CHAPTER 4

REPAIRS

Section I. GENERAL

61. General Precautions and Techniques for Replacement of Parts

Most of the parts in Radio Set AN/PRC–9A and –10A are readily accessible and replaceable. Careless replacement, however, may cause new troubles. Observe the following precautions and techniques in addition to the organizational maintenance instructions given in TM 11–612.

a. When replacing tubes, use the same type tube as the one that was removed. Be sure that the tube is correctly oriented above the socket before attempting to insert it. Insert with a firm but gentle pressure. *Do not use force.*

b. Before unsoldering a component, locate and identify each lead. This assures proper replacement.

c. When soldering, be careful not to allow the soldering iron to touch adjacent components. Use only a small pencil-type soldering iron, and the minimum amount of solder necessary to make a good electrical joint.

d. Do not allow drops of solder to fall into the set.

e. When parts with the same voltage or power rating cannot be obtained, use a part with a higher and not a lower rating. Locate the part in the same position as the original part.

f. When a part is replaced in the rf or if. circuits, place the new part in the exact position occupied by the old part. A part that has the same electrical value but different physical size may cause trouble in high frequency circuits. Give particular attention to proper grounding. Use the same ground as in the original wiring. Failure to observe these precautions can result in decreased gain or in oscillation.

g. After repairs are completed, field organizations will brush moistureproofing and fungiproofing varnish on exposed surfaces of the equipment. Moisture and Fungus Proofing Equipment MK–2/GSM may be requisitioned for this purpose. Complete moistureproofing and fungiproofing will be accomplished at depots after repairs have been completed.

62. Replacement of Plug-in Cans

Six plug-in cans are used in the receiver-transmitter. They consist of four yellow if. amplifier cans (U101–U104), one blue discriminator transformer can (T201), and one red pulse-sweep generator can (U301). The cans are color-coded for proper identification.

a. Removal. Remove the four screws that hold the retaining clamp plate in place on the back of the chassis (fig. 32) and remove the plate. Remove the individual cans by pulling them straight out.

b. Replacement. Aline the pins, which are located on the can, with the holes in the socket and push the can in place. Be sure that the cans are placed in the correct sockets. Refer to the designation on the cans and chassis. Replace the clamp plate and the four screws that hold it in place.

63. Tube Replacement

All accessible tubes and the six plug-in cans are shown on figures 32 and 33. The tubes inside the if. amplifier and pulse-sweep generator cans are not directly accessible because the cans are hermetically sealed. When defective, the cans must be replaced, and defective cans should be turned in for repair (par. 75–94). Electron tubes and plug-in cans carried as running spares are shown in TM 11–612.

a. Modulator, Squelch, Audio, and 2.15-mc Calibrating Oscillator Tubes. To remove any one of these tubes (V2, V11, V7, and V9), first remove the clamping plate (fig. 33). Unfasten the two securing screws and remove the tube clamp. Re-

move the desired tube by pulling it straight up. When replacing these tubes, be sure that the red mark on the tube corresponds to the red mark on the tube socket. After the tubes are in place, return the tube clamp and tighten the two screws that secure the clamp over the four tubes.

b. First and Second Rf Amplifier, Mixer, and Receiver Oscillator Tubes. These tubes (V4, V5, V6, and V8) are mounted on the box assemblies (fig. 32). Remove and replace as follows:

(1) Remove the two screws that secure the tube shield (or cover plate), and remove the shield.

(2) Loosen but do not remove the two screws that secure the tube clamp for the four tubes; remove this clamp by sliding it away from the tubes.

(3) Remove the desired tube by pulling it straight out. When replacing a tube, be sure that the red mark on the tube corresponds to the red mark on the socket.

(4) Before installing a new V6 (mixer) tube, break the electrical connection between the external tube coating and pin 3 of the tube. An ohmmeter check should indicate a reading of infinity between pin 3 and the metallic tube coating.

(5) After all four tubes are inserted into the sockets on the boxes, replace the tube clamp and tighten the two holding screws.

(6) Replace the tube shield and tighten its two holding screws.

c. Transmitter Oscillator Tube. Remove the shield of tube V3 (fig. 33) by taking out the three screws that hold it to the chassis. (Two screws fasten into the chassis underneath the alining tool and the third screw is at the tube socket base.) Pull the tube straight out from the socket. Do not rock or twist it, because this may damage the tube. Replace the tube by lining up the base pins with the holes in the socket and pushing until the tube is firmly seated. Replace the tube shield and secure it with its three fastening screws. Clamp the alining tool back in place.

64. Crystal Replacement

The receiver-transmitter has one crystal Y1 located in the 2.15-mc calibrating oscillator stage. It can be removed and replaced after taking off the tube clamping plate (fig. 33) which holds the four tubes and crystal firmly in place. No polarity need be observed when replacing crystal Y1.

65. Dial Lamp Replacement

a. Unscrew the LITE CAP on the front panel.

b. While holding a hand under the opening, turn the receiver transmitter so that the control panel faces down, and shake slightly until the dial lamp drops out into the hand.

c. To insert a new lamp, hold the control panel face up and insert a lamp into the opening.

d. Screw on the LITE CAP.

66. Replacement of Box Assemblies

Five box assemblies are used in the receiver-transmitter. They consist of the transmitter oscillator, first rf, second rf, mixer, and receiver oscillator boxes (U2, U3, U4, U5, and U6, respectively). Refer to figure 32.

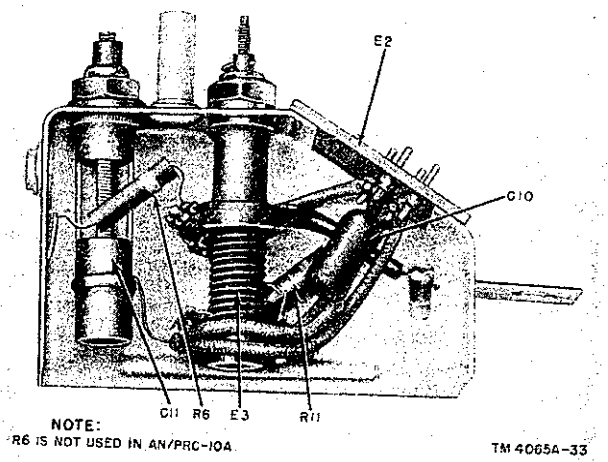


Figure 34. Transmitter oscillator box U2, inside view.

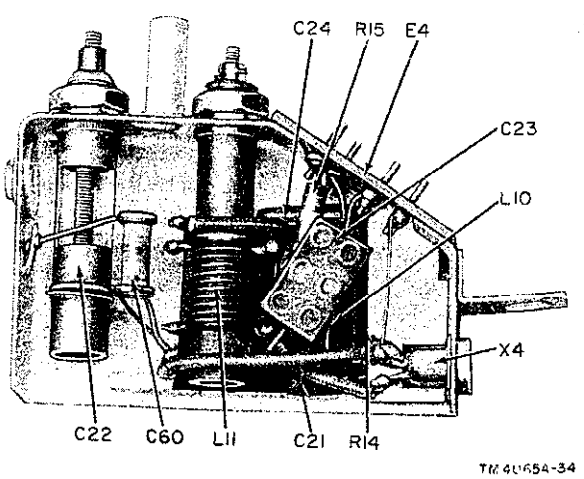


Figure 35. First rf box U3, inside view.

a. Removal.

(1) First remove the transmitter tube V3 (par. 66*c*).

(2) Remove the tube from each box (except the transmitter oscillator box). Refer to paragraph 63*b* for the removal procedure.

(3) Unsolder the leads on the terminal board of the box.

(4) Unfasten the three screws that secure the box to the chassis. One screw is on the side, one on the bottom of the chassis, and one on the top. The box can now be lifted out of the chassis.

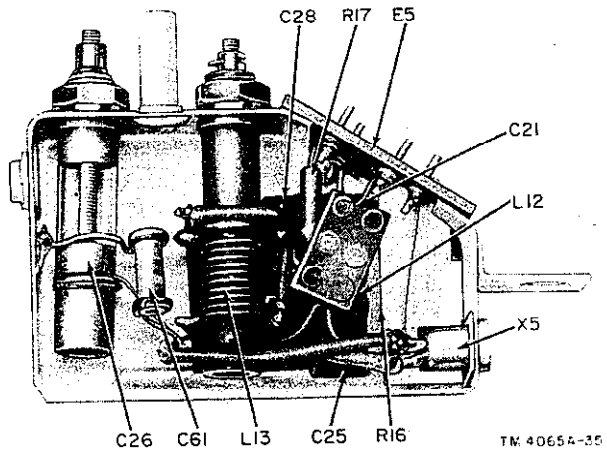


Figure 36. Second rf box U4, inside view.

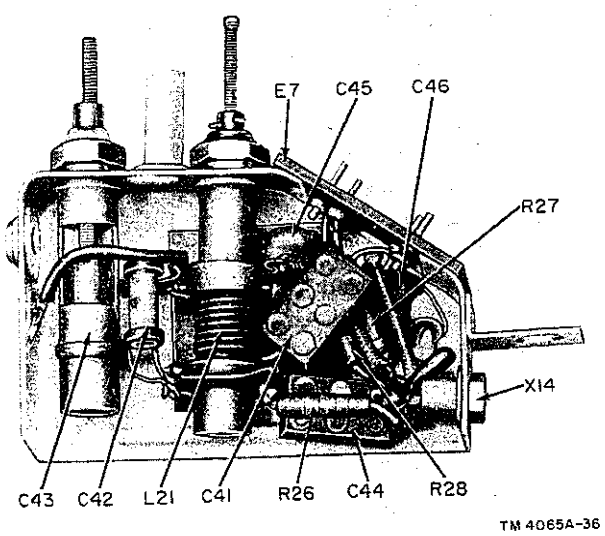


Figure 37. Receiver oscillator box U6, inside view.

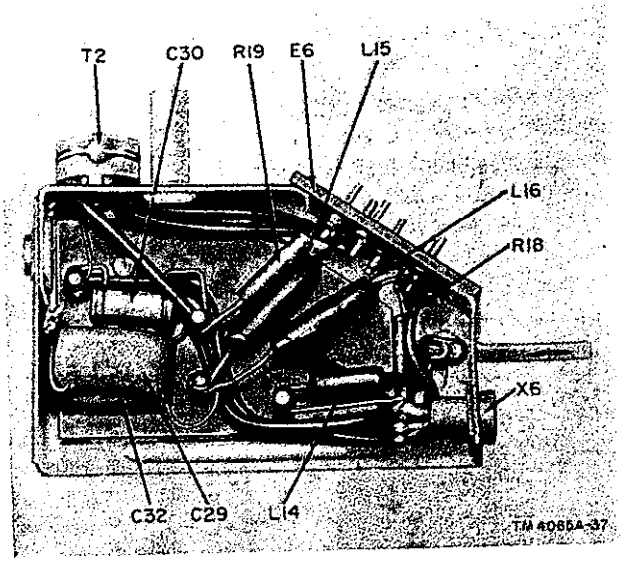


Figure 38. Mixer box U5, inside view.

b. Replacement.

