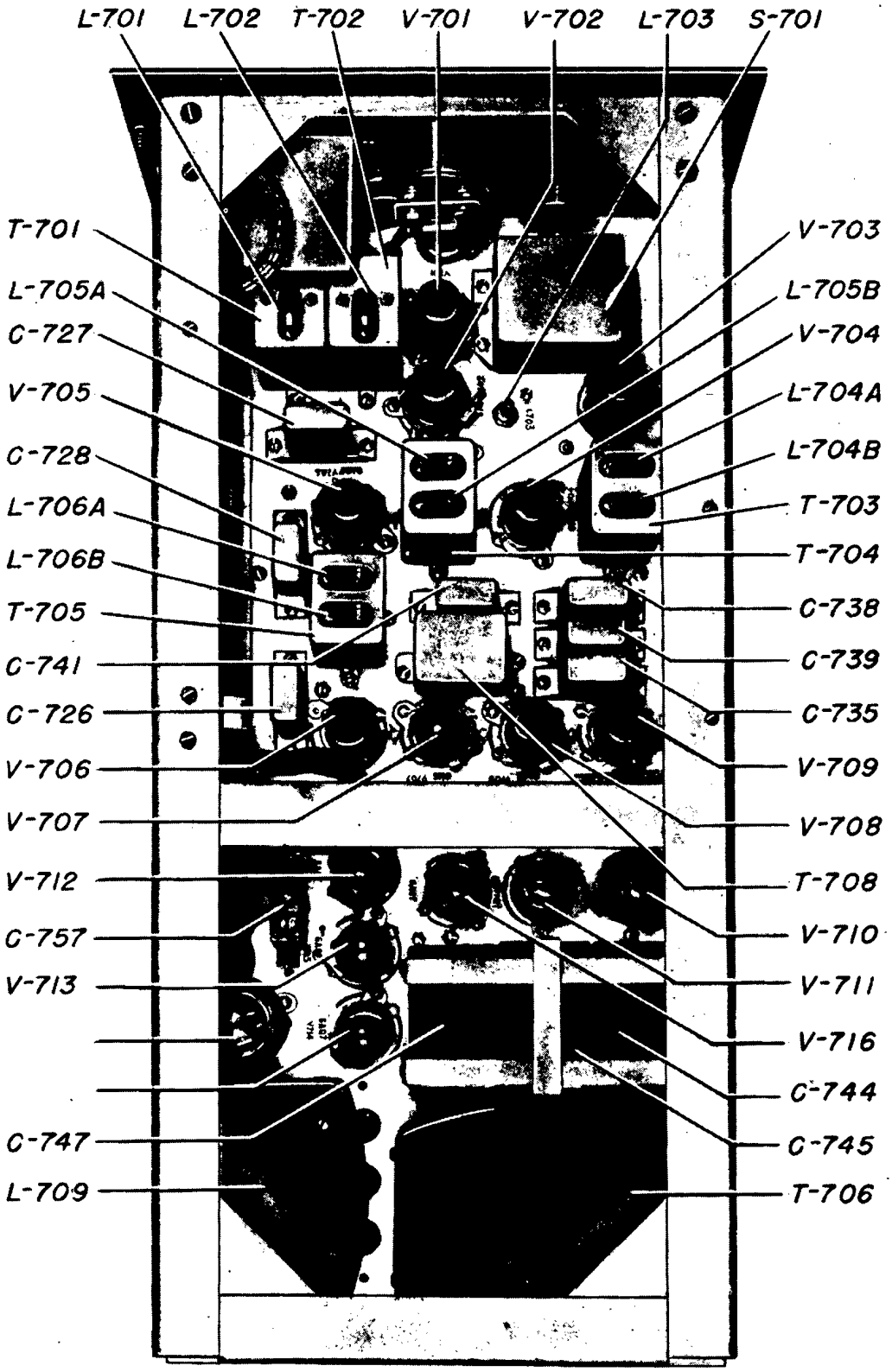


Figure 7-105. Console Receiver, Alignment Controls

Turn the REJ 1 control to 100 and the REJ 2 control to 0.

(2) Adjust the trimmer in the top of inductor L-702 so that a *minimum* reading is recorded on the JAMMING INDICATOR meter. Inductor L-702 is shown in Fig. 7-105. This adjustment is very critical. Care must be taken to see that the absolute minimum reading is obtained on the meter. The signal generator attenuator should be turned up (decreased) during this operation if the meter reading drops near the zero point. After increasing the signal generator output so that the signal on the meter is in the vicinity of its original value, repeat the adjustment until the trimmer adjustment shows maximum signal attenuation. Replace the REJ 1 control to the 0 position.

(3) Adjust the signal generator to 14.8 megacycles. Turn the REJ 2 control to 100 and the REJ 1 control to 0. Adjust the trimmer in inductor L-701 until the signal is attenuated. Follow the same procedure described for tuning REJ 1, until the trimmer is adjusted for maximum attenuation of the signal on the meter. Return REJ 2 control to 0.

CAUTION

HIGH VOLTAGES SUFFICIENT TO CAUSE INSTANT DEATH ARE PRESENT IN THE RANGE SCOPE. USE EXTREME CARE TO AVOID CONTACT WITH OPEN TERMINALS, TUBE CAPS, ETC. USE AN INSULATED SCREWDRIVER FOR MAKING ADJUSTMENTS.

39. ELECTRICAL ADJUSTMENTS IN RANGE SCOPE.

a. GENERAL.

(1) The range marker coils are adjusted at the factory, and sealed. The adjustment should not be disturbed unless it is absolutely necessary. They can be checked whenever necessary by turning on the PPI MARKERS switch on the front panel of the Console Receiver. When the markers in the Range Scope are turned ON, they may also be seen on the face of the PPI Scope. By turning up the RANGE MARKERS control, the markers generated in the PPI scope will also appear on the PPI Scope tube face. The markers from the Range Scope should coincide with the markers from the PPI Scope marker circuit which appear on the tube.

b. RANGE MARKER CALIBRATION.

(1) Attach a range calibrator such as Range Calibrator TS-34 to the Range Scope radar video input terminal 80 in the top of the Range Scope case. Set the Range Scope MARKERS switch and the Challenge switch on the IFF Coordinator to the OFF position. Then turn the RANGE switch to the 4-mile range. The I.F. GAIN control in the Console Receiver should be in the minimum, or 0 position.

(2) Adjust the range calibrator to its 1-mile output frequency. A series of pips should now appear on the sweep line. Set the calibrator phase shift knob so that one of its markers coincides with the start of the sweep. Turn the MARKERS switch on the front panel of the Range Scope to the ON position. If the range marker coil for the 4-mile range is accurately set, the range marker pips will coincide with the calibrator marker pips. If they do not, or if there is a difference in position between the calibrator markers and the range markers at some points, the range markers are inaccurately adjusted. To adjust the markers, loosen the locknut and reset the screwdriver adjustment on the 4-mile range marker coil, L-601. See Fig. 7-106.

(3) These screwdriver adjustments are SEALED ADJUSTMENTS and should not be moved unless absolutely necessary. Reseal with glyptol, after securely locking the adjustment. Check to make certain that the adjustment is not changed when the lock is being tightened.

(4) Repeat the check, and the adjustment on the other ranges, if necessary. Use the marker calibrator range and the range scope range which permits lining up at least two of the markers with corresponding pips from the calibrator. L-602 is the 20-mile range marker inductor, inductor L-603 is for the 80-mile range and inductor L-604 is for the 200-mile range. These inductors are shown in Fig. 7-106.

(5) With the range scope markers accurately aligned, it will be possible to check the PPI scope markers and the markers in the remote PPI indicators. This may be done by turning on the PPI MARKER switch on the Console Receiver and comparing the markers generated in the PPI Indicators with the range scope markers.

c. SWEEP LENGTH ADJUSTMENT.

(1) Connect the Range Scope trigger circuit to the trigger circuit of the radar equipment and adjust the SWEEP LENGTH control R-671 on the front panel until the first four markers on the 4-mile range correspond to the numerals on the plexiglass in front of the cathode ray tube.

d. IFF SWEEP ADJUSTMENT.

(1) With the CHALLENGE switch on the IFF Coordinator in its ON position, two sweeps should appear on the Range Scope. One sweep should be above the etched line (preferably three-eighths of an inch) and the other sweep should be below the etched line. The markers should appear on the upper or radar sweep. If they appear on the lower sweep or if there is not sufficient separation, pull the chassis forward and adjust the IFF LINE ADJUST control R-6026 until the sweeps are properly located. This control is located on the rear of the righthand deck and is shown in Fig. 7-107.

e. FOCUS BALANCE ADJUSTMENT.

(1) This adjustment secures the best focus of the sweep on the cathode ray tube. The condition is

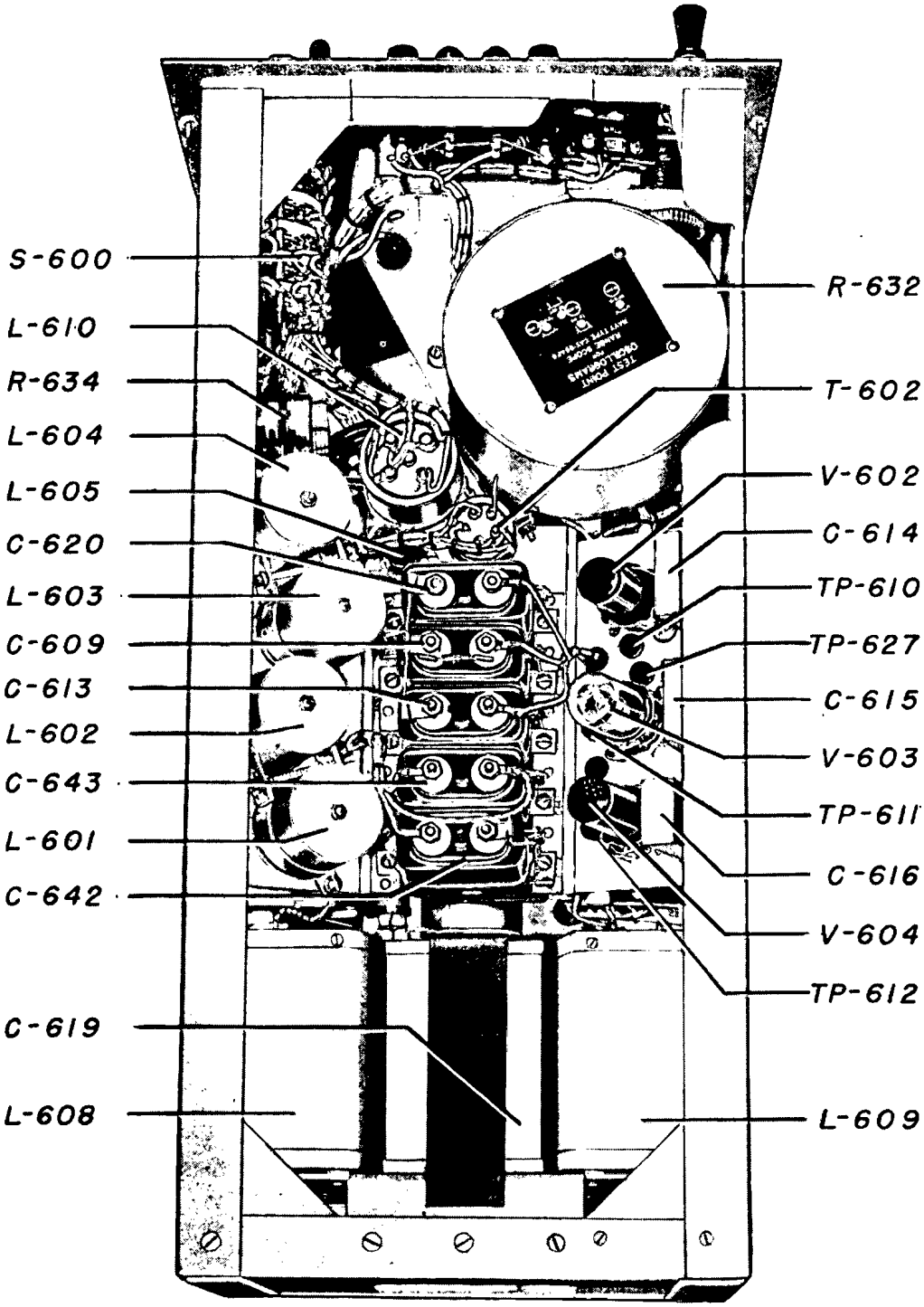


Figure 7-106. Range Scope, Bottom View

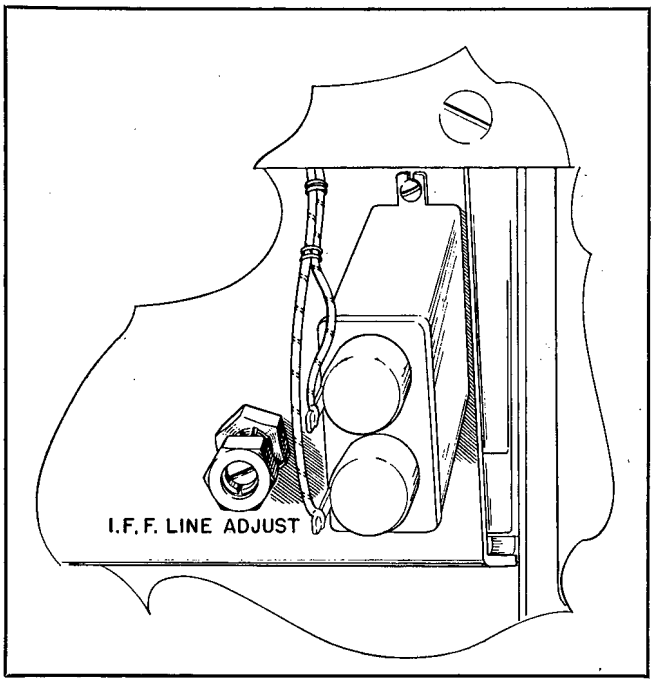


Figure 7-107. IFF Line Adjust Control

attained when the main accelerating anode in the cathode ray tube is approximately at the same potential as that of the deflection plates. However, the vertical and horizontal plates do not have the same potential because of the centering voltages, sweep voltages, video voltages, etc. Nevertheless, all of these voltages add up to a resultant d-c field at the center of the four deflection plates. The purpose of this adjustment is to set the accelerating anode at the potential of this resultant field.

(2) Turn off all video voltages by turning the I.F. GAIN to 0. This control is on the Console Receiver. This will leave a single line on the face of the tube. Turn the MARKERS switch to the ON position, and allow the markers to remain on the tube during the adjustment period.

(3) Adjust the FOCUS BAL potentiometer, R-645, and the FOCUS control on the front panel alternately until the sweep line and marker pips are *both* as sharp as possible. The FOCUS BAL control is on the left-hand side of the chassis and is shown in Fig. 7-108. It is possible to regulate these controls so that the sweep line can be sharpened while the markers are thickened. Ideal adjustment is when *both* the horizontal sweep line and the marker indications are balanced and *both* are as thin as possible.

f. PHANTASTRON ADJUSTMENT.

(1) It is necessary to align the Phantastron circuit so that, when the step is placed adjacent to a target, the range of the target may be accurately read on the RANGE counters. If the range markers are known to be accurate, adjustment can be made by

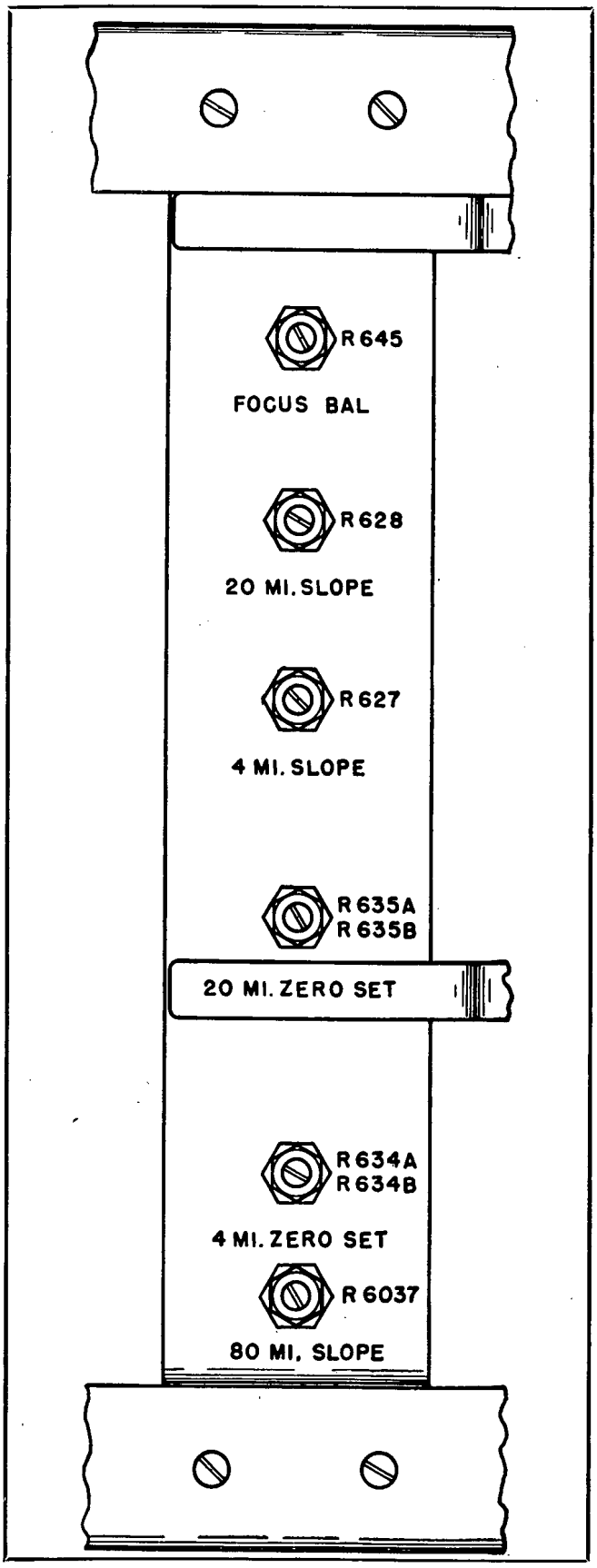


Figure 7-108. Range Scope Controls on Left Side of Chassis

calibrating the phantastron against the range markers. However for greater accuracy, a calibrator may be used. The output of the calibrator should be connected to the video input terminal in the top of the Range Scope cabinet. The calibrator should be set to provide 2,000-yard pips and the RANGE switch should be turned to the 4-mile range.

(2) Adjust the calibrator for proper output and turn on the MARKERS switch on the front panel. Place the RANGE SELECTOR switch on the 4-mile range and adjust the calibrator phasing control until one of the pips lines up exactly with the range markers nearest to the start of the sweep line. Then turn off the MARKERS. If only the markers are used for calibration, the MARKERS switch should be left on.

(3) Pull out the RANGE STEP control so that the vertical step appears on the sweep line of the Range Scope. Adjust this control until the step is as far to the left of the tube as possible.

(4) Rotate the RANGE STEP handle until the range step just touches the left-hand marker, or range calibrator pip. Then, record the range of the pip and the reading of the range counter. The range counter reading should be the same as the calibrator or marker range, ±100 yards. Continue aligning the range step with each of the calibrator or marker pips until the range step reaches the right-hand end of the sweep. At no point should the range as read on the counters be more than ±100 yards from the range read on the calibrator or marker pips. The markers should be 2000 yards apart on the 4-mile range, 10,000 yards apart on the 20-mile range and 20 miles apart on the 80-mile range. If these readings should be plotted, as shown in Fig. 7-109, a straight line will appear. If the line is not straight, the helipot R-632 should be replaced. If the line is straight, it should be at a 45 degree angle with the two coordinates of the graph.

(5) If the line is straight, but not a 45 degree angle, the SLOPE control should be adjusted. For the 4-mile range, this control is R-627, for the 20-mile range, it is R-628 and for the 80-mile range it is R-6037. These controls are shown in Fig. 7-108. When the readings at the various calibration points do not vary more than ±100 yards, the slope adjustment is properly set.

(6) Repeat the above adjustment for each of the other ranges.

(7) The adjustment just described has set the linearity of the phantastron circuit. It is now necessary to adjust it so that the mileage read from the counters will start at zero. This can be done in two ways. The first, and more accurate way, is to plot the various readings taken from the calibrator or marker pips and from the counters, in a graph similar to Fig. 7-109. When the phantastron is accurately zeroed, the line, if lengthened (it is not possible to actually reduce the phantastron delay to zero) will extend through the origin of the coordinates of the graph. If this does not happen on the first set of readings, the ZERO SET control R-634 for the 4-mile range and R-635 for the 20-mile range, should be regulated and another set of readings plotted. These controls are shown in Fig. 7-108. The 20 and 80-mile ranges are zeroed with the same control. The second method is to line up the range step with one of the range markers. The ZERO SET controls should then be adjusted until the range on the counters is the same as the range indicated by the range marker. This provides approximate results if the range markers are accurately calibrated and the Slope Control is accurately adjusted.

g. RADAR VIDEO FREQUENCY RESPONSE.

(1) Remove the bezel from the front of the Range Scope and connect a 400-mmf capacitor between terminals 83 and 01 which are exposed when the bezel is removed. Connect a 300-ohm resistor between terminals 80 and 01.

(2) Connect a signal generator such as Navy Model LP (Series) or equivalent to terminals 80 and 01.

(3) Apply power to the Range Scope and adjust the attenuator on the signal generator to deliver a constant input of 0.5 volts.

(4) A vertical line should appear on the face of the Range Scope tube. Measure the height of this line with a plastic rule.

