DEPARTMENT OF THE ARMY TECHNICAL MANUAL

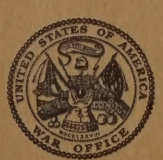
TM 11-2148

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TO 16-30TCC11-5

B-22

TELEPHONE REPEATER AN/TCC-11





DEPARTMENTS OF THE ARMY AND THE AIR FORCE
SEPTEMBER 1953

THIS SUPPLEMENT WILL REMAIN IN EFFECT ONLY UNTIL THE INFORMATION IS PUBLISHED IN AN OFFICIAL DEPARTMENT OF THE ARMY AND DEPARTMENT OF THE AIR FORCE PUBLICATION.

SUPPLEMENT

13 APRIL 1954

SUPPLEMENT TO
TM 11-2148/TO 16-30TCC11-5
TELEPHONE REPEATER AN/TCC-11

The following information, published on Order No. 14181-Phila-51 supplements TM 11-2148/TO 16-30TCC11-5, September 1953. The serial numbers covered in this supplement are:

Name	*Serial numbers*
Telephone Repeater AN/TCC-11	1 through 4400

Personnel using this equipment and having custody of this technical manual will enter suitable notations beside each affected paragraph and figure in the technical manual to indicate the presence of this supplementary information.

Page 9. Par. 6. In the last sentence, change "130" to read: 137.

Page 9. Par. 7. In the last sentence, change "75" to read: 82.

Page 13. Fig. 6. Delete figure 6 and substitute new figure 6:

Page 14. Fig. 7. Delete figure 7 and substitute new figure 7:

Page 15. Par. 15. Delete the sixth and seventh sentences.

Page 19. Par. 24. Make the following changes in subparagraph *a*:

Delete subparagraph (2) and substitute new subparagraph (2).

(2) Press down on the J1 end cover assembly. Loosen each of the three captive mounting screws on the rim of the end cover assembly a few turns at a time until all three screws become free about the same time. The J1 end cover assembly will become loosened by the outward pressure exerted by the assemblies within the case. Remove the J1 end cover assembly.

Caution: Do not unscrew completely any one of the captive mounting screws without also loosening the other two. Excessive stress would be placed on the remaining captive mounting screws securing the cover assembly because of the outward pressure exerted by the assemblies within the case. The captive screws may be damaged as a result of this stress.

Delete subparagraph (3).

Page 21. Par. 24. Make the following changes in paragraph 24.

In subparagraph *a* (13), last line, add the following after "screws": while pressing down on the end cover assembly.

In subparagraph *b* (1), third line, change "*a* (1) through (3)" to read: *a* (1) and (2).

In subparagraph *b* (9), last line, add the following after "screws": while pressing down on the end cover assembly.

Page 33. Fig. 16. Delete figure 16 and substitute new figure 16.

Page 85. Par. 140. Make the following change in the table in subparagraph *a* (4):

In the column headed "Normal resistance (ohms)," last line, change "5" to read: 3.5.

Page 86. Par. 140. Make the following change in the table in subparagraph *b* (3):

In the column headed "Normal resistance (ohms)," last line, change "5" to read: 3.5.

Page 98. Fig. 45. Delete figure 45 and substitute new figure 45.

Page 99. Fig. 46. Delete figure 46 and substitute new figure 46.

Page 104. Fig. 51. Delete the filter section catch release and its callout from this figure.

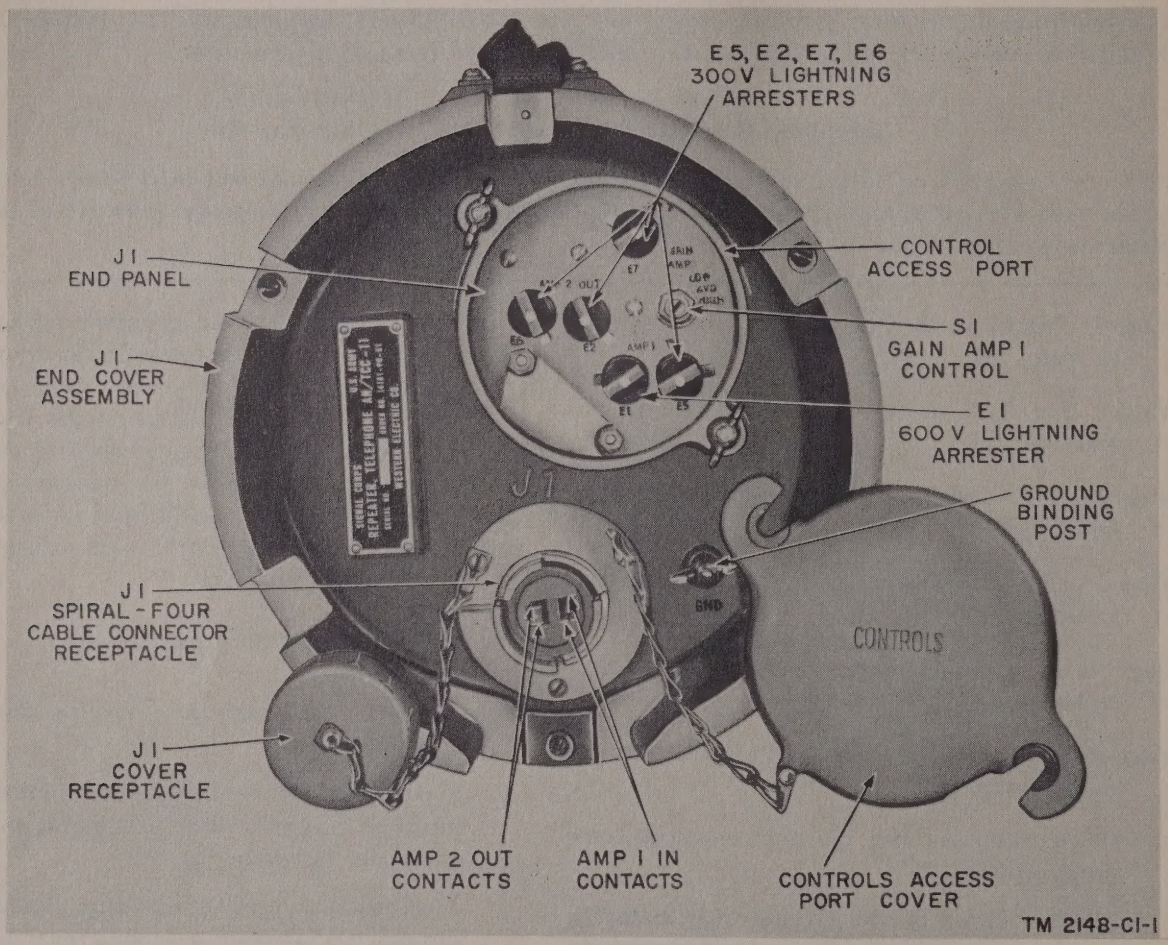


Figure 6. Telephone Repeater AN/TCC-11, J1 end cover assembly, controls access port open.

Page 120. Par. 169. Make the following changes in paragraph 169:

Delete subparagraph *b* and substitute new subparagraph *b*.

b. Press down on the J1 end cover assembly. Loosen the three captive mounting screws on the rim of the end cover assembly a few turns at a time until all three screws become free about the same time. The J1 end cover assembly will become loosened by the outward pressure exerted by the assemblies within the case. Remove the J1 end cover assembly.

Caution: Do not unscrew completely any of the captive mounting screws without also loosening the other two. Excessive stress would be placed on the remaining captive mounting screws securing the cover assembly because of the upward pressure exerted by the assemblies within the repeater case. The captive screws may be damaged as a result of this stress.

Delete subparagraph *c*.

In subparagraph *d*, fourth and last lines, delete "so that the line amplifier may be removed."

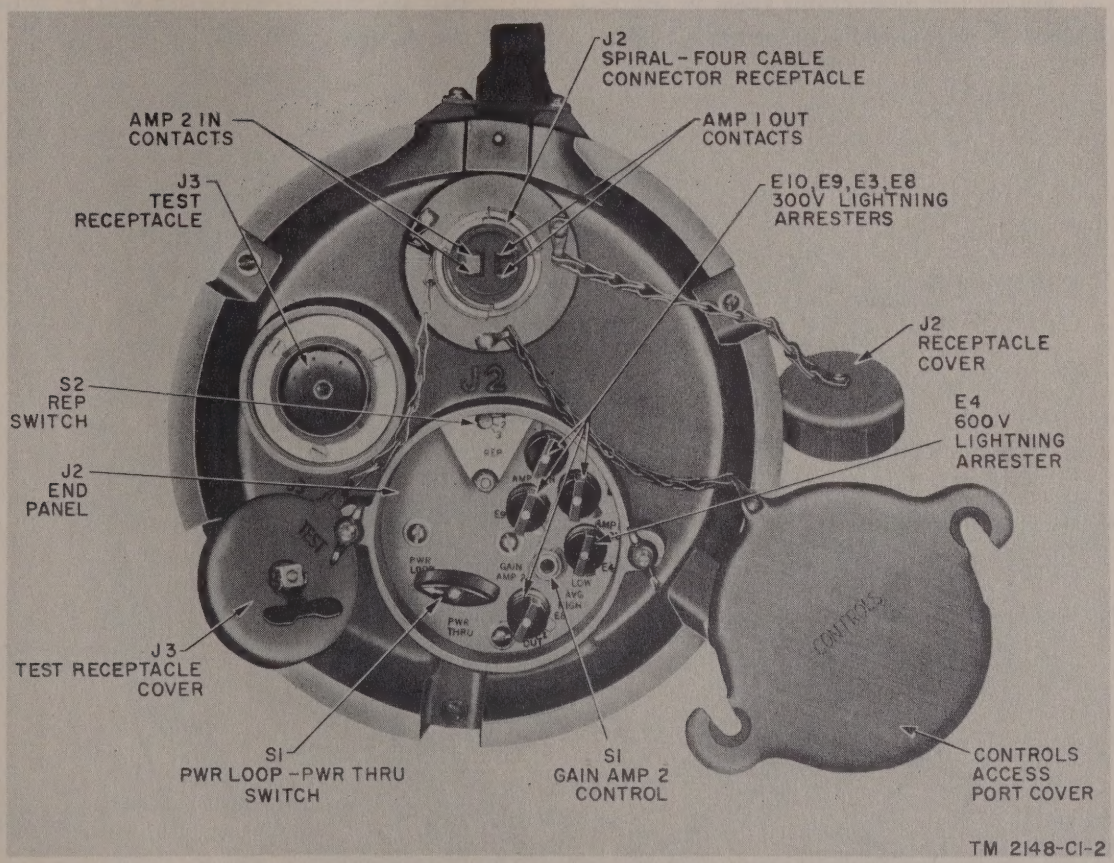


Figure 7. Telephone Repeater AN/TCC-11, J2 end cover assembly, controls access port open.

Page 120. Par. 169 (cont'd)

In subparagraph *j*, last line, add the following after "assembly": and pry it loose with a screw driver or similar tool (fig. 60). Slide the screw driver blade into the prying notch located under the end cover assembly rim and work the blade between the cover assembly and the repeater case. Remove the J2 end cover assembly.

In subparagraph *m*, delete "Depress the filter section catch release and."

Add the following paragraph after paragraph 169:

169.1. Alternate Method for Disassembly of Telephone Repeater AN/TCC-11

a. Follow the instructions given in subparagraphs *a, b, d, i, j,* and *k* of paragraph 169.

b. Place the repeater on its side. Pull the assembled filter section and line amplifier from the case by inserting fingers in the holes of the line amplifier cover and pulling along the mounting rails, or by pushing the assemblies from the other end.

Page 121. Fig. 60. In the figure caption, add the following after "assembly": with other end cover assembly removed.

Page 124. Fig. 63. Delete the filter section catch release and its callout from the figure.

Page 124. Par. 170. Make the following changes in paragraph 170:

In subparagraph *c*, second sentence, delete "so that the filter section catch will be alined with the slotted guide rail."

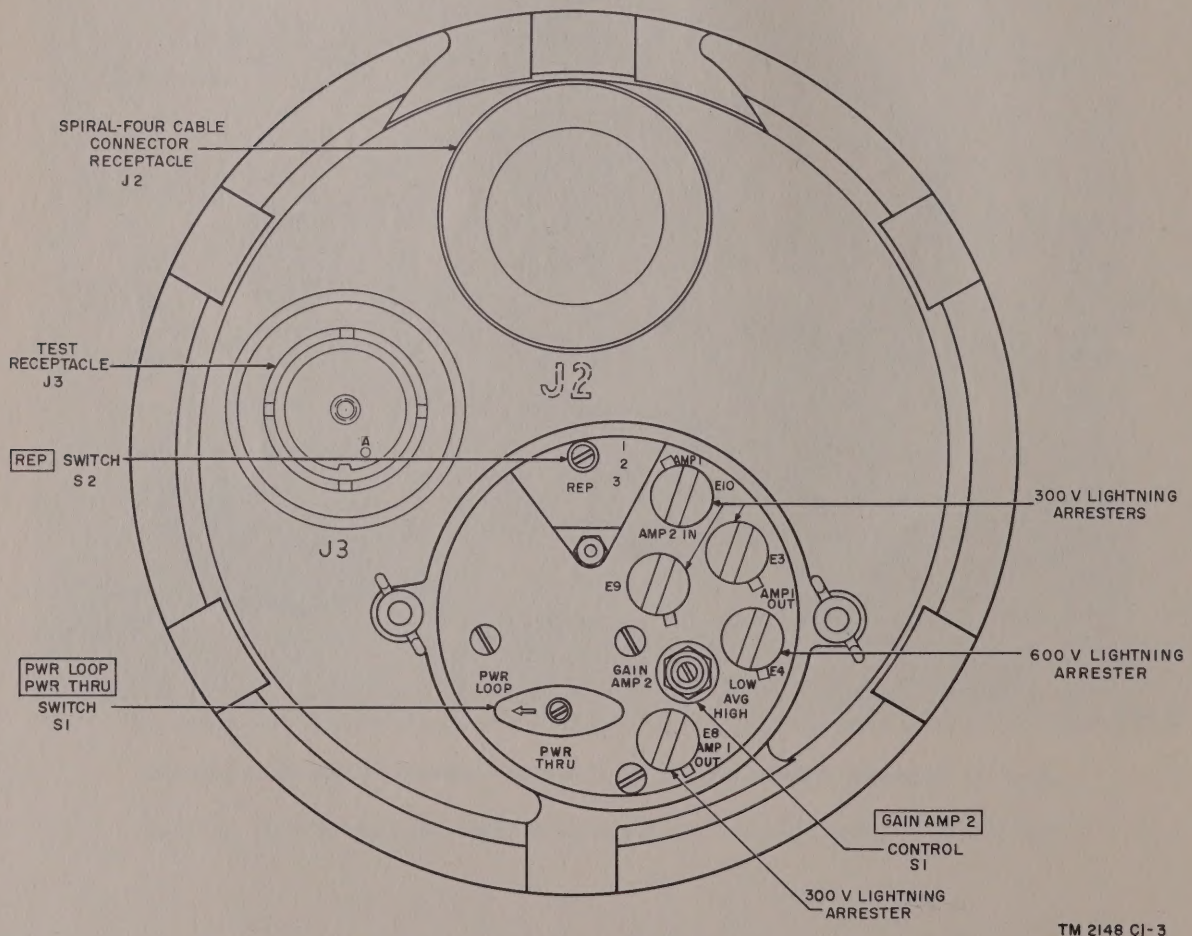


Figure 16. Telephone Repeater AN/TCC-11, J2 end panel controls.