(1) Place the box in position, tightly screw the three mounting screws.

(2) Solder the leads on the terminal board of the box.

(3) Replace the tube in the socket of the box.

(4) Replace the transmitter oscillator tube V3 (par. 63*c*).

67. Replacement of if. Subassembly

The if. subassembly is supplied as a spare *without* the six plug-in cans. The if. subassembly, can be removed and replaced as follows:

a. Removal.

(1) Remove the four screws that hold the clamp plate in place on the back of the chassis (fig. 23) and remove the plate.

(2) Unsolder two leads (one brown and one orange) on terminal board E9 which connect to socket X7 on the if. subassembly. Remove a two-conductor shielded cable at socket X7 and unsoldering the two leads and the shield.

(3) Unfasten the two screws at the rear of the chassis and the four screws from the top of the chassis. The if. subassembly is now free for removal except for unsoldering six leads and a ground bus which come out of the socket X11 corner in a laced cable. This should be done at the points on the chassis to which these leads connect.

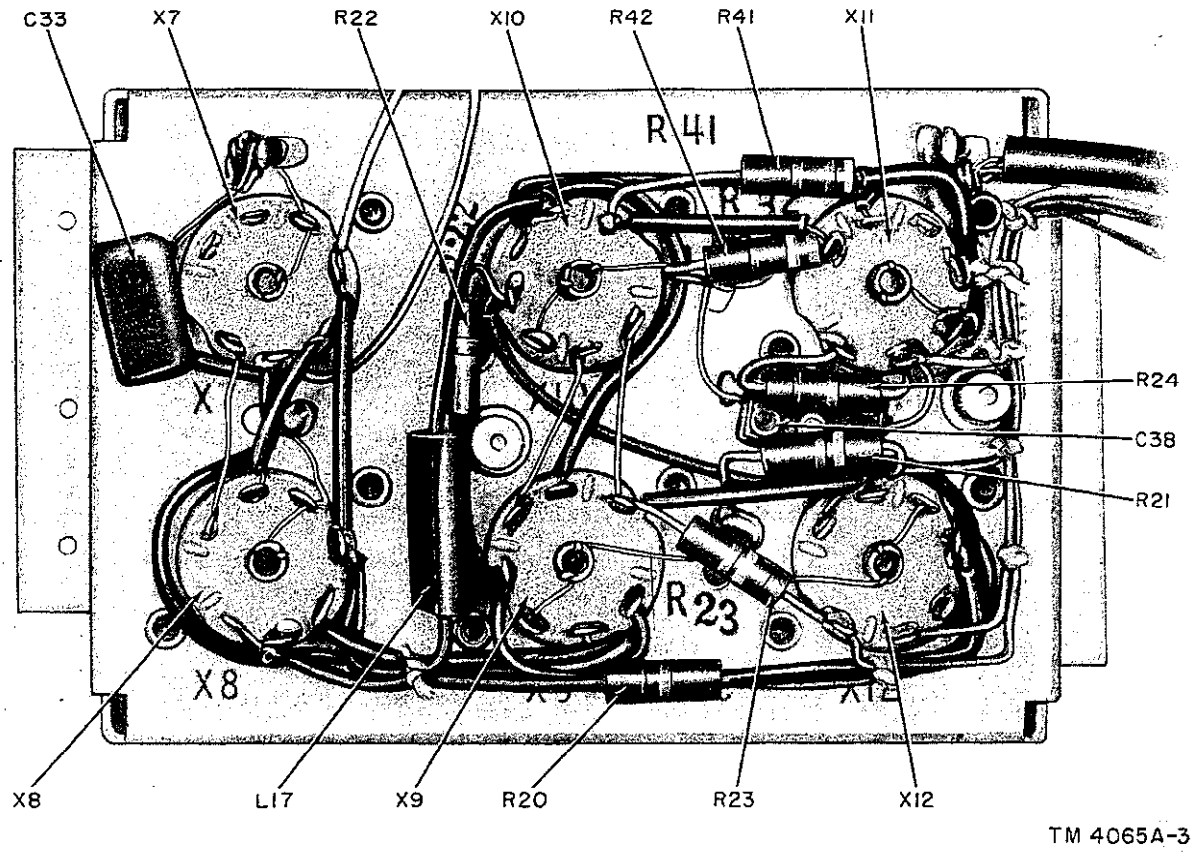


Figure 39. If. subchassis with shield removed.

b. Replacement.

(1) Place the if. subassembly in position. Dress the laced cable into place, and solder each lead to the terminal from which it (or the old corresponding lead) was disconnected.

(2) Tighten the if. subassembly to the chassis with the six mounting screws previously removed.

(3) Solder the orange and brown leads back on to the terminals of E9 from which they were disconnected. Also replace the two-conductor shielded cable.

(4) Install the six plug-in cans, if previously removed. Replace the cover plate and the four screws that hold it in place.

68. Replacement of TUNING Capacitor C9

a. Removal.

(1) Remove transmitter oscillator tube V3 as described in paragraph 63*c*.

(2) Operate the TUNING control until the gang is fully meshed.

(3) Unsolder the five leads and four grounding wires from the five sections of the TUNING gang assembly.

(4) At the dial drum (fig. 32), remove the spring between the pointer and terminal board E9. Also loosen the two screws through the two openings in the dial drum. Unfasten the socket-head screw in the center of the dial drum. Remove the screw together with the pointer, lockwasher, and flat washer, so that the dial drum may be removed.

(5) Remove the mixer and receiver oscillator tubes (V6 and V8 as described in paragraph 63*b*, so that the third mounting screw of the gang assembly can be reached.

Note. If the gang is going to be replaced, apply the scissor-gear tension clip (fig. 40) to the gang scissor gear to maintain shear tension on the two sections of the scissor gear. An alternate method is to tie a small piece of bus wire between the two sections (bottom view fig. 36).

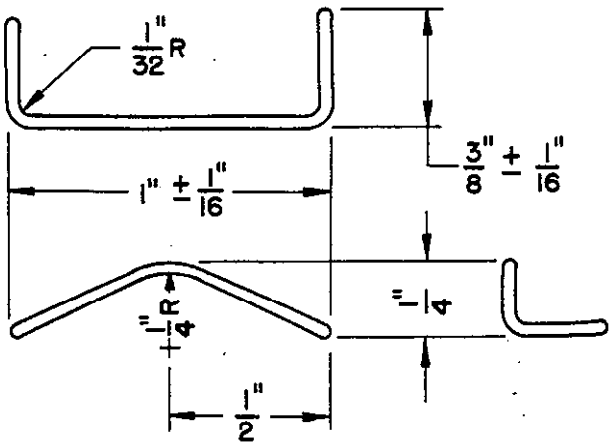


Figure 40. Scissor-gear tension clip.

(6) Unfasten the two screws previously loosened under the dial drum, and the third screw under the two tubes just removed. The tuning gang can then be lifted out of the chassis.

b. Replacement.

(1) Carefully position the gang assembly back in place, and be sure that the scissor gear meshes smoothly with the tuning-drive mechanism.

Note. The gang assembly should be fully meshed when being replaced.

(2) Secure the gang assembly to the chassis with the three mounting screws previously removed.

(3) Replace the mixer and receiver oscillator tubes.

(4) Replace the dial drum, the pointer, and the spring between the pointer and terminal board E9.

(5) Solder the five leads and the ground wires back to the five sections of the gang assembly.

(6) Replace the transmitter tube V3.

(7) Calibrate and realine as described in paragraphs 97 through 100.

69. Replacement of Miscellaneous Items

a. Relay K1.

(1) To remove relay K1, unsolder 14 leads on 9 pins in the base of the relay (fig. 33). Unfasten the two hexagonal nuts through which the relay mounting studs are secured to the chassis. Before one of these nuts (on the longer stud) can be unfastened, it is necessary to move the terminal board E1. Remove its mounting nut, and in the diagonally opposite corner unfasten its one mounting screw. Lift up the board so that the corner through which the relay stud extends can be cleared of the stud. Slip the spacer off the stud and then remove the hexagonal nut.

(2) To replace, insert the relay so that its longer mounting stud comes through the small terminal board. Secure the relay with the two hexagonal nuts previously removed. Solder the leads to the relay pins.

b. Squelch Relay K2.

(1) To remove squelch relay K2 (fig. 33), unfasten the two mounting screws from the top side of the chassis. One of these screws also secures a grounding lug to the chassis. From the bottom side of the chassis, unsolder seven leads on five terminals in the base of the relay.

Note. To facilitate replacement of K2, it may be necessary to disconnect the control panel from the chassis. This partial disassembly is described in paragraph 70.

(2) To replace, solder the leads back to the terminals, and then fasten the relay to the chassis with the two screws previously removed.