(5) Set the output frequency of the signal generator to 100 kc/s. Record the height of the vertical line. Then set the output frequency of the signal generator to 10 kc/s and record the height of the line. Repeat this operation with a frequency of 3.5 mc/s. The video frequency response should be better than 3 db down at 10 kc/s and 3.5 mc/s, using the height of 100 kc/s as zero db. If it is not, the circuit should be carefully checked.

h. IFF VIDEO FREQUENCY RESPONSE.

(1) Remove the bezel of the Range Scope and connect a 400-mmf capacitor and a 560-ohm resistor in parallel between terminals 84 and 01. Connect a 300-ohm resistor between terminals 80 and 01 and connect the signal generator to terminals 82 and 01.

(2) Set the output frequency of the signal generator at 100 kc/s and set its attenuator to deliver a constant output voltage of 0.5 volts. Measure the height of the vertical line that appears on the Range Scope with a plastic rule.

(3) Repeat step (2) using frequencies of 10 and 1000 kc/s. The frequency response should be better than 3 db down at 10 and 1000 kc/s using the height of 100 kc/s as zero db.

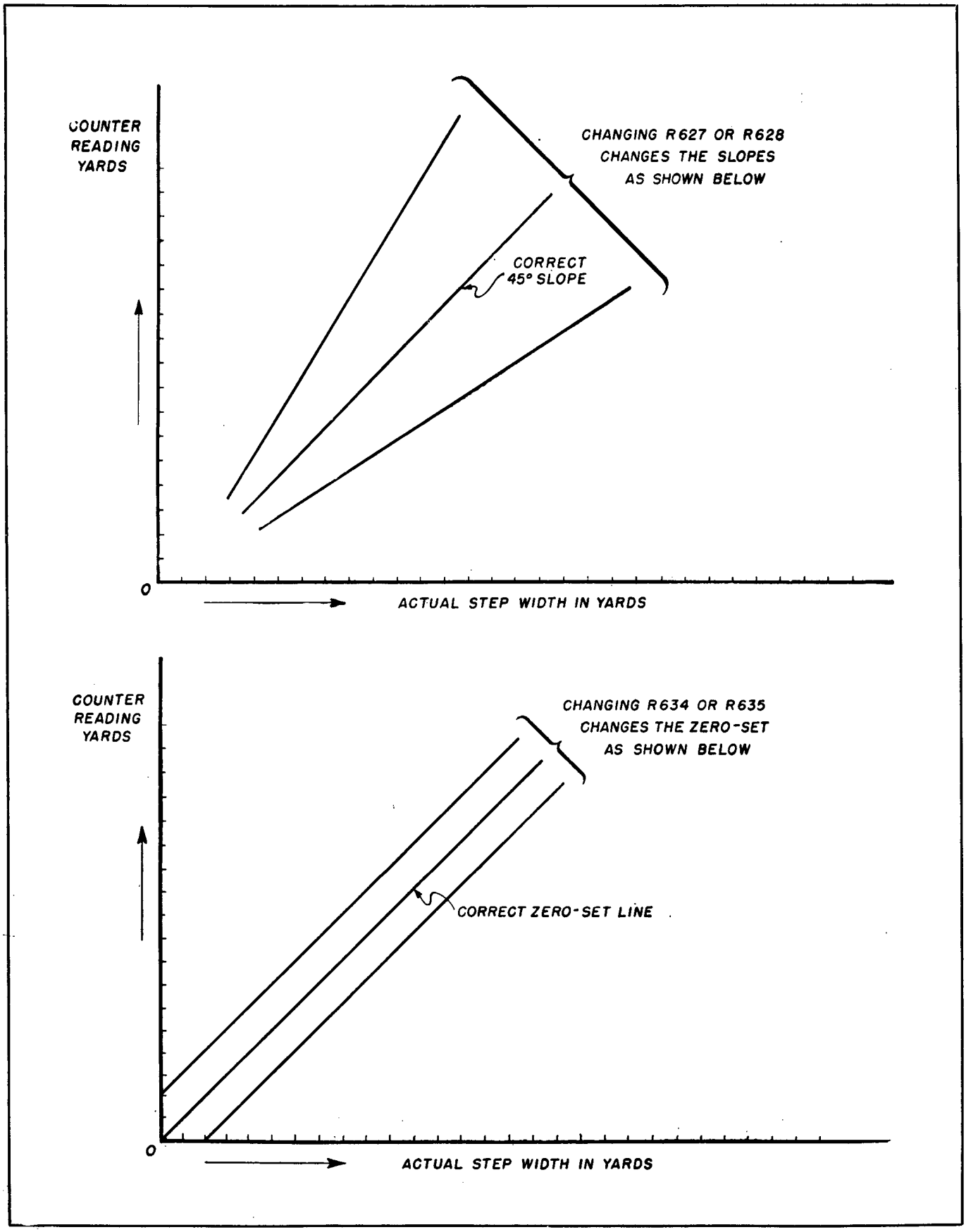


Figure 7-109. Plot of Range vs. Counter Readings

40. ELECTRICAL ADJUSTMENTS IN IFF COORDINATOR.

a. GENERAL.

(1) There are only two adjustments on the IFF Coordinator. To insure proper operation, these adjustments should be made whenever tubes are changed and at infrequent intervals due to the aging of tubes and other circuit components.

b. IFF BIAS ADJUSTMENT.

(1) The purpose of this adjustment is to set the bias applied to the Eccles-Jordan multivibrator tubes in the unit. The bias may be adjusted over a range which permits the proper operation of new tubes, and tubes which have deteriorated slightly. The procedure that follows assumes that the IFF Coordinator is properly connected to the various components in the system and is being triggered with a trigger of at least 20 volts amplitude.

(2) Place the CHALLENGE switch on the front panel to its ON position. The IFF Transmitter may be turned off for the test.

(3) Connect a test oscilloscope such as a Dumont 208 or its equivalent between terminals 185 and 01. Disconnect the Range Scope leads from these terminals if a good pattern cannot be obtained otherwise. Two broad square pulses should be seen when the equipment is turned on.

(4) If the proper waveform is not observed, adjust the BIAS VOLTAGE control shown in Fig. 7-110 until the pulses appear and their amplitudes are approximately equal. Lock the control. The bias thus obtained is approximately —85 volts as measured from the arm of potentiometer R-944 to ground.

c. IFF DELAY ADJUSTMENT.

(1) The purpose of the IFF delay adjustment is to set the delay of the IFF sweep trigger to the range scope so that the radar and IFF targets will coincide. This value compensates for the delay inherent in an IFF response system with which the Indicator Console may be used. To make the adjustment, a friendly ship or aircraft equipped with the proper type IFF response equipment is necessary unless a synchroscope is available. This adjustment should preferably be made on the 4-mile range for greatest accuracy although comparatively accurate results may be secured from the 20-mile range.

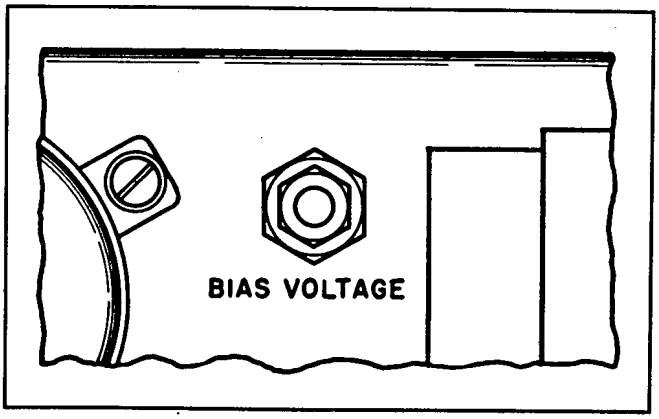


Figure 7-110. BIAS VOLTAGE Control on IFF Coordinator

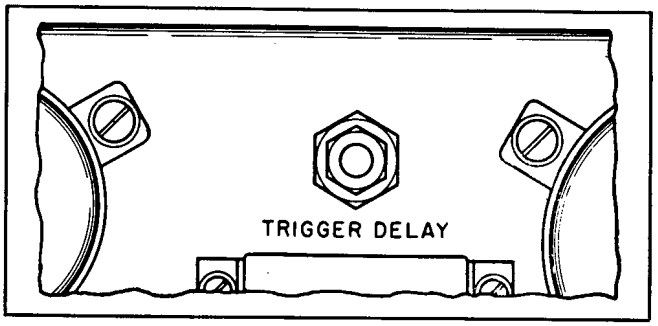


Figure 7-111. TRIGGER DELAY Control on IFF Coordinator

(2) Position the antenna so that the radar signal from the friendly target is visible on the Range Scope.

(3) Operate the CHALLENGE switch to the ON position.

NOTE

DO NOT LEAVE THIS SWITCH IN THE ON POSITION TOO LONG IF IN ENEMY WATERS. TO DO SO MAY ENABLE THE ENEMY TO FIND AND MEASURE THE FREQUENCY OF THE IFF EQUIPMENT. IT IS BETTER TO USE THE MOMENTARY POSITION OF THE SWITCH AND HOLD IT ON ONLY FOR A SHORT PERIOD OF TIME.

(4) With the CHALLENGE switch in the MOMENTARY or ON position, and the IFF receiver operating properly, an IFF response should appear on the Range Scope. This should be under, or nearly under the radar target indication. Adjust the IFF REC. GAIN control on the IFF Coordinator if the IFF response does not have sufficient amplitude.

(5) Loosen the clamp nut and adjust the TRIGGER DELAY control until the radar pip and IFF pip are in the same vertical line. This control is shown in Fig. 7-111. The adjustment should not have to be changed unless the ship is required to operate with another type IFF equipment requiring a different delay period.

41. ELECTRICAL ADJUSTMENTS IN PPI INDICATOR.

a. GENERAL.

(1) An oscilloscope TS-34( )AP or its equivalent, and a pulse marker calibrator such as Range Calibrator TS-358( )/UP or pulse marker voltage from the ship's radar equipment are required to align the PPI Indicator. The source of marker voltage must supply four marker pips each for the 4-, 20-, 80-, and 200-mile ranges. An alignment tool, adjustable wrench, and glyptol or its equivalent are also required.

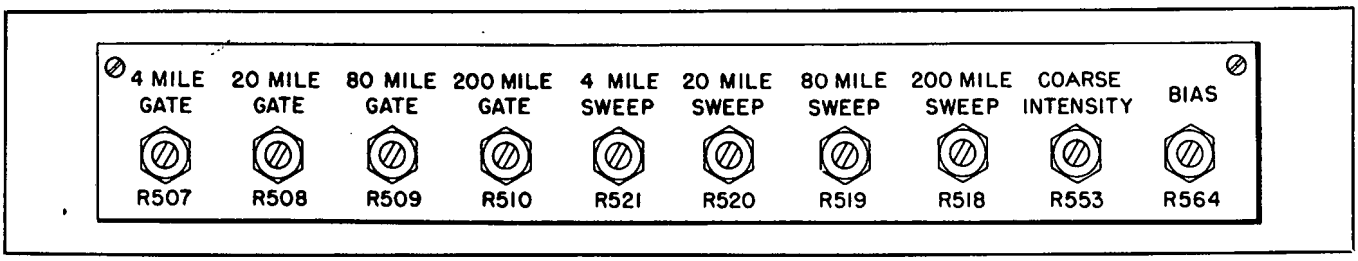


Figure 7-112. Alignment Controls in PPI Indicator

(2) With the ship's radar equipment supplying trigger voltage, turn the Indicator on and allow it to warm up. If the ship's radar equipment cannot be operated, some other source of trigger voltage should be connected to terminals 285-A and 01 which are located in the top of the Indicator Console case above the PPI Indicator.

(3) Connect a d-c vacuum tube voltmeter (Navy Model OBQ (Series) or equivalent) between the junction point of capacitor C-513 and C-538 and ground. Adjust potentiometer R-564 until the meter reads —65 volts. This control is shown in Fig. 7-112.

b. INTENSITY ADJUSTMENT.

(1) Set the RANGE SELECTOR switch on the 4-mile range, the CENTER EXPAND switch to OFF and the MARKERS control completely off. Turn the FINE INTENSITY control all the way on, and then gradually raise or lower the COARSE INTENSITY control, R-553, on the right side of the chassis as shown in Fig. 7-112, until a light clean line appears on the scope face. Lock the COARSE INTENSITY control R-553 in this position. Switch the RANGE SELECTOR knob to the other 3 positions successively, lowering the FINE INTENSITY control each time until approximately the same line intensity appears on the scope face. There should be adequate range on the FINE INTENSITY control to accomplish this test and blank the PPI tube on the 200-mile range. If this condition is not obtainable, circuit-check the unit for trouble.

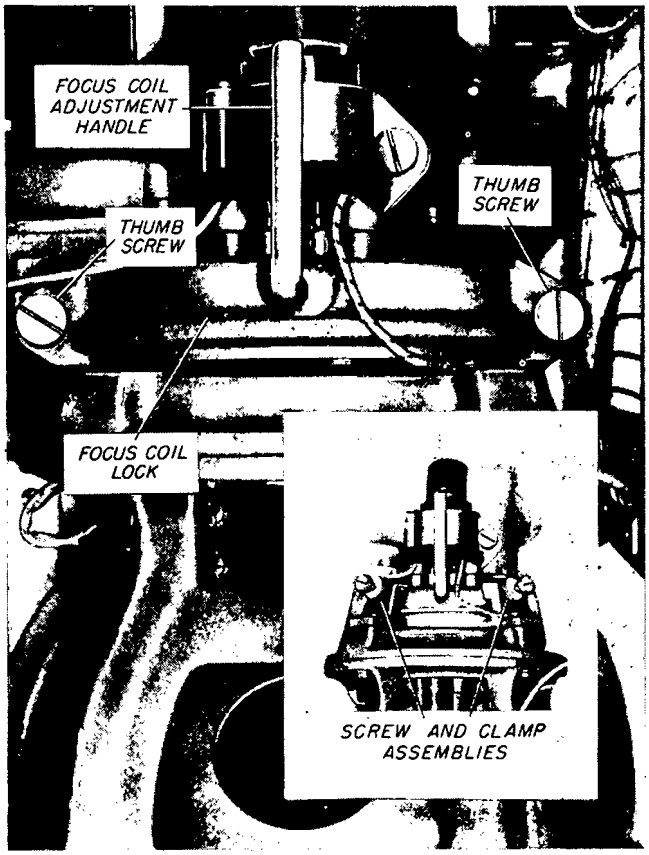


Figure 7-113. Focus Coil Adjustment in PPI Indicator

c. FOCUS COIL ADJUSTMENT.

(1) Loosen the clamp locks and clamps on the focus coil and grasp the handle. The clamp and focus coil adjustment are shown in Fig. 7-113. Rotate the coil until the start of the sweep line is in the center of the tube. The center is located at the end of the etched bearing line over the face of the tube. Tighten the clamps and locks. It may be necessary to readjust the focus coil after all the other tests have been made.

d. PRELIMINARY GATE ADJUSTMENT.

(1) With the trigger applied to the equipment, observe the blanking pulse at the plate of V-501 on an oscilloscope such as Oscilloscope TS-34()/AP or equivalent. With the RANGE SELECTOR switch on the 80-mile range, observe how many scale divisions on the scale over the face of the oscillograph tube are occupied by a complete repetition or duty cycle. Then adjust R-509, shown in Fig. 7-112, until the positive pulse occupies one-fifth of the entire repetition cycle.

(2) Turn the RANGE SELECTOR switch to the 200-mile range. Adjust potentiometer R-510 until the positive pulse occupies approximately one-half of the entire repetition cycle (actually $1\frac{2}{25}$ of it). Tentatively lock potentiometers R-507, R-508, R-509 and R-510. They will receive final adjustment later. These controls are shown in Fig. 7-112.

e. PRELIMINARY SWEEP LENGTH ADJUSTMENT.

(1) Adjust potentiometers R-521, R-520, R-519 and R-518 on range positions 4, 20, 80 and 200 miles, respectively, until the sweep length runs out to just one-half inch from the edge of the cathode ray PPI tube. Tentatively lock all four controls. These controls are shown in Fig. 7-112 and are marked 4-, 20-, 80-, and 200-MILE SWEEP respectively.

f. MARKER CALIBRATION.

(1) If a range marker calibrator such as Range Calibrator TS-358( )/UP is available, feed its 1-mile output into video terminals 180-A and 01. The MARKERS control on the PPI Scope should be turned off. With the RANGE SELECTOR switch in the 4-mile position, adjust the VIDEO GAIN and INTENSITY controls so that small dots appear on the sweep of the scope. Turn the phase shift knob on the calibrator until one dot coincides as closely as possible with the start of the sweep circuit. Now slowly turn up the MARKERS control on the PPI Scope until the PPI MARKER dots appear. These dots should be very close to the original set of dots. If they are not, adjust the screw on inductor L-502 until the two sets of marks coincide as closely as possible. Then, holding the screw at this position, tighten the locknut and seal the adjustment with glyptol. Check to make sure that the adjustment has not been changed during tightening. This adjustment is located on the inductor shield can beneath the chassis.

NOTE

THE ADJUSTMENT JUST DESCRIBED IS SEALED AT THE FACTORY. IT SHOULD BE MADE ONLY WHEN ABSOLUTELY NECESSARY.

If the range scope marker circuits are known to be correctly adjusted, calibrating markers can be obtained by placing the PPI MARKER switch on the Console Receiver in its ON position.

g. GATE AND SWEEP LENGTHS, FINAL ADJUSTMENT.

(1) With the trigger applied, the RANGE SELECTOR switch at 80 miles, and the MARKERS control and INTENSITY control adjusted so that dots appear, adjust potentiometer R-509 (see Fig. 7-112) so that exactly 4 dots (not counting the center) appear on the face of the tube. Next, adjust potentiometer R-519 (80-MILE SWEEP control) so that the fourth dot is about one-half inch from the usable edge of the tube.

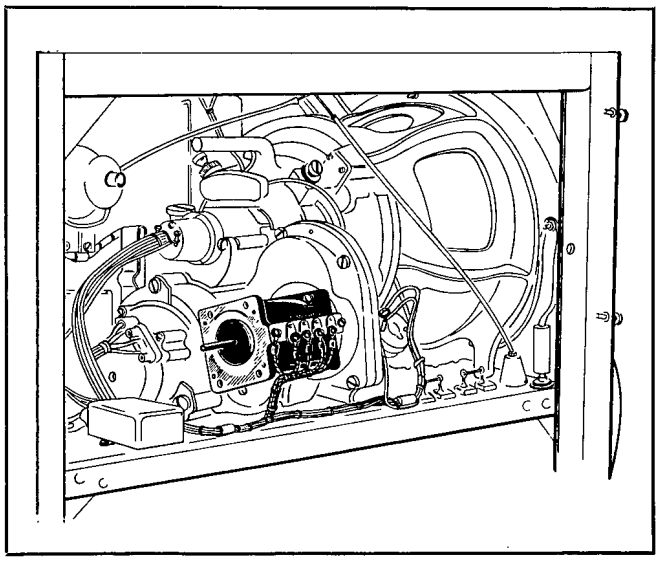


Figure 7-114. Drive Motor in PPI Indicator

(2) Switch the RANGE SELECTOR to 200 miles and adjust potentiometer R-510 (200 MILE GATE) so that the fourth dot terminates the sweep. Now adjust potentiometer R-518 (200-MILE SWEEP) so that the fourth dot on both ranges coincide when the RANGE SELECTOR is rapidly shifted from 200 to 80. The other dots should also coincide very closely. Repeat this adjustment on the 20-mile range using potentiometers R-508 and R-520, and on the 4-mile range using potentiometers R-507 and R-521. When these adjustments have been finally made, all of the screwdriver controls on the right side bracket of the scope should be firmly locked. The adjustments just described are shown in Fig. 7-112.

h. ANTI-HUNT ADJUSTMENT.

(1) The anti-hunt circuits are adjusted with the Indicator in operation except that no OSC voltage is supplied to the PPI drive motor B-501.

(2) Connect a test oscilloscope between plate 2 of V-514A and ground.

(3) Remove fuse F-501A from its holder. This fuse is the second 3 AMP fuse from the left on the front panel. Removing this fuse breaks the OSC circuit to the PPI drive motor.

(4) Turn the Indicator's ON-OFF switch ON.

(5) Rotate the shaft of the PPI drive motor by hand until a good sized 60-cycle pattern appears on the screen of the test oscilloscope. The drive motor is shown in Fig. 7-114.

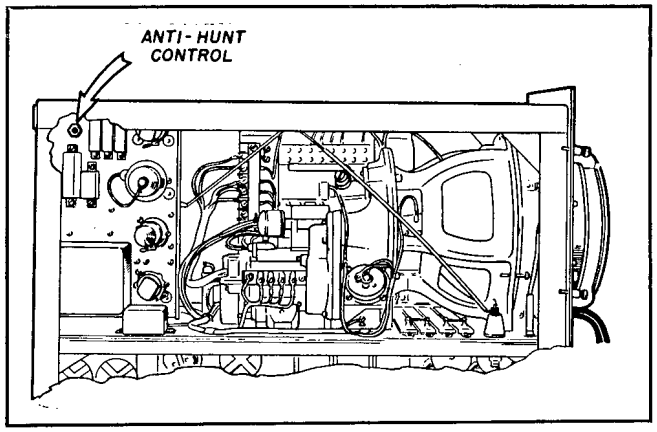


Figure 7-115. Anti-Hunt Control in PPI Indicator

(6) Adjust the anti-hunt potentiometer, R-590, for minimum amplitude on the oscilloscope. Lock the control. This control is shown in Fig. 7-115.

(7) Connect the test oscilloscope between test point J-528 and ground.