Page 124. Par. 170 (cont'd)

Delete subparagraph *d* and substitute new subparagraph *d*.

d. Insert the filter section into the case and push it down to approximately the center of the case.

Caution: Be sure that the cables and connectors associated with the filter section do not get caught on the mounting rails.

In subparagraph *t*, add the following "Note" after the last sentence:

Note. Press the J2 end cover assembly down while tightening the three captive mounting screws.

Add the following after paragraph 170:

170.1. Alternate Method for Assembly of Telephone Repeater AN/TCC-11

a. Mount the line amplifiers on the filter section and fasten each of the line amplifier covers to a line amplifier.

b. Position the repeater case vertically with the red dot on the inside of the case pointing upward.

c. Insert the filter section and line amplifier assembly into the repeater case so that the red dot on the filter section chassis is pointing upward, and the mounting slide nearest the

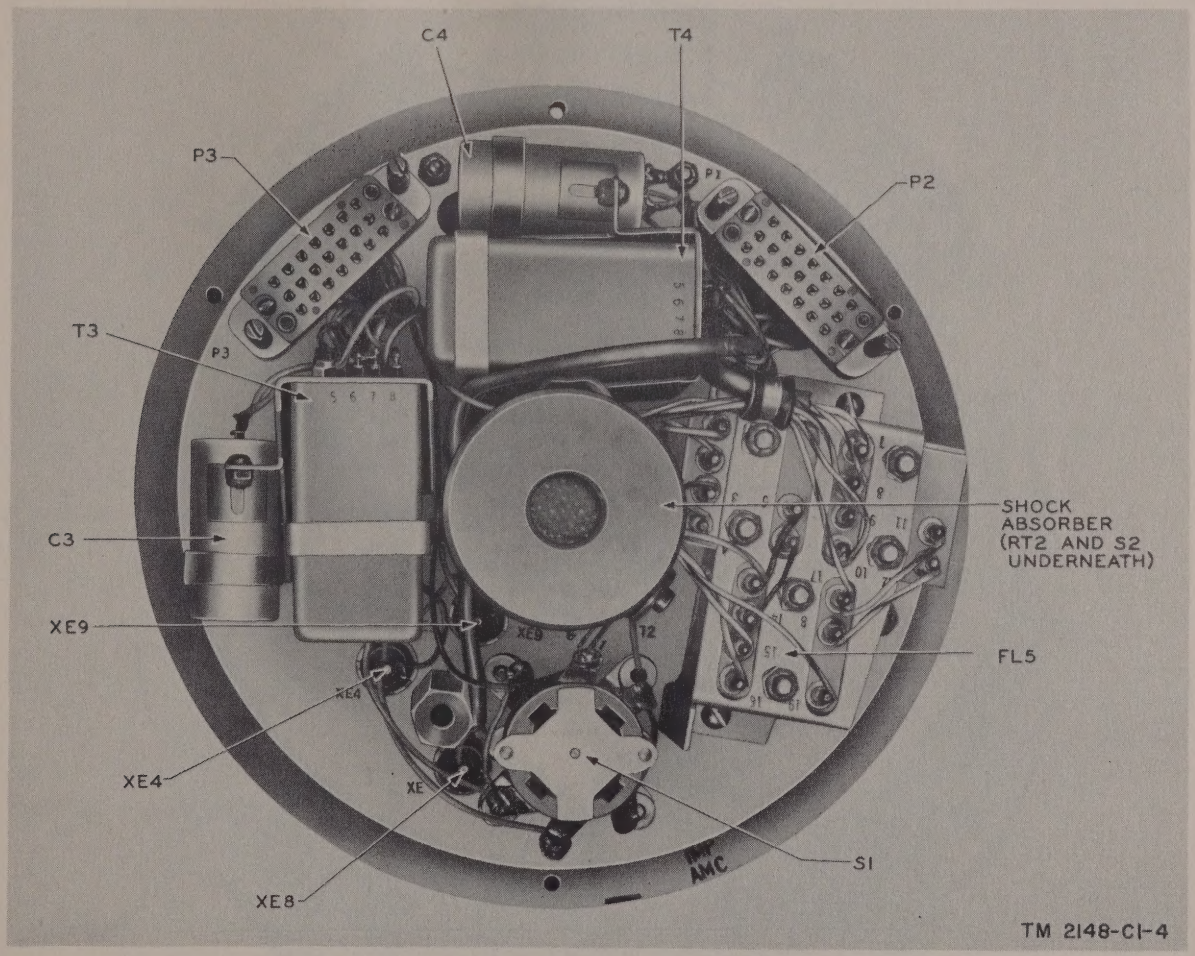


Figure 45. Telephone Repeater AN/TCC-11, J2 end cover assembly, rear view

Page 124. Par. 170.1 (cont'd)

red dot on the filter section chassis slides along the repeater case mounting rail nearest the red dot in the repeater case (fig. 63). Allow the weight of the assembly to move it down into the repeater case.

Caution: Make sure that the cables and connectors associated with the filter section do not get caught on the mounting rails.

d. Follow the instructions in paragraphs 170*k* through *o*.

e. Repeat the instructions in paragraph 170*k* through *n* for the J1 end of the repeater. Substitute connectors J4 and J9 for connectors J5 and J6 in paragraph 170*k*.

Page 126. Par. 175. In the table in subparagraph *b* (2), in the column headed "Min," lines 2 and 3, change "A+ 1.0" to read: A+ .6.

Page 127. Par. 178. Make the following changes in subparagraph *b*:

In subparagraph (16), change "(10)" to read: (9).

In subparagraph (17), last line, change "(16)" to read: (15).

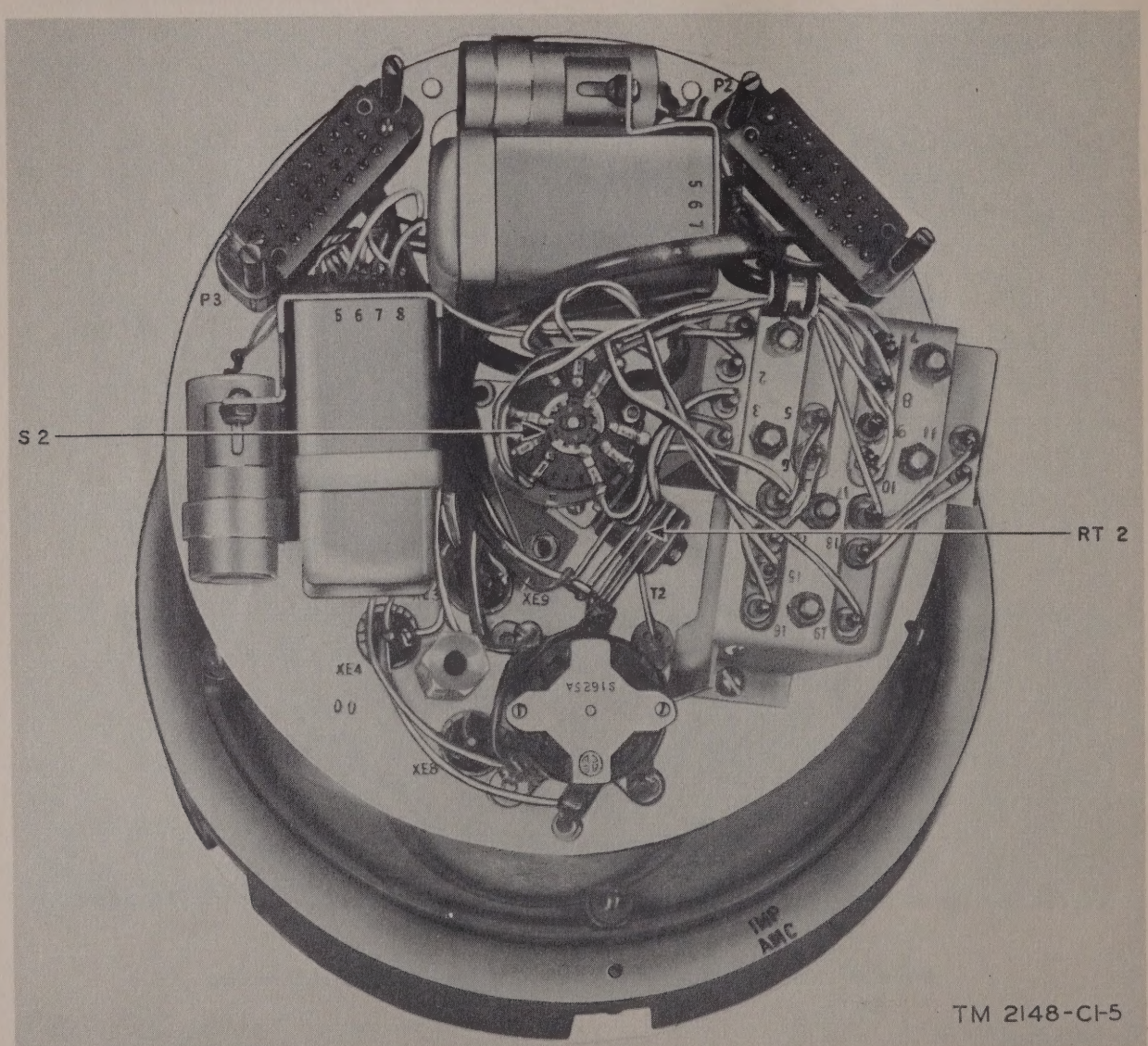


Figure 46. Telephone Repeater AN/TCC-11, J2 end cover assembly, rear view, parts removed to show thermistor RT2 and switch S2.

TECHNICAL MANUAL
No. 11-2148
TECHNICAL ORDER
No. 16-30TCC11-5

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *16 September 1953*

TELEPHONE REPEATER AN/TCC-11

		Paragraph	Page
CHAPTER 1.	INTRODUCTION		
Section I.	General	1, 2	7
II.	Description and data	3–16	7
CHAPTER 2.	INSTALLATION INSTRUCTIONS		
Section I.	Service upon receipt of Telephone Repeater AN/TCC-11	17–28	16
II.	Preinstallation tests	29–43	25
III.	Controls and instruments	44, 45	31
CHAPTER 3.	OPERATING INSTRUCTIONS		
Section I.	Operation under usual conditions	46–53	34
II.	Operation under unusual conditions	54–57	37
CHAPTER 4.	ORGANIZATIONAL MAINTENANCE INSTRUCTIONS		
Section I.	Preventive maintenance services	58–61	39
II.	Lubricating and weatherproofing	62–64	42
III.	Troubleshooting at organizational maintenance level	65–67	42
IV.	Troubleshooting at the unattended point	68–80	43
V.	Troubleshooting at the attended point	81–91	49
CHAPTER 5.	THEORY		
Section I.	Introduction	92–102	58
II.	Theory of transmission circuits	103–120	61
III.	Theory of auxiliary circuits	121–131	68
CHAPTER 6.	FIELD MAINTENANCE INSTRUCTIONS		
Section I.	Troubleshooting at field maintenance level	132–137	75
II.	Troubleshooting Telephone Repeater AN/TCC-11	138–151	84
III.	Additional troubleshooting information	152–155	109
IV.	Signal substitution	156–158	112
V.	Parts testing	159–167	116
VI.	Repairs	168–171	120
VII.	Final testing, line amplifier	172–180	125
VIII.	Final testing, Telephone Repeater AN/TCC-11	181–192	128
CHAPTER 7.	SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE		
Section I.	Shipment and limited storage	193, 194	136
II.	Demolition of material to prevent enemy use	195, 196	136
APPENDIX I.	REFERENCES		137
II.	IDENTIFICATION TABLE OF PARTS		139
GLOSSARY			147
INDEX			149

WARNING

HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

may result if personnel fail to observe safety precautions

Be careful not to contact high-voltage connections or 200-volt input connections when working on or near this equipment.

When working inside the equipment, after the power has been turned off, always short-circuit the high-voltage capacitors.

ARTIFICIAL RESPIRATION

GENERAL PRINCIPLES

1. Seconds count! Begin at once! Don't take time to move the victim unless you must. Don't loosen clothes, apply stimulants or try to warm the victim. Start resuscitation! Get air in the lungs! You may save a life!

2. Place the victim's body in a prone position, so that any fluids will drain from the respiratory passages. The head should be extended and turned sideward *never flexed forward;* the chin shouldn't sag, since obstruction of the respiratory passages may occur.