70. Partial Removal of Control Panel for Servicing

Caution: Removal of the panel should be performed only when repair or maintenance of the radio set makes it absolutely necessary.

a. Release the clamps on the receiver-transmitter case (fig. 29), and remove the chassis (with control panel attached).

b. Unsolder the leads at J3 between the AUX ANT connector J3 and terminal 4 of L6, and the lead at L6 between the LONG ANT connector J1A and terminal 5 of L6. Refer to figure 41. Note the positions of the leads so that they may be reconnected properly.

c. Remove the two screws that hold the chassis to the tuning drive mechanism. These two screws are located underneath the dial drum, and are accessible through the holes in the dial drum after

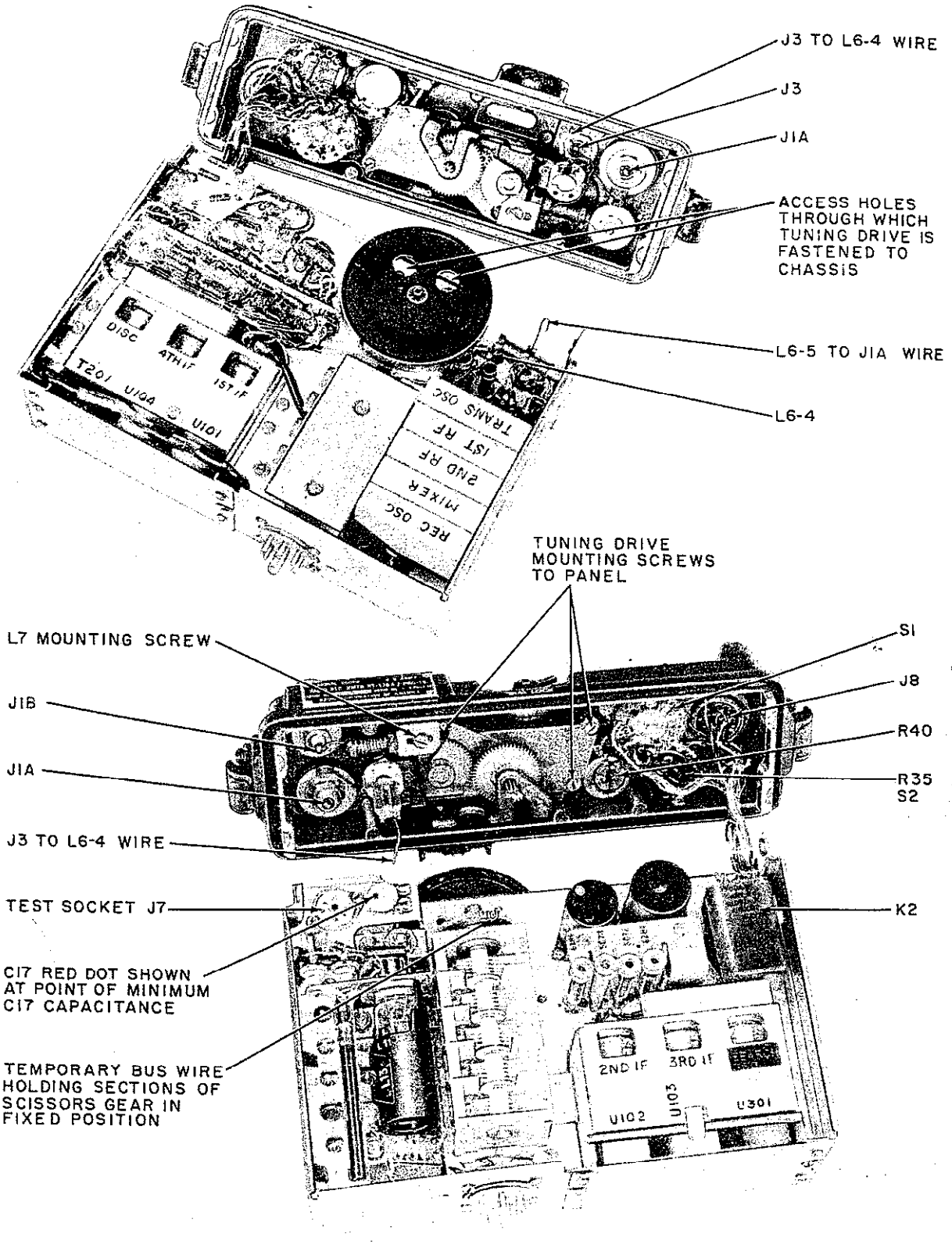


Figure 41. Control panel partially disassembled from chassis for servicing, bottom and top views.

the dial drum has been properly positioned by the TUNING dial. These positions of the TUNING dial are approximately 46.7 and 48.8. Be careful not to remove the two mounting screws of the tuning gang assembly. They also are accessible through the other two holes of the dial drum when the gang is fully meshed.

d. Apply the spring tension clip (fig. 40) to the gang scissor gear. This maintains shear tension on the two sections of the scissor gear when the scissor gear is disengaged from the tuning-drive mechanism. An alternate method is to tie a small piece of bus wire between the two sections of the scissor gear, as shown in the bottom view of figure 41.

e. Remove the four screws, two on each side, that hold the control panel to the chassis. Carefully separate the chassis from the control panel for servicing. Remove the dial pointer and spring from the dial drum. Save them for replacement with the removed hardware.

71. Replacement of Components on Control Panel Assembly

(fig. 42)

These components include the AUDIO connector (J8), SQUELCH control (S2 and R35) VOL control (R40), POWER switch (S1), tuning drive (O 22), and the electrical components (C12, L7) on the tuning drive assembly.

a. Replacement of POWER, SQUELCH, and VOL Controls.

(1) To remove any one of these items, first remove the control panel for servicing (par. 70). Then unfasten the center screw of the TUNING control knob, remove the screw and knob, unscrew the panel nut, slip the control out from behind the panel, and unsolder the electrical connections.

(2) To replace, position the control in place, make electrical connections, secure the control firmly to the panel with the fastening nut, and replace the control knob.

b. Replacement of AUDIO Connector.

(1) After removing the control panel (par. 70), unsolder the leads connector J8, unscrew the panel nut, and remove the connector.

(2) To replace, insert the connector from behind the control panel, secure it with the panel nut, and resolder the leads.

c. Replacement of Tuning Drive Mechanism (figs. 42 and 43).

(1) After removing the control panel (par. 70), unfasten the center screw, of the TUNING knob and remove the knob. Unsolder three leads: one at capacitor C12 between the grounding lug on J1A and C12, the second at L7 between the AUX ANT connector J3 and terminal 1 of L7, and the third also at L7 between the SHORT ANT connector J1B and terminal 2 of L7. Note position of leads so that they may be reconnected properly. Unfasten the screw at the head of the DIAL LOCK control. Remove the screw, lockwasher, and flat washer; pry off the lever (O 2). Unscrew the threaded stud assembly, and lift it out. Loosen the three mounting screws that secure the tuning drive to the control panel. If necessary, loosen the mounting screw that secures the bracket of L7 to the casting (after marking its position) to gain access to the mounting screw below the casting top surface. Remove the tuning drive assembly; be careful that the stop plate (O 19) and rectangular nut (H7) underneath the bracket (O 6) do not slip off the tuning shaft.

(2) Before replacing the tuning drive assembly, check the condition of the two gaskets (O 14) on the tuning shaft, and the two gaskets (O 9) on the threaded stud of the DIAL LOCK mechanism. Replace if necessary. Place the bracket (O 6) in position on the tuning shaft with the stop plate (O 19) and rectangular nut (H7) (fig. 42). Place the assembly in position and insert the tuning shaft through the hole in the control panel. Look down through the DIAL LOCK opening and, with a thin-bladed screw driver, position the bracket, nut, and plate below, so that the threaded stud may be inserted into the nut. After threading the stud into the nut, and observing that one end of the bracket has not slipped off the shaft, secure the tuning drive assembly to the control panel. Fasten the three mounting screws evenly and tightly. Replace the

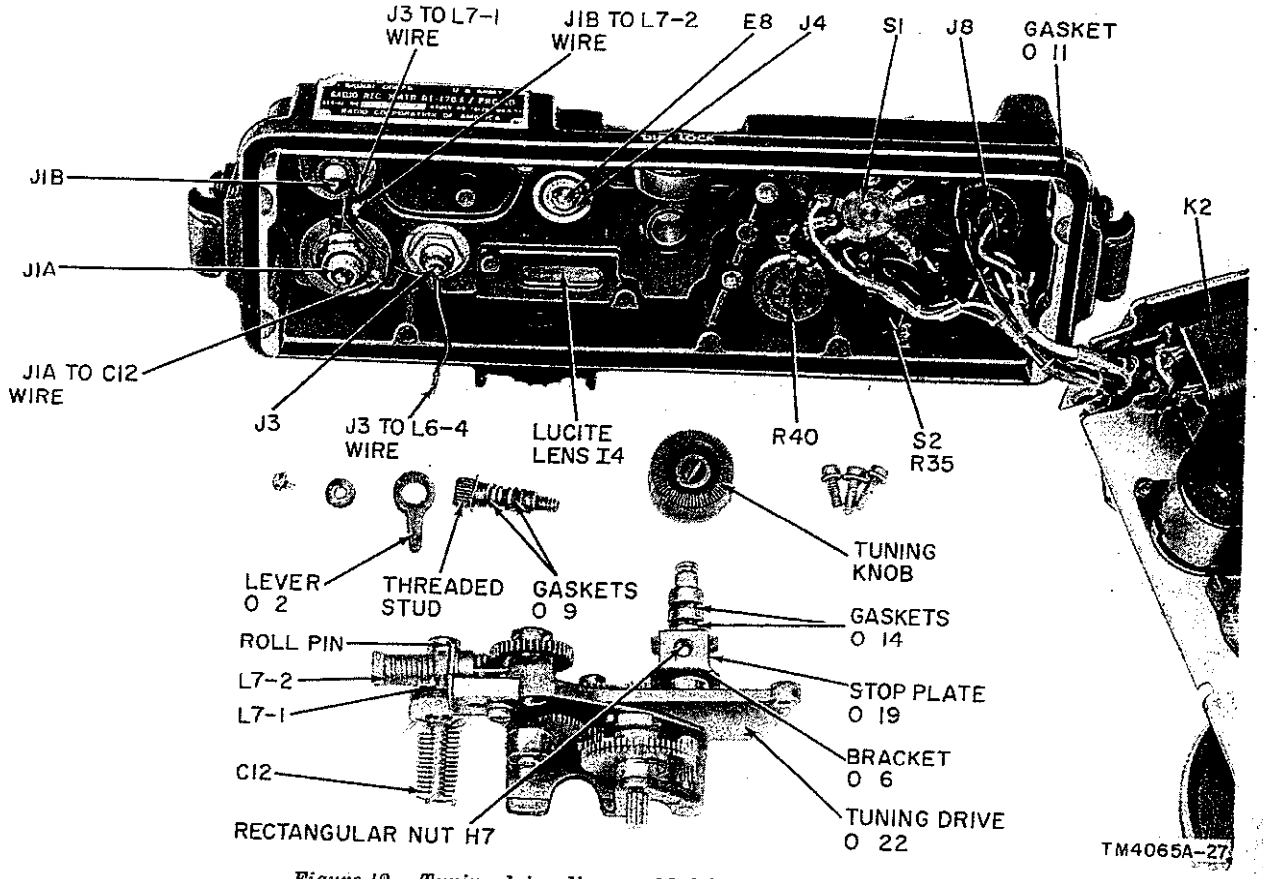


Figure 42. Tuning drive disassembled from control panel.

TUNING control knob and rotate the shaft to check for binding.

(3) Thread the DIAL LOCK stud into the rectangular nut until the TUNING shaft begins to lock. Just before locking, fit the lever (O 2) on the head of the stud so that the lever may be turned to lock the tuning shaft. Secure the lever with the washers and screw previously removed.

(4) Solder the three leads previously disconnected.