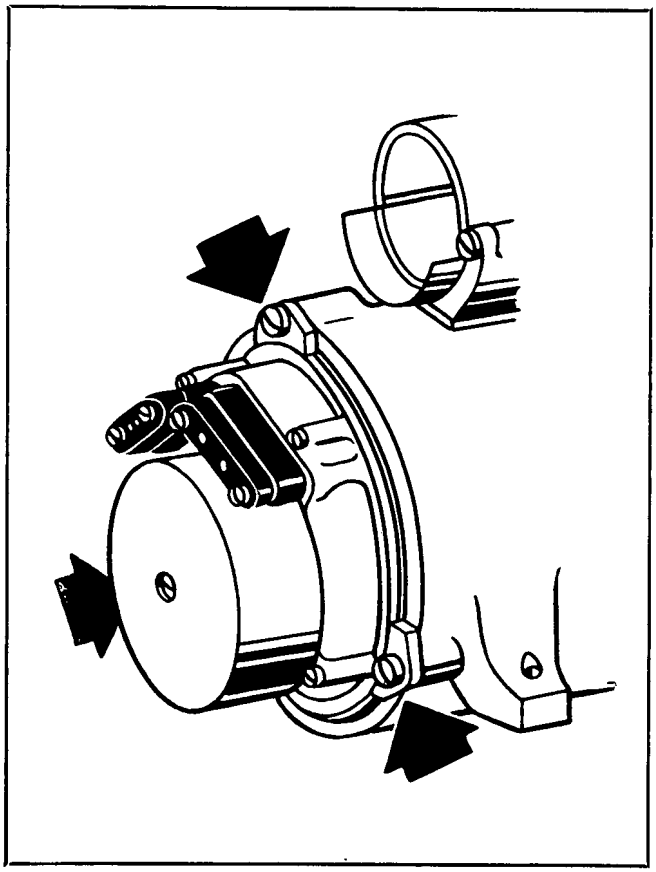


Figure 7-116. Synchro Transformer Adjustment in PPI Indicator

(8) Rotate the shaft of the drive motor until the amplitude of the 60-cycle pattern on the test oscilloscope is zero. Note the positions of the trace on the PPI scope with respect to the azimuth scale.

(9) Rotate the drive motor shaft until the trace has moved exactly one degree on the azimuth scale.

(10) Adjust the vertical amplifier on the test oscilloscope until the amplitude of the 60-cycle pattern is exactly two inches.

(11) Replace Fuse F-501A and rotate the radar antenna. The height of the test pattern should never be less than one inch, or one large square, during the rotation of the antenna. This indicates that the bearing error at the Indicator does not exceed one-half of one degree.

(12) Watch the PPI sweep while the antenna is rotating. Reverse the direction of the antenna several times. The PPI trace should follow the antenna smoothly with very little jumpiness. If jumpiness is observed, readjust the anti-hunt control R-590 until the jumpiness disappears.

i. ORIENTATION WITH THE RADAR ANTENNA.

(1) Stop the radar antenna on zero degrees azimuth. Loosen the clamps on the synchro-control transformer B-502 and rotate it until the PPI trace also indicates zero degrees of azimuth. See Fig. 7-116. Tighten the clamps. The Indicator will now indicate the position of the radar antenna in azimuth.

j. VIDEO FREQUENCY RESPONSE.

(1) Measure the video frequency response of the equipment by connecting a signal generator such as Navy Model LP (Series) or equivalent to the input video terminals, 180-A and 01. The regular video leads should be disconnected and the bridging-terminating switch should be thrown in the terminating position. This places a 68-ohm resistance across the signal generator. Connect a vacuum tube voltmeter (Navy Model OBQ (Series) or equivalent from cathode 7 on V-512 (in socket of cathode ray tube) to ground. The socket should be removed from the tube. Next, measure the voltage output at this point holding the input volts constant, preferably at a 2-volt level. The video gain control should be set at its midpoint. Vary the frequency of the signal generator between the limits of 60 cps and 3 mc/s and check to see that the video response is better than 2.5 megacycles wide at 3 db. down, also better than 3 db. down at 10 kc/s.

42. ELECTRICAL ADJUSTMENTS IN GENERAL CONTROL UNIT.

a. This unit does not require alignment. However, the PLATE VOLTMETER should be checked to see that it is zero centered at periodic intervals.

43. ELECTRICAL ADJUSTMENTS IN BEARING INDICATOR.

a. GENERAL.

(1) The Bearing Indicator is aligned with the antenna rotation equipment of the radar set with which the Indicator Console is being used. Consequently, the alignment procedure will depend upon the operations required for lining up the complete radar set.

b. RESETTING INDICATOR DIALS.

(1) Provisions are made for correcting errors in the reading of the indicator dials. This is done by loosening the three screws which hold the synchro units in position on the vertical plate behind the front panel. See Fig. 7-117. Then the body of the synchro units should be turned until the dial readings indicate the known bearing of the radar antenna. Tighten the screws while holding the synchro unit in its correct position. *Do not attempt to move the dials. All adjustments should be made by turning the synchros.*

c. SLEWING MOTOR SPEED ADJUSTMENT.

(1) Connect 115 volts ±2 volts to a-c terminals 603 and 302.

(2) Set the SLEWING MOTOR switch to each of its positions and record the rotational speed of the HAND SLEW wheel for each position. The speed for each position is as follows:

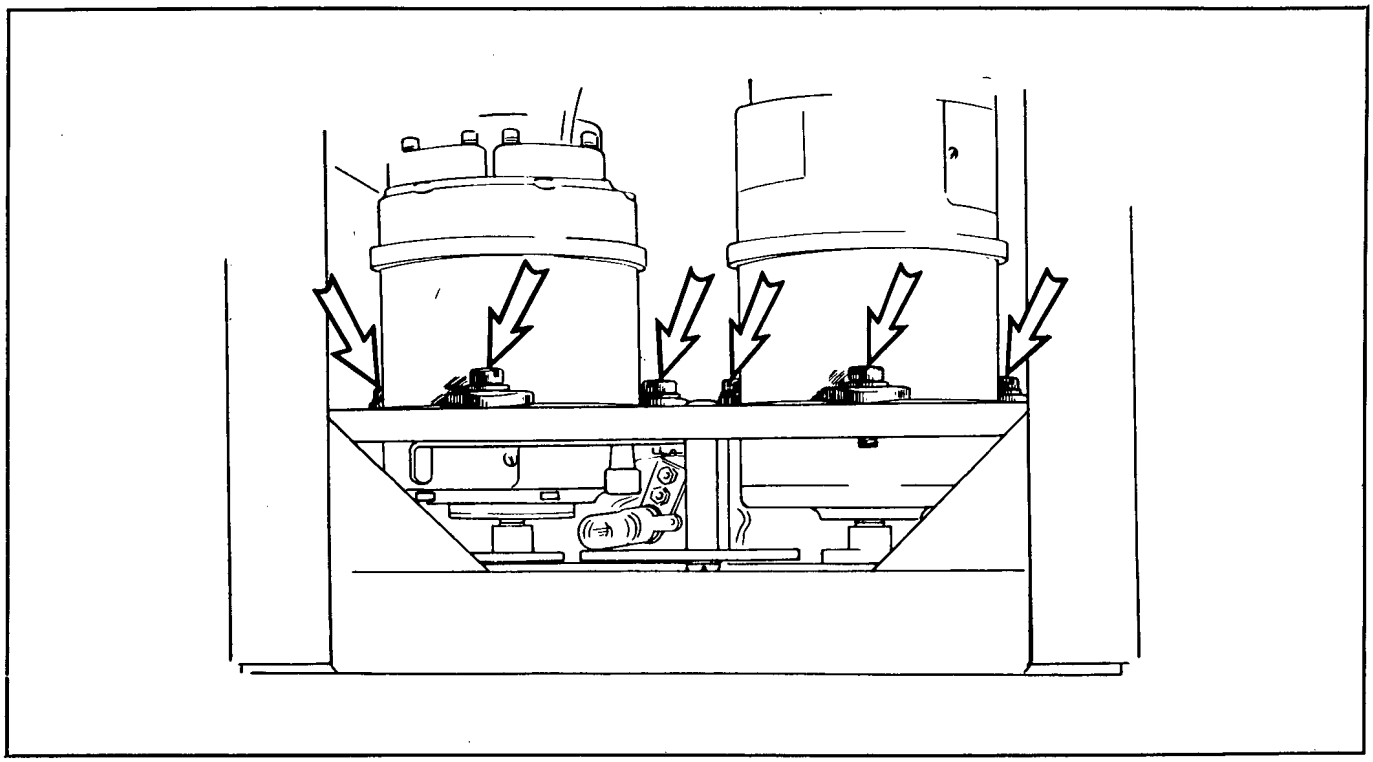


Figure 7-117. Synchro Adjustment in Bearing Indicator

SLEWING MOTOR switch position
5 (CW or CCW)
1¼ (CW or CCW)
0
Speed of HAND SLEW Wheel
180 rpm ±20%
45 rpm ±40%
0 rpm

(3) These speeds may be adjusted by varying the connections of rectifiers CR-801 and CR-802 on the taps of transformer T-801. The d-c output from CR-801 should not exceed 35 volts or be less than 18 volts. The d-c output from CR-802 should not exceed 20 volts or be less than 10 volts. Change the position of a tap connection and recheck the speed, as directed in step (2). If the speed is still incorrect, change the tap connections again. Repeat this operation until the correct speed is obtained.

44. ELECTRICAL ADJUSTMENTS IN ROTATION CONTROL UNIT.

a. GENERAL.

(1) Two series of adjustments are given in this paragraph. The series given in Par. 44*b* applies to unmodified units and the adjustments in Par. 44*c* apply only to modified units.

b. UNMODIFIED ROTATION CONTROL UNITS.

(1) Place the ROTATION SWITCH S-804 on the panel of the Bearing Indicator in its NORMAL position.

(2) Place the SLEWING MOTOR switch S-801 in its OFF position. This switch is located on the panel of the Bearing Indicator.

(3) Loosen the panel screws on the Servo Amplifier and pull the chassis forward until it locks. Turn the interlock bars so that the interlock switches are closed.

(4) Place the ON-OFF switch of the Rotation Control Unit in its ON position.

(5) Turn the INPUT GAIN control R-113 counterclockwise. See Fig. 7-118. If the Antenna hunts, connect an a-c voltmeter with a 50-volt range to terminals 63 and 64 on terminal board E-1103 in the top of the case. Then adjust the BALANCE control (R-1112) until the system ceases to hunt and the voltage reading is steady. This control is shown in Fig. 7-118.

(6) Place the SLEWING MOTOR switch in one of its 1¼ positions.

(7) Advance the setting of the INPUT GAIN control until the Antenna follows smoothly in both CW and CCW rotation. This can be observed by watching the Bearing Indicator dials.

(8) If the voltage indicated on the meter is fluctuating at 42 cps, adjust the ANTI-HUNT control R-1118 until the rotation is even and smooth and the voltage fluctuation disappears. This control is shown in Fig. 7-118. Again advance the INPUT GAIN control until hunting starts and re-adjust the ANTI-HUNT control as before to stop the hunting. Continue these two adjustments alternately until the opti-

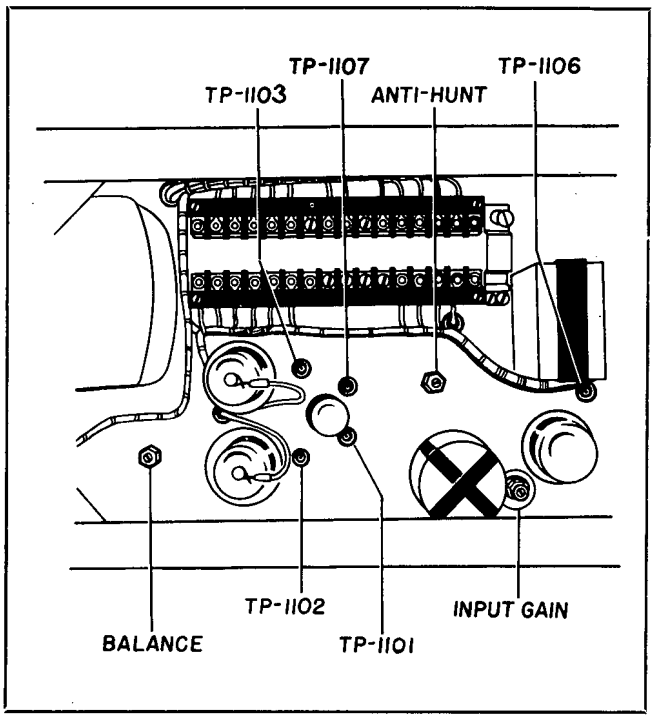


Figure 7-118. Internal Controls of Servo Amplifier

mum point is reached where any further advance of the INPUT GAIN control cannot be compensated by adjusting the ANTI-HUNT control. Disconnect the voltmeter and connect it with a 0.5 mf capacitor in series with one of its leads to terminals 68 and 69 on terminal board E-1101. Adjust the ANTI-HUNT control for minimum voltage. See Fig. 7-118.

(9) Reverse the direction of rotation several times in rapid succession. The Antenna should come to a full stop without hunting. With the SLEWING MOTOR switch in its OFF position, the Antenna should follow the HAND SLEW control smoothly and instantaneously. If it does not, repeat all of the above adjustments.

(10) Place the ROTATION switch in its PPI or EMERGENCY position. The Antenna should rotate smoothly at approximately 7 rpm.

c. MODIFIED ROTATION CONTROL UNITS.

(1) Place the ROTATION switch S-804 on the panel of the Bearing Indicator in its NORMAL position.

(2) With all switches in their OFF position, proceed in adjusting the modified system in the same way as was described for adjusting the unmodified system.

(3) Place the SLEWING MOTOR switch in one of its four rotational positions, and count the revolutions per minute of the Bearing Indicator dials. If the speed is too low, which sometimes occurs as a result of aging of the rectifier units, move the taps on transformer T-1104. The lead normally on tap 4 should be moved to tap 5 and the lead normally on tap 7 should be moved to tap 8.

45. ELECTRICAL ADJUSTMENTS IN SERVO GENERATOR.

a. There are no electrical adjustments in the Servo Generator. The replacement of brushes is described in Section 6.

46. ELECTRICAL ADJUSTMENTS IN SYNCHRO AMPLIFIER UNIT.

a. GENERAL.

(1) There are two types of adjustments in the Synchro Amplifier Unit. One is the adjustment of the Amplifier Unit and the other is the adjustment of the Synchro Unit. The adjustment of the Synchro Unit is described in Par. 32 of this section.

b. ANTI-HUNT ADJUSTMENT.

(1) An indication of the degree of hunting may be obtained by watching the motor pinion or observing the fluctuation of an a-c voltmeter connected to terminals HR1 and HR2 or 2R1 and 2R2 on the terminal board in the lower compartment. The range of the meter should be 0-5 volts and it should have a sensitivity of 1000 ohms per volt.

(2) Rotate the GAIN control clockwise through three-fourths of its range. This control is shown in Fig. 7-119.

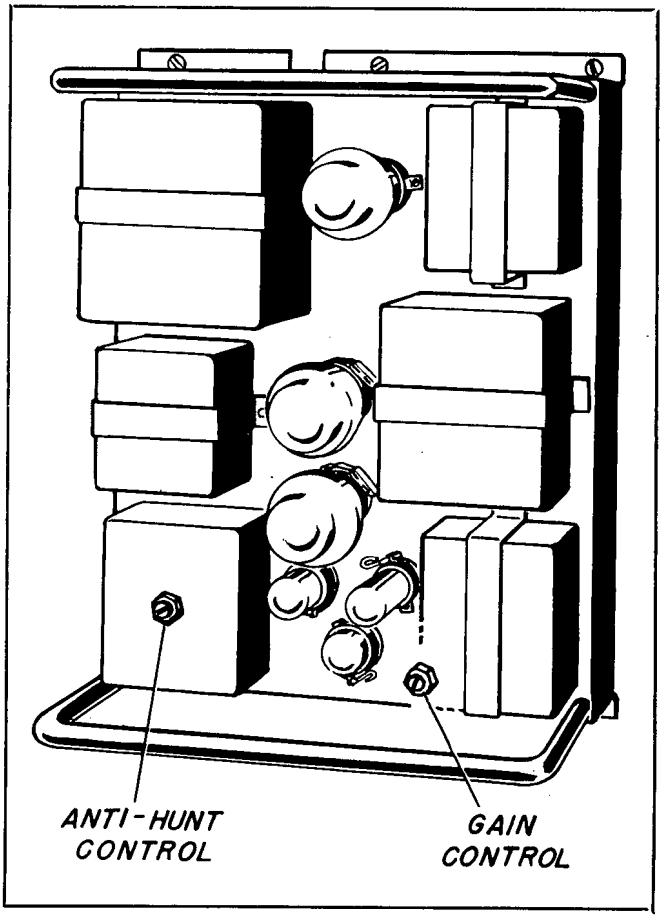


Figure 7-119. Adjustments in Synchro Amplifier

(3) Adjust the ANTI-HUNT control until hunting ceases. When this control is set completely counterclockwise, the hunting is very rapid and has a low amplitude. At the other end of the range, the hunting is slow and has a larger amplitude. The best adjustment is obtained by turning the control completely counterclockwise and then advancing it in a clockwise direction until hunting ceases. The voltmeter should indicate less than 1.5 volts at this point. If this voltage is exceeded, advance the GAIN control clockwise and readjust the ANTI-HUNT control.

47. ELECTRICAL ADJUSTMENTS IN ANTENNA PEDESTAL.

a. GENERAL.

(1) The electrical adjustments in the Antenna Pedestal consist of zeroing the synchro units. These units are correctly adjusted when the equipment leaves the factory and should require no further attention unless they have been removed for lubrication or for replacement. When orienting the antenna positioning system, check the adjustment of the synchro units in the Bearing Indicator and PPI Indicator before deciding that it is necessary to zero the synchro units in the Antenna Pedestal.

b. SYNCHRO ADJUSTMENTS.

(1) Remove the disconnect plug P-1301 in the Pedestal base. Then remove the plug from the rear end of the drive motor and insert the handcrank, making certain that the tongue on the crankshaft engages the groove in the motor shaft.

(2) Loosen the captive fillister head screws in the edge of the synchro inspection door shown in Fig. 7-68. Pull the door away from the housing until all screws are clear and lower the door on its hinges.

(3) Rotate the Antenna with the hand crank until the Antenna is facing directly forward and engage the stowing lock. This lock is shown in Fig. 7-68.

(4) Place the SYNCHRO SYSTEM switch S-1105 on the Rotation Control Unit in its A.C. position.

(5) Disconnect leads 60, 61 and 62 from the terminal block E-1301 which is located on the terminal panel shown in Fig. 7-68.

(6) Tie the disconnected 61 lead to terminal 155.

(7) Connect one lead of an a-c voltmeter to terminal 154 and connect the other lead of the voltmeter to the disconnected 60 lead. The voltmeter should be operated on the 250 volt range.

(8) Loosen the three screws which hold the synchro clamp ring in place.

(9) Place the ON-OFF switch on the front panel of the Rotation Control Unit in its ON position.

(10) Carefully rotate the stator of the synchro until a minimum reading is obtained on the voltmeter.

(11) Remove the voltmeter, and remove lead 61 from terminal 155.

(12) Connect one lead from a voltmeter to the disconnected 60 lead.

(13) Connect the other voltmeter lead to the disconnected 62 lead. This voltmeter should be capable of indicating 0.1 volts. It should have a maximum range of approximately 50 volts, and should be operated on that range for initial indications.

(14) Obtain a zero indication on the meter by adjusting the position of the stator of the synchro. Use the high meter scales for the initial indication and, as a zero indication is approached, switch to 0.1 scale. If a zero indication is not possible, approach it as nearly as possible. Clamp the stator of the Synchro in the zero voltage position. Be certain that the zero indication does not change as the clamp is tightened.

(15) Place the ON-OFF switch in its OFF position and replace leads 60, 61 and 62 on their terminal strip. The 36 speed synchro is now in its electrical zero position.

(16) Disconnect leads 57, 58, and 59 from their terminal strip E-1305 adjacent to the 1 speed synchro. Tie the disconnected 58 lead to terminal 152.

(17) Connect one lead of an a-c voltmeter to terminal 59 and the other lead to terminal 151. This meter should have a range of from 0-250 volts.

(18) Loosen the clamp ring of the one-speed synchro unit as in the case of the 36-speed unit.

(19) Place the ON-OFF switch on the Rotation Control Unit in its ON position and rotate the stator until minimum voltage is indicated on the meter.

(20) Turn off the power, disconnect the voltmeter, and remove lead 58 from terminal 152.

(21) Connect one lead from a voltmeter to the disconnected 59 lead, and connect the other voltmeter lead to the disconnected 57 lead. This should be the same voltmeter as was used in aligning the 36 speed unit.

(22) Obtain a zero indication on the meter and clamp the stator of the synchro as was done in aligning the 36-speed unit.

(23) Clamp the stator of the synchro in the zero voltage position. Be certain that the voltage does not change as the clamp is tightened.

(24) Remove power from the unit and replace leads 57, 58, and 59 on their terminal strip.

(25) Replace the cover for the synchro access door in the Pedestal. Do not release the stowing lock.

(26) Apply power to the system by placing the power switch of the Rotation Control Unit in its ON position.

(27) Loosen the mounting screws holding each unit to the frame of the bearing indicator and rotate the stator of each unit until the zero position of the dial of the unit coincides with the index on the frame

of the Bearing Indicator. Clamp the stators in this position. See Par. 43 of this section.

(28) Release the stowing lock in the Antenna Pedestal and replace the disconnect plug in the Pedestal base.

48. ELECTRICAL ADJUSTMENTS IN POWER EQUIPMENT.

a. GENERAL.