3. Remove any froth or debris from the mouth with your fingers. Draw the victim's tongue forward.

4. Begin artificial respiration. Continue it rhythmically and without any interruption until natural breathing starts or the victim is pronounced dead. Try to keep the rhythm smooth. Split-second timing is not absolutely essential.

5. When the victim starts breathing, or when additional help is available loosen the clothing; remove it, if it's wet; keep the victim warm. Shock should receive adequate attention. Don't interrupt the rhythmical artificial technique for these measures. Do them only when you have help or when natural breathing has started.

6. When the victim is breathing, adjust your timing to assist him. Don't fight his efforts to breathe. Synchronize your efforts with his. After resuscitation, keep him lying down until seen by a physician or until recovery seems certain.

7. Don't wait for mechanical resuscitation! If an approved model is available, use it, but, since mechanical resuscitators are only slightly more effective than properly performed "push-pull" manual technique, *never* delay manual resuscitation for it.

BACK-PRESSURE ARM LIFT METHOD

1. *Position of Victim.* Place the victim in the prone (face-down) position. Bend his elbows; place one hand upon the other. Turn his face to one side, placing his cheek upon his hands.

2. *Position of Operator.* Kneel on your left or right knee, at the victim's head, facing him. Your knee should be at the side of the victim's head close to his forearm, your foot should be near his elbow. Kneel on both knees if you find it more comfortable, with one knee on each side of the head. Place your hands on the flat of the victim's back so that their heels are just below the lower tip of his shoulder blades. With the tip of your thumbs touching spread your fingers downward and outward. (See A)

3. *Compression Phase.* Rock forward until your arms are approximately vertical and allow the weight of the upper part of your body to exert a slow, steady, even, downward pressure upon your hands. This forces air out of the lungs. Keep your elbows straight and press almost directly downward on the back. (See B)

4. *Expansion Phase.* Release the pressure, avoid any finish thrust, and commence to rock backward slowly. Place your arms upon the victim's arms just above the elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the victim's shoulders.

Don't bend your elbows. As you rock backward, the victim's arms will be drawn toward you. (The arm lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest.) Drop the arms gently to the ground or floor. This completes the cycle. (See C and D). Now repeat the cycle.

5. *Cycle Timing and Rhythm.* Repeat the cycle 10 to 12 times per minute. Use a steady uniform rate of Press, Release, Lift, Release. Longer counts of about equal length should be given to the "Press" and "Lift" steps of the compression and expansion phases. Make the "Release" periods of minimum duration.

6. *Changing Position or Operator.*

(*a*) Remember that you can use either or both knees or can shift knees during the procedure, provided you don't break the rhythm. Observe how you rock forward with the back-pressure and backward with the arm-lift. The rocking motion helps to sustain the rhythm and adds to the ease of operation.

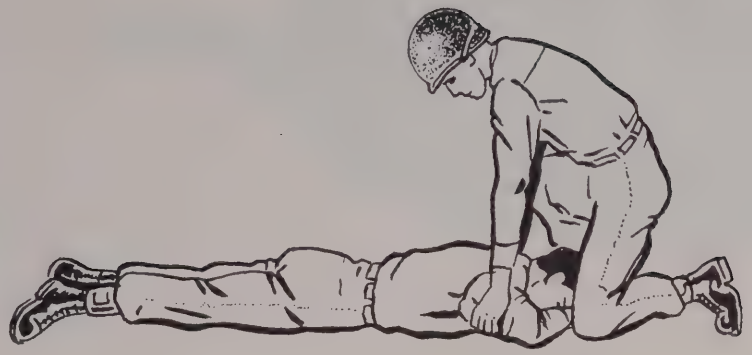
(*b*) If you tire and another person is available, you can "take turns." Be careful not to break the rhythm in changing. Move to one side and let your replacement come in from the other side. Your replacement begins the "Press-Release" after one of the "Lift-Release" phases, as you move away.



A **Position of operator and victim**



B **Compression phase**



C **Expansion phase (arm lift)**



D **Expansion phase (arm release)**

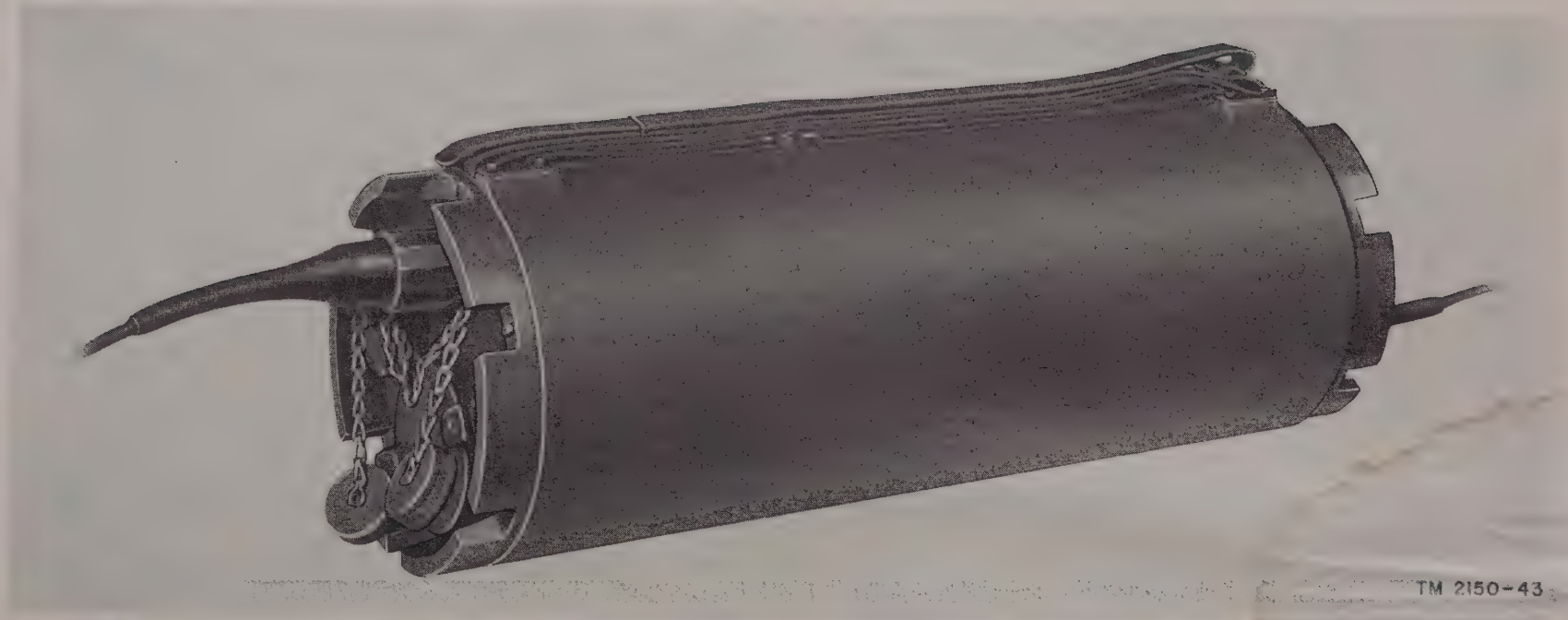


Figure 1. Telephone Repeater AN/TCC-11.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual is published for the use of the personnel to whom this equipment is issued. It contains information for the installation, operation, and repair of Telephone Repeater AN/TCC–11.

b. There are two appendixes. Appendix I contains a list of references. Appendix II contains an identification table of parts and a glossary.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and in performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), Navy Shipping Guide, Article 1850–4, and AFR 71–4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. DA AGO Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar) will be prepared in accordance with instructions on the back of the form (fig. 17).

e. DA AGO Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar) will be prepared in accordance with instructions on the back of the form (fig. 18).

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

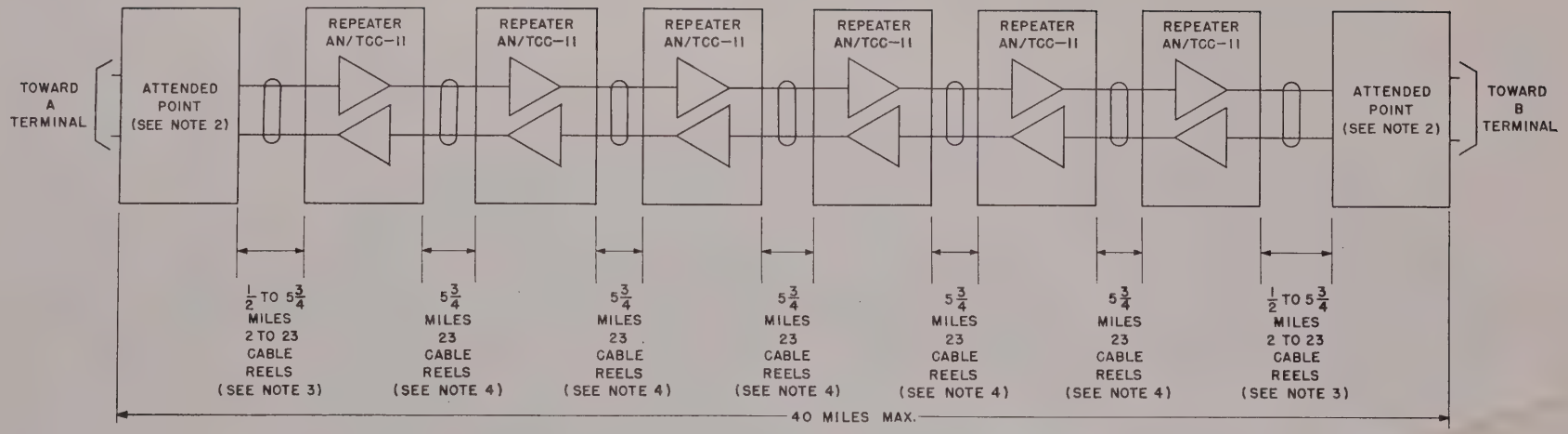
a. Telephone Repeater AN/TCC–11 (fig. 1) is a four-wire, unattended, carrier-telephone repeater. It is used to extend the length of a 12-channel carrier-telephone system that uses Telephone Terminals AN/TCC–7 and Telephone Repeaters AN/TCC–8 at the attended points, and uses nonloaded spiral-four cable as the main transmission medium. The extension obtained for each AN/TCC–11 added to the system is 5¾ miles (23 reels of Cable Assembly CX–1065/G).

b. Telephone Repeater AN/TCC–11 contains facilities for amplifying, equalizing, and regulating the two-way transmission of a band of frequencies from 12 kc (kilocycles) to 99 kc. This band contains 12 carrier frequency message channels, a 68-kc pilot frequency, and three fault finding frequencies of 83 kc, 91 kc, and 99 kc. Amplification is supplied to overcome cable losses in the two directions of transmission. Equalization is supplied to correct for differences in cable loss at the various frequencies transmitted. Regulation is applied to correct for changes in cable loss which occur with changes in temperature. In addition, a means of ringing, talking, and listening to attended points is provided over an unamplified voice-frequency maintenance circuit called the order wire.

Note. Throughout this technical manual, whenever the term AN/TCC–11 is used, it will refer to Telephone Repeater AN/TCC–11; similarly, reference to AN/TCC–7 will mean Telephone Terminal AN/TCC–7; reference to TS–712 Test Set will mean Telephone Test Set TS–712/TCC–11; and reference to AN/TCC–8 will mean Telephone Repeater AN/TCC–8. Basic nomenclature followed by ( ) refers to all models of the equipment, regardless of past or present procurement.

4. System Application
(fig. 2)

a. Block Diagram. The simplified block diagram of figure 2 illustrates a typical application of Telephone Repeater AN/TCC–11 in a carrier communications system. For more complete system application information, see TM 11–2150.



NOTES:

1. THE NUMBER OF AN/TCC-11 REPEATERS BETWEEN ATTENDED POINTS MAY VARY FROM NONE TO SIX.
2. ATTENDED POINTS MAY BE TELEPHONE TERMINALS AN/TCC-7 OR TELEPHONE REPEATERS AN/TCC-8.
3. CABLE REELS BETWEEN ATTENDED POINT AND FIRST AN/TCC-11 REPEATER MAY CONSIST OF CABLE ASSEMBLIES CX-1065/G OR MAY BE SIMULATED BY ATTENUATION NETWORKS AT THE ATTENDED POINTS.
4. CABLE REELS BETWEEN SUBSEQUENT AN/TCC-1 REPEATERS ARE CABLE ASSEMBLIES CX-1065/G, EACH 1/4 MILE IN LENGTH.
5. ( ) SYMBOL INDICATES SPIRAL-FOUR CABLE.

TM 2158-2

Figure 2. Telephone Repeater AN/TCC–11, system application block diagram.

b. Transmission Directions, Definition. Telephone Terminal AN/TCC–7 equipment at the opposite terminals of the 12-channel carrier system are designated as A terminal and B terminal to distinguish one from the other. The A terminal is the control point of the system and usually is at the site of the higher headquarters. The A terminal is shown on the left side of drawings, and the B terminal is shown on the right. The A–B direction of transmission is defined as the transmission path from the A terminal to the B terminal and is shown on drawings from left to right. The B–A direction of transmission is defined as the transmission path from the B terminal to the A terminal and is shown on drawings from right to left.

c. Repeater Spacing. The number of Telephone Repeaters AN/TCC–11 used between any two attended points is determined by the number of reels of spiral-four cable between the attended points. An AN/TCC–11 repeater is inserted after every 23 cable reels (5¾ miles). Fewer reels may be used when Telephone Repeater AN/TCC–11 is installed in the system adjacent to an attended point. When fewer than 23 cable reels are installed between any attended point and an AN/TCC–11, the attenuation of the missing reels is supplied by attenuating networks at the attended point. Attended points may be located so that no unattended repeaters are required between them; however, from one to six AN/TCC–11 repeaters usually are required between attended points to supply the necessary amplification, equalization, and regulation. Maximum distance between attended points (utilizing six AN/TCC–11 repeaters) is 40 miles. Maximum distance between two system terminals is 200 miles.

d. Power Loops. Telephone Repeater AN/TCC–11 obtains power for its operation over the spiral-four cable from the attended point. When one or more AN/TCC–11 repeaters are used between attended points, the repeaters are divided into two groups called power loops (par. 126). Each power loop may contain up to three repeaters receiving power from one attended point.