(5) If the mounting screw of L7 was removed, replace and tighten it in its original position. Coil L7 is adjusted when its mounting screw (see bottom view in fig. 42) appears between the center and end of the elongated hole in the mounting bracket. The mounting screw should be closer to the end at the outer edge of the bracket, so that the adjacent tuning drive screw hole will be less covered by the mounting bracket.

d. Replacement of C12, Coil and Slug of L7 on the Tuning Drive Assembly (figs. 42 and 43). These three electrical items are provided as spares, and after tuning drive assembly is removed, these spares can be replaced as follows:

(1) To replace the coil of L7, unfasten the screw which secures its mounting bracket to the aluminum casting of the tuning drive mechanism. Slip out the coil gently so that the slug of L7 does not fall off the casting ear into which it is hooked. Slip the new coil over the slug and secure it to the casting with the single mounting screw previously removed.

(2) To replace the slug of L7, first remove the coil as described in (1) above. Then slip off the slug and hook the new slug on the casting ear. Slip the coil over the slug, and secure it to the casting.

(3) To remove capacitor C12, drive out the roll pin through which its shaft is linked to the gear train. Slip off the gear, and

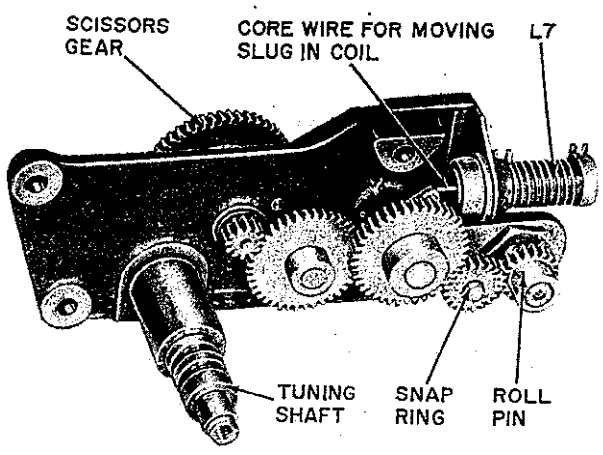


Figure 43. Tuning drive O 22.

then unscrew the hexagonal retaining nut that secures the capacitor to the casting. Remove the capacitor. To replace C12, position it in place on the casting and secure it tightly with the retaining nut. Instead of replacing the removed gear, remove the adjacent gear after first taking the snap ring off its shaft. Now replace the gear on the capacitor shaft, pinning it in place with the roll pin. Turn the tuning shaft fully counterclockwise and adjust the capacitor shaft so that its rotor is entirely between the stator plates. Maintain this alinement position, and carefully mesh the removed gear back into the gear train, secure it on the shaft with the snap ring.

72. Replacement of Control Panel

Caution: Complete removal of the panel is a complicated operation. It should be performed only when repair or maintenance of the radio set makes it absolutely necessary.

a. Complete Removal of Control Panel from Chassis.

(1) Remove the panel as described in paragraph 70.

(2) Unfasten the center screws of the TUNING, VOL, SQUELCH, and POWER controls on the panel, and remove the knobs. Unscrew the panel nuts on the VOL, SQUELCH, and POWER controls and on the AUDIO connector so that they may slip out when the panel is removed.

(3) Remove the tuning drive assembly (par. 71) and LITE CAP socket J4. The control panel should now be completely free of the chassis.

b. Replacement of Panel.

(1) Replace LITE CAP socket J4, dial lock and tuning drive assembly (par. 71*c*), AUDIO connector, TUNING knob, POWER switch, and the VOL and SQUELCH controls on the control panel.

(2) Carefully position the control panel back in place over the chassis.

(3) Replace the panel on the chassis with the four 6–32 by ¼-inch binder-head screws, which were previously removed. The scissor gear of the tuning gang and the pinion of the tuning drive should smoothly mesh in their original positions.

Note. If other than the same (original) control panel is being replaced, mechanically aline the panel and chassis assembly as described in *c* below.

(4) Remove the spring tension clip (or bus wire) from the TUNING gang scissor gear. Replace the drum dial pointer and dial pointer spring in their original positions.

(5) Replace the two mounting screws that fasten the tuning drive mechanism to the chassis. These screws can be reached through the openings in the dial drum.

(6) Solder the two leads back to their original connections; one lead at LONG ANT connector J1–A extending coil L6, and the second lead at terminal 4 of L6 extending from AUX ANT connector J3.

c. Mechanical Alinement of Panel and Chassis Assembly. A jig (fig. 44) is required to assure correct mechanical alinement of the panel and chassis assembly so that it fits properly in its case.

(1) *Fabrication of jig.*

(*a*) Make the jig from a salvaged receiver-transmitter case (fig. 29).

(*b*) Remove the eight-pin male battery plug and flexible eight-wire cable from the bottom of the case; leave the female receptacle intact.

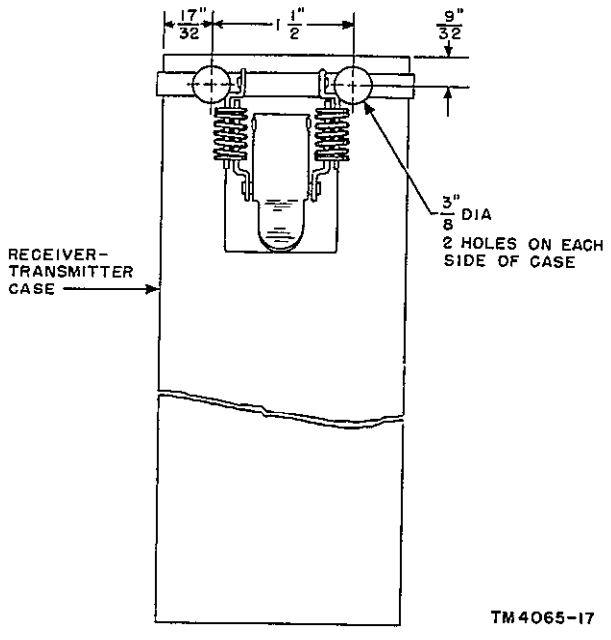


Figure 44. Holes in jig used for panel and chassis alinement.

(*c*) Remove the two clamps located on each side near the back (bottom) of the case.

(*d*) Drill four 3/8-inch diameter holes, two on each side of the case, near the front (top), as shown on figure 44.

(2) *Use a jig.*

(*a*) Loosen the four 6–32 by 1/4-inch long binder-head machine screws that fasten the panel to the chassis. These screws are located two on each side of the chassis, just behind the edge of the panel.

(*b*) Secure the case jig in a vertical position in some convenient location. Insert the chassis (with panel attached) in the case jig and fasten the case jig clamp.

(*c*) Tighten the four 6–32 screws that fasten the panel to the chassis. These screws are accessible through the four 3/8-inch holes in the jig.

(*d*) The panel and chassis assembly is now correctly alined. Remove the assembly from the case jig by opening the clamps. It will now fit correctly when installed in its own receiver-transmitter case.

73. Lubrication of Tuning Drive Mechanism (fig. 45)

a. The tuning drive mechanism O 22 is the only lubricated assembly in the radio set. With normal care and use, it is expected that the assembly will never require additional lubrication (after leaving the factory) for the life of the radio set. If the chassis is exposed to moisture and dirt and there is corrosion or dirt on the gears, cleaning and lubrication is necessary. To thoroughly clean and lubricate the tuning drive mechanism, remove the control panel from the chassis of the receiver-transmitter (par. 70), and then remove the tuning drive mechanism from the control panel (par. 71*c*). *This should be performed only when absolutely necessary.*

b. Clean the tuning drive mechanism with Cleaning Compound (Federal Stock No. 7930–395–9542); be careful not to get it on other parts. Dry with a clean cloth while tuning the mechanism so that all portions will become clean and dry.

c. Use a small toothpick or No. 20 AWG bare wire and apply 1 drop of lubricating oil to all bearings and shafts except the gears. Use Oil, Lubricating, Preservative, Special (PL Special) in accordance with MIL–L–644A specification. Keep oil away from the two gaskets (O 6) on the tuning shaft to prevent damage to the seals. Apply this lubricating oil to the surfaces of the stop disk so that the oil may work down between the disks.

d. Apply grease sparingly to the teeth of the scissor gears, meshing gears, and pinions, as shown in figure 45. Use grease in accordance Grease, Aircraft and Instruments (GL), MIL–G–3278 specification. Work the grease in and spread it by turning the dial shaft several times from one end of travel to the other. Wipe off the excess lubricant from the sides of the gears and pinions.

74. Dial-Drum Adjustment After Replacement

a. Turn the TUNING capacitor exactly to its fully meshed position. This brings the low-frequency end of the dial scale opposite the dial window.

b. Turn the POINTER ADJUST knob and center the pointer midway between its two extremes of travel.

c. Position the dial drum so that the full-width line, located just below the lowest frequency mark

on the dial, is lined up with the pointer. Tighten the Allen-head screw in the center of the tuning dial drum. Use a wrench and spanner to hold the bevel gear.

Caution: If the wrench and spanner are not used to hold the bevel gear during tightening and loosening of the Allen-head screw, damage to the bevel gear will result.

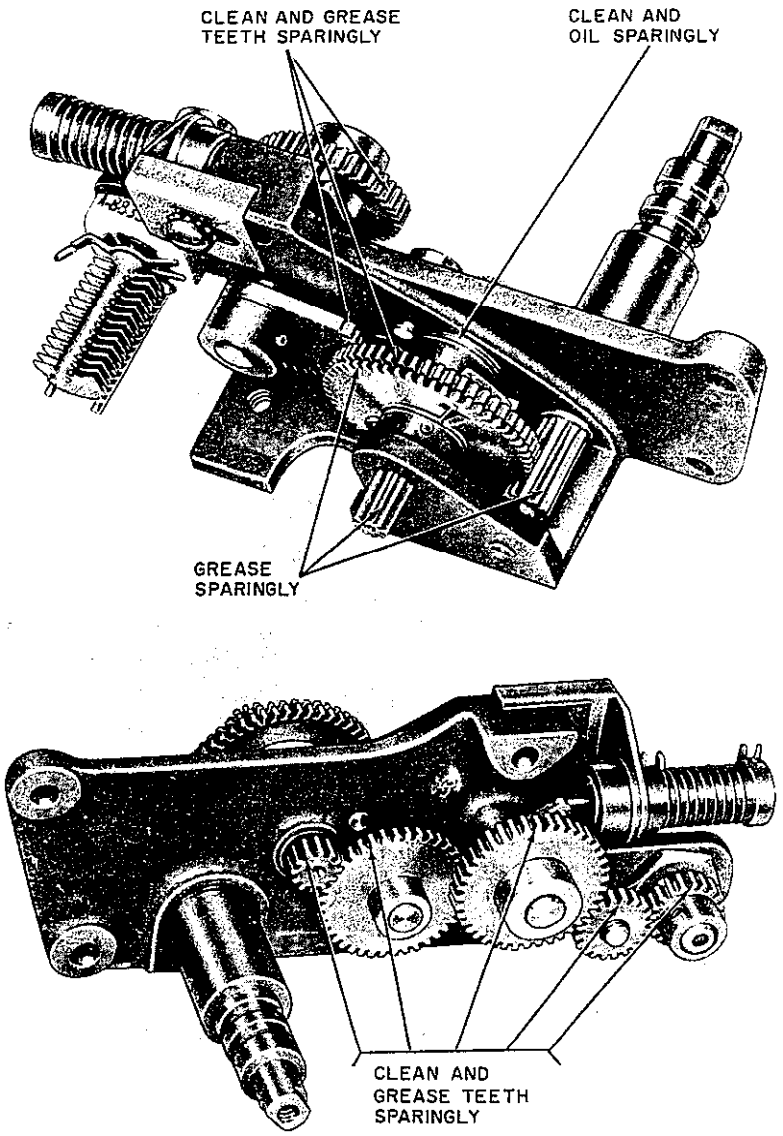


Figure 45. Tuning drive mechanism, lubrication points.