(1) The adjustments in the power equipment are confined to the Motor Generator, Magnetic Controllers and Voltage Regulators. The adjustments are relatively simple and once they are accurately made there should be no occasion to change them unless the equipment is disassembled for some reason.

b. MAGNETIC CONTROLLERS.

(1) The relay contacts in the Magnetic Controllers should be periodically inspected. Burned, or worn contacts should be replaced. There is no adjustment on the relays. The only adjustments in the controllers are the tapped resistors that control the accelerating speed of the Motor Generator during starting. The Magnetic Controller in the 115-volt equipment has two tapped resistors. These are resistors R-1444 and R-1445. Resistor R-1444 should be adjusted to the point where approximately three seconds elapse between the closing of relay K-1443 and the closing of relay K-1444. Resistor R-1445 should be adjusted so that about three seconds elapse between the closing of relay K-1444 and relay K-1445.

(2) There is only one adjustable resistor in the Magnetic Controllers used with the 230-volt equipment. In Magnetic Controller CAY-211187 this resistor is R-1452. It should be adjusted for approximately three seconds between the closing of relays K-1452 and K-1453. In Magnetic Controller CAY-211325 the tapped resistor is R-1582. It should be adjusted for the same time lag recommended for the other two Magnetic Controllers.

c. VOLTAGE REGULATORS.

(1) The Voltage Regulators have only one elec trical adjustment. This is the tapped resistor in the Silverstat. If the Silverstat has a cover it must be removed in order to adjust the resistor. Prior to adjustment, close the Line Disconnect Switch and press the START button on the Push Button Station to start the Motor Generator.

(2) Place switch S-1461 in its AUTO position and adjust the VOLT. ADJ. RHEO. control R-1462 to the center of its range.

(3) Adjust the tap on resistor R-1461 until the voltmeter M-1461 indicates approximately 120 volts. Resistor R-1461 is located below the torque motor in the Silverstat.

(4) Replace the cover on the Silverstat. Further adjustments for correct voltage are made with the VOLT. ADJ. RHEO. control.

d. MOTOR GENERATOR.

(1) There are two types of controls on the Motor Generators. The Motor Generators purchased on contract NXsr-30306 have an overspeed switch mounted on the free end of the motor armature shaft. The Motor Generators purchased on contract NXsr-46032 have a speed regulating switch instead of the overspeed switch.

(2) To adjust the overspeed switch, remove the screws holding the cover and lift it off. An adjustment screw will be found on the circumference of the drum of the governor assembly. Turning this screw clockwise increases the speed at which the switch operates. Counterclockwise rotation of the screw decreases the speed at which the switch opens. By the trial and error method adjust this screw to the position where the switch opens at speeds of 1860 rmp or greater. The adjustment should then be checked for the varying loads encountered in normal operation of the equipment. Once this adjustment is made it should not have to be disturbed.

(3) If the Motor Generator is equipped with a speed regulator, remove the cover plate and loosen the set screw at the center of the brass plate on the slip ring assembly. Then adjust the speed adjustment screw to set the speed within the limits of 140 and 1860 rpm for loads varying from one-quarter of full load to full load and at voltages from 210 to 260 volts. Check the air gaps between the contacts on the switch to see that they are set at 0.025 inches before the adjustment is completed. To raise the speed of the motor, turn the adjusting screw counterclockwise. To lower the motor speed, turn the screw clockwise. Tighten the set screw after each adjustment. Do not turn the speed adjustment screw more than a half turn at a time. If the motor cannot be brought to the correct speed with one and one-half turns of the screw, check the motor for electrical trouble. The resistance of the motor shunt field should be 42 ohms plus or minus one ohm at room temperature (25 degrees C.). Resistor R-1521, mounted on the right-hand side of the front bracket when looking at the commutator end, should measure 110 ohms plus or minus three per cent. Resistor R-1522, mounted on the left-hand side of the front bracket should measure 225 ohms plus or minus three per cent. If the speed is too high there may be an open circuit in the branch in which resistor R-1521 is connected. If the speed is too low, either of the resistor circuits may be short circuited.

TABLE 7-2

COIL DATA

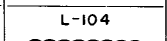
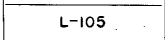
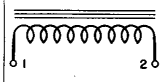
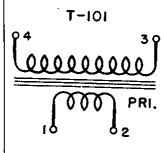
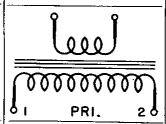
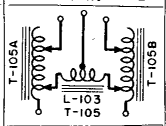
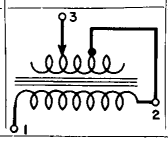
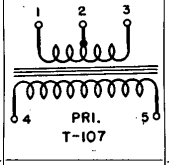
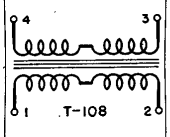
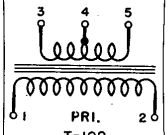
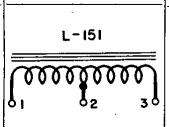
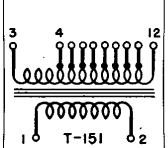
Desig. Symbol	Wecorp Pt. No.	Diagram	Winding	Wire Size	Turns	D-C Resistance in Ohms	Impedance Ratio	Hi-Pot A-C Volts	Remarks
L-103	7610981 P102	(See T-105)	2 Sections	½"x.020" Copper Strap	63" required for both sections				Part of T-105.
L-104	7710716 G1		Single 1 Section	# 18	10				Inductance 2.3 to 2.7 mh.
L-105	7610981 P104		Single 1 Section	# 18	20				Part of L-104. Inductance 5.3 to 5.8 mh.
L-107	7610981 P106		Single	.081x.114	314	.27		1500 V. 60 cps. to grd. for 60 sec. 345 V. 400 cps. across winding for 2 min.	Reactance to give 100 V. drop at 7.9 amps., 60 cps.
T-101	7610982 P168		Primary Secondary	.072x.410 (2 in par.) # 19E	37 2470	.012 50.6		2.5 kv. pri. to grd. for 60 sec. 22 kv. sec. to pri. and grd. for 60 sec. 230 V. 400 cps. across pri. for 60 sec.	
T-102 and T-103	7610982 P169		Primary Secondary	# 26 SCCE .032x.182	263 12	9.37 .03215		2500 V. 60 cps. pri. to grd. 36 kv. from sec. to pri. and grd.	
T-105	7610982 P172		2 Parts	# 16 Heavy Formex	160 ea. tapped at 137	.35 .3 to tap			
T-106	7610982 P174		Primary (2 Sections) Secondary	# 21E # 9 Sq. DCC	126 per section 33 tapped at 17			2500	Data given for one coil assembly. Two assemblies required per unit.

TABLE 7-2 (Continued)

COIL DATA

Desig. Symbol	Wecorp Pt. No.	Diagram	Winding	Wire Size	Turns	D-C Resistance in Ohms	Impedance Ratio	Hi-Pot A-C Volts	Remarks
T-107	L-382533		Primary Secondary	#30E #19E	1280 83 tapped at 41	72 ohms ±15% 0.27 ohms ±15%		1500 V. 60 cps. between windings and from each winding to core for 1 min. 330 V. 400 cps. across pri. for 30 sec.	Secondary delivers 6.3 V. ±2% at 1.8 amp. load with 115 V. 60 cps. primary.
T-108	L-406824		2 coils ea. Primary Secondary	#26 SCCE #26 SCCE	25 parallel, ea. Coil 25 parallel, ea. Coil	0.93 ohms ±15% 0.93 ohms ±15%		1500 V. 60 cps. between windings and from each winding to case for 1 min.	Start and Finish leads of 1st wire to be ½ turn ahead of respective leads of 2nd wire.
T-109	L-423141		Primary Secondary	.064x.258 D.C.C. .129x.365 D.C.C.	102 10 tapped at 5	.058 ohms ±15% .00093 ohms ± 15%		1500 V. 60 cps. between windings and from each winding to core for 1 min. 345 V. 400 cps. across primary for 18 seconds.	Secondary is 3 strands of .129 x .365 stacked to form a section .387 x .365 and wound simultaneously.
L-151	7610979 P14		Single	#37E	7500 tapped at 5340½	4200		10000 V. 60 cps. to grd. for 60 sec.	Inductance with .036 amps. d.c. and 1200 V. 60 cps. 125 H. 60 H. at tap.
T-151	7610979 P63		Primary Secondary	#21 #26 Formex	399½ 1759½	3.04 ±15% 60 ±15%		4500 V. 60 cps. between windings and between sec. and grd. for 60 sec. Pri. winding 1500 V. 60 cps. to grd. for 60 sec. and 345 V. 400 cps. across pri. for 18 sec.	Ind. with .145 a. d.c., 114 V. 60 cps. a.c. .455 h. Ind. with .033 a. d.c., 500 V. 60 cps. a.c. 8.8 H to 5.7 H. in 8 steps.

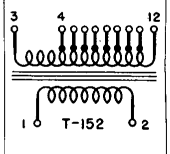
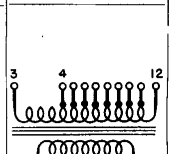
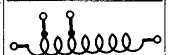
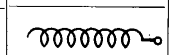
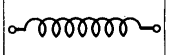
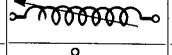
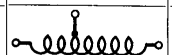
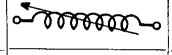
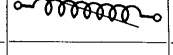
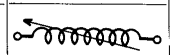
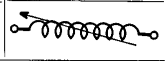
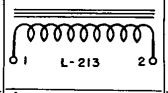
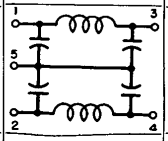
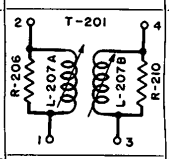
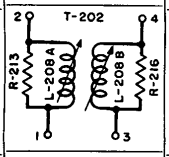
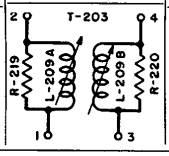
T-152	7610979 P64		Primary Secondary	#23E #27E	393 1710	3.6 55		4500 V. 60 cps. between windings and between sec. and grd. and 1500 V. between pri. and grd. for 60 sec. 230 V. 400 cps. across pri. for 18 sec.	Sec. Ind. with 22 mils. d.c. and 162.5 V. 60 cps. a.c. 3.3 h. to 2.5 H. in 8 equal steps.
T-153	7610979 P65		Primary Secondary	#25E #30 Formex	621 2700½	7.75 155		4500 V. 60 cps. between windings and between sec. and grd. and 1500 V. 60 cps. between pri. and grd. for 60 sec. 230 V. 400 cps. across pri. for 18 sec.	Sec. Ind. with .006 a. d.c. and 162.5 V. 7.3 to 5.7 H. in 8 equal steps.
L-201	7417816 G1		Hair Pin Loop	Copper Strap ¼x.032	1				
L-202	7411763 G1		Single 1 Section	#20	5				
L-203	7412601 G1		Single 1 Section	#22	17				
L-205	7412638 P14		Single	#16	2 5/6				Part of C-207A.
L-206	7412638 P13		Single	#16	2				Part of C-207A.
L-207A	7710422 G4		Single	#28	18				
L-207B	7710422 G5		Single	#28	22				
L-208A	7710422 G6		Single	#30	28				
L-208B	7710422 G7		Single	#28	22				

TABLE 7-2 (Continued)

COIL DATA

Desig. Symbol	Wecorp Pt. No.	Diagram	Winding	Wire Size	Turns	D-C Resistance in Ohms	Impedance Ratio	Hi-Pot A-C Volts	Remarks
L-209A	7710422 G10		Single	# 30	27				
L-209B	7710422 G11		Single	# 28	23				
L-210, L-211	7710422 G1		Single	# 28	12				
L-213	L-423118		Single	# 29E	2550	92 ohms ± 15%		2000 V. 60 cps. between winding and core for 1 min.	Inductance at 25 V. 60 cps. with .110 amps d.c. to be 10 H. min.
L-214	L-406820		2 Sections	# 18 SCCE	30 ea. Section	Avrg. .065 ohms Max. .075 ohms Min. .052 ohms			
L-215, L-216	7419094 G1		Single	# 36	44				
T-201	7610639 G1		Primary Secondary	See L-207A See L-207B					
T-202	7610639 G2		Primary Secondary	See L-208A See L-208B					
T-203	7610639 G3		Primary Secondary	See L-209A See L-209B					

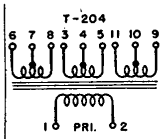
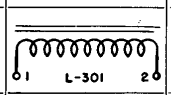
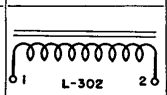
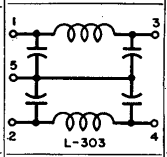
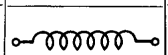
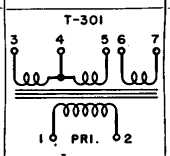
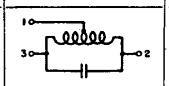
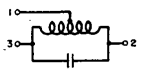
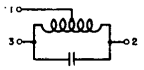
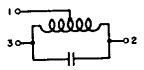
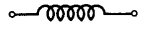
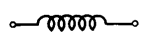
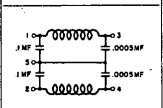
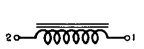
T-204	L-406806		Primary Secondary (1) Secondary (2) Secondary (3) Shield	※ 20E ※ 29E ※ 12 SCCE ※ 16E ※ 29E	318½ 1800½ tapped at 900½ 18½ tapped at 9 15 tapped at 7½ 150	1.86 ohms ± 15% 106 ohms ± 15% .025 ohms ± 15% .054 ohms ± 15%		2000 V. 60 cps. between windings and from S1, S2 and S3 to core for 1 min. 345 V. 400 cps. across Pri. for 18 sec. 1500 V. 60 cps. from Pri. to core for 1 min.	Wind shield winding over primary.
L-301	L-406819		Single	※ 38E	18000	5260 ohms			
L-302	L-423118		Single	※ 29E	2550	92 ohms ± 15%		2000 V. 60 cps. between winding and core for 1 min.	Inductance at 25 V. 60 cps. with .110 amp. d.c. to be 10 H. min.
L-303	L-406820		SAME AS L-214						
L-304	7414504 G1		2 Sections	※ 34 Silk E	230 ea. Section				1.5 MH ± 10%.
T-301	L-382664		Primary Secondary (1) Secondary (2) Secondary (3)	※ 30E ※ 24E ※ 20E ※ 42E	960 62 25 16000	57 ohms ± 15% 0.6 ohms ± 15% 0.11 ohms ± 15% 12300 ohms ± 15%		1500 V. 60 cps. between windings and from each winding except S1 to case for 1 min. 345 V. 400 cps. across Pri. for 18 sec., leads ※ 3, ※ 7 to grd.	Pri. inductance at 110 V. 60 cps. and .033 amp. d. c. 3 H min.
T-302	L-406806		SAME AS T-204						
L-502 and L-601	L-406844		Single 1 Section	※ 38 S.S.E.	680	Start to C-T 36 ohms ± 15%. C-T to Finish 41 ohms ± 15%		500 V. 60 cps. for 10 sec.	Inductances at 1 Kc/s, Min. 4.75 MH; Avrg. 5.15 MH; Max. 5.45 MH. Capacitor 5.25 MMF.

TABLE 7-2 (Continued)

COIL DATA

Desig. Symbol	Wecorp Pt. No.	Diagram	Winding	Wire Size	Turns	D-C Resistance in Ohms	Impedance Ratio	Hi-Pot A-C Volts	Remarks
L-503 and L-602	L-406845		Single 1 Section	# 38 S.S.E.	1650	Start to C-T 90 ohms ± 13%. C-T to finish 110 ohms ± 13%		500 V. 60 cps. for 10 sec.	Inductance at 1 Kc/s, Min. 26 M H Avrg. 29.5 MH Max. 33 MH. Capacitor 2630 MMF.
L-504 and L-603	L-406846		Single 1 Section	# 38 S.S.E.	3300	Start to C-T 190 ohms ± 10%. C-T to finish 250 ohms ± 10%		500 V. 60 cps. for 10 sec.	Inductance at 1 Kc/s, Min. 116 MH; Avrg. 121 MH; Max. 125 MH. Capacitor .01 MF.
L-505	L-406848		Single 1 Section	# 38 S.S.E.	4800	Start to C-T 300 ohms ± 10%. C-T to finish 445 ohms ± 10%.		500 V. 60 cps. for 10 sec.	Inductance at 1 Kc/s, Min. 280 MH; Avrg. 295 MH; Max. 310 MH. Capacitor .025 MF.
L-506	P-7708623 G2		Single	# 36 S.S.E.	780	44.2 ohms		500 V. 60 cps. for 10 sec.	Inductance Avrg. 2.5 MH ± 10%.
L-509	4712182 G1		Single 2 Sections	# 34 S.S.E.	130 65 in ea. section	Start to C-T 2.33 ohms ± 10%. C-T to finish 2.33 ohms ± 10%		500 V. 60 cps. for 10 sec.	Inductance Avrg. 150 MH. ± 10%.
L-510, L-610, L-710, and L-902	L-406820		2 Sections	# 18 SCCE	30 in ea. section	Each Section Min. .052 ohms Avrg. .065 ohms Max. .075 ohms		500 V. 60 cps. for 10 sec	.0005 MF Capacitor, 600 V. D. C. .1 MF Capacitor, 400 V. D. C.
L-511 and L-512	L-423117		Single 9 Coils	# 26E	3000	77 ohms ± 15%		2000 V. 60 cps. for 1 Min. 1500 V. 400 cps. for 18 sec.	Inductance at 110 V. 60 cps., .2 a. d.c. 10 H. Min.

ORIGINAL

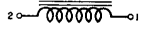
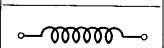
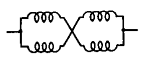
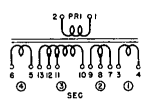
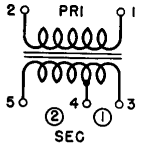
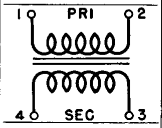
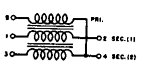
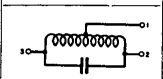
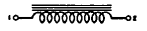
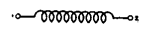
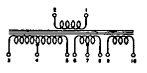
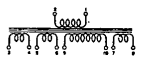
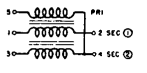
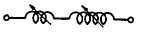
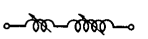
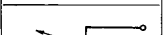
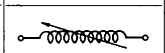
L-513	L-406819		Single 15 Coils	※ 38E	18000	5260 ohms ± 20%		2000 V. 60 cps. for 1 min. 780 V. 400 cps. for 18 sec.	Inductance at 260 V. 60 cps. and .01 a. d.c. 200 H Min.
L-514	7710769 P1		Single	※ 36E	26000	7500 ohms Min., 7900 ohms Avrg., 8300 ohms Max.		1700 V. 60 cps. Coil to case for 10 sec.	
L-515	7713032 G1		Single 4 Coils	※ 36 Formex Insulated	1000 in each coil	90 ohms ea. coil. Series Parallel, 90 ohms ± 15%		2200 V. 60 cps. to grd. 500 V. 60 cps. between coils	Inductance 60 MH at 60 cps.
T-500 T-706	7610898 P300 P222		Primary Secondary (1) Secondary (2) Secondary (3) Secondary (4)	※ 18E ※ 14E ※ 16E ※ 29E ※ 22E	167½ 9½ 7½ tap at 3½ 1270½ taps at 635 and 730 9½	.855 ± 15% .009 ± 15% .026 ± 15% 94.5 ± 15% .130 ± 15%		1000 V. 1500 V. 2000 V. 1500 V. 1500 V. 60 cps. winding to core for 1 min.	212 VA Excitation current at 115 V. 60 cps. is .348 amps.
T-501	L-406784		Primary Secondary (1) Secondary (2)	※ 26E ※ 16E ※ 38E	400 9.5 13500	10 ohms ± 15% .038 ohms ± 15% 7500 ohms ± 15%		Primary to core 1500 V. 60 cps. for 1 min. across primary; 300 V. 400 cps. for 18 sec. 9000 V. 60 cps. between pri.-gnd. and S1, S2 shorted for 1 min.	Primary Inductance at 115 V. 60 cps. and .066 A is 1.2 H Min. S1 delivers 2.5 V. at 3A. S2 delivers 3800 V. at .0023 A.
T-502	7610898 P302		Primary Secondary	※ 32E ※ 30E	3200 1430	260 ohms ± 15% 110 ohms ± 15%	5:1	1500 V. 60 cps. winding to core for 1 min.	10 VA output transformer
T-503	7610898 P303		Primary Secondary (1) Secondary (2)	※ 32E ※ 32E ※ 32E	40 40 80	.45 ohms ± 15% .40 ohms ± 15% 1.90 ohms ± 15%	 1:1 1:4	600 V. 60 cps. between windings, core and case for 1 min.	
L-604	L-406847		Single with C-T.	※ 38	6200	Start to C-T 400 ± 8% C-T to end 650 ± 8%		500 V. 60 cps. between windings and can for 10 sec.	Inductance at 1 Kc/s; Max. 560 MH; Avrg. 543 MH; Min. 530 MH.