5. Technical Characteristics

Amplified frequency range	12 kc to 100 kc.
Unamplified frequency range (Order wire).	300 cycles to 1,700 cycles.
Fault finding frequencies required	83 kc, 91 kc, and 99 kc.
D-c power required	148 v, 0.1 amp, current regulated.
Nominal repeater gain	23 db at 68 kc.
Output transmission level, nominal	0 db.
Input transmission level range, 68 kc	−16 db to −30 db.
Output transmission level range, 68 kc	−5 db to +5 db.

6. Packaging Data

When packaged for export shipment, Telephone Repeater AN/TCC–11 is placed in a moisture-vaporproof container and packed in a wooden export crate. An exploded view of Telephone Repeater AN/TCC–11 packed for export is shown in figure 9. The export crate is 14 inches wide, 16 inches high, and 34 inches deep. It has a volume of 4.4 cubic feet. The packed crate weighs 130 pounds.

Note. Items may be packaged in a manner different from that shown in figure 9, depending on the supply channel.

7. Table of Components

Telephone Repeater AN/TCC–11 is a one-component equipment. It measures 10 inches in diameter and is 28¼ inches long. It has a volume of 1.3 cubic feet and weighs 75 pounds.

8. Description of Telephone Repeater AN/TCC–11

(fig. 3)

a. Telephone Repeater AN/TCC–11 is a four-wire, unattended, carrier-telephone repeater designed for use in systems using Telephone Terminal AN/TCC–7 and Telephone Repeater AN/TCC–8 at the attended points. The AN/TCC–11 consists of two end cover assemblies, two plug-in amplifiers (with covers), and a filter section, all contained within a hollow metal cylinder called the case. Four mounting rails are fastened to the interior walls of the case. These rails engage strips, or slides, on the plug-in amplifiers and the filter section to hold these units in place.

b. Removable covers on the exterior side of the end cover assemblies (figs. 4 and 5) permit access to controls, connectors, and lightning arrestors.

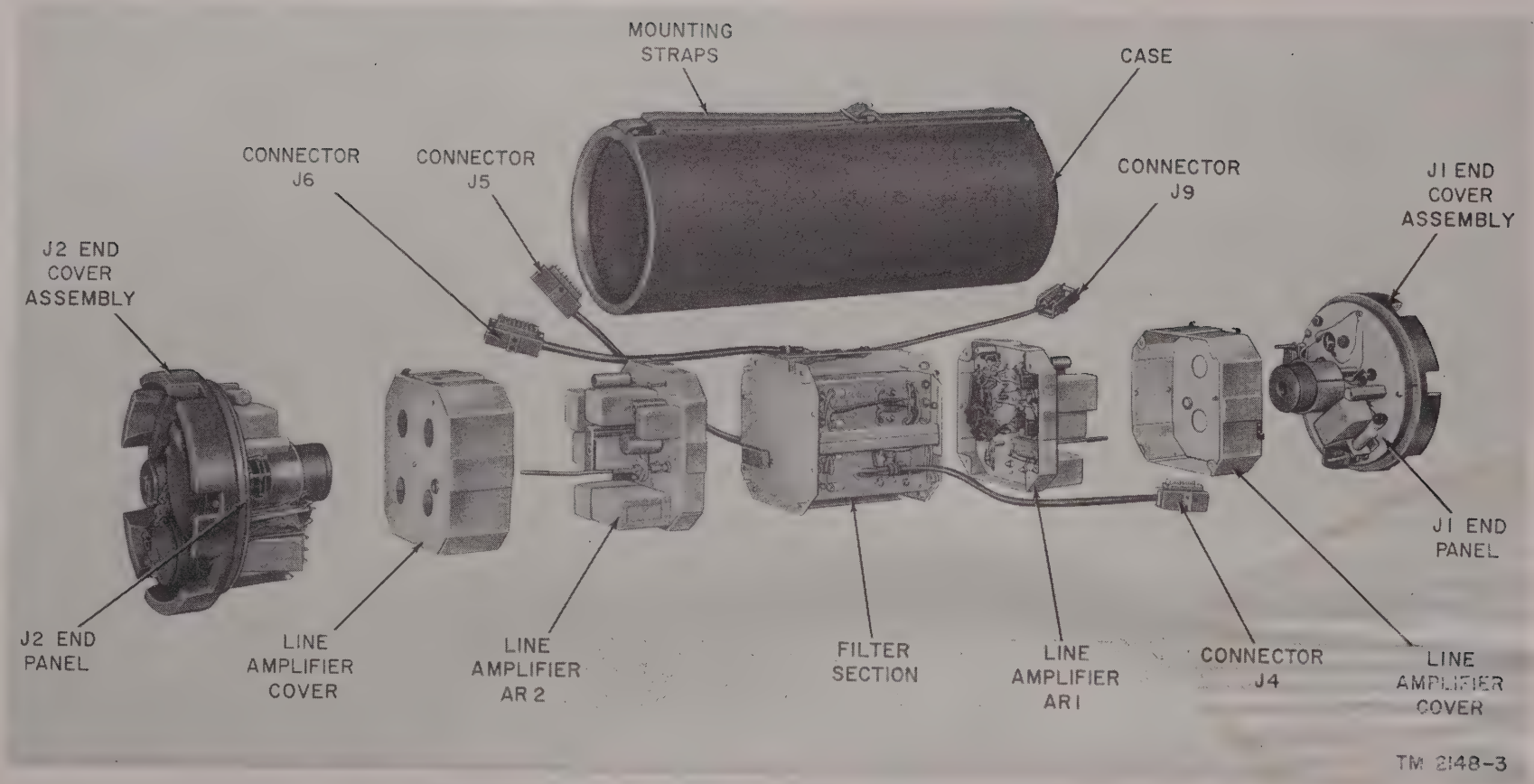


Figure 3. Telephone Repeater AN/TCC-11, assemblies removed from case.

c. Two 7-foot webbing straps are provided for mounting Telephone Repeater AN/TCC–11 to poles or trees. These straps are fastened along the length of the repeater case and are secured by being passed through retaining brackets at each end of the case. When attached to the case, the straps may be used for carrying the repeater. When removed from the case, the straps are used for mounting the repeater.

9. Telephone Repeater AN/TCC–11, Identification of Ends

(figs. 4 and 5)

The markings on the cover assemblies are used to distinguish between opposite ends of the equipment. The cover assembly marked J1 in raised lettering on its external surface identifies the J1 end of the repeater. The cover assembly marked J2 identifies the J2 end.

10. J1 End Cover Assembly, Description

(fig. 6)

The cover assembly for the J1 end of Telephone Repeater AN/TCC–11 consists of two parts—the external cover and a control panel, designated the J1 end panel, mounted behind the cover and separated from it by metal spacers. A controls access port, with a removable cover, permits access to the controls and replaceable lightning arresters on the externally facing side of the J1 end panel. Spiral-four cable connector J1 is mounted on the external cover.

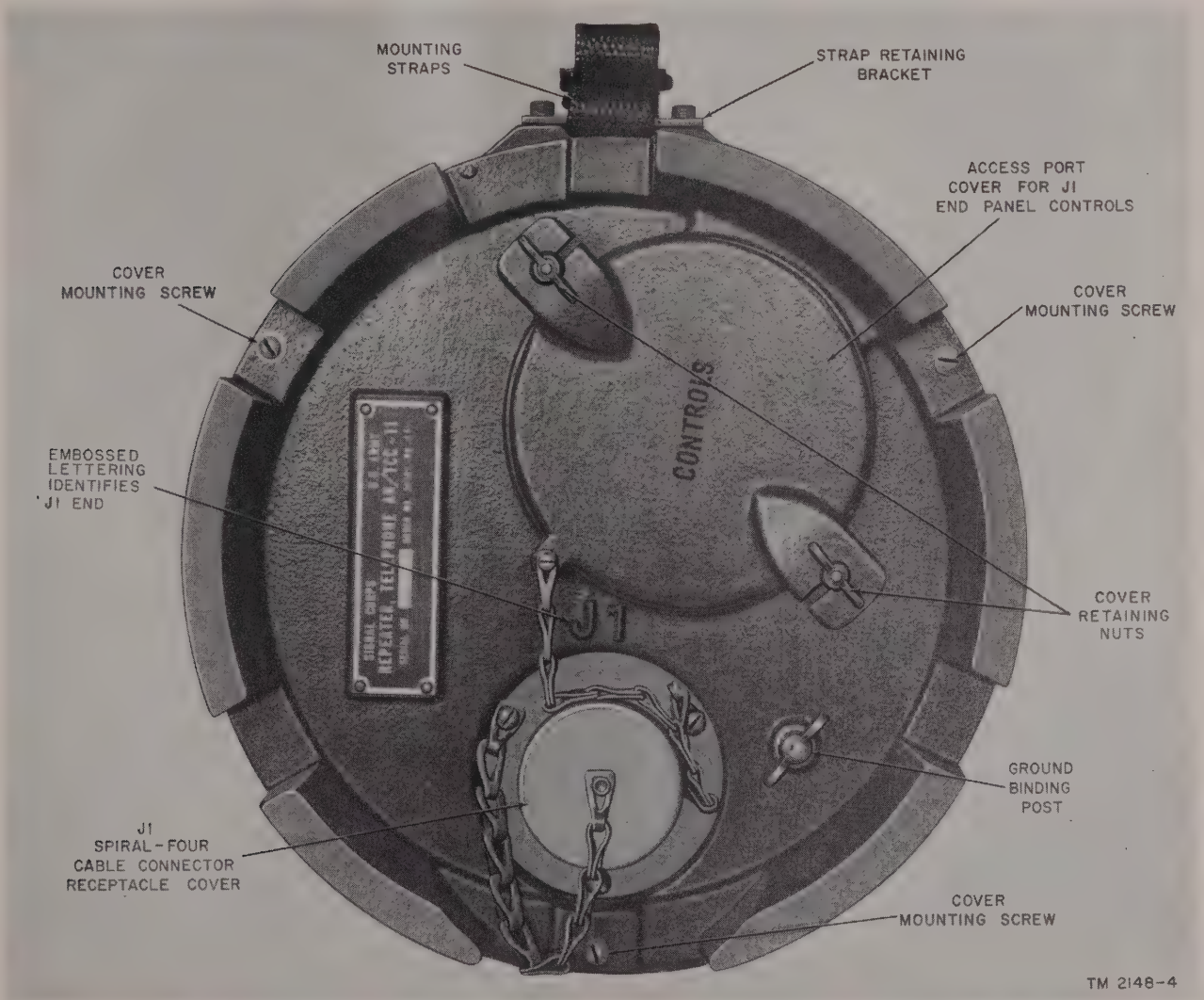


Figure 4. Telephone Repeater AN/TCC–11, J1 end cover assembly.

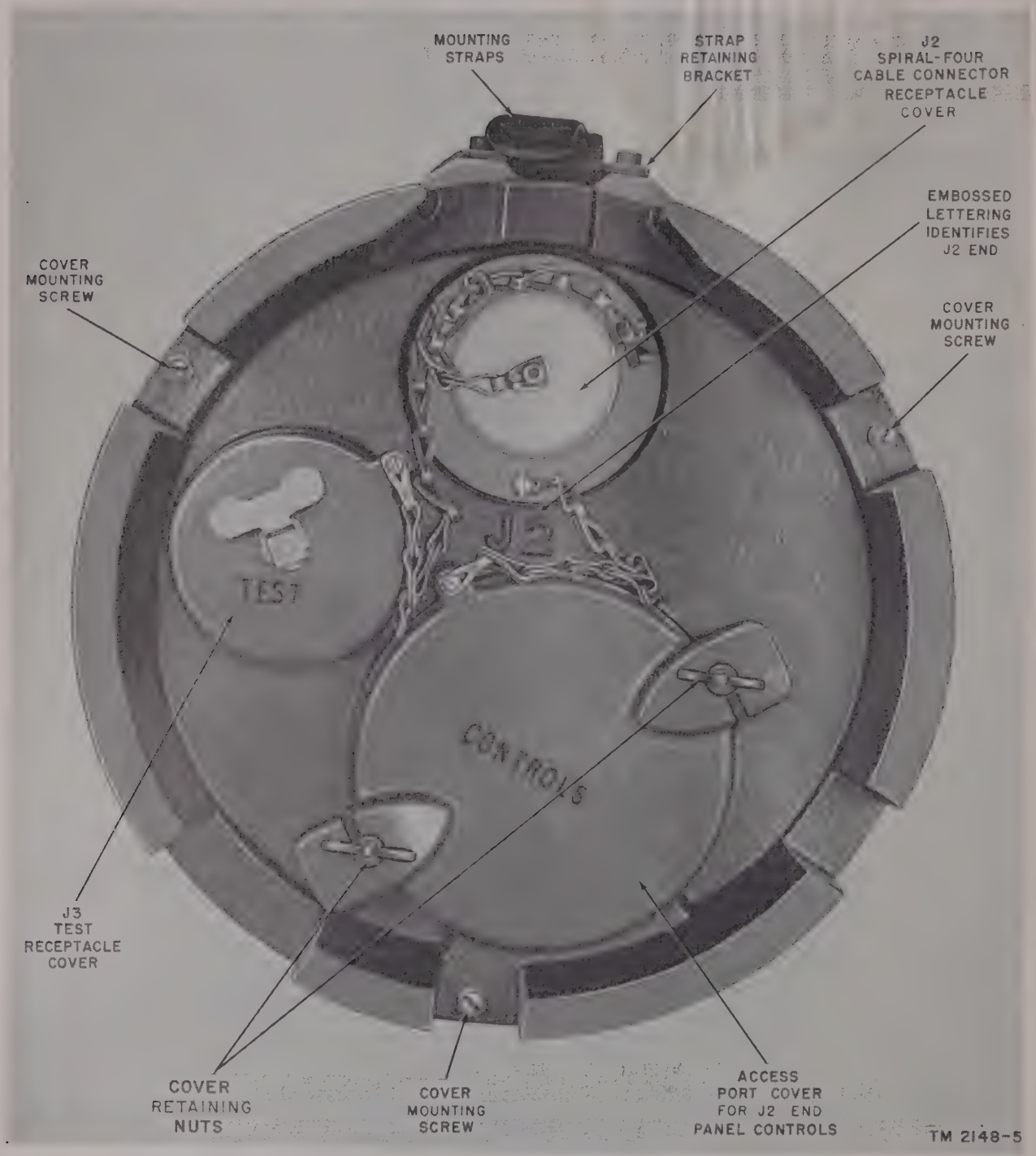


Figure 5. Telephone Repeater AN/TCC–11, J2 end cover assembly.