Section II. REPAIR AND TEST OF IF. AMPLIFIER, DISCRIMINATOR, AND PULSE-SWEEP GENERATOR PLUG-IN UNITS

75. General

The repair and test of defective if. amplifier, discriminator, and pulse-sweep generator plug-in units are described in paragraphs 76 through 94. The basic repair and test procedure includes the unsealing process, the electrical troubleshooting and maintenance of a plug-in unit, and the resealing process for a repaired plug-in unit.

76. Test Equipment Required

The following equipment is used to test if. amplifiers V101, discriminator transformer T201, and pulse-sweep generator V301 plug-in units.

a. Rf Signal Generator. Rf Signal Generator Set AN/URM–25A or equivalent is used to furnish a 4.3-mc signal for testing the if. amplifier plug-in units.

b. Multimeter. Electronic Multimeter ME–6A/U, Voltmeter ME–30A/U or equivalent is used for discriminator transformer alinement and stage gain voltage measurements.

c. Oscilloscope. Oscilloscope OS–8A/U or equivalent is used for testing the pulse-sweep generator.

d. Audio Oscillator. Audio Oscillator TS–382A/U or equivalent is used to furnish a 10-cycle signal for the pulse-sweep generator test.

e. Test Chassis. This test chassis must be fabricated. The components and their values are shown in figure 46.

Note. The test chassis or similarly constructed device may be used until a suitable test set is standardized.

f. Plug-in Test Cans. Three plug-in test cans must be fabricated from spare if. plug-in cans. The modification to these cans is shown in figure 47.

g. Battery and Battery Cable. Battery BA–279/U and a battery cable are used to supply power to the test chassis.

77. Modifications to If. Amplifier Cans for Test Purposes (fig. 47)

a. For test can No. 1, modify a plug-in unit in the following manner:

(1) Remove the leads from pin 1 of J101 and pin 2 of J101. Remove the lead from pin 4 of V101.

(2) Connect pin 1 of J101 to pin 4 of V101.

(3) Paint the can with a large numeral "1".

b. For test can No. 2 (for gain), modify a plug-in unit as follows:

(1) Remove R101. Connect a shorting wire across pins 3 and 4 of T101.

(2) Paint the can green, and print a large numeral "2" on the top.

c. For test can No. 2 (for alinement), strip a defective plug-in unit, and proceed as follows:

(1) Connect detector 1N81 between pins 2 and 7 of J101 (plate to pin 2 and cathode to pin 7).

(2) Connect a 100-$\mu\mu$f capacitor and 120K resistor (in parallel) across pins 7 and 3 of J101.

(3) Ground pins 1 and 3 of J101.

(4) Paint the can orange, and print a large numeral "2" on the top of the can.

78. Special Tools Required

The following tools are necessary to unseal, repair, and reseal the plug-in units.

a. A small pencil-type, 6-volt soldering iron.

b. One 100-watt and one 200-watt soldering irons, with specially prepared tips (fig. 48) for unsealing the can.

c. A 300-watt soldering iron with specially prepared tip (fig. 48) for resealing the can.

d. Bench fixture for holding the if. unit by the base rim and that is capable of fixing the if. unit in any position or angle desired. This device can be made from a rod one end of which is a ball that is positioned under spring tension, and other end terminated by an alligator-actuated rim fitting around the base of the plug-in unit.

79. Test Setup

a. Connect the test equipment to the test chassis (fig. 46). The test chassis includes sockets for the modified plug-in units, the 4.3-mc calibration-oscillator circuit, test sockets, and switches. On figure 47, the removed components of the modified if. test can units are shown in dotted lines and the added connections are shown in extra heavy lines. Figures 49 and 50 show two views of the discriminator, if. amplifier and pulse-sweep generator with cover removed.

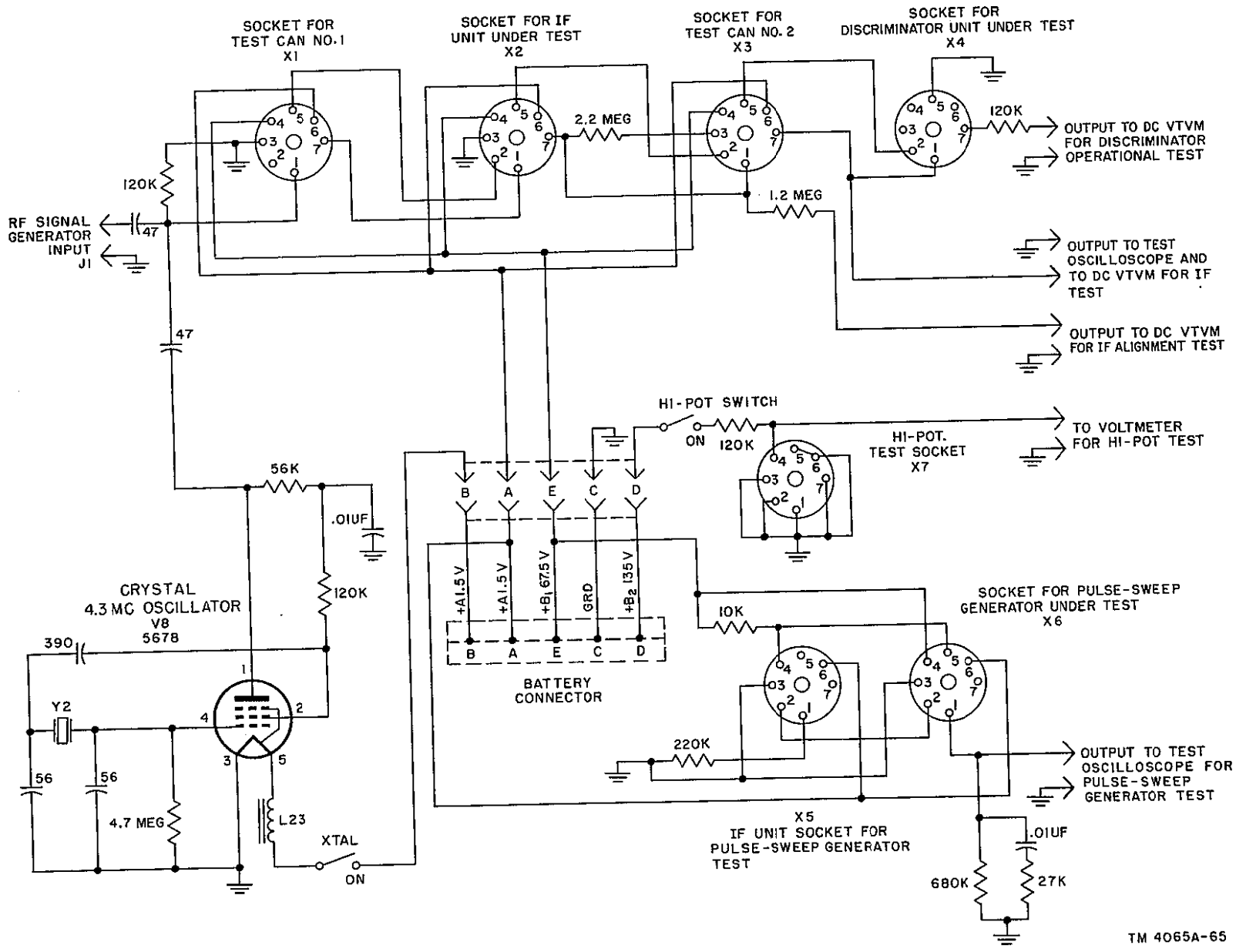


Figure 46. Test chassis schematic diagram.