TABLE 7-2 (Continued)

COIL DATA

Desig. Symbol	Wecorp Pt. No.	Diagram	Winding	Wire Size	Turns	D-C Resistance in Ohms	Impedance Ratio	Hi-Pot A-C Volts	Remarks
L-605	P-7708623 G2		Single 3 Sections	# 38	2601 per Section	80			Inductance 2.5 MH.
L-608 and L-609	T-7610948 P112		Single	# 28 E	4500	183 ± 15%		2000 V. 60 cps. between coil and core for 1 min.	Inductance at 60 V. 60 cps. with .15 amps. d.c., 15 H Min.
L-611	M-7414514		Single	# 30	56	0.5			Inductance, 25 MH.
T-600	7610950 P238		Primary Secondary (1) Secondary (2) Secondary (3)	# 20E # 28E # 12E # 16E	318 2130 CT 18½ 15	1.74 ohms ± 15% 100 ± 15% .053 ± 15% .0221 ± 15%	 1:6.7 17.2:1 21.2:1	2000 2000 2000 2000	143 VA Exciting current is .148 amps.
T-601 and T-901	7610950 P239 7610939 P101		Primary Secondary (1) Secondary (2) Secondary (3) Secondary (4)	# 24E # 22E # 22E # 16E # 38E	500 29 29 11½ 12170	6.0 ohms ± 20% .20 ohms ± 20% .26 ohms ± 20% .026 ohm ± 20% 6330 ohms ± 20%	 17.25:1 17.25:1 43.5:1 1:24.3	1500 4000 1500 4000 4000	
T-602	7610950 P240		Primary Secondary (1) Secondary (2)	# 32E # 32E # 32E	40 40 80	.45 ohms ± 15% .40 ohms ± 15% 1.9 ohms ± 15%	 1:1 1:2	600 600 600	
L-701	7710883 G1		Single Section (1) Section (2)	 # 28E # 28E	 5½ 11				On form ½" O.D.
L-702	7710883 G2		Single Section (1) Section (2)	 # 28E # 28E	 5½ 14				On form ½" O.D.
L-703	7714532 G1		Single	# 22 Silver	14 with C-T at 10 5/6 turns				On form ½" O.D.
L-704A	7710422 G8		Single	# 30	28				On form ½" O.D.
L-704B	7710422 G2		Single	# 30	20				On form ½" O.D.

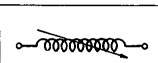
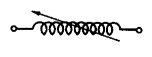
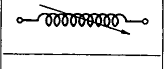
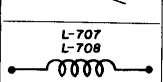
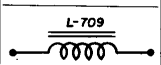
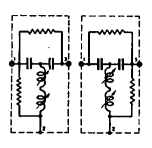
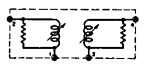
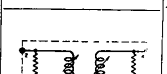
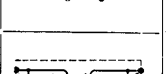
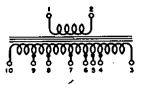
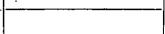
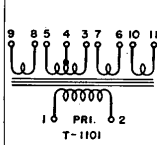
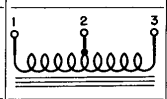
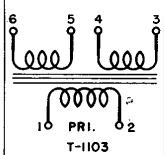
L-705A	7710422 G12		Single	※ 30	26				On form ½" O.D.
L-705B	7710422 G14		Single	※ 30	19				On form ½" O.D.
L-706A	7710422 G13		Single	※ 30	27				On form ½" O.D.
L-706B	7710422 G9		Single	※ 30	23				On form ½" O.D.
L-707, L-708	7411618 G1		Single	※ 34 SSCE	300	11.75			Inductance 0.6 MH
L-709	L-423117		Single	※ 26E	3000	77 ± 15%		2000 V. 60 cps. between winding and core for 1 min. 1500 V. 400 cps. across winding for 18 sec.	Inductance at 110 V. 60 cps. with .200 amps. d.c. is 10 H Minimum.
T-701	7610967 G1		Single Section (1) Section (2)	 ※ 28E ※ 28E	 5½ 11				
T-702	7610967 G2		Single Section (1) Section (2)	 ※ 28E ※ 28E	 5½ 14				
T-703	7611123 G1		Primary Secondary	See L-704A See L-704B			1:1.96		
T-704	7611123 G2		Primary Secondary	See L-705A See L-705B			1:1.87		
T-705	7611123 G3		Primary Secondary	See L-706A See L-706B			1:1.38		

TABLE 7-2 (Continued)

COIL DATA

Desig. Symbol	Wecorp Pt. No.	Diagram	Winding	Wire Size	Turns	D-C Resistance in Ohms	Impedance Ratio	Hi-Pot A-C Volts	Remarks
T-708	7610937 G1		Winding (1) Winding (2)	See L-707 See L-708					
T-801	L-423120		Primary Secondary	※ 24E ※ 18E	845 484	12 ± 15% 1.2 ± 15%	3:1	1500 V. 60 cps. between each winding and case for 1 min. 345 V. 400 cps. across pri. for 18 sec.	
L-901	L-422232		Single	※ 32	5000	312		2500 V. 60 cps. winding to core for 1 min.	Inductance at 70 V. 60 cps. and .75 Ma. d-c is 10 H max.
T-1101	7611798 P128		Primary Secondary (1) Secondary (2) Secondary (3) Secondary (4)	※ 22E ※ 29 Formex ※ 15E ※ 18E ※ 18E	620 1680 37 37 37	5.15 54.4 .072 .153 .162			Sec. (1) 300 V. .055 amp. tapped at 35 V. .007 amp. Sec. (2) 6.3 V. 4 amp. Sec. (3) 6.3 V. 1.2 amp. Sec. (4) 6.3 V. 1.8 amp. Pri. 115 V.
T-1102	L-423159		2 Sections Section (1) Section (2)	 ※ 20E ※ 22E	 165 415	 .86 ohms ± 15% 4.20 ohm ± 15%		1500 V. 60 cps. each winding to core for 1 min.	
T-1103	L-423155		Primary Secondary (1) Secondary (2)	※ 38E ※ 41E ※ 41E	3000 6000 6000	455 ohms ± 15% 2740 ohms ± 15% 3010 ohms ± 15%		1500 V. 60 cps. between windings and from each winding to case for 1 min.	Pri. and Sec. (1) wound clockwise Sec. (2) wound counter-clockwise. Inductance of pri. at 50 V. 60 cps. zero d-c not less than 40H.

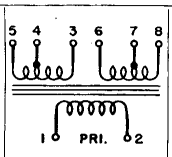
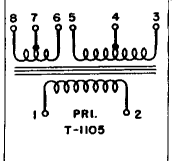
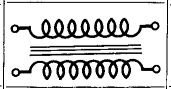
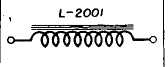
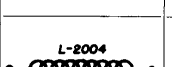
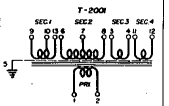
T-1104	7611798 P131		Primary Secondary (1) Secondary (2)	#16E #20E #29 Formex	170 397 481	.598 2.88 38.1		2000 V. 60 cps. between windings and to grd. for 60 sec. 345 V. 400 cps. across pri. for 18 sec.	
T-1105	L-426506		Primary Secondary (1) Secondary (2)	#22E #29E #16E	235 1380 tapped at 690 11 tapped at 5½	2.3 ohms ±15% 78 ohms ±15% .040 ohms ±15%		2000 V. 60 cps. between windings and from each winding to case for 1 min. 340 V. 60 cps. across Pri. for 5 sec.	
T-1461	45-J-52 P16		Primary Secondary	#30E #26E	6500 5500	830 ohms 200 ohms			
L-2001	L-426666		Single	#29E	2550	92 ±15%		2000 V. 60 cps. between winding and core for 1 min.	22 layers of 117 turns each. Inductance at 25 V. 60 cps. with .110 amps. d.c. 10 H. min.
L-2002 and L-2003	L-426619		4 Sections	#26 DBBL EN.	880 each section	145 ±15%		18 KV. 60 cps. between windings and each winding to core for 1 min. 10 KV. 400 cps. across terminals for 5 secs.	Inductance with 1700 V. 60 cps., .176 amps. d.c. 10.3 H. ±10%.
L-2004	7716044 P4		Single	10 x 30 Aeroglass 1250 V. Wire	16				3.8 mh.
T-2001	L-426611		Primary Secondary (1) Secondary (2) Secondary (3) Secondary (4)	#18 .091x.129 #28 #14 #22	250 15 tapped at 14 1210 tapped at 605 12 15	1.02 ±15% .0083 ±15% 65 to 84 .028 ±15% .2 to .29		1500 V. 60 cps. 1000 V. 60 cps. 2000 V. 60 cps. 2000 V. 60 cps. 5000 V. 60 cps.	Hi-Pot test from winding indicated to case and all other windings for 1 min. Connect term. 5 to case during tests.

TABLE 7-2 (Concluded)

COIL DATA

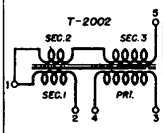
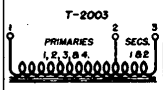
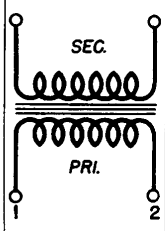
Desig. Symbol	Wecorp Pt. No.	Diagram	Winding	Wire Size	Turns	D-C Resistance in Ohms	Impedance Ratio	H-iPot A-C Volts	Remarks
T-2002	L-426621		Primary Secondary (1) Secondary (2) Secondary (3)	#36E #36E #36E #36E	100 100 100 100	11.7 ±15% 10.5 ±15% S2 and S3 26.5 ±15%		1500 V. 60 cps. between windings and each winding to case for 1 min.	
T-2003	L-426625		Primary (1) Primary (2) Primary (3) Primary (4) Secondary (1) Secondary (2)	All #26 2 wires wound in parallel	22 22 22½ 22 18 18	Terms. 1 to 3 .837 ±15%		17000 V., 1 micro sec. pulse, 600 p. p.s. for 1 min. to term. 3 with term. 1 grounded and 100 ohms non-inductive resistance between term 2 and gnd.	
T-2004 and T-2005			Primary Primary Shield Secondary	#24 #24 .081x.081	600 56 29	5.8 ±15% .032 ±15%		18 KV. 60 cps. between windings and from sec. to case for 1 min. 345 V. 400 cps. across pri. 18 secs. 1500 V. 60 cps. pri. to case.	

TABLE 7-3

MOTOR DATA

	MOTOR B-101		MOTOR B-102	
Stator	Winding I	Winding II		
Conductor Size	#29	#29	19 B & S	26 B & S
Conductor Ins.	Heavy Formex	Heavy Formex	Enamel	Enamel
Turns per Pole	336	336		
Turns per Coil			55/51/44/34	34/34/37
Resistance per Pole (Ohms)	Approx. 15 ohms	Approx. 15 ohms		
Resistance between Terminals	Blue lead to black 60 ohms	Blue lead to red 60 ohms	3.8 ohms	
No. Poles	4 Series Connected	4 Series Connected		
No. Coils and Slots			8 coils, 24 slots	6 coils
ARMATURE	Squirrel Cage Rotor		Squirrel Cage Rotor	
Conductor Size				
Conductor Ins.				
Turns per Coil				
No. Slots				
Resistance (Ohms)				
No. Coils				

TABLE 7-3 (Continued)

MOTOR DATA

	MOTOR B-151	MOTORS B-401, B-501, B-503, B-806
FIELD		Two-phase Winding
Conductor Size	# 29 GA.	# 32
Conductor Ins.	Plain Enamel	Formvar
Turns per Coil	400	99
Resistance per Coil (Ohms)	15.5	12.6
Resistance between Terminals		152
No. Coils	2	12 in each phase Winding
ARMATURE		Squirrel Cage
Conductor Size	# 32 GA.	
Conductor Ins.	Silk and Enamel	
Turns per Coil	130	
No. Slots	11	
Resistance (Ohms)	20.8 (Total)	
No. Coils	11	

	MOTOR B-801	MOTOR B-1101B	
FIELD	Shunt	MAIN	START
Conductor Size	#34	#22 (2 skeins 20 turns per skein)	#25 (2 skeins, 8 turns per skein)
Conductor Ins.	Enamel	H. E.	T. F. X.
Turns per Coil	1100	20-40-40-40-40-20	8-8-16-16-16-24
Resistance per Coil (Ohms)	175.0		
Resistance between Terminals	350.0		
No. Coils	2		12
ARMATURE		Squirrel Cage	
Conductor Size	#31		
Conductor Ins.	Enamel		
Turns per Coil	45		
No. Slots	13		
Resistance (Ohms)	18.7		
No. Coils	26		

TABLE 7-3 (Continued)

MOTOR DATA

	MOTOR B-1303		Exciter CAY-211190 or CAY-211329 Part of Motor-Generator CAY-211182, CAY-211188 or CAY-211326	
FIELD	Series	Shunt	Shunt	Commutator
Conductor Size	#18	#34	⁄ 22	.081 x .081
Conductor Ins.	Formvar	Formvar	E	D.C.C.
Turns per Coil	200	7150	730	55
Resistance per Coil (Ohms)			12.9	.072
Resistance between Terminals			51.6	.144
No. Coils	2	2	4	2
ARMATURE				
Conductor Size	#22		2 of ⁄ 18	
Conductor Ins.	Formvar		S.C.C.E.	
Turns per Coil	23-92		3	
No. Slots	20		25	
Resistance (Ohms)			.41	
No. Coils	40		99	

	115 V. Motor CAY-211183 Part of Motor-Generator CAY-211182			230 V. Motor CAY-211189 Part of Motor-Generator CAY-211188		
FIELD	Shunt	Series	Commutator	Shunt	Series	Commutator
Conductor Size	# 14, # 24	# 2	5/32 x 5/8	# 17, # 27	# 2	# 2
Conductor Ins.	S.C.C.	D.C.C.	Bare	S.C.C.	D.C.C.	D.C.C.
Turns per Coil	476 of # 14 1115 of # 24	1½	20½	893 of # 17 1900 of # 27	2	35
Resistance per Coil (Ohms)	54.7	.000476	.38	187.3	.00063	.0057
Resistance between Terminals	218.8	.0019	.76	749.2	.00252	.0228
No. Coils	4	4	2	4	4	4
ARMATURE						
Conductor Size	.047 x .5			.047 x .27		
Conductor Ins.	D.C.C.			D.C.C.		
Turns per Coil	1			2		
No. Slots	37			37		
Resistance (Ohms)	.029			.113		
No. Coils	111			111		

TABLE 7-3 (Continued)

MOTOR DATA

	230 V. Motor CAY-211327 Part of Motor-Generator CAY-211326			Generator CAY-211184 or CAY-211328 Part of Motor-Generator CAY-211182, CAY-211188 or CAY-211326
FIELD	Shunt	Series	Commutator	Rotating Field
Conductor Size	#21	#2	#2	.057
Conductor Ins.	S.C.C.	D.C.C.	D.C.C.	S.C.C.E.
Turns per Coil	2000	2	35	683
Resistance per Coil (Ohms)	45	.00063	.0057	
Resistance between Terminals	180	.00252	.0228	
No. Coils	4	4	4	4
ARMATURE				Stator
Conductor Size	.047 x .27			2 of .081 x .144
Conductor Ins.	D.C.C.			Cotton
Turns per Coil	2			7
No. Slots	37			48
Resistance (Ohms)	.113			
No. Coils	111			32

	SERVO GENERATORS CAY-211192 AND CAY-211192A						
	MOTOR		EXCITER			GENERATOR	
FIELD	Main	Starting	Shunt #1	Shunt #2 (Wound Over #1)	Interpole	Shunt	Interpole
Conductor Size	#18	#20	#35	#35	#25	#21	#20
Conductor Ins.	En.	S.C.C.E.	En.	En.	En.	En.	En.
Turns per Coil	16/16/16/8/8	44/22/22	3750	3750	425	325	425
Resistance per Coil (Ohms)			907	1170	8.6	4.25	3.5
Resistance between Terminals	.36	3.42	1814	2340	17.2	8.5	7
No. Coils	10	6	2	2	2	2	2
ARMATURE	Cage						
Conductor Size	.182 dia. copper		#27			#23	
Conductor Ins.			Enamel			SCCE	
Turns per Coil			45			23	
No. Slots	36		19			20	
Resistance (Ohms)			20.4			9.3	
No. Coils			38			60	

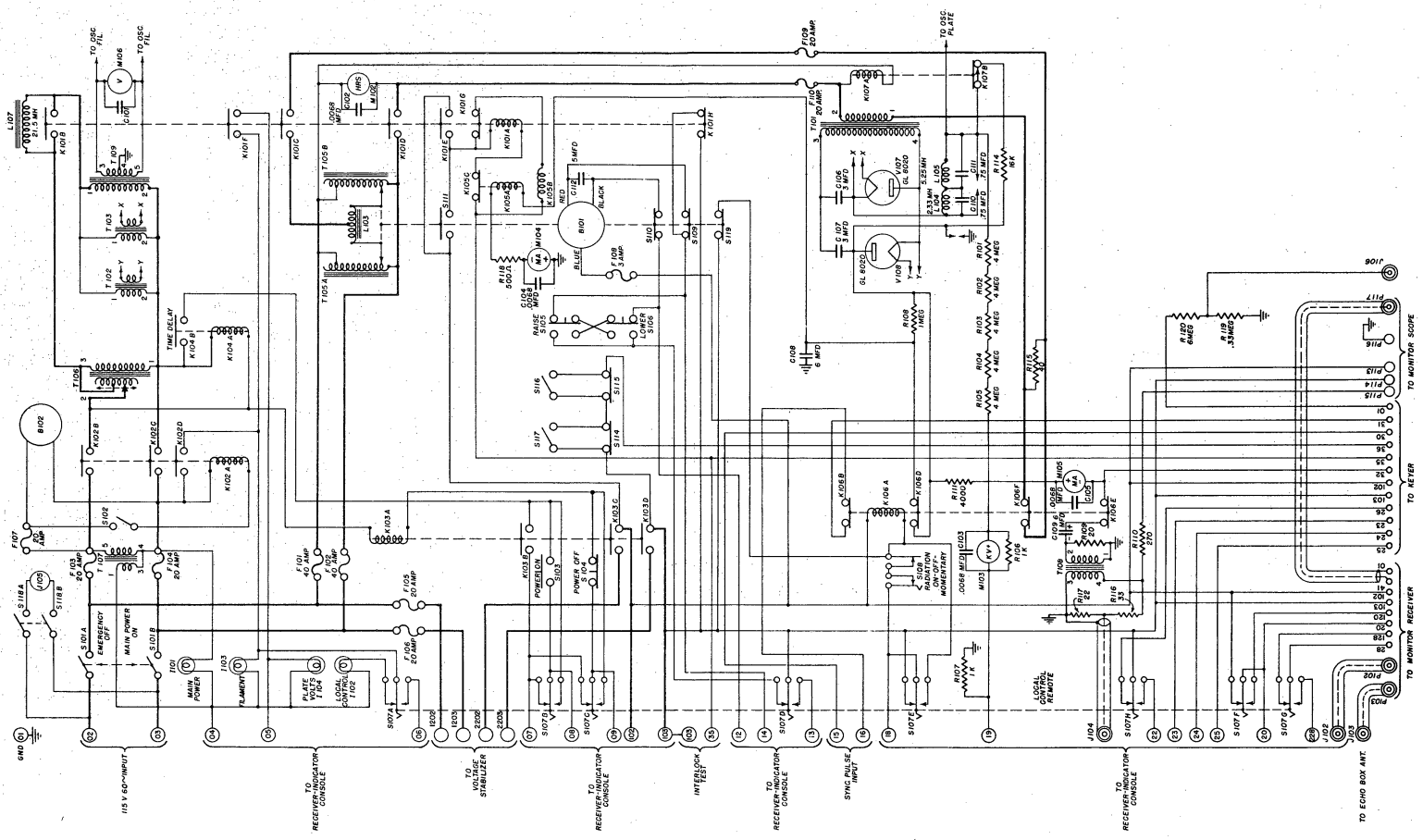


Figure 7-120. Transceiver Console, CAY-43ACM, Schematic Diagram

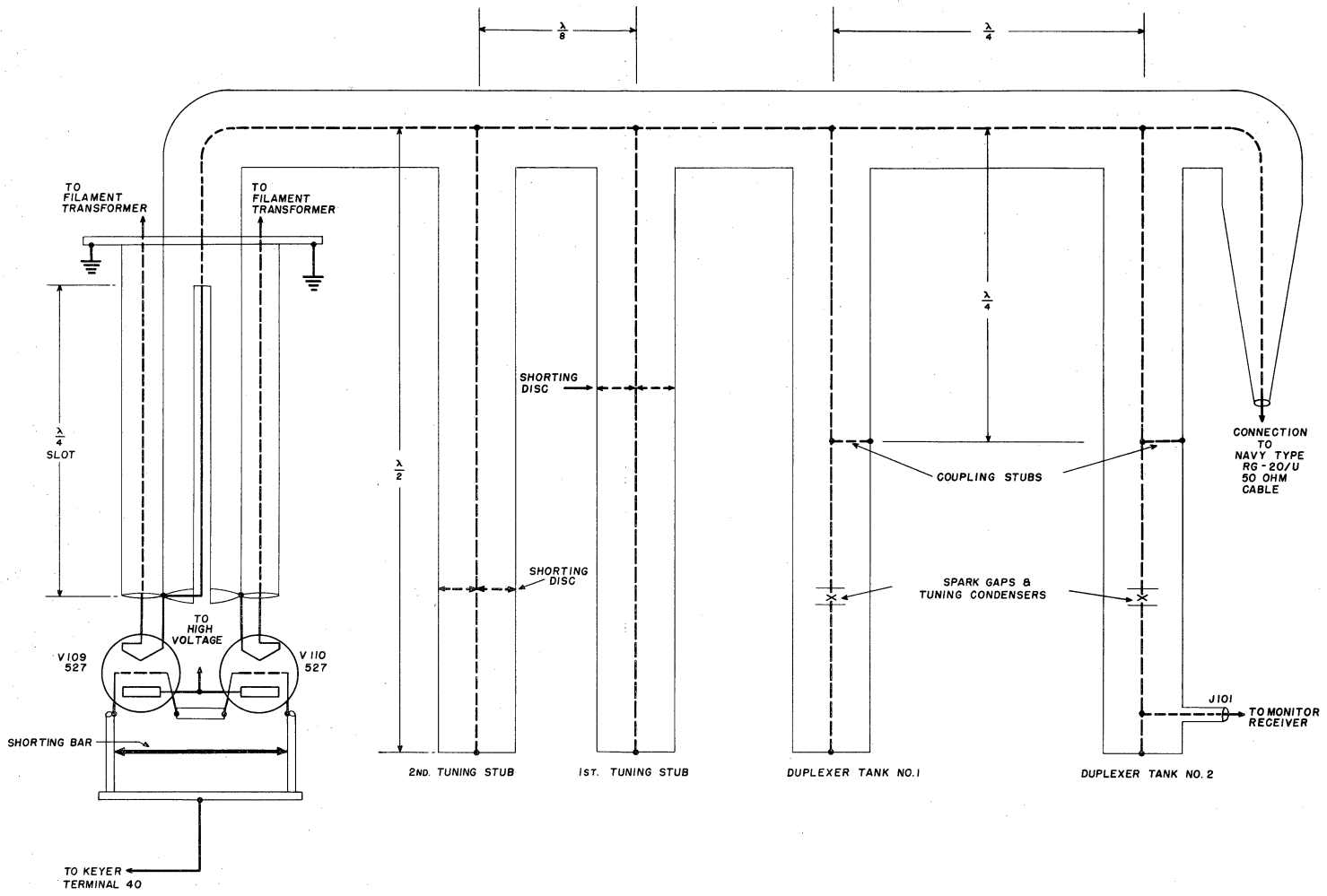


Figure 7-121. Transceiver Console, Transmitting Oscillator, CAY-43ACM, Schematic Diagram