11. J2 End Cover Assembly, Description

(fig. 7)

The cover assembly for the J2 end consists of an external cover and a control panel mounted behind it. This control panel is designated the J2 end panel. A controls access port, with a removable cover, permits access to the controls and replaceable lightning arresters on the externally facing side of the J2 end panel. Spiral-four cable connector J2 and multicontact test receptacle J3 are mounted in the external cover.

12. J1 End Panel, Description

The externally facing side of the J1 end panel (fig. 6) mounts the GAIN AMP 1 control that permits adjustment of the amplifier gain in one direction of transmission. Five replaceable lightning arresters E1, E2, E5, E6, and E7 are also grouped on this side of the panel. The internally facing side of the panel (fig. 43) mounts regulator thermistor RT1, two line repeating coils, and other parts. Two multicontact plugs P1 and P4 are provided to accept connectors J4 and J9 (fig. 3), respectively. These connectors are attached to short cables leading from the filter section.

13. J2 End Panel, Description

The externally facing side of the J2 end panel (fig. 7) contains the following controls: the GAIN AMP 2 control, which permits adjustment of the

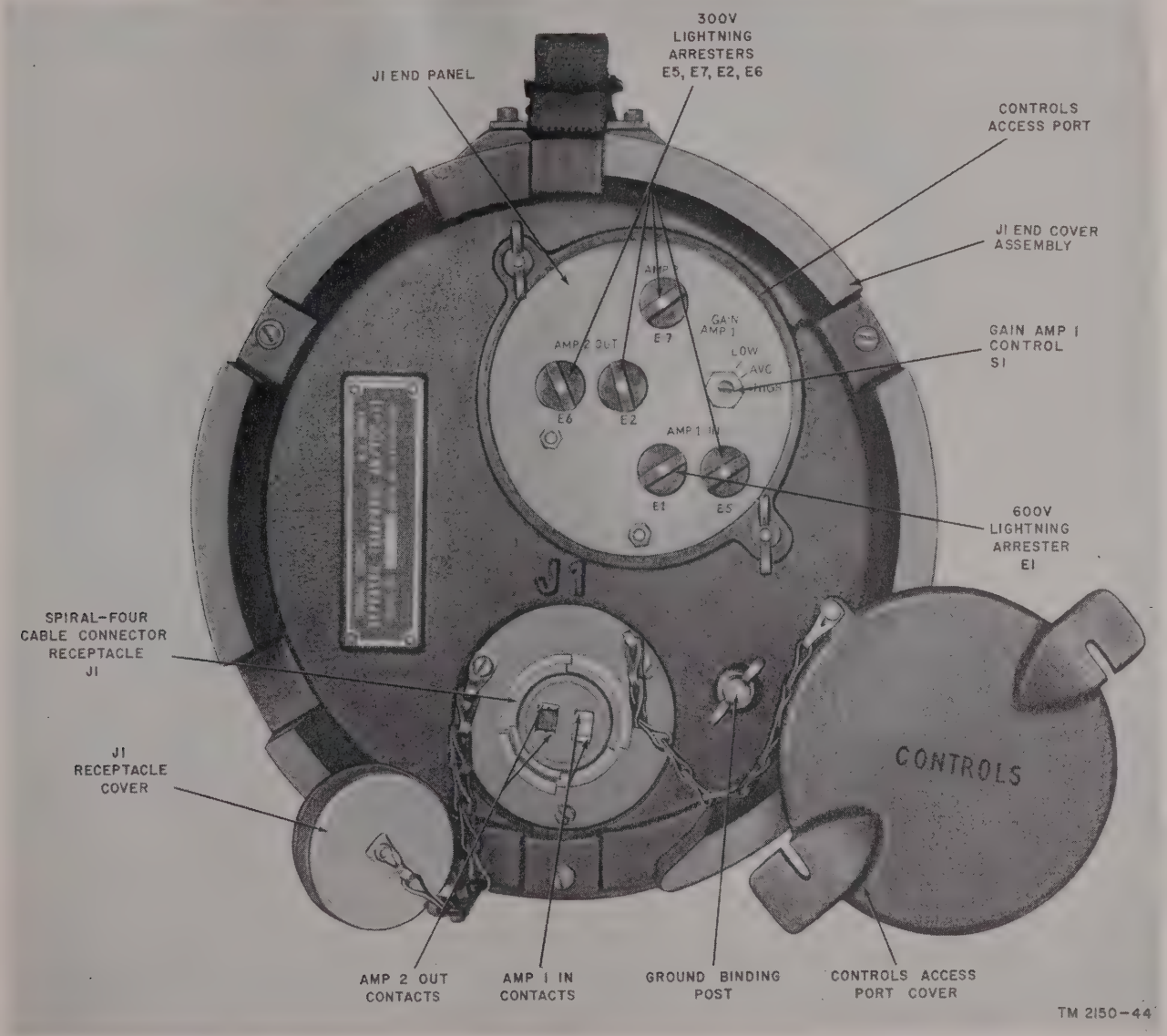


Figure 6. Telephone Repeater AN/TCC–11, J1 end cover assembly, controls access port open.

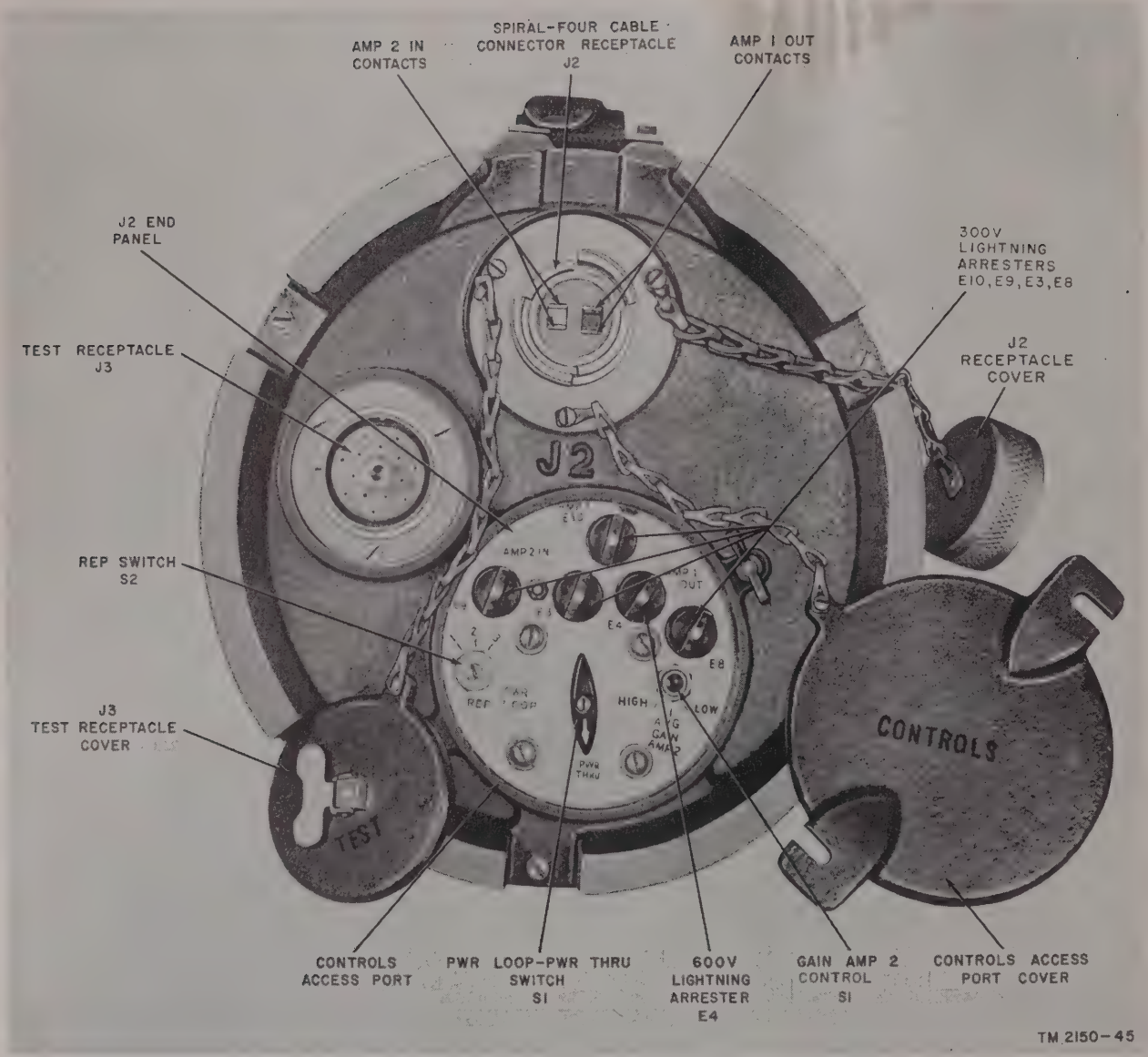


Figure 7. Telephone Repeater AN/TCC–11, J2 end cover assembly, controls access port open.

repeater gain in the opposite direction of transmission from the adjustment permitted at the J1 end panel; the REP switch, which provides a return path for one of three fault locating frequencies transmitted from the attended point to identify a specific repeater location; and the PWR LOOP-PWR THRU switch, which permits d-c (direct-current) power to flow through the equipment to additional equipment or loops the power back to the power source. The J2 end panel also mounts replaceable lightning arresters E3, E4, E8, E9, and E10. The internally facing side of the panel (fig. 45) mounts regulator thermistor RT2, two line repeating coils, filter FL5, and other parts. Multicontact plugs P2 and P3 are provided for accepting connectors J5 and J6 (fig. 3), respectively, which are affixed to short cables leading from the filter section.

14. Plug-in Assemblies, Description
(fig. 3)

a. General. The amplification circuits are contained in two plug-in amplifiers, designated line amplifier AR1 and line amplifier AR2. Additional circuits, common to both amplifiers, are located in an assembly called the filter section. The two line amplifiers plug into opposite sides of the filter section, which acts as a common chassis to both.

b. Line Amplifiers. The circuits and parts which apply the amplification and equalization to the carrier and pilot frequencies are contained in two line amplifier assemblies, line amplifier AR1 and line amplifier AR2. The two line amplifiers are identical and may be interchanged. The amplifier assemblies are octagonal and have removable covers. The gain control for line amplifier AR1 is brought out to the J1 end panel by means of a flexible shaft. A similar shaft is used to extend the gain control from line amplifier AR2 to the J2 end panel.

c. Filter Section. The filter section assembly contains the power circuits and connecting circuits, common to both line amplifiers, and the high-pass, low-pass filters for separating the order wire circuit from the carrier circuit. Connectors J7 and J8 (fig. 52) accept plug P1 (fig. 49) of either of the two interchangeable amplifiers. Four multicontact jacks on the ends of short cables affixed to the filter section connect with plugs mounted on the internally facing side of the end panels to provide connections between the assemblies. Jacks J5 and J6 mate with plugs P2 and P3 (fig. 45), respectively, on the J2 end panel. Jacks J4 and J9 mate with plugs P1 and P4 (fig. 43), respectively, on the J1 end panel.

15. Shock Mounting, Description

Assemblies of Telephone Repeater AN/TCC–11 are mounted on four metal rails (fig. 61) that are affixed to the inside of the cylindrical metal case. The mounting rails are backed with fiberglas to absorb shock. Metal slides on four sides of the assemblies slide on the mounting rails. A cylindrical fiberglas shock absorber (figs. 43 and 45) is mounted on the rear of each cover assembly. These shock absorbers bear against the line amplifier covers to center the entire inner assembly without loss of shock protection. The filter section is held in place by a spring catch that locks into place in a slot in one of the mounting rails. This slot also serves as a means of orienting the plug-in assemblies on the mounting rails by orienting the filter section. Four positioning pins, located on each end of the filter section chassis, fit into corresponding holes located on the bottoms of the line amplifiers. Two captive mounting screws, located in diagonally opposite corners of the line amplifier chassis, are used to fasten the line amplifiers firmly to the filter section.

16. Running Spares

No running spares are supplied with Telephone Repeater AN/TCC–11. Spare lightning arresters for the AN/TCC–11 are stored in the cover of Telephone Test Set TS–712/TCC–11. Spare tubes are stored in Telephone Terminal AN/TCC–7 and Telephone Repeater AN/TCC–8. For the location of these items, refer to the appropriate instruction book.

CHAPTER 2
INSTALLATION INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF TELEPHONE REPEATER AN/TCC–11

17. Siting, General
(fig. 8)

The tactical situation and local conditions determine the best location for an unattended Telephone Repeater AN/TCC–11. Factors to be considered in selecting a site include: accessibility of the repeater for maintenance, protection from arms fire, conditions of the terrain, and the need for matching the temperature conditions of the repeater to those of the cable.

18. Siting, Normal Conditions

Under normal conditions, Telephone Repeater AN/TCC–11 is pole-mounted when the spiral-four cable is installed as an aerial line, or placed on the ground when the spiral-four cable is installed as a ground line. The repeater should be covered if the cable is buried. For the best performance, the AN/TCC–11 should be installed so that its temperature will remain about the same as that of the cable, regardless of changing conditions. The repeater should not be installed in the shade if most of the cable line between repeaters is exposed to the heat of the sun. Conversely, the repeater should not be sited in the open if most of the cable line between repeaters is protected by foliage.