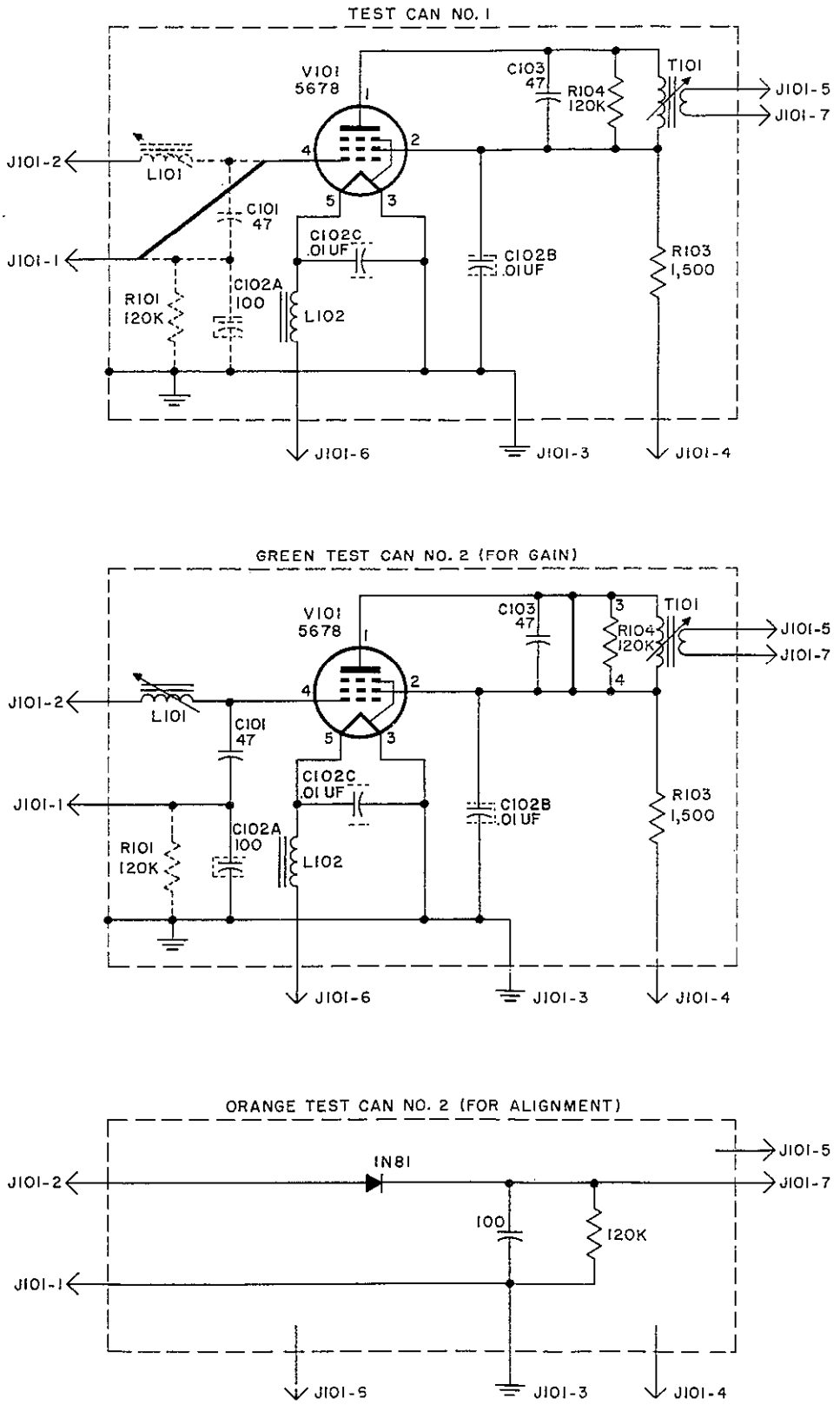
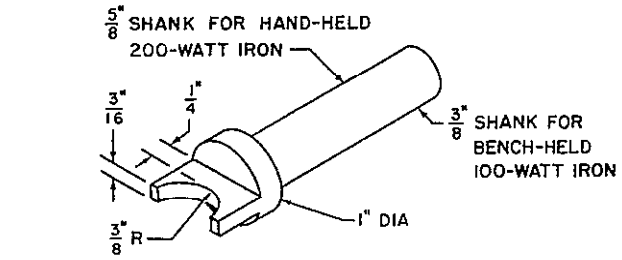


Figure 47. Modified if. amplifier plug-in test cans.



COPPER SOLDERING TIP FOR REMOVING COVERS FROM IF CANS

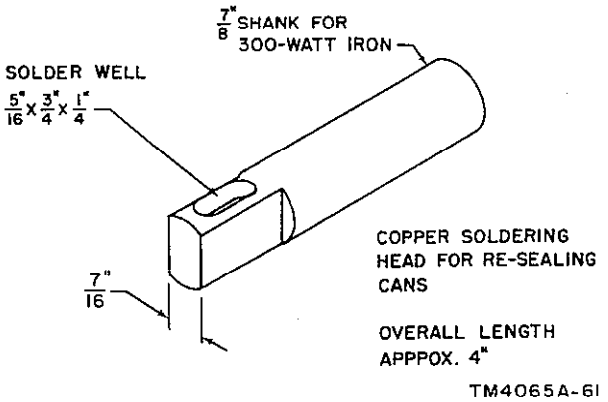


Figure 48. Soldering iron tips.

b. The battery and battery cable are the same as those used in the receiver-transmitter equipment. The test chassis requires 1.5-volt filament power, 67.5 volts and 135 volts dc power sources.

80. Unsealing Plug-in Units

a. Remove the fungus-resistant varnish on the cover of the can.

b. Anchor the 100-watt soldering iron with the special semicircular soldering tip (fig. 48), so that the iron will not move. Hold the 200-watt soldering iron in one hand, and clamp the circular base on the unit between the two semicircular soldering tips. Press the soldering iron so that the unit is held securely in the vertical position with its base facing upward. The assembly is held secure by the base rim and not by the shell of the can. Hold the cover of the can with one hand while holding the iron with the other hand.

c. As the rim of the base heats, apply pressure to rotate the cover. As soon as the solder around the rim starts to melt and the cover is felt to give, pull it straight down. Painting the rim with soldering flux may help the removal. Keep the tips clean. As the cover is pulled off, the strip of insulation is pulled off also, thereby preventing solder scrapes from getting on the unit chassis. While the unit is still warm, strike it gently on the bench to shake excess solder off the rim.

Caution: Do not overheat the can. The shells are not force-fitted onto the rims, and do come off easily once the solder starts to flow. Overheating will damage the insulators around the pins in the base.

81. Tube Replacement Procedures

The replacement and repair of tube should only be attempted by trained technicians that have the proper tools. To replace a tube, proceed as follows:

a. Bend and lift the tube clamping wire until it can be brought under the tip of the tube. Be careful not to damage the tube.

b. Lift the tube up and then slightly off to a side to facilitate unsoldering the tube leads.

c. Unsolder the tube leads to the chassis and remove the tube.

d. Cut the leads of the new tube to proper size (use old tube as reference). Slide the new tubing on the leads that require it and then bend all leads to their approximate final position. Resolder the leads. Dress the tube and leads into position, and then slip the clamping wire back over the tube tip.

82. Troubleshooting Defective If. Amplifier Plug-in Units

Troubleshooting the if. amplifier units after they have been opened consists of an inspection for visible faults, a continuity and circuit check, a high potential test, and an operational check for open capacitors. If all these tests do not locate the fault, then the tube is probably defective.

a. Inspection.

(1) Check L101 and T101 (fig. 49) assemblies for a loose bobbin, a cracked or loose ring, or a split terminal board. These faults could be the cause of intermittent operation.

(2) Check for cracked or broken components.

(3) Check for stray particles, which may be causing a shorted or grounded circuit.

(4) Check for solder splashes, which may have occurred when the cover was removed.

b. Continuity and Circuit Check. The resistance measurements made with an ohmmeter should conform to the following chart:

Checks	From		To		Indications (ohms)
	Pin	Of	Pin	Of	
T101 output winding	3	T101	4	T101	Approx 1.
Continuity through T101	5	J101	7	J101	Approx 1.
Continuity through L101	2	J101	2	L101	Approx 1.
C101	2	J101	1	J101	Infinity.
R101	3	J101	1	J101	120K.
Continuity	3	J101	Chassis		0.
C102B	3	J101	4	J101	Infinity.
R103	4	T101	4	J101	1,500.
V101 filament, L102	6	J101	Chassis		25.

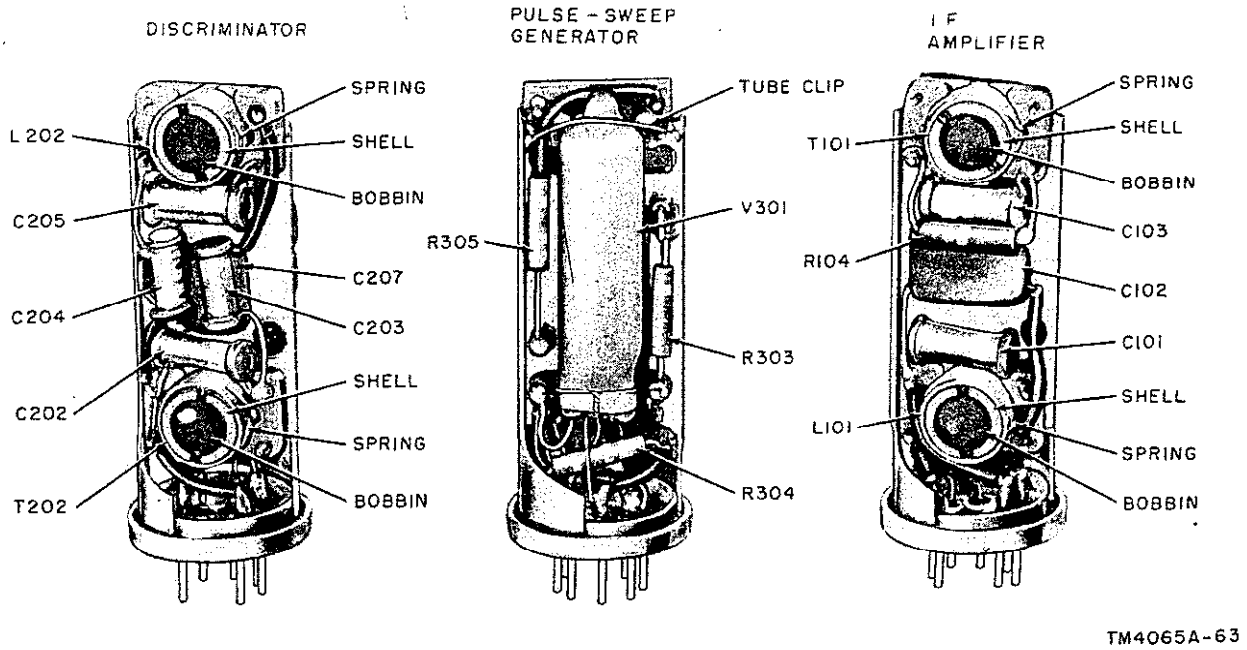


Figure 49. Discriminator, pulse-sweep generator and if. amplifier plug-in units with covers removed.

Caution: When checking tube filament for continuity, ohmmeter must be in ×10 (or a higher scale) or the ohmmeter battery will burn out the tube filament. *Never* check filament with ohmmeter in the ×1 scale. The resistance of L102 is less than 1 ohm.

c. High Potential Test. Before making the operational test, always check for breakdowns under high potential as follows:

(1) Insert the unit into the high potential test socket (fig. 46) on the test chassis. Hold down the high potential switch and observe the indication on the voltmeter that is connected to the high potential output terminals. It should read approximately 135 volts. While testing, tap the can gently to check for an intermittent circuit.

(2) If the voltmeter reads zero, the unit is shorted. Reading much lower than 135 volts indicates leakage in the unit. Circuit check for the cause of trouble, as

outlined in *b* above. If this should not reveal the fault, then the trouble is probably a faulty capacitor.