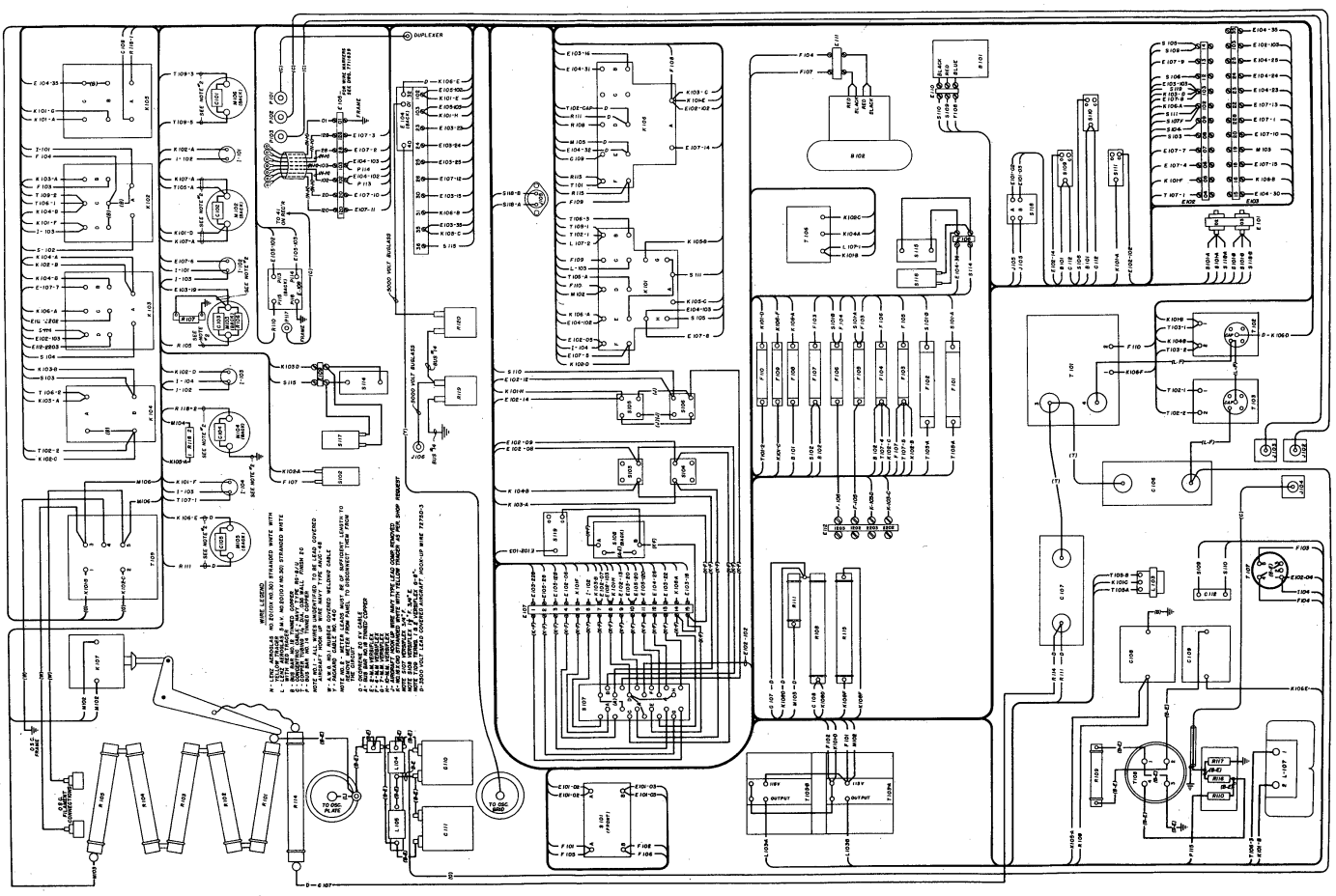


Figure 7-122. Transceiver Console, CAY-43ACM, Wiring Diagram

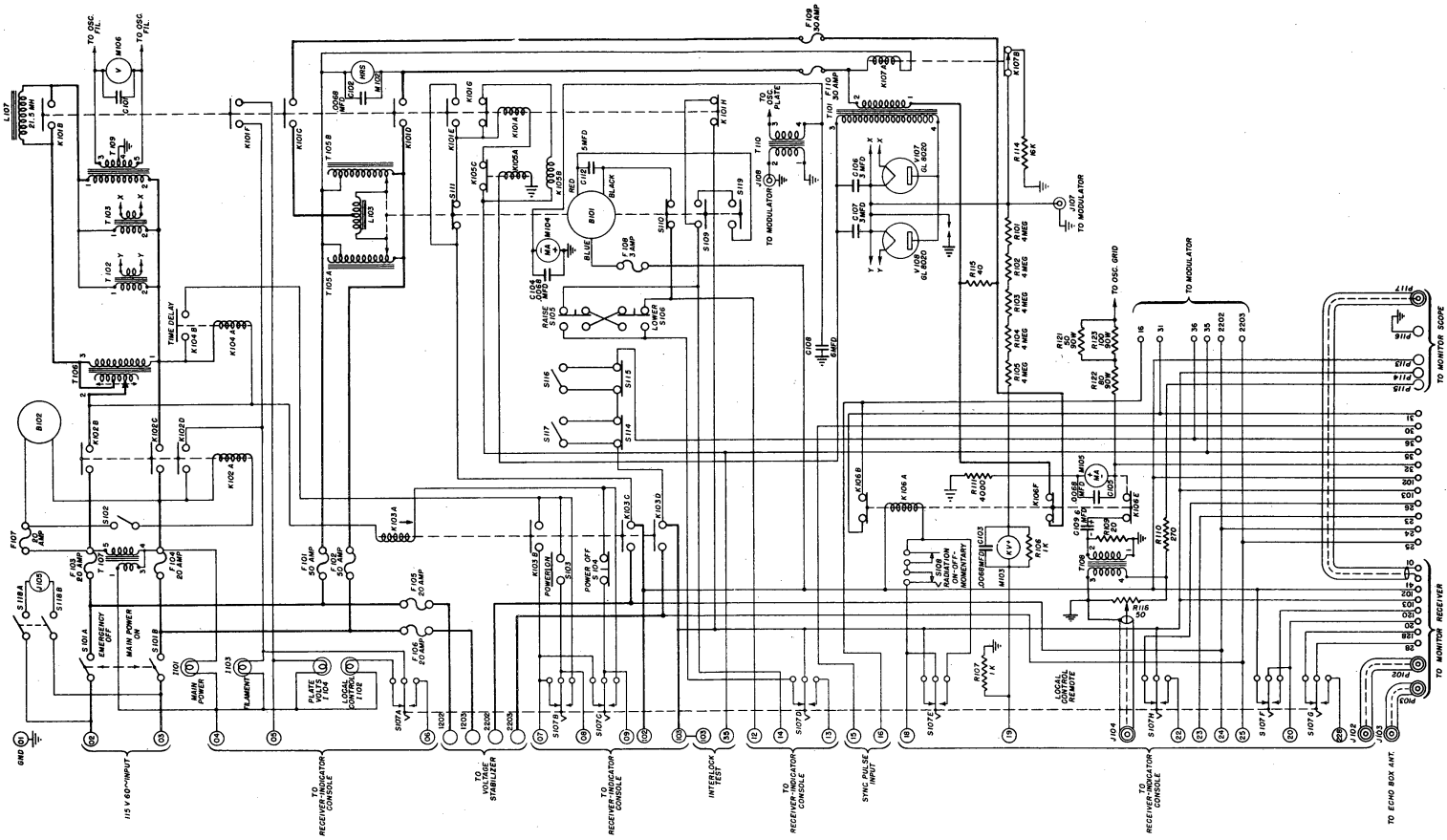


Figure 7-123. Transceiver Console, CAY-43ADK, Schematic Diagram

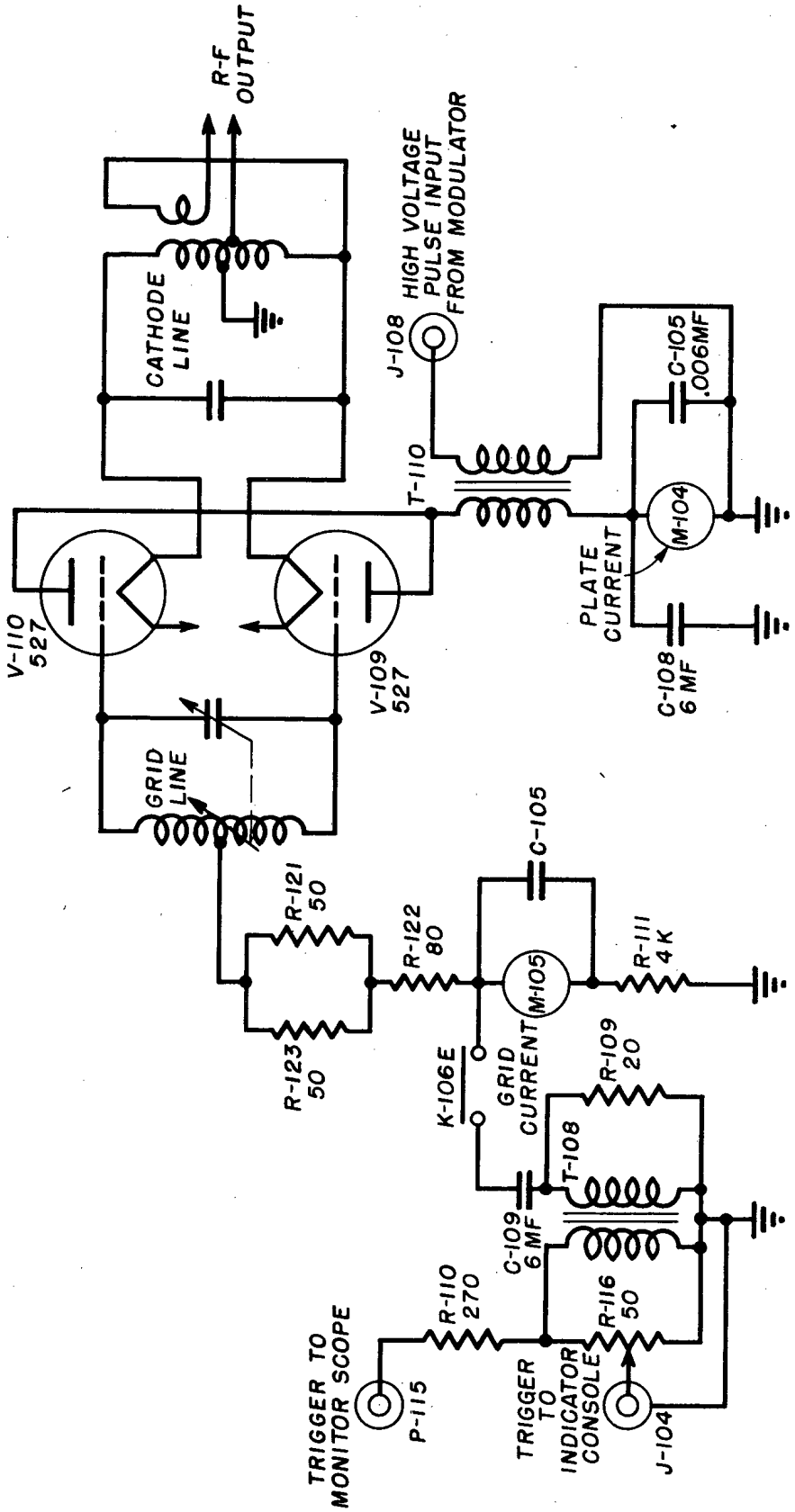


Figure 7-124. Transceiver Console, CAY-43ADK, Transmitting Oscillator, Schematic Diagram

Figure 7-124. Transceiver Console, CAY-43ADK, Transmitting Oscillator, Schematic Diagram

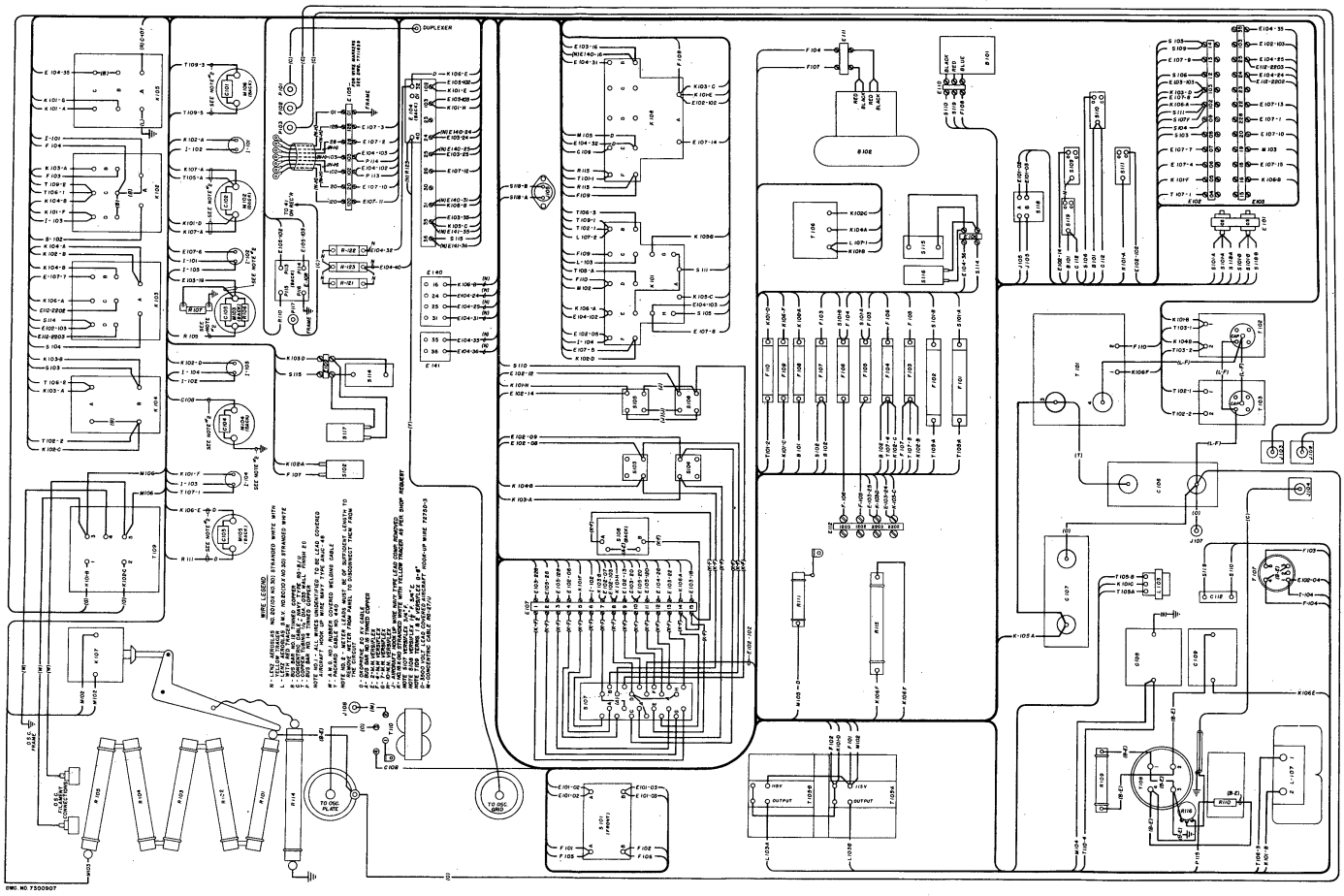
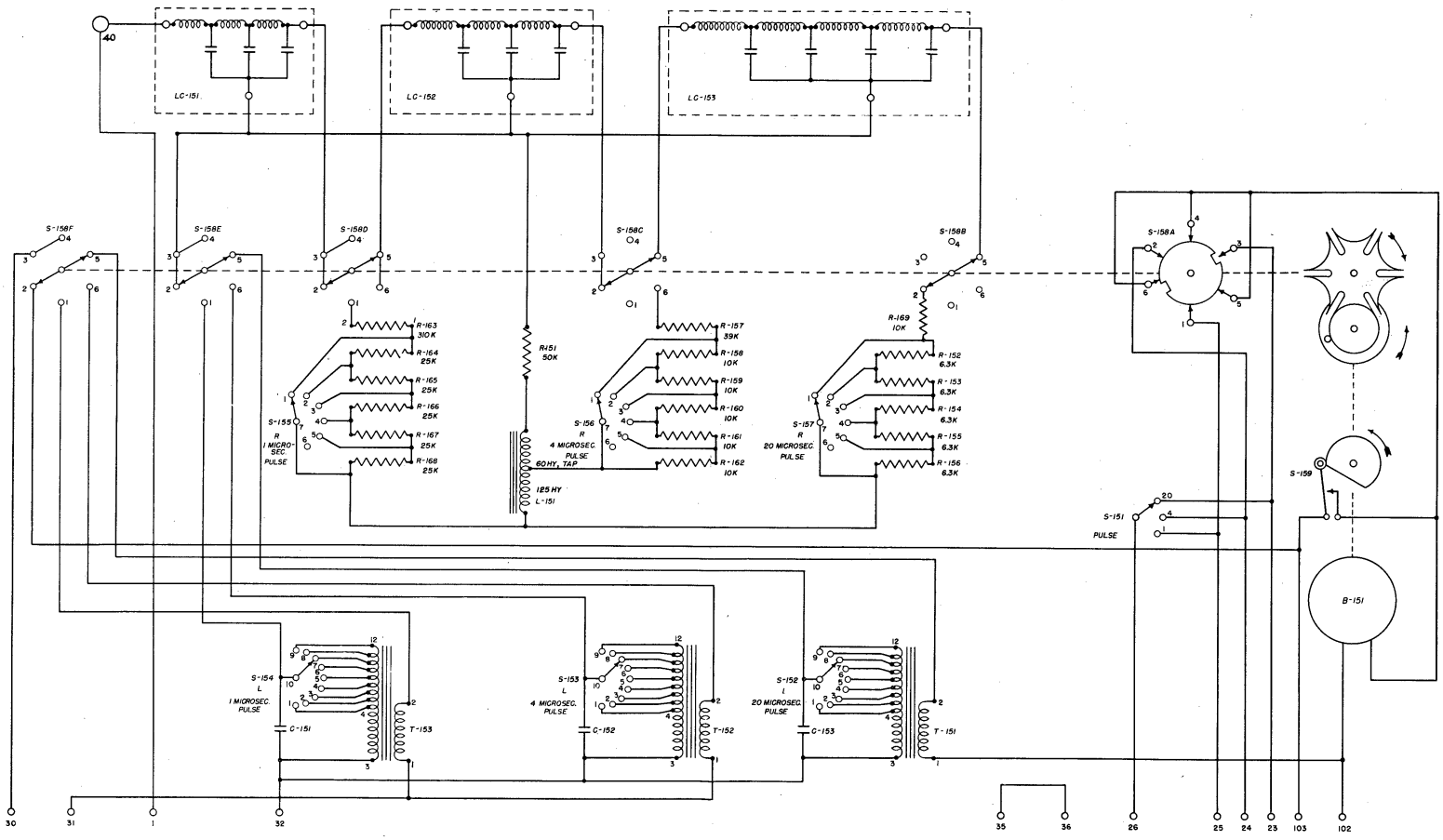