19. Pole Mounting

When Telephone Repeater AN/TCC–11 is pole-mounted, the preferred location is on the upright portion of the pole. The repeater is strapped securely to the pole with the two 7-foot webbing straps provided with the equipment. The correct height at which the repeater is mounted on the pole will depend on tactical conditions. The equipment should not be mounted on the cross arm of a telephone pole because of the interference from open wire lines and because of the difficulty of reaching the controls and connectors when mounted in this position. Paragraph 25 gives detailed instructions for mounting the AN/TCC–11 on a pole.

20. Ground Installation

When local conditions do not permit mounting on poles, the repeater may be laid on the ground and connected into the system. In ground installations, the repeaters should be sited away from roads to reduce the possibility of damage by vehicles. Be careful in siting in installations near headquarters, dumps, depots, motor pools, and other areas where vehicular traffic normally is heavy. In forward areas, consider dips and folds of the terrain as cover from arms fire.

21. Siting Precautions

a. Submersion. Telephone Repeater AN/TCC–11 is weatherproof, waterproof, and can withstand submersion under 6 feet of water. However, such locations as ravines, dry stream beds, storm mains, or drainage ditches normally should be avoided. Sites of this type are subject to flooding and make testing and maintenance difficult.

b. Tagging. Whenever the repeaters or cables of several carrier telephone systems are located along the same route, the cable connectors should be tagged to prevent incorrect connections. In the information on the tag, state whether the cable connects to the J1 end or the J2 end of the repeater.

22. Uncrating, Unpacking, and Checking New Equipment

a. General. Equipment may be shipped in overseas packing cases or sometimes in its own case. The instructions in *b* below apply to equipment shipped in export packing cases. Aside from checking that the equipment is undamaged, no special unpacking and uncrating procedures are necessary for equipment shipped without packing cases.

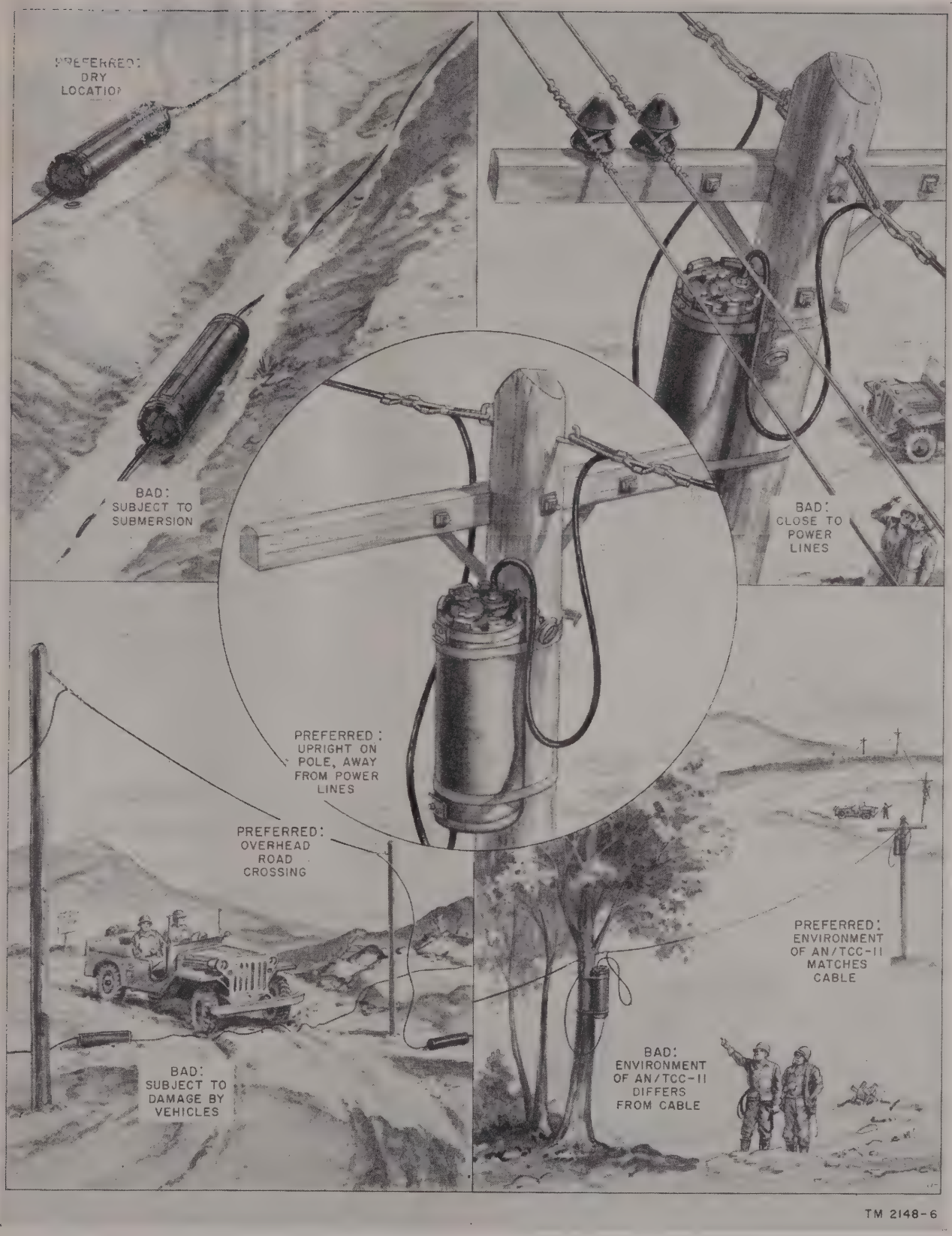


Figure 8. String Telephone Repeater AN/TCC–11.

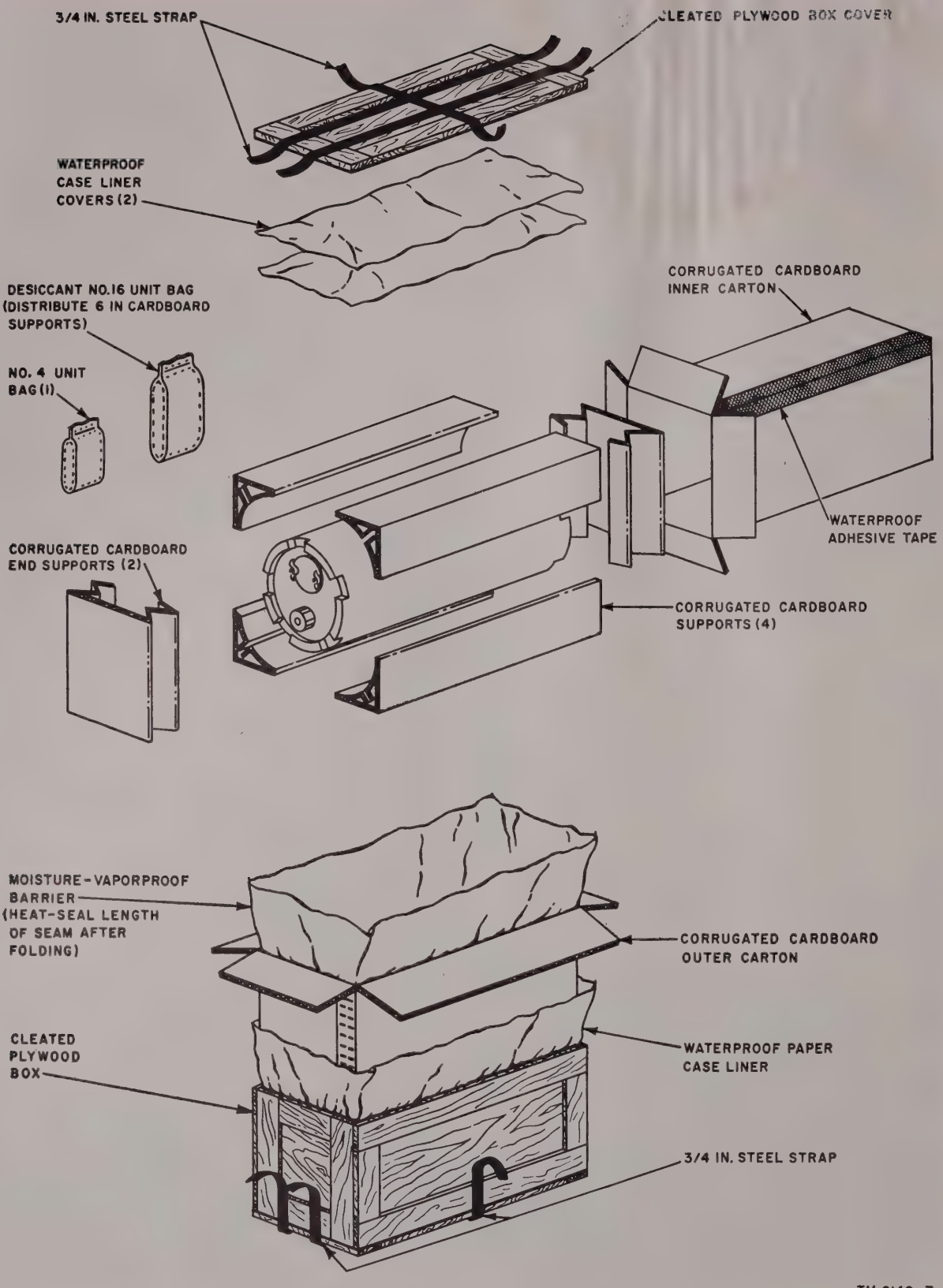


Figure 9. Telephone Repeater AN/TCC–11, packing and packaging details.

Caution: Be careful in uncrating, unpacking, and handling the equipment. If it becomes damaged, a complete overhaul may be required or the equipment may be rendered useless.

b. Step-by-step Instructions for Uncrating and Unpacking Export Shipments (fig. 9).

(1) Cut and fold back the steel straps.

(2) Remove the nails from the cleated plywood box with a nail puller. Remove the top and one side of the box. Do not attempt to pry off the sides and top; the equipment may be damaged as a result.

(3) Remove the waterproof case liner covers and open the corrugated cardboard outer carton.

(4) Open the moisture-vaporproof barrier and remove the corrugated cardboard inner carton.

(5) Open the inner carton at one end and remove the corrugated cardboard end support. Slide the repeater out of the inner carton and place it on the workbench or in a location convenient for making an inspection.

(6) Inspect the equipment for possible damage incurred during shipment. Check the lightning arresters to determine that they are of the proper rating.

(7) Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers. They can be used again when the equipment is repacked for storage or shipment.

23. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 22 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the change in this technical manual, preferably on the schematic diagram.

c. Check the operating controls for ease of operation.

d. Perform the preinstallation, installation, and connection procedures given in paragraphs 24, 25, and 26.

24. Preinstallation Procedures

Before installing Telephone Repeater AN/TCC–11 in the system, make transmission checks at attended point as described in paragraphs 29 through 43. If the results indicate trouble, follow the instructions in *a* and *b* below. Check to see that the tubes are seated firmly in their sockets. Both line amplifiers use 6028 tubes throughout. If trouble still exists in the repeater, refer to the instructions for organizational level troubleshooting at the attended point (pars. 81 through 91).

a. Line Amplifier AR1.

(1) Stand the repeater on end with the J1 end on top.

(2) Unscrew the three captive mounting screws (fig. 4) located on the rim of the J1 end cover assembly.

(3) Pry loose the J1 end cover assembly with a screwdriver or other tool (fig. 60). Slide the screwdriver blade into the prying notch located under the end cover assembly rim and work the blade around between the cover assembly and the repeater case. Remove the J1 end cover assembly.

(4) Remove connectors J4 and J9 from their retaining brackets on the interior wall of the repeater case and allow them to dangle over the edge of the repeater case, so that the line amplifier cover may be removed.

(5) Turn the fastener in the center of the line amplifier cover (fig. 61) counterclockwise to release the cover.

(6) Grasp the cover firmly; use the holes in the cover as grips, and slide the line amplifier cover out of the repeater case.

(7) See that the tubes are seated firmly in their sockets.

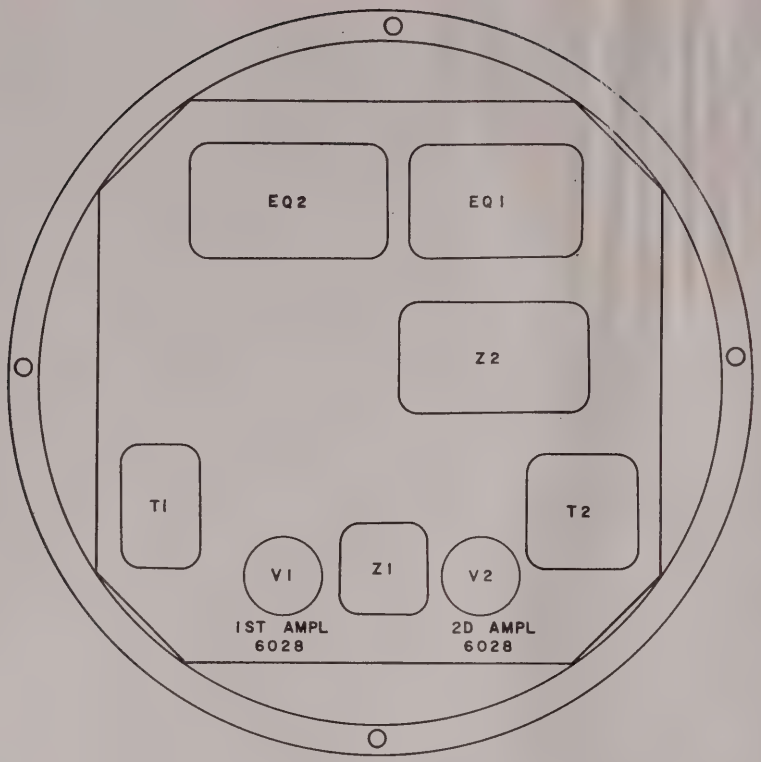
(8) Check the tightness of the two line amplifier mounting screws (fig. 62) that fasten the line amplifier to the filter section. Be sure that the line amplifier is plugged firmly into the filter section.