83. Operational Check

Before making the operational check, always test the if. unit for high potential short; also check L101 and T101 for open or shorted windings. Use an if. test unit known to be in good operating condition for troubleshooting defective plug-in units. This test unit can be used to obtain typical voltage indications, signal generator input levels, and vtvm output indications and to assist in zero-beating the signal generator frequency to 4.3 mc. To make the operational check, proceed as follows:

a. Insert the if. plug-in unit under test into the ×2 IF. UNIT test socket. Connect the signal generator, oscilloscope, and dc vtvm, as shown in figure 46.

b. Tune the signal generator to 4.3 mc, and feed this signal into the test chassis at a high level (on the order of 50,000 microvolts or more). Turn on the 4.3-mc crystal oscillator circuit on the test chassis. If there is no indication of a beat note on the oscilloscope or of an output on the dc vtvm, then increase the signal generator output.

c. Check for an open capacitor by temporarily connecting a 47-$\mu\mu$f capacitor across C103 (fig. 49), and then across C101. If neither of these tests causes an output indication, connect a .01-μf capacitor from the chassis to C102C, C102B, and finally to C102A. If neither of these tests causes an output, tune L101 and T101.

Note. An output indication will be obtained only if the signal generator is tuned to 4.3 mc, inductor L101 and transformer T101 is tuned to 4.3 mc, and no open capacitors exist in the circuit. Once an indication is obtained, it is easy to determine whether the trouble is caused by misalinement of L101 and/or T101, or to a defective component.

d. If the trouble can not be traced to an open or shorted capacitor, misalinement, or other fault, then check the tube. Do this by substituting an if. plug-in unit known to be in good operating condition for the suspected plug-in unit.

84. Repair and Replacement of Transformer T101

a. A split or crack in the terminal (and mounting) board of T101 (fig. 49) can be repaired by using a special cement (Armstrong's adhesive A–2 or equivalent). Paint on the cement and allow the cement to set into a solid bond.

b. A cracked shell (ring) can be replaced by a new ring, without changing the entire transformer assembly. Unthread the cracked shell. Remove broken fragments and clean out and insert a new shell. Thread it in carefully, without forcing. Make sure the spring applies sufficient tension to hold the ring securely in position.

c. If a winding of T101 is open, replace the entire T101 assembly. To remove T101, first unsolder the leads of C103 and R104 (fig. 49) at terminals 3 and 4 of T101.

d. Bend and lift the tube clamping wire until it can be brought under the tip of the tube. Be careful not to damage the tube.

e. Unsolder the leads at the four terminals of T101 on the tube side of the chassis. The tube may be lifted out of the way. Figure 49 shows a partial assembly of the if. chassis. The terminal board of T101 is secured to the chassis by two lugs. These lugs pass through slots in the chassis and are twisted and soldered. Melt the solder at these two lugs, straighten the lugs, and push out the defective T101 transformer assembly, one side at a time.

f. Install the new T101 assembly; orient it so that the open ends of the spring are on the right side, the same as the L101 assembly (fig. 49). The L101 bobbin has a blue mark on it.

g. Insert the mounting lugs through the chassis slots, twist them securely, and solder. Replace the leads on the terminals of T101. Dress the tube and leads into position, and then slip the clamping wire back over the tip of the tube.

h. Aline the if. plug-in unit (par. 87).

85. Repair and Replacement of Inductor L101

a. A split or crack in the terminal (and mounting) board of L101 can be repaired by using cement (par. 84*a*).

b. A cracked shell can be replaced by a new ring, without changing the entire L101 assembly (par. 84*b*).

Note. The shell, or ring, used in the L101 and T101 assemblies are identical and interchangeable. The bobbins (core and winding assembly) are not the same.

c. To remove L101, unsolder the leads on all four of its terminals. Free the tube so that it can be shifted out of the way. Figure 49 shows a cutaway view of the if. plug-in unit. The terminal board of L101 is secured to the chassis by two lugs.

These lugs pass through slots in the chassis and are twisted and soldered. Melt the solder at these two lugs, straighten the lugs, and push out the defective L101 assembly, one side at a time.

d. Replace the new L101 assembly; orient it so that the open ends of the spring are on the right side, the same as the T101 assembly. Check to see that the bobbin has a red mark on it, indicating it to be a T101 assembly.

e. Insert the mounting lugs through the chassis slots, twist them securely, and solder. Replace the leads on the terminals of L101. Dress the tube and leads back into position.

86. Stage Gain

To check the stage gain of an if. plug-in unit, proceed as follows:

a. Connect an if. plug-in unit known to be in good operating condition into the X2 IF. UNIT test socket. Replace orange test can No. 2 with green test can No. 2 for gain test.

b. Adjust the signal generator frequency to 4.3 mc (unmodulated signal). Set the signal level so that an output indication is observed on the dc vtvm. Note the signal level.

c. Replace the good if. test unit with the repaired plug-in unit. Check the level of the unmodulated signal required to produce the same output indication on the dc vtvm. It should be within ±15 percent of the old level.

87. Alinement of If. Plug-in Units

To aline the if. plug-in unit, proceed as follows:

a. Connect the test equipment to the test chassis as shown in figure 46 (for alinement), with the oscilloscope and dc voltmeter connected to their proper outputs and the signal generator to the test chassis input. Insert the if. plug-in unit into the X2 IF. UNIT test socket on the test chassis. Check to see that test can No. 1 and orange alinement test can No. 2 are in their proper sockets.

b. Tune the signal generator to 4.3 mc, and feed this unmodulated signal at a level of 50,000 microvolts (or more) into the test chassis. Switch on the 4.3-mc crystal oscillator circuit on the test chassis. Tune the signal generator for zero-beat indication on the oscilloscope; this sets the input frequency exactly to 4.3 mc. Turn off the 4.3-mc crystal oscillator circuit.

Note. If no beat note is observed, and no indication is seen on the vtvm, the if. plug-in unit may be completely out of alinement. Tune L101 and T101 until an output is obtained. Adjust the signal generator to the crystal oscillator frequency (4.3 mc), and continue as below.

c. Adjust the movable rings of L101 and T101 for peak output on the vtvm. It may be necessary to reduce the output level of the signal generator as L101 and T101 are adjusted. When L101 and T101 are tuned to peak output, vary the signal generator frequency to each side of 4.3-mc and check whether the output indication drops. This method can be used to check the if. at peak output.

d. Detune the L101 and T101 adjustment slightly without the cover, so that when the cover is placed on the can, the if. will return to 4.3-mc.

e. Place the cover on the can and repeat the procedure given in *d* above, if necessary, until peak output is obtained.

88. Troubleshooting and Opened Pulse-Sweep Generator Plug-in Unit

Troubleshooting the pulse-sweep generator plug-in unit consists of an inspection for visible faults, a continuity and circuit check, a high potential test, and an operational check. If these tests do not locate the fault, then the tube is probably defective.

a. Inspection.

(1) Check for cracked, broken, or loose components.

(2) Check for stray particles, which may be causing a shorted or grounded circuit.

(3) Check for solder splashes, which may have occurred when the cover was removed.

b. Continuity and Circuit Check.

(1) The resistance measurements made with an ohmmeter should conform to the following chart:

Checks	From		To	Indications (ohms)
	Pin	Of		
R302, R303	2	J301	Ground	7.8 meg.
R301	1	V301	C301	470K.
R304	1	V301	Pin 4 of J301	47K.
R305	1	J301	C303	3.3 meg.

(2) To check capacitors C301, C302, and C303 (fig. 50), disconnect one end of the capacitor to be checked and connect across it a known good capacitor of the same value. Proceed with the opera-

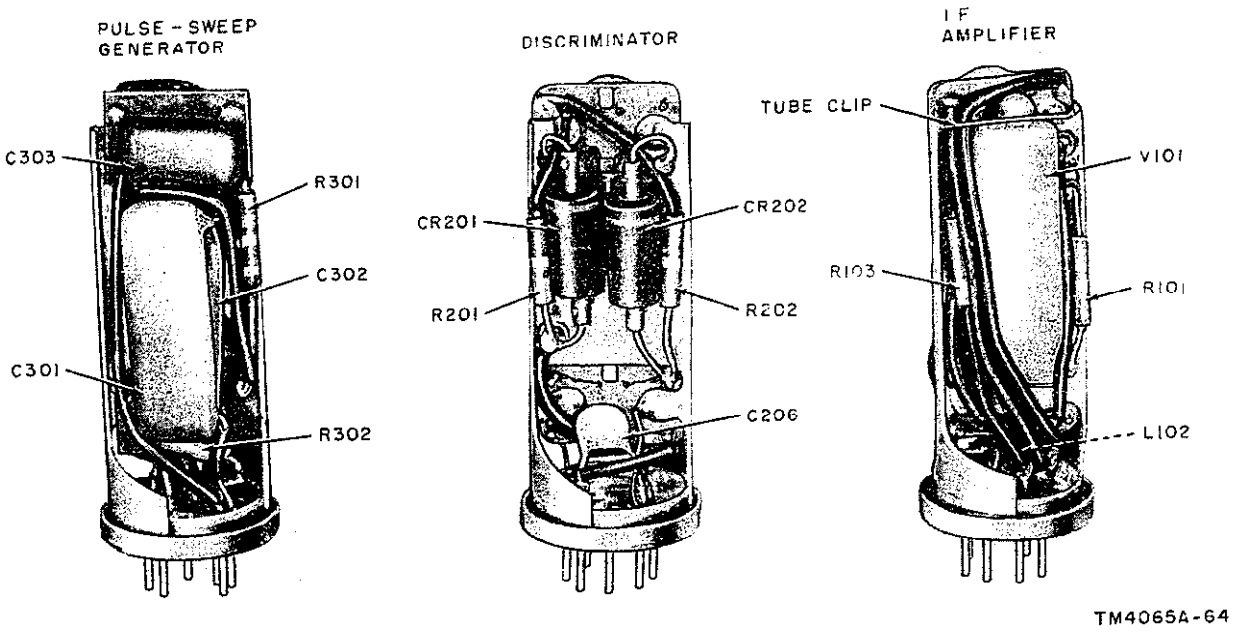


Figure 50. Pulse-sweep generator, discriminator and if. amplifier plug-in units with covers removed.

tional check and if requirements are met the part in question can be considered defective.

c. High Potential Test. The high potential test is the same as that in paragraph 82*c*.

d. Operational Test.

(1) *Preparatory adjustments.*

(*a*) Calibrate the timing oscillator in the oscilloscope by applying a 10-cycle audio signal from the audio oscillator to the vertical plates. Mark the position of the sweep rate knob when it is set at the maximum position at which the trace of the unit under test will "lock in." Use this mark to determine the correct knob position if it is ever moved.