Figure 7-125. Transceiver Console, CAY-43ADK, Wiring Diagram



7-126. Keyer Unit, CAY-67AAD, Schematic Diagram

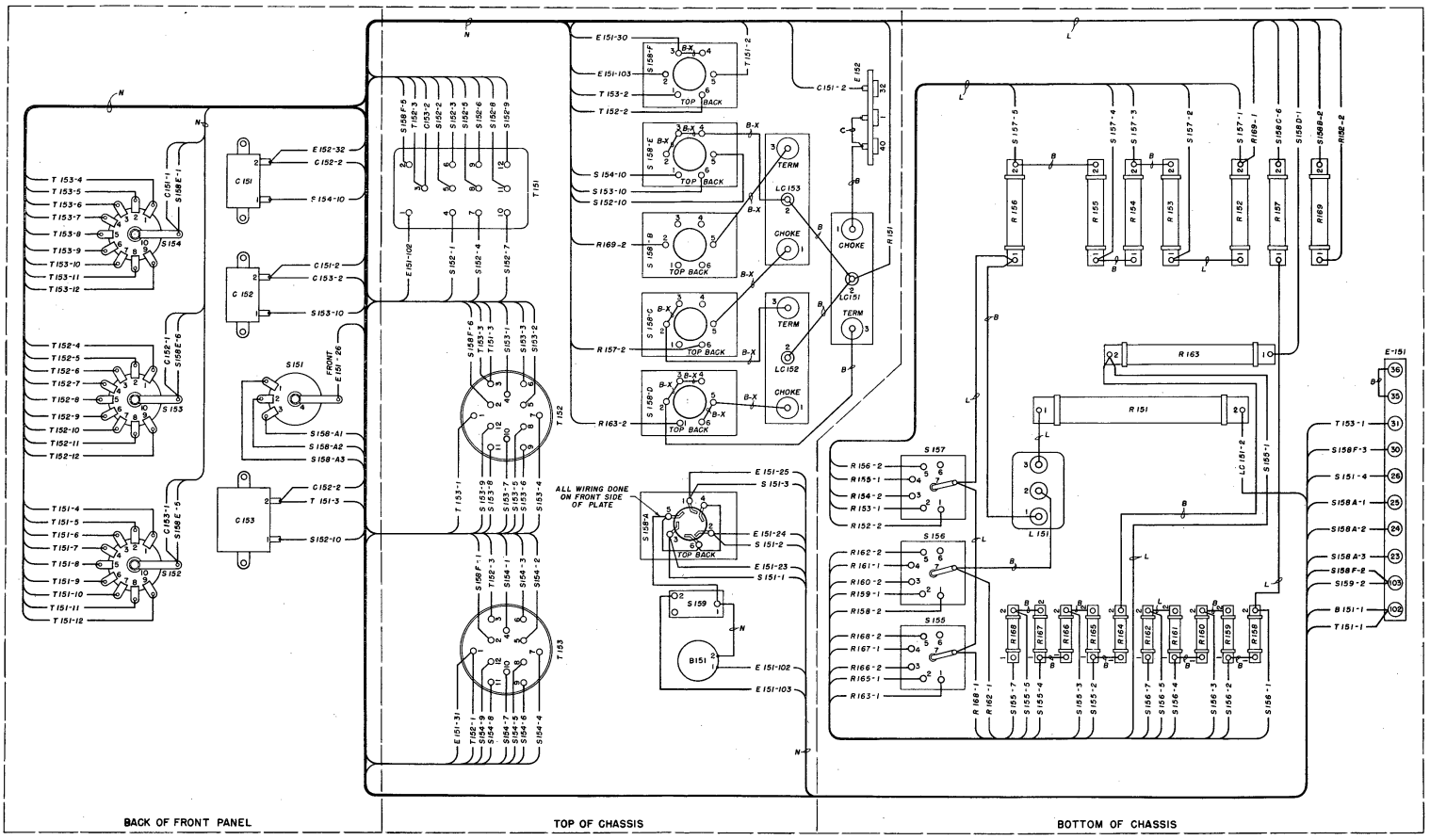


Figure 7-127. Keyer Unit, CAY-67AAD, Wiring Diagram

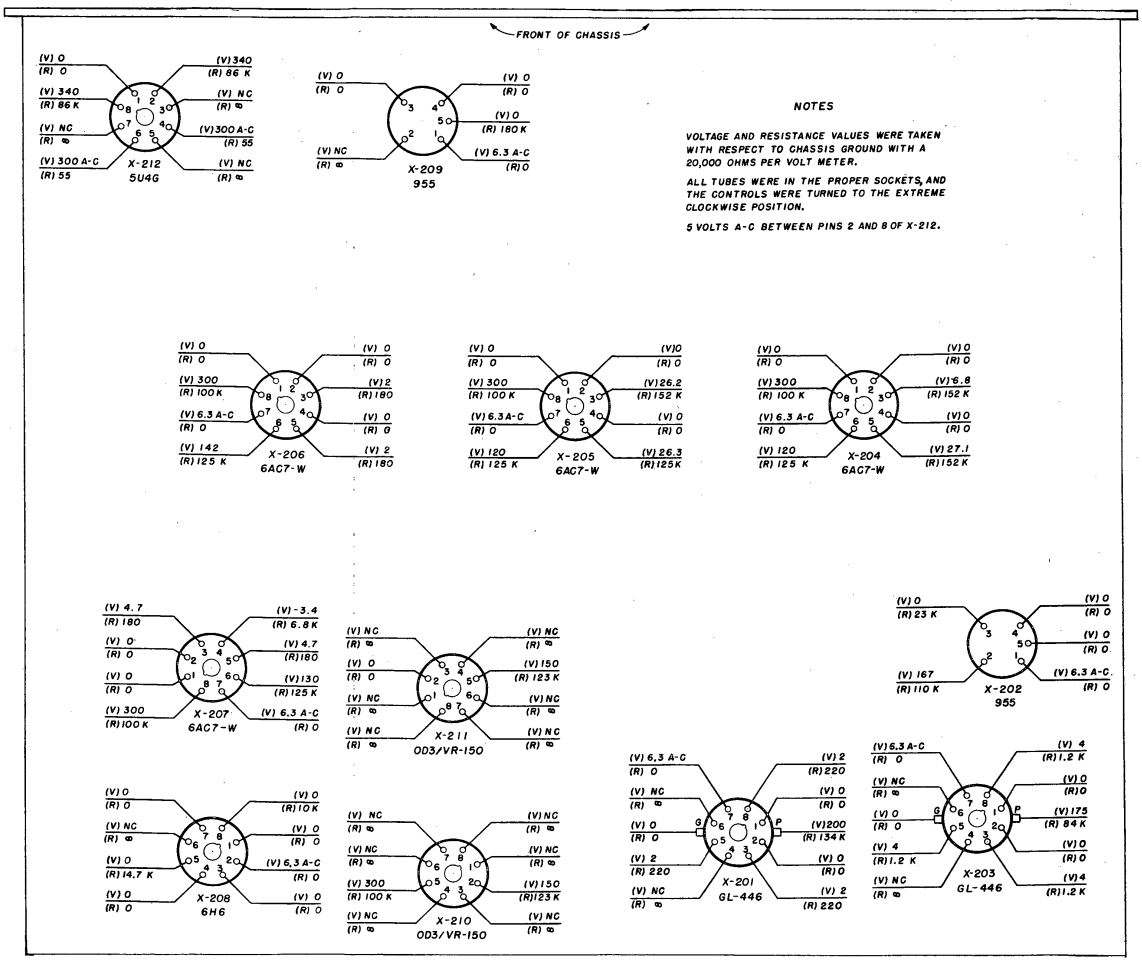


Figure 7-128. Monitor Receiver, CAY-46AKD, Voltage and Resistance Chart

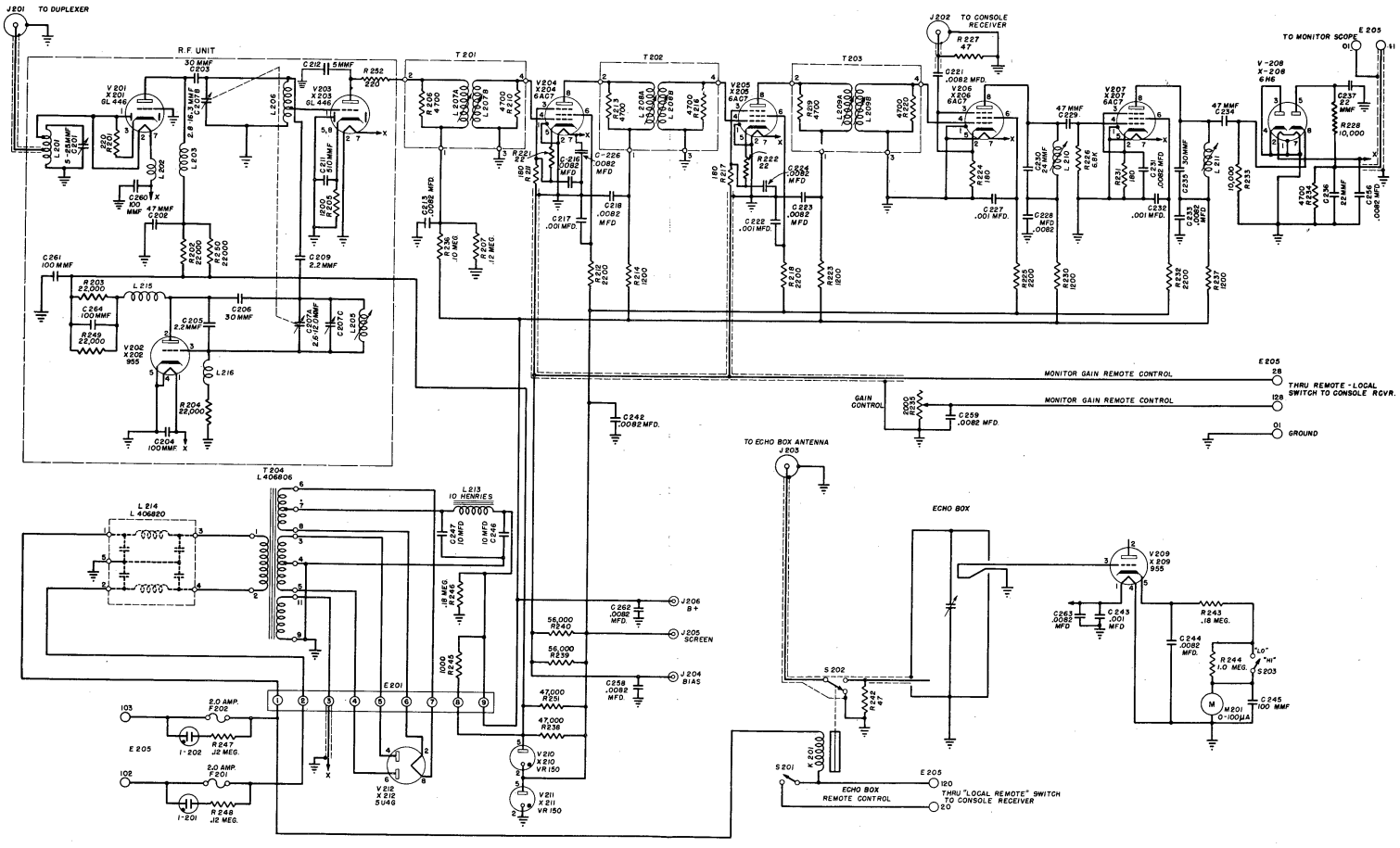
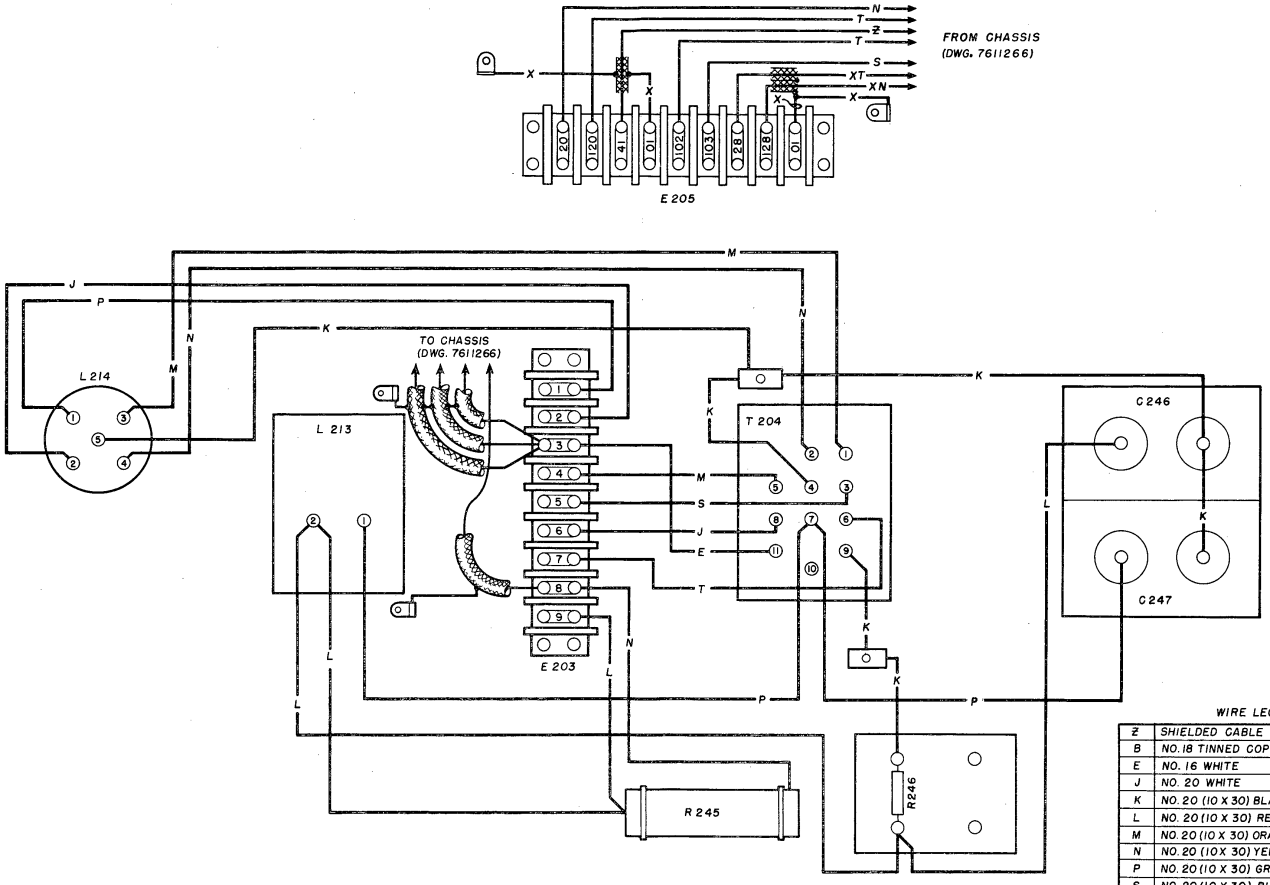


Figure 7-129. Monitor Receiver, CAY-46AKD, Schematic Diagram



WIRE LEGEND

Z	SHIELDED CABLE RG 58/U (51 Ω)
B	NO. 18 TINNED COPPER BUS
E	NO. 16 WHITE
J	NO. 20 WHITE
K	NO. 20 (10 X 30) BLACK TRACER
L	NO. 20 (10 X 30) RED TRACER
M	NO. 20 (10 X 30) ORANGE TRACER
N	NO. 20 (10 X 30) YELLOW TRACER
P	NO. 20 (10 X 30) GREEN TRACER
S	NO. 20 (10 X 30) BLUE TRACER
T	NO. 20 (10 X 30) BROWN TRACER
X	TINNED COP. BRAID 72 STRANDS .0045 TC
XT	T WIRE WITH X BRAID COVERING
XN	N WIRE WITH X BRAID COVERING