(9) Aline the widest guide on the line amplifier cover with the widest mounting rail and insert the four guides into the four mounting rails.

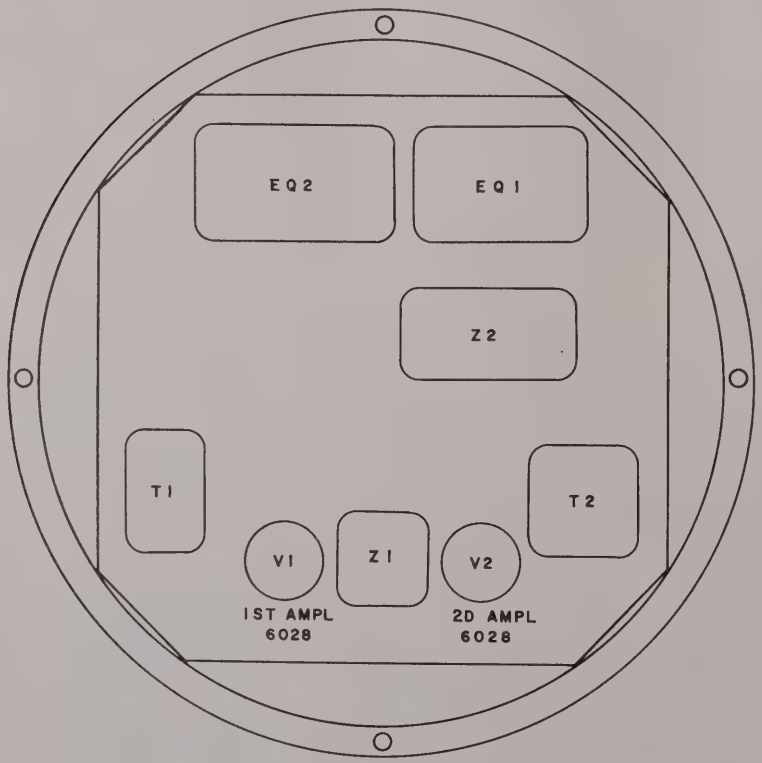
(10) Place the cover on the line amplifier. Make sure that the gain switch flexible shaft extension passes through the proper hole (fig. 47) in the cover.

(11) Turn the fastener in the line amplifier cover clockwise to secure the cover in place.

(12) Place connectors J4 and J9 in their retaining brackets.



TUBE LOCATION, LINE AMPLIFIER AR1, SEEN FROM J1 END



TUBE LOCATION, LINE AMPLIFIER AR2, SEEN FROM J2 END

TM 2148-8

Figure 10. Telephone Repeater AN/TCC–11, tube location diagram.

(13) Replace the J1 end cover assembly and tighten the three captive mounting screws.

b. Line Amplifier AR2.

(1) Reverse the repeater end-for-end and remove the J2 end cover assembly; use the procedures outlined in *a*(1) through (3) above for the J1 end cover assembly.

(2) Remove connectors J5 and J6 from their retaining brackets on the interior wall of the repeater case (fig. 61) and allow them to dangle over the edge of the repeater case so that the line amplifier cover may be removed.

(3) Remove the cover of line amplifier AR2 in the same manner as given for line amplifier AR1 (*a*(5) and (6) above).

(4) See that the tubes are seated firmly in their sockets.

(5) Check the tightness of the two mounting screws that fasten the line amplifier to the filter section.

(6) Replace the cover for line amplifier AR2 in the same manner as given for line amplifier AR1 in *a*(9) and (10) above.

(7) Turn the fastener in the line amplifier cover clockwise to secure the cover in place.

(8) Replace connectors J5 and J6 in their retaining brackets.

(9) Replace the J2 end cover assembly and tighten the three captive mounting screws.

25. Installation on Telephone Pole

(fig. 11)

Telephone Repeater AN/TCC–11 is mounted in an upright position on telephone poles, or trees, with the J1 end on top. Install Telephone Repeater AN/TCC–11 in the following manner:

a. Drive two hooks (J-Hook PF–81) about 2 feet apart vertically at the desired height into the opposite side of the pole from the side on which the repeater is to be mounted.

b. Unbuckle the two 7-foot webbing straps and remove both from the repeater case. Pass one strap through each strap retaining bracket.

c. Raise the repeater by using a suitable pulley, block and tackle, or other means. Place the repeater against the pole with the J1 end on top.

d. Wrap both straps around the repeater and the pole about 2 feet apart, and pass the straps through the two J-hooks.

e. Buckel both straps and pass the ends under one of the turns of the straps.

f. Attach spiral-four cables from both directions to the top of the pole with cable clamps. If none is available, improvise cable clamps of field wire.

g. Allow enough slack cable between the cable clamps and the repeater so that the repeater may be lowered to the ground for making operational checks.

h. Connect Telephone Repeater AN/TCC–11 to a suitable ground (par. 26).

i. Insert the spiral-four cable connector on the cable from the attended point supplying power into receptacle J1 on the J1 end of the repeater (fig. 12).

j. Insert the spiral-four cable connector on the cable from the other attended point into receptacle J2 on the J2 end of the repeater.

26. Grounding Telephone Repeater AN/TCC–11

Telephone Repeater AN/TCC–11 must be grounded to protect personnel and equipment from lightning and other sources of high voltage. Use the following procedure to ground the equipment:

a. Connect one end of a suitable length of No. 14 AWG wire (or larger diameter) to the ground binding post on the J1 end panel and tighten the wingnut on the binding post.

b. Scoop out a small hole approximately 6 inches deep at the location selected for the ground rod.

c. Clean any paint or grease from Ground Rod MX–148/G.

d. Drive the ground rod into the hole until the top of the rod is approximately 3 inches above th bottom of the hole.

e. Connect Clamp TM–106 to the protruding portion of the ground rod.

f. Connect wire from the ground binding post to the clamp.

g. Saturate the ground around the rod with water.

h. Use any existing buried metal piping or other ground whenever possible.

27. Line Connections

(fig. 12)

Telephone Repeater AN/TCC–11 is connected into the carrier communication system by inserting the spiral-four cable connector from the attended point supplying power into the J1 receptacle and the spiral-four connector on the other cable into the J2 receptacle.

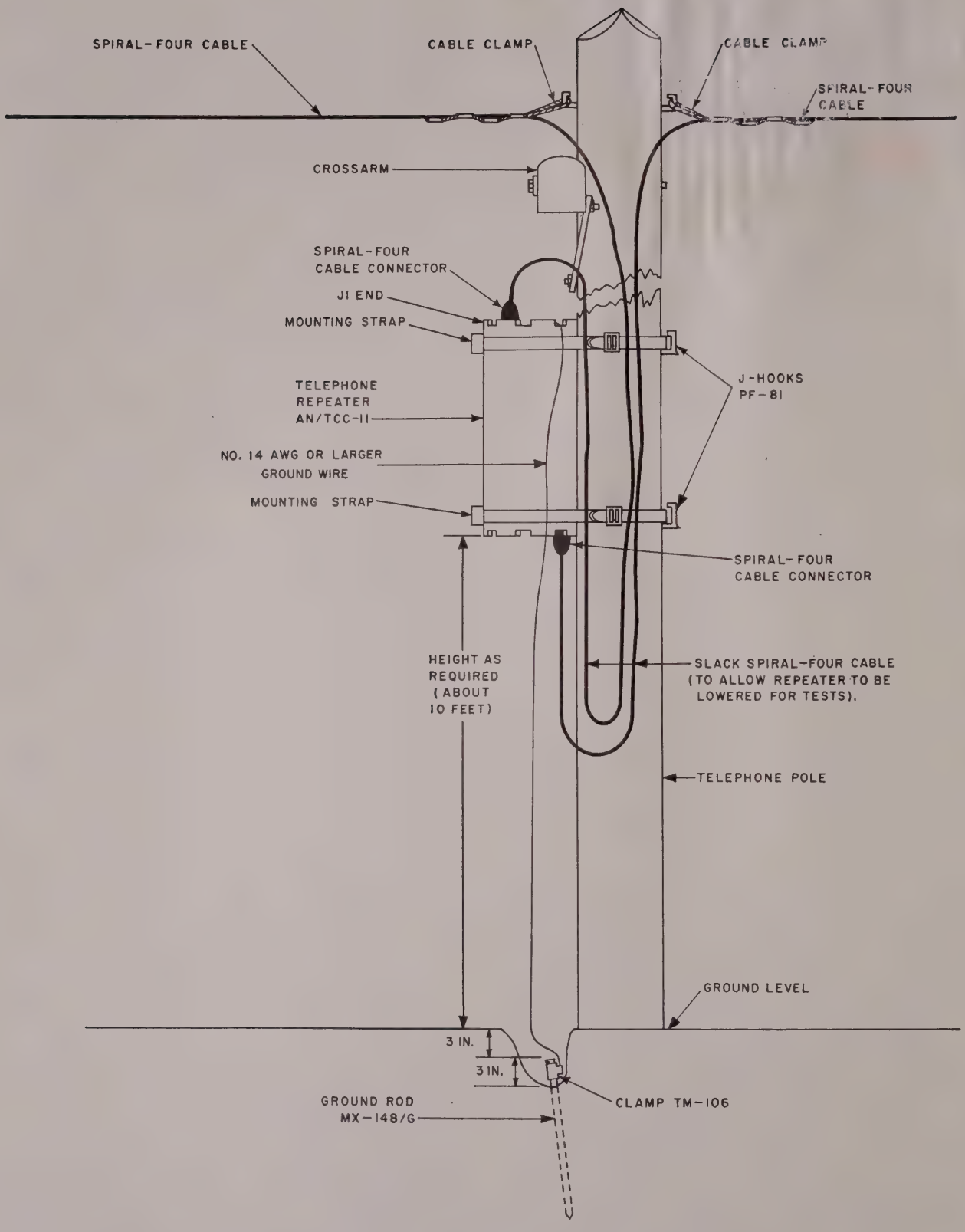
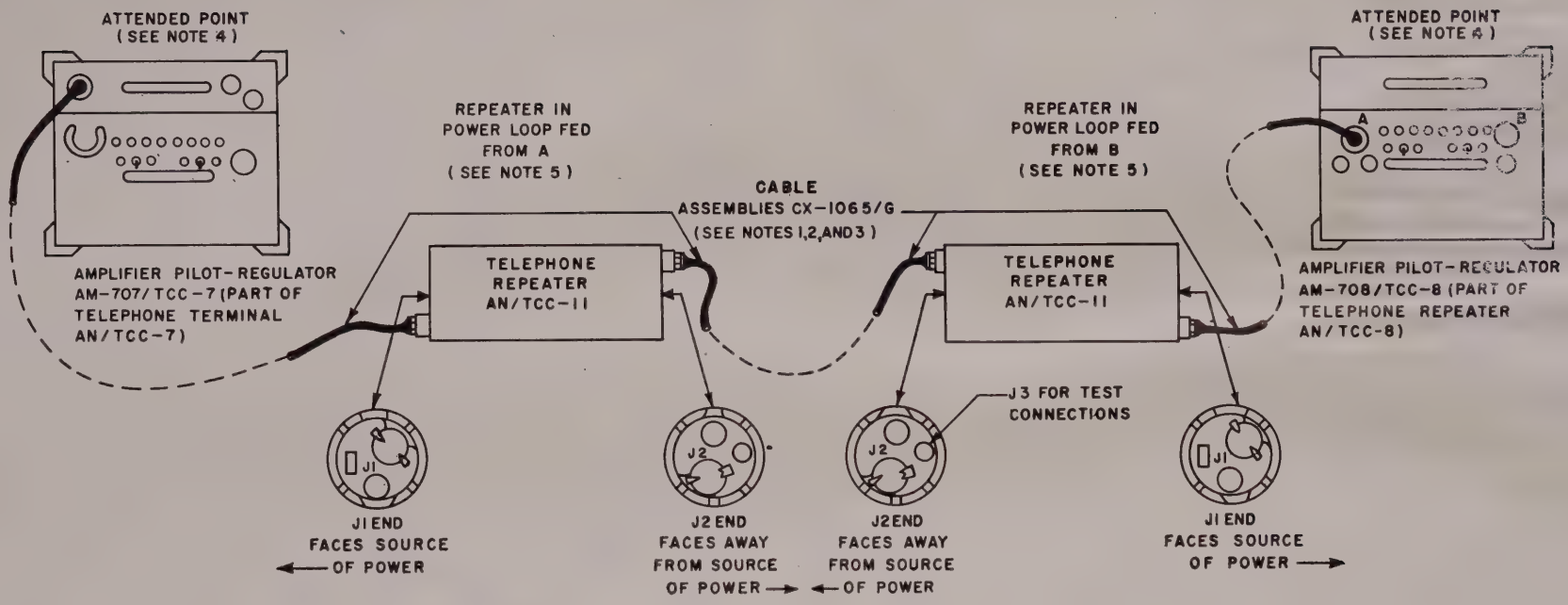


Figure 11. Telephone Repeater AN/TCC-11 mounted on telephone pole.



NOTES:

1. CABLE ASSEMBLY CX-1065/G CONSISTS OF A 1/4 MILE LENGTH OF SPIRAL-FOUR CABLE WITH A SPIRAL-FOUR CABLE CONNECTOR ON EACH END.
2. 23 CABLE ASSEMBLIES CX-1065/G ARE NORMAL NUMBER REQUIRED BETWEEN 2 AN/TCC-11 REPEATERS.
3. FROM 2 TO 23 CABLE ASSEMBLIES CX-1065/G ARE USED BETWEEN THE AN/TCC-11 AND THE ATTENDED POINTS. WHEN LESS THAN 23 ARE USED THE ATTENUATION OF THE MISSING REELS MAY BE SIMULATED BY ATTENUATION NETWORKS AT THE ATTENDED POINTS.
4. AN ATTENDED POINT MAY BE EITHER A TELEPHONE TERMINAL AN/TCC-7 OR A TELEPHONE REPEATER AN/TCC-8.
5. ONE AN/TCC-11 REPEATER IS SHOWN IN EACH POWER LOOP. WHEN MORE ARE USED THE CONNECTIONS ARE MADE IN THE SAME MANNER AS SHOWN FOR EACH POWER LOOP. THE MAXIMUM NUMBER OF REPEATERS BETWEEN ATTENDED POINTS IS SIX.