(*b*) Calibrate the oscilloscope for voltage readings by applying a known 10-cycle signal of 3.55 volts rms (10 volts peak to peak) to the vertical plates and adjust the vertical gain of the oscilloscope for 20 graph divisions (2 div=1 volt).

(2) *Test procedure.*

(*a*) Before making the operational check, always test the pulse-sweep generator plug-in unit for high potential shorts.

(*b*) If the pulse-sweep generator unit checks good in the high potential test, remove the power and place the unit in pulse-sweep generator test socket X6.

(*c*) Place a known good if. plug-in unit in socket X5.

(*d*) Connect the calibrated oscilloscope to the pulse-sweep generator output jack.

(*e*) Observe the output frequency on the calibrated oscilloscope. The frequency should not exceed *10 cycles per second*.

(*f*) While still observing the oscilloscope pattern, note the output voltage peaks. These peaks should not exceed −3 volts and +2 volts.

(*g*) Replace the cover and seal as described in paragraph 94.

89. Troubleshooting an Opened Discriminator Plug-in Unit

Troubleshooting the discriminator plug-in unit consists of an inspection for visible faults, a continuity and circuit check, and an operational test. This circuit has no tube, therefore it does not require a high potential test.

a. Inspection. Follow the instructions in paragraph 88*a* for this inspection.

b. Continuity and Circuit Checks.

(1) With an ohmmeter, make the following checks:

Checks	From—		To—		Indication (ohm)
	Pin	Of	Pin	Of	
T202, primary	1	J201	2	J201	0
T202, secondary	1	J201	2	T202	∞
R201, R202	7	J201	1	J201	540K
L202	*CR201	------	CR202	--------	1

*Disconnect CR201 and CR202 from R201 and R202 when this check is made. The forward resistance of these crystal rectifiers should be 500,000 ohms and the reverse resistance should be 330 ohms minimum.

(2) If these checks do not reveal the fault, then check each capacitor by disconnecting one end of the capacitor to be checked and placing a known good capacitor in the circuit in its place. Replace any faulty capacitor and then proceed with the operational check.

c. Operational Check. Refer to figure 46 for the test equipment setup and proceed as follows:

(1) Place three good if. plug-in units in test sockets X1, X2, and X3 of the test chassis.

(2) Place the discriminator plug-in unit in test socket X4.

(3) Set the rf signal generator for an output of 4.3 mc at a 50,000-uv level.

(4) At the discriminator output jack on the test chassis, note the voltmeter reading. Tune the signal generator for zero output on the voltmeter. This zero reading *must* occur within ±5 kc of the 4.3-mc center frequency.

(5) The signal generator should be tuned to 30 kc above the discriminator center frequency. Note the output voltage on the voltmeter.

(6) Tune the signal generator to 30 kc below the discriminator center frequency. Note the output voltage on the voltmeter. This voltage must be at least 75 percent of the voltage reading in the previous procedure.

(7) Detune the signal generator off center frequency until a maximum reading is obtained on the voltmeter. Note the frequency reading. Detune the signal generator in the opposite direction until a maximum voltage output is obtained. The sum of these two frequencies away from the center frequency is the bandwidth and must be at *least* 100 kc.

(8) If any or all of the requirements listed can not be obtained a component failure or misalinement is present. To realine the discriminator, proceed as follows:

(*a*) Repeat the procedure in (1) above.

(*b*) Adjust L202 for zero output at 4.3 mc.

(*c*) Tune the signal generator to 30 kc above the center frequency. Note the discriminator output voltage on the voltmeter. Tune the signal generator to 30 kc below the center frequency and note the discriminator output voltage on the voltmeter. To make these two voltages equal each other as much as possible, tune T202. Two voltages of the same value rarely occur but the closer the voltages are to each other, the better the circuit is balanced.

(*d*) The discriminator must meet the requirements previously listed.

(*e*) Replace the cover and reseal (par. 94).

90. Repair and Replacement of Transformer T202

a. A split or crack in terminal (and mounting) board of T202 (fig. 49) can be repaired by using a special cement (par. 84*a*).

b. A cracked shell (ring) can be replaced by a new ring, without changing the entire transformer assembly (par. 84*b*).

c. If a winding of T202 is open, the entire T202 assembly must be replaced. To remove T202, first unsolder the leads of C202, C207, and C203 at terminals 1 and 2 of T202.

d. Unsolder the leads that connect to terminals 3 and 4 of T202.

e. The terminal board of T202 is secured to the chassis by two lugs. These lugs pass through slots in the chassis, are twisted and soldered. Melt the solder at these two lugs, straighten the lugs, and push out the defective T202 assembly, one side at a time. Orient the new T202 assembly so that the open ends of the spring are on the right side.

f. Check to see that the bobbin has a yellow mark on it, indicating it to be the L202 assembly.

g. Insert the mounting lugs through the chassis slots, twist them securely, and solder. Replace the leads on the terminals of T202. Dress the leads into position.

h. Inspect, aline, and test the discriminator plug-in unit (par. 89).

91. Repair and Replacement of Inductor L202

a. A split or crack in the terminal (and mounting) board of L202 can be repaired by using cement (par. 84*a*).

b. A cracked shell can be replaced by a new ring without changing the entire L202 assembly (par. 84*b*).

Note. The shell, or ring, used in the L202 and T202 assemblies are identical and interchangeable. The bobbins (core and winding assembly) are not the same.

c. To remove L202, unsolder the leads on terminals 2, 3, and 4. The terminal board of L202 is secured to the chassis by two lugs. These lugs pass through slots in the chassis and are twisted and soldered. Melt the solder at these two lugs, straighten the lugs, and push out the defective L202 assembly, one side at a time.

d. Orient the new L202 assembly so that the open ends of the spring are on the right side. Check to see that the bobbin has a green mark on it, indicating it to be a T202 assembly.

e. Insert the mounting lugs through the chassis slots, twist them securely, and solder. Replace the leads on the terminals of L202. Dress the leads into the proper position.

f. Inspect, aline, and test the discriminator plug-in unit as described in paragraph 89.

92. Inspection of a Repaired Plug-in Unit

After test, repair, and alinement of the plug-in units, it is important that a close mechanical inspection be given before resealing them.

a. Solder Faults.

(1) Inspect all soldered points to see that none are unsoldered or cold solder joints.

(2) Remove solder splashes, wire segments, lumps of rosin, and other foreign objects. Check for tiny pieces of solder that may have stuck to leads or lodged between leads.

(3) Check for excessive solder. Sufficient spacing should exist around all soldered joints to eliminate the possibility of a shorted or grounded circuit.

b. Broken Parts.

(1) Check to see that the rings (shells) on inductors and transformers are not chipped so that they can be rotated by the alinement tool. If defective, replace these shells.

(2) Inspect capacitors. They should not be chipped or broken and they should not lie on the chassis at any point.

(3) Check resistors. They should not be chipped, burned, or broken and their color coding should be readable.

(4) Check to see that the terminal boards are not broken or split. Repair or replace if defective (par. 84*a*).

(5) Check to see that the tube is not chipped at the base or at the tip.

c. Loose Parts.

(1) Touch the bobbins and shells; they should feel secure and not loose. A loose shell may be caused by the spring wire becoming unsoldered. The bobbin is cemented on to the base; if it becomes loose, change the entire assembly.

(2) Check to see that there is no solder, dirt, metal, insulation, etc. lodged between components, ready to come loose.

d. Lead Dress.

(1) Check all leads to be sure they are properly dressed, and are neither too taut nor too slack.

(2) The tube should lie on the chassis. Its envelope is coated with a metallic conductive paint and is grounded by a wire (around its base) connected to tube pin 3 and chassis ground. If this lead should become ungrounded or the metallic coating breaks off the wire around the tube base, the stage may become regenerative, noisy, and cause trouble. Check to see that no ungrounded items are shorted to the grounded metallic coating of the tube.

(3) Check to see that the insulation on the insulated leads is not frayed, burned, cut, too short, bruised, or damaged.

e. Outer Shell (Cover).

(1) Inspect the outer shell of the can to see that there are no sharp edges or pieces of solder inside the shell (par. 94).

(2) Check the fit of the can. The assembly should slide easily into the shell without forcing, and should go in full length

without the tip of the tube touching the shell. On Sonotone-type tubes (which physically are a trifle longer than the Raytheon-type tubes) this should be carefully checked. This can be done by cutting out a window in an old shell, and checking all assemblies in it before sealing in a new shell.

f. Wiring connections. If repair work was done that required leads to be removed and replaced, check the wiring connections. Refer to the appropriate schematic diagram to check the wiring.

Caution: Do not place an ohmmeter across the filament circuit of a tube; the battery of the ohmmeter may burn out the 1.25-volt filament winding.

93. High Potential Test and Alinement of Repaired Plug-in Units

Before testing a repaired unit, inspect it as outlined in paragraph 92.

a. High Potential Test for If. Amplifier and Pulse-Sweep Generator Units.

(1) Insert the plug-in unit into the hi-pot test socket (fig. 46). Hold down the hi-pot test switch and observe the voltmeter indication. It should read 135 volts. Tap the assembly gently to check for an intermittent circuit.

(2) Repeat the test after placing a cover over the assembly. Be sure a new sheet of insulation is placed between the cover and the assembly.

b. Alinement. Aline the unit and reseal it.

94. Resealing Plug-in Unit

Replace the cover of the units with new shells if available. If a shell must be reused, clean off the solder by painting on flux, then dipping the lower portion of the shell into a pot of melted solder, and slowly withdrawing the shell. The top of the cover should also be cleaned, and the hole left in the center of the top.

a. Fit the sheet of insulation around the assembly, and close the shell over the assembly. The cover should fit snug into the rim of the base.

b. Prepare a well of melted solder on the special soldering tip of the 300-watt iron. The soldering iron should be anchored rigid.

c. Hold the unit in a horizontal position. Use a gripper to hold the cover at one end, and another gripper to hold the base pins at the opposite end. Exert just sufficient pressure at each end so that the cover is seated all the way in the rim of the base.

d. Lower the if. unit over the soldering iron so that the seam to be soldered is in the well of the molten solder. Then slowly rotate the if. unit horizontally about its axis, so that the circular seam rolls through the molten solder and becomes sealed.

e. Test the solder seal at the base by applying air under pressure (2 pounds per square inch) through the hole in the top of the can, or by blowing into it and immersing in water. No bubbles should appear, indicating an airtight seal at the base.

f. Complete the sealing of the if. unit by soldering the hole at the top of the cover. Do not let excessive solder enter the can.

g. Coat the cover with a moisture- and fungus-resistant varnish, after masking the base so that the pins and underside of the base are not affected.

h. After resealing the repaired plug-in unit, check it electrically before placing it into service.