Figure 7-130. Monitor Receiver, CAY-46AKD, Power Supply Wiring Diagram

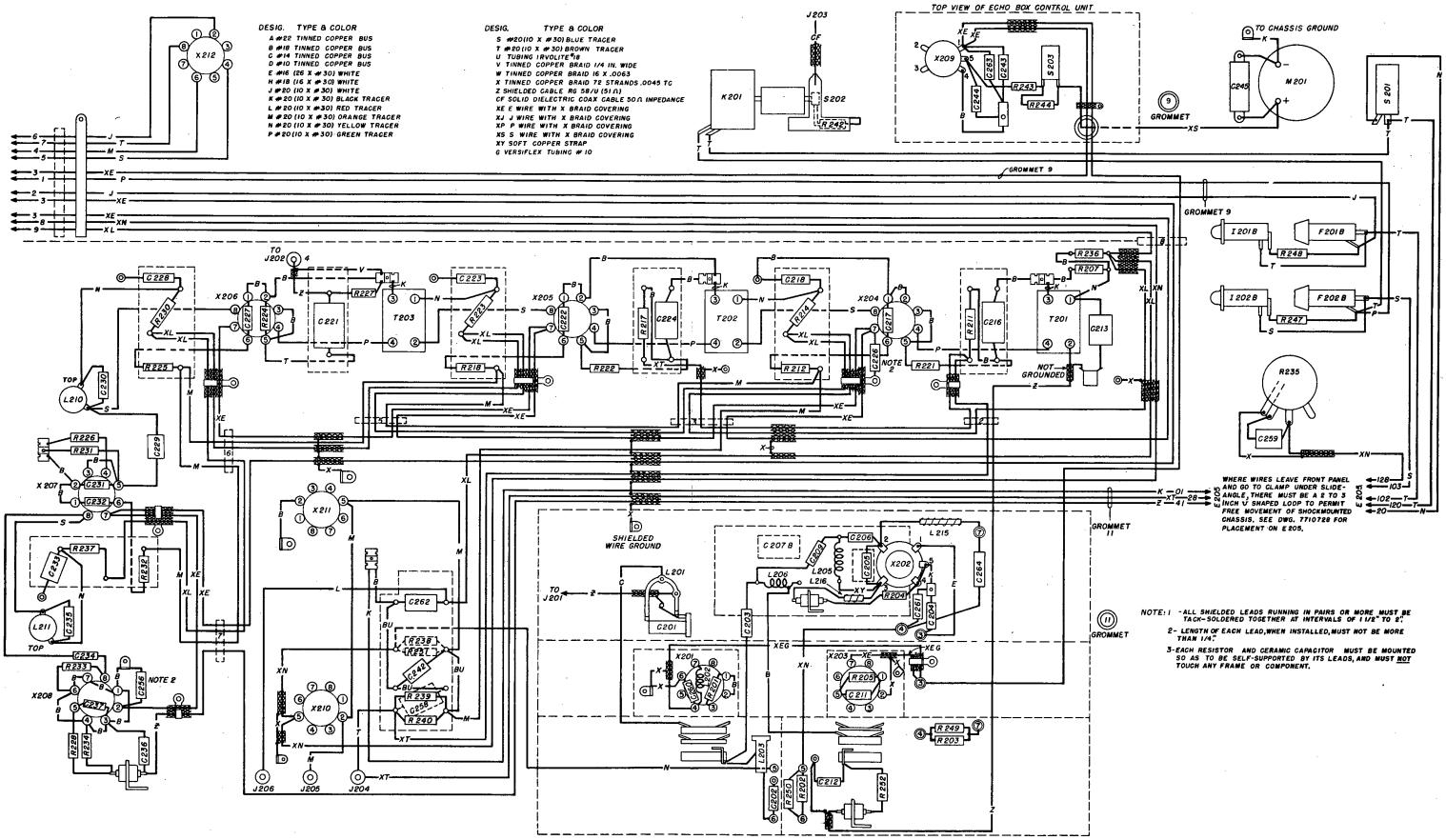


Figure 7-131. Monitor Receiver, CAY-46AKD, Wiring Diagram

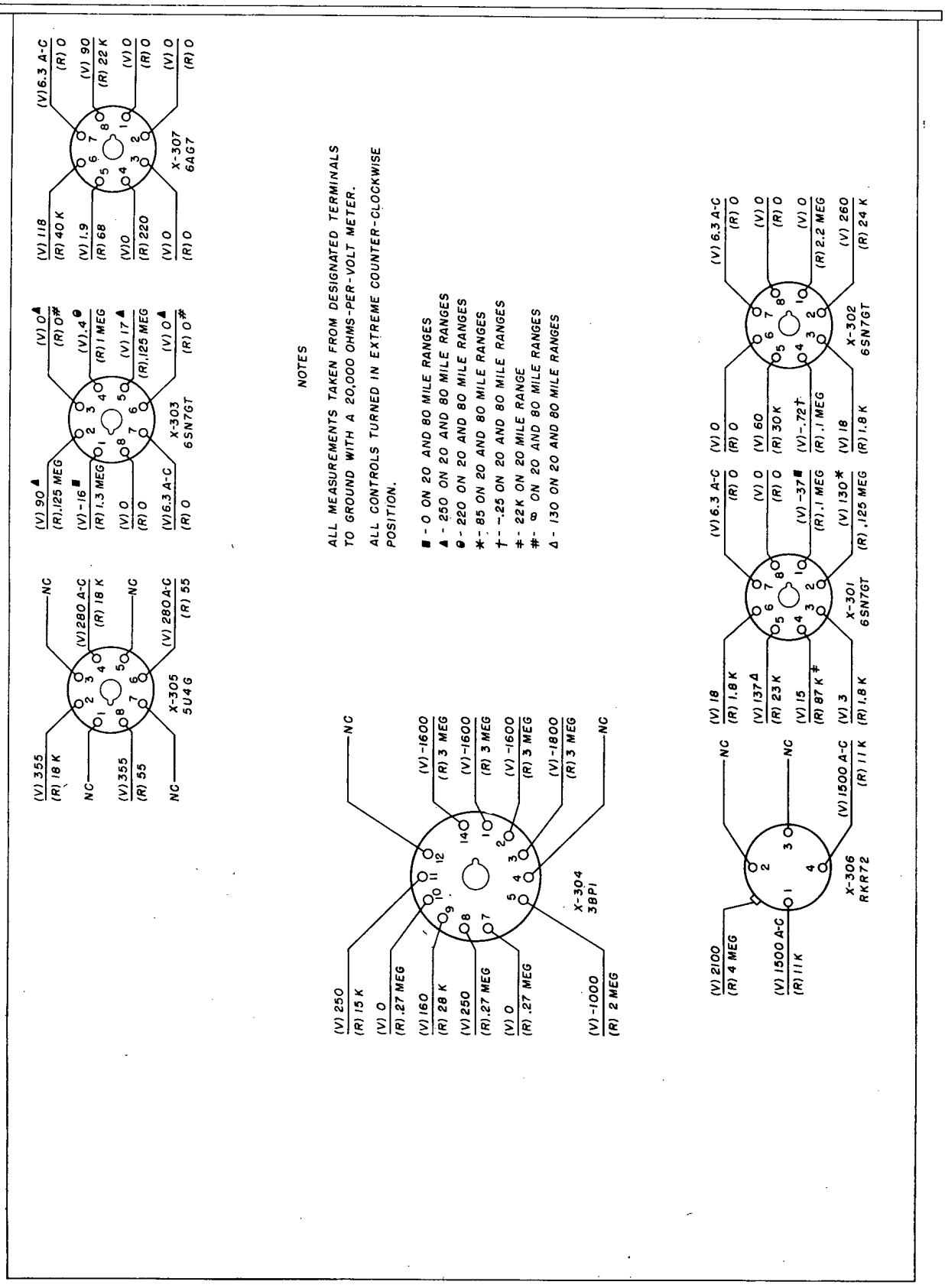


Figure 7-132. Monitor Scope, CAY-55AFD, Voltage and Resistance Chart

Figure 7-132. Monitor Scope, CAY-55AFD, Voltage and Resistance Chart

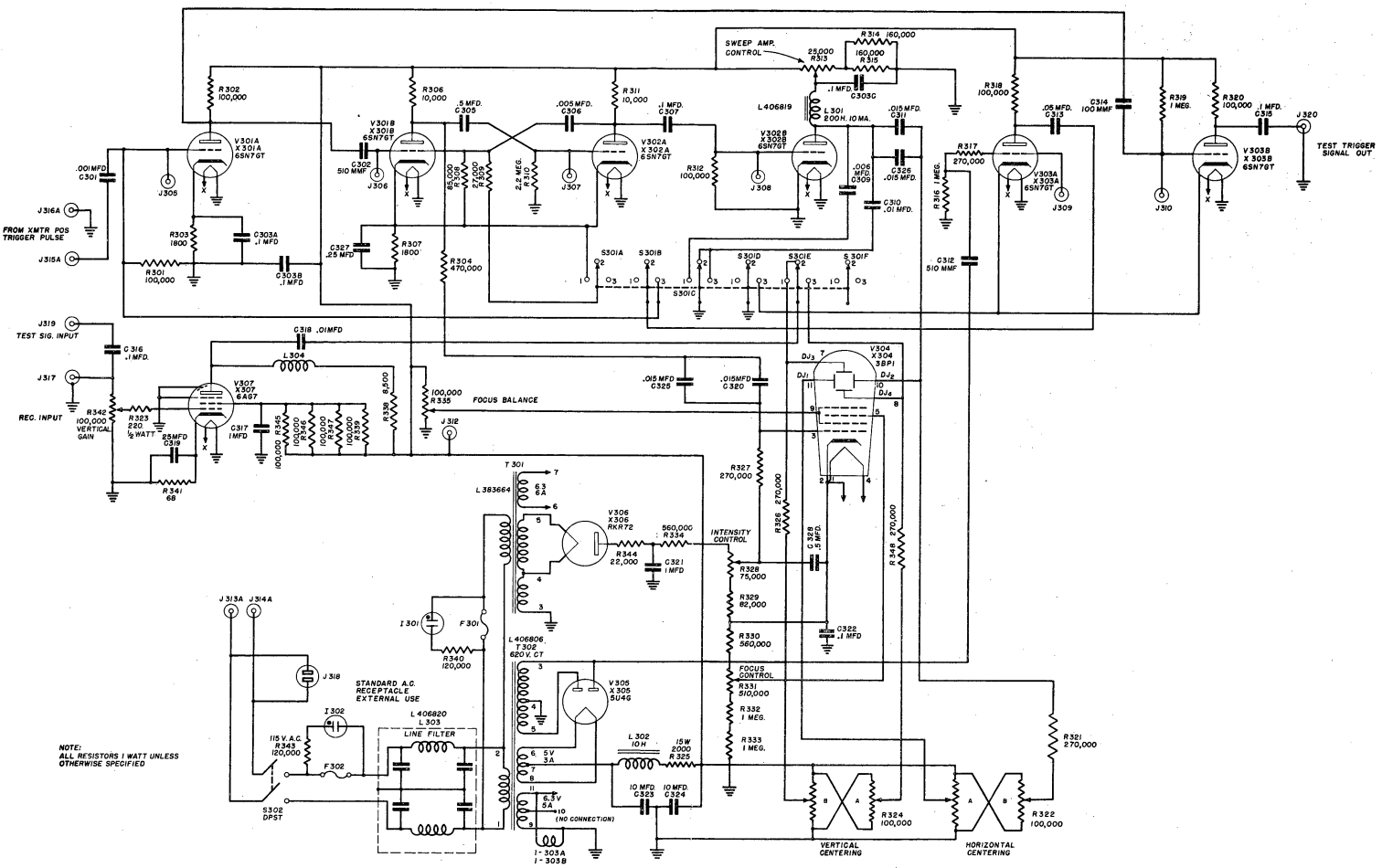


Figure 7-133. Monitor Scope, CAY-55AFD, Schematic Diagram

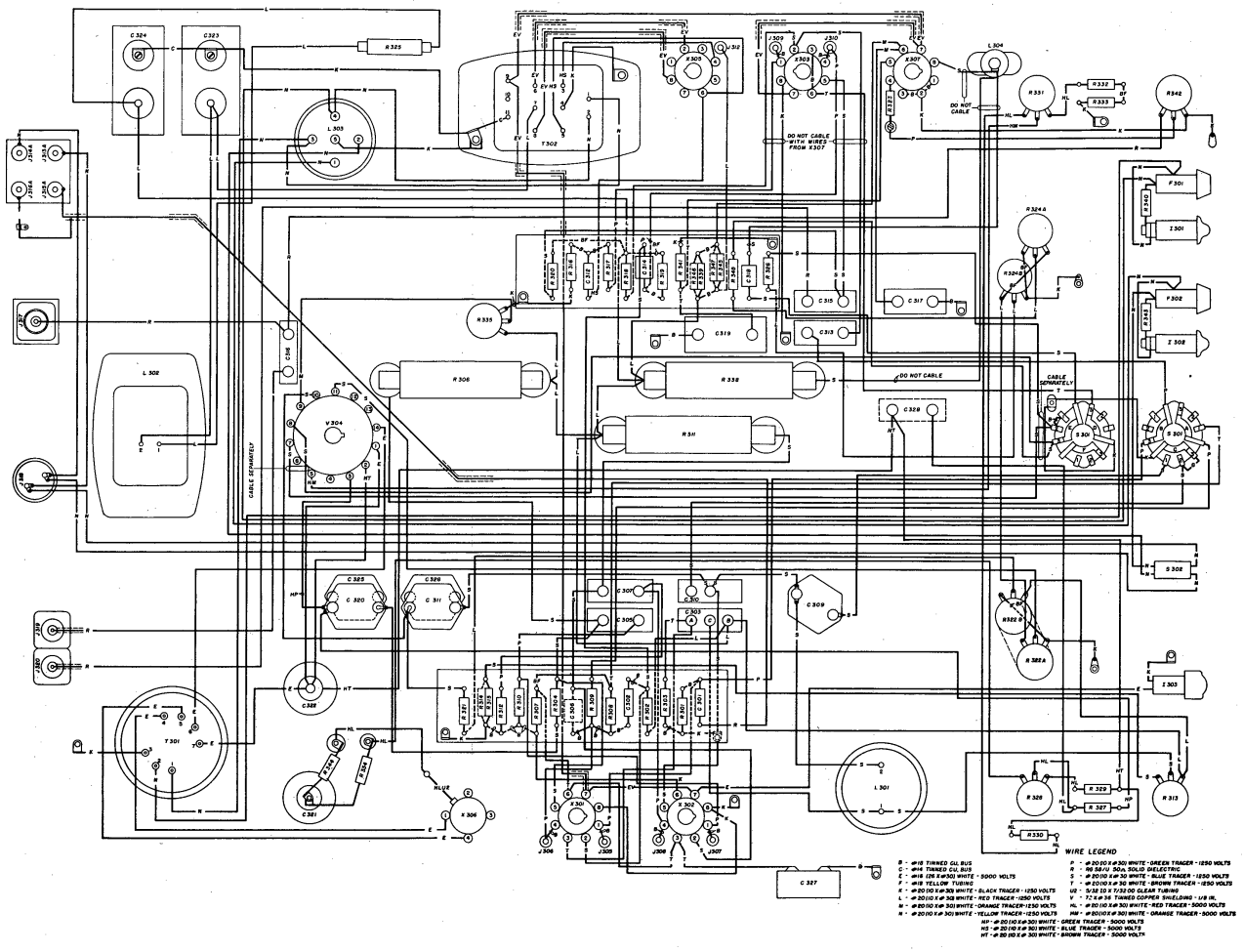


Figure 7-134. Monitor Scope, CAY-55AFD, Wiring Diagram

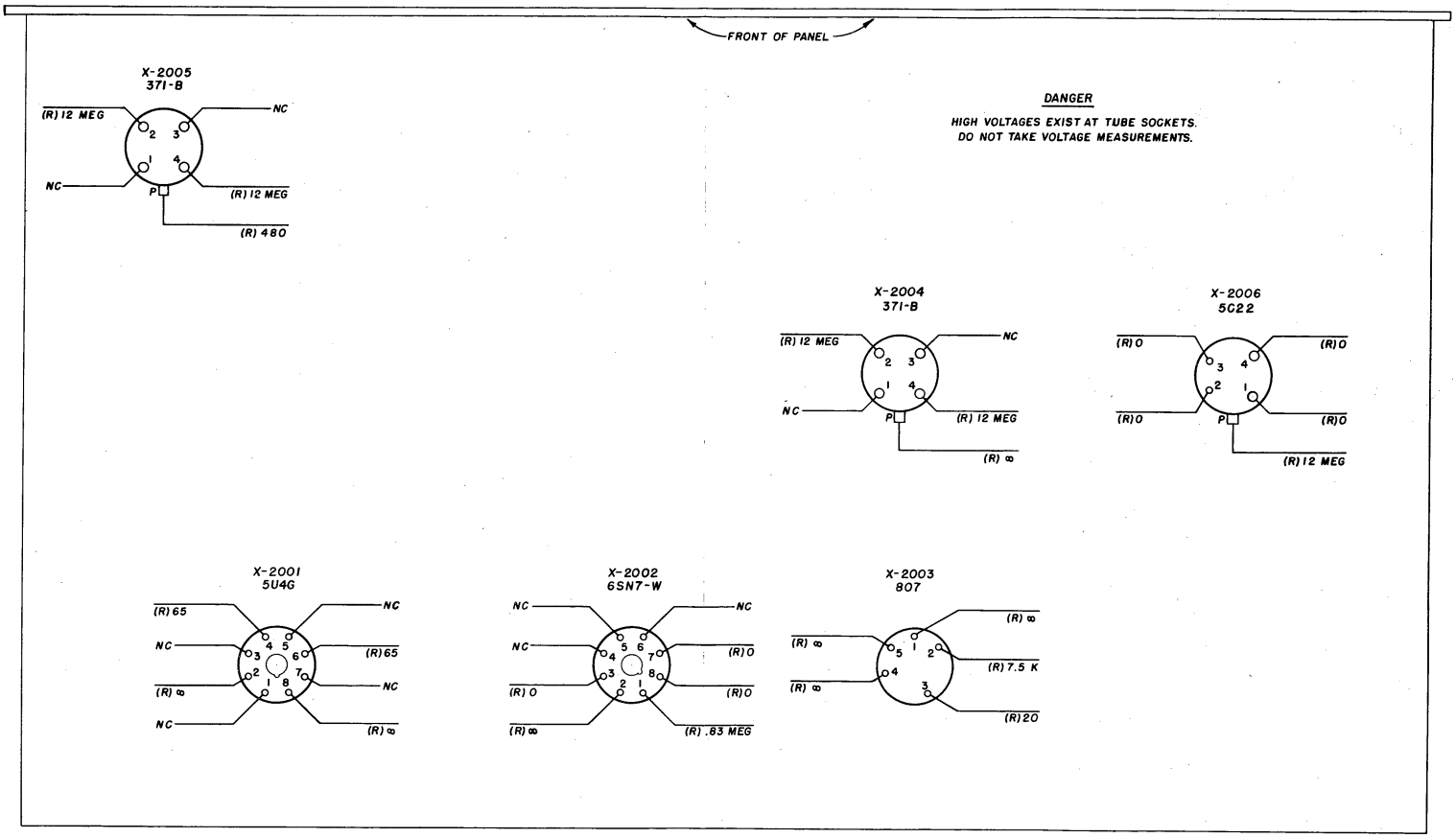
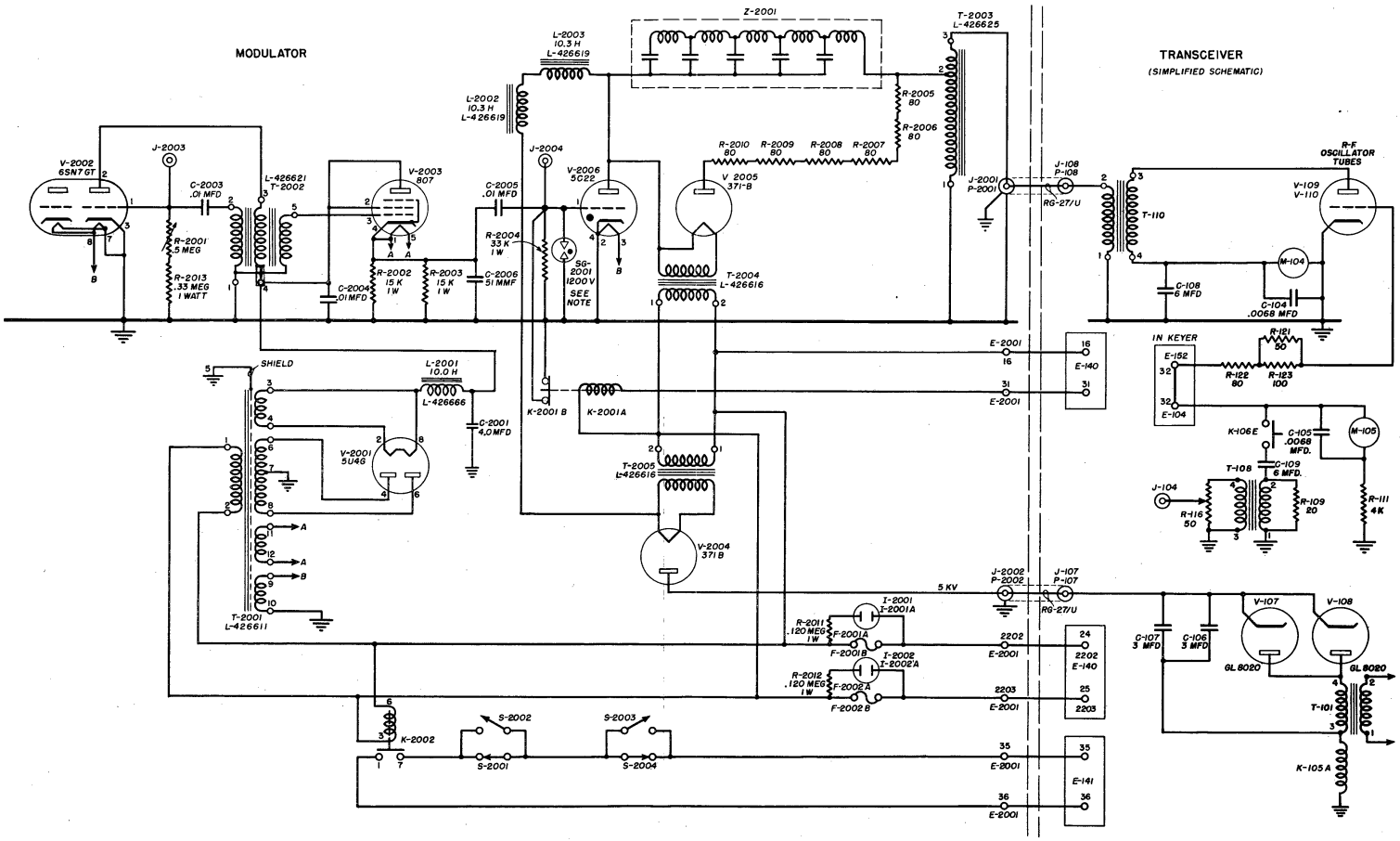
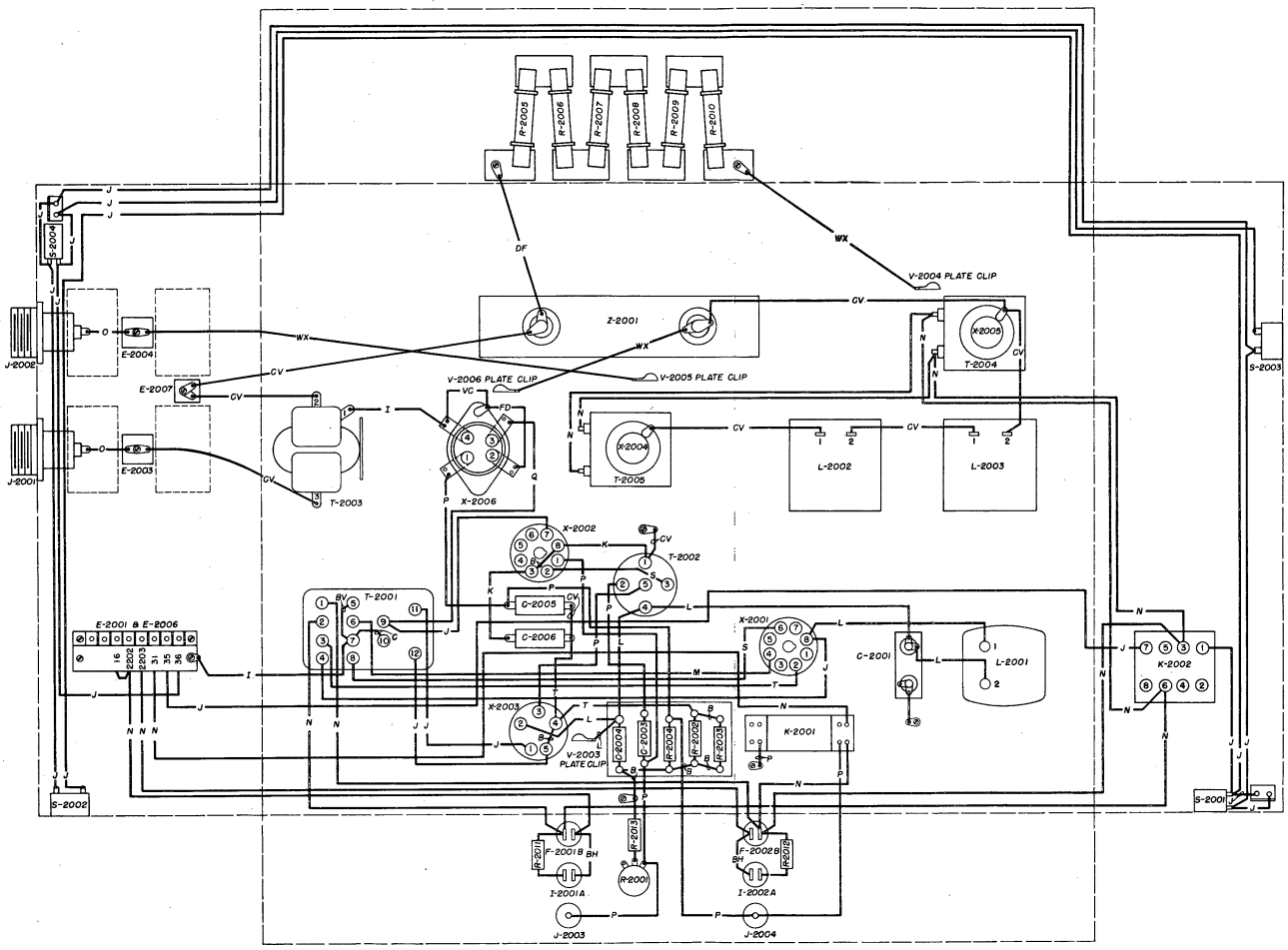


Figure 7-135. Modulator, CAY-50AGU, Voltage and Resistance Chart



NOTE: ADD SG-2001 TO SETS, SERIAL NOS. 1 TO 50 INCLUSIVE, BY FIELD MODIFICATION KIT.

Figure 7-136. Modulator, CAY-50AGU, Serial #1 to 50, Schematic Diagram



WIRE LEGEND

B - #18 TINNED COPPER BUS
C - #14 TINNED COPPER BUS
D - #10 TINNED COPPER BUS
F - TUBING TO FIT "D"
I - 65 OF .010 AEROGLASS 1250 V BLACK TRACER
J - 10 OF .010 AEROGLASS 1250 V WHITE
K - 10 OF .010 AEROGLASS 1250 V BLACK TRACER
L - 10 OF .010 AEROGLASS 1250 V RED TRACER
M - 10 OF .010 AEROGLASS 1250 V ORANGE TRACER
N - 10 OF .010 AEROGLASS 1250 V YELLOW TRACER
O - COPPER TUBING 1/4 OD
P - 10 OF .010 AEROGLASS 1250 V GREEN TRACER
Q - 65 OF .010 AEROGLASS 1250 V WHITE
S - 10 OF .010 AEROGLASS 1250 V BLUE TRACER
T - 10 OF .010 AEROGLASS 1250 V BROWN TRACER
V - TUBING TO FIT "C"
H - TUBING TO FIT "B"
W - 41 OF .010 AEROGLASS 5000 V
X - TUBING TO FIT "W"

Figure 7-137. Modulator, CAY-50AGU, Serial #1 to 50, Wiring Diagram