TM 2148-10

Figure 12. Telephone Repeater AN/TCC-11, line connections.

28. Test Set Connections

Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ) are connected to Telephone Repeater AN/TCC–11 for ringing, talking, and listening on the order wire (par. 49), and for making installation tests.

a. Connections for Order Wire Use (fig. 13). To connect Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ) to the order wire circuits of Telephone Repeater AN/TCC–11, proceed as follows:

(1) Connect binding posts L1 and L2 on Telephone EE–8–( ) to binding posts L1 and L2 on Telephone Test Set TS–712/TCC–11 by using field wire or similar wire.

(2) Unscrew the receptacle cover from receptacle J3 on the AN/TCC–11 and insert plug P1 of Telephone Test Set TS–712/TCC–11.

b. Connections for Installation Test (fig. 14). To connect Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ) to Telephone Repeater AN/TCC–11 for performing installation test at the attended point, proceed as follows:

(1) Make the connections described in *a* above.

(2) Insert the plug on the end of the short cable from the artificial cable of Telephone Test Set TS–712/TCC–11 into spiral-four receptacle J2 on Telephone Repeater AN/TCC–11.

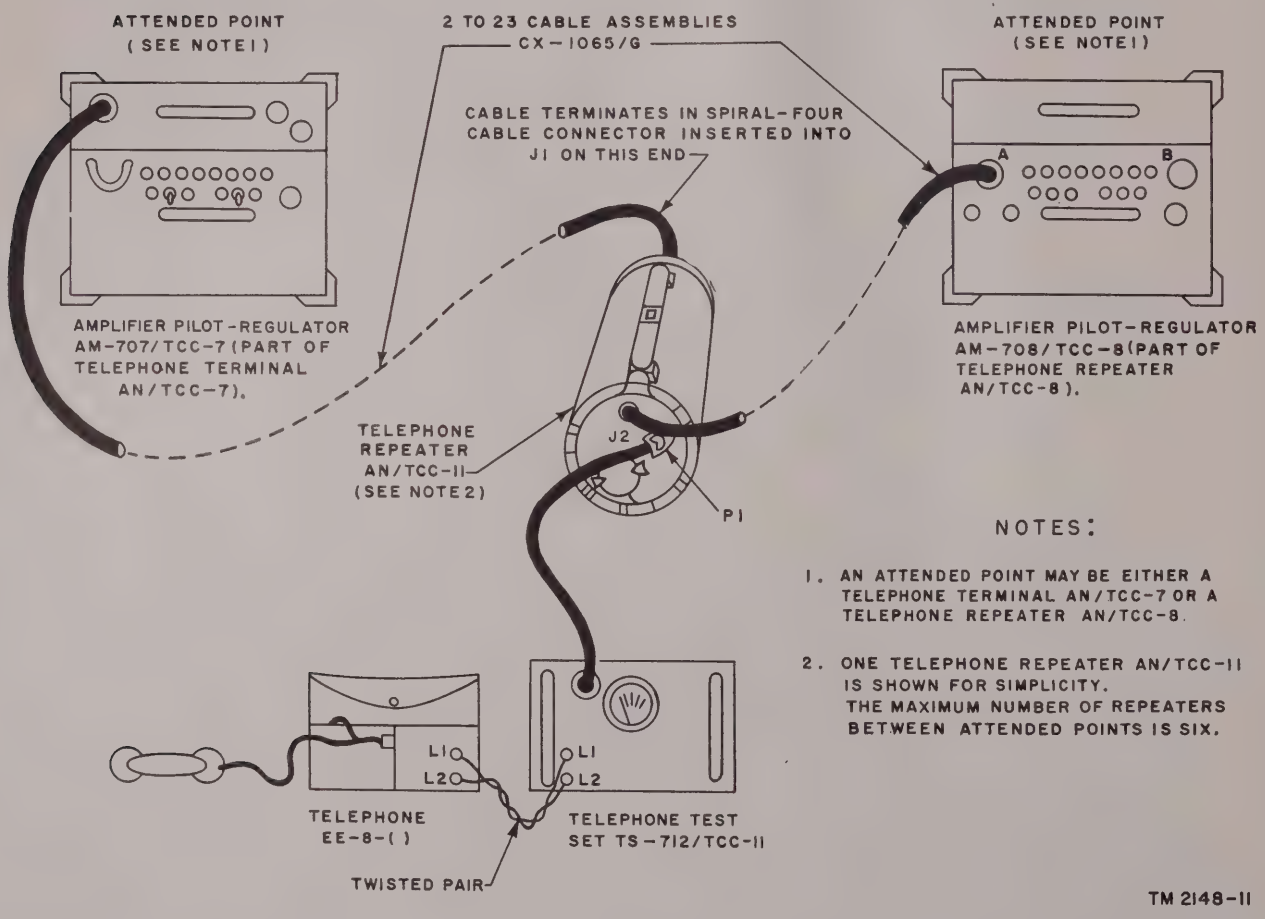


Figure 13. Telephone Repeater AN/TCC–11, connections to Telephone Test Set TS–712/TCC–11 for order wire use.

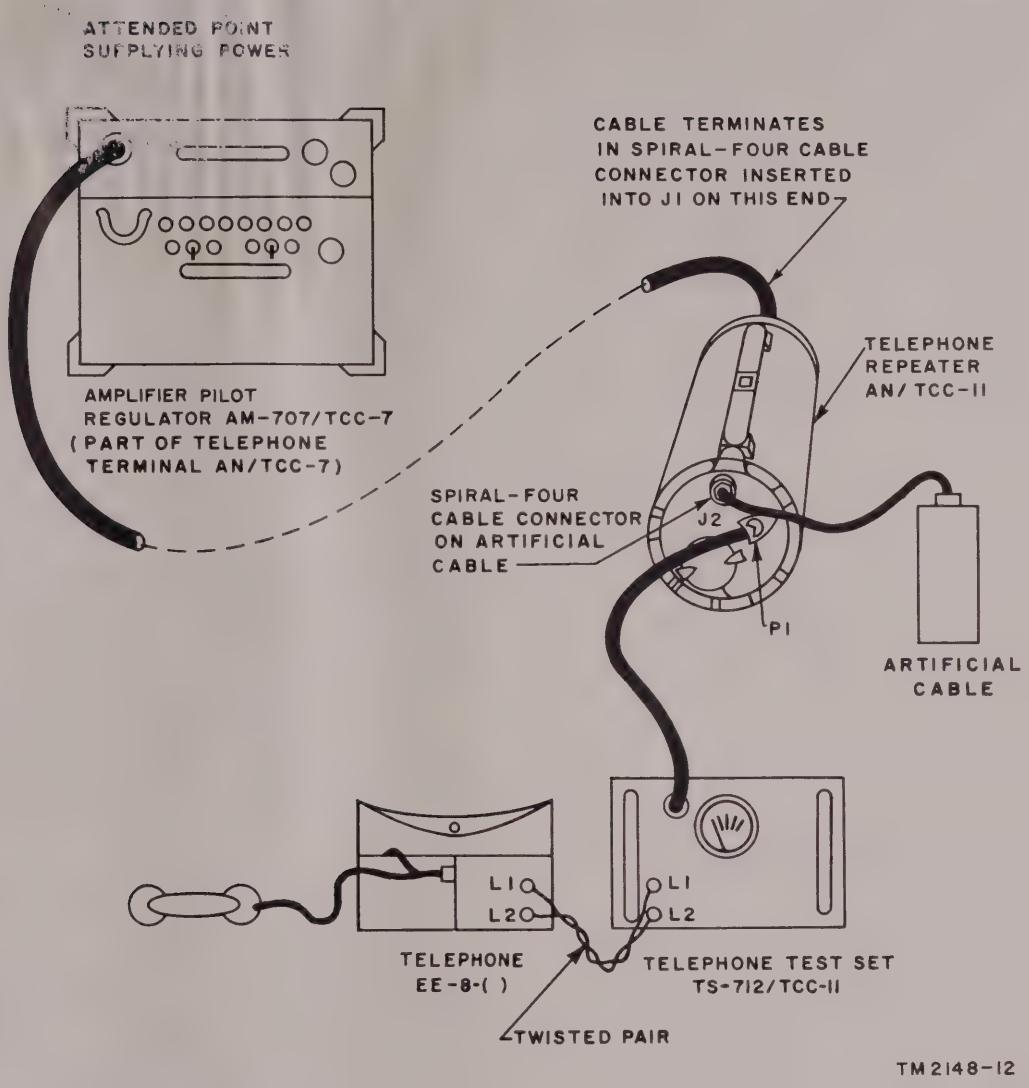


Figure 14. Telephone Repeater AN/TCC–11, connections to Telephone Test Set TS–712/TCC–11 for installation test.

Section II. PREINSTALLATION TESTS

29. General

This section describes the testing of the AN/TCC–11 repeaters at attended points. This testing is performed prior to the installation of the repeaters at their final locations.

30. Test of AN/TCC–11 at AN/TCC–7 Point, General

The AN/TCC–11 repeaters should be tested before being transported to their final locations along the cable route. These tests may be performed at an attended point with the use of AN/TCC–7 or AN/TCC–8 equipment. Paragraphs 31 through 36 describe the test procedures at an AN/TCC–7 point. Paragraphs 37 through 43 describe the test procedures at an AN/TCC–8 point.

31. Adjustment of AN/TCC–11 for Testing at AN/TCC–7 Point

a. Use Telephone Cable Assembly CX–1606/G to connect from the cable connector on the JUNCTION PANEL of the AN/TCC–7 to the J1 cable connector at one end of the AN/TCC–11 repeater.

b. Connect the artificial cable to the AN/TCC–11 repeater by connecting connector P1 of the artificial cable to connector J2 of the AN/TCC–11 repeater.

c. Remove the two covers marked CONTROLS and the cover marked TEST at the ends of the repeater (figs. 4 and 5).

d. At the J1 end of the repeater, operate the GAIN AMP 1 switch to the AVG position.

e. At the J2 end of the repeater, operate the GAIN AMP 2 switch to the AVG position. Operate the REP switch to position 1. Operate the PWR LOOP-PWR THRU switch to the PWR THRU position.

32. Adjustment of AN/TCC–7 for Testing AN/TCC–11 at AN/TCC–7 Point

The adjustment of AN/TCC–7 should be completed as described in the installation procedure and test covered in the AN/TCC–7 equipment instruction book. The following readjustments should be made to prepare the equipment for testing the AN/TCC–11 repeater.

a. Operate the CABLE REELS TO FIRST AN/TCC–11 switches (REC and TR) to the positions marked 2.

b. Operate the AC POWER switch of the PP–827 200 VOLT POWER SUPPLY to the ON position.

c. Make the following adjustments on the PP–826 600 VOLT POWER SUPPLY.

(1) Operate the REPEATER switch to the position marked 1.

(2) The 600 VOLT ADJ LOAD CURRENT, HIGH-VOLT ALARM, AND LOW-VOLT ALARM controls should be left as adjusted in the installation test procedure described in the equipment instruction book.

d. Arrange the TS–760 TEST PANEL to measure the PP–826 600 VOLT POWER SUPPLY output voltage as described below.

(1) Operate the MEASURE switch to the 600 VOLTS position.

(2) Operate the MEASURE SELECTIVE switch to the OFF position.

(3) Operate the MEASURE NON-SELECTIVE switch to the OFF position.

e. Operate the AC POWER switch on the PP–826 600 VOLT POWER SUPPLY panel to the ON position. The LOAD ALARM lamp will light and the buzzer will sound.

f. Observe the reading on the TS–760 TEST PANEL meter. After several seconds it should rise to a value near 0 db (decibel) and stop. Adjust the 600 VOLT ADJ control to obtain a reading of 0 db on the meter. If the 600 VOLT ADJ control is considerably out of adjustment, a power alarm may be received, indicated by lighting of the HIGH VOLTAGE or LOW VOLTAGE lamp, and the TEST PANEL meter reading will fall (output voltage removed). If this happens, operate the RESTORE lever switch momentarily to restore power. When the TEST PANEL meter reading has risen again and stops climbing, quickly adjust the 600 VOLT ADJ control to obtain a reading of 0 db. (There is a delay of several seconds before the alarm is received.) The LOAD ALARM lamp will be extinguished and the buzzer will be silenced when the 600 VOLT ADJ control is adjusted correctly.

g. Observe the reading on the CURRENT meter on the PP–826 600 VOLT POWER SUPPLY. Adjust the LOAD CURRENT control, if necessary, to obtain a reading of 100 milliamperes. Then readjust the 600 VOLT ADJ control, if necessary, to obtain a reading of 0 db on the TEST PANEL meter.

h. Operate the PWR LOOP-PWR THRU switch on the AN/TCC–11 repeater to the PWR LOOP position. The reading on the TEST PANEL meter should reduce slightly (less than .5 db).

33. Test of AN/TCC–11 Order Wire Circuit at AN/TCC–7 Point

a. Adjust controls on the RT–280 ORDER WIRE PANEL of the AN/TCC–7 as follows:

(1) Operate the TR GAIN and REC GAIN controls to their maximum clockwise positions.

(2) Operate the CABLE REELS TO NEXT AN/TCC–7 OR AN/TCC–8 switch to the 0–11 position.

b. Operate the ORDER WIRE lever switch of the AN/TCC–7 to the TALK position. Listen to the receiver of the telephone handset provided with the AN/TCC–7 equipment. Singing tone should not be heard.

c. Operate the SEND OW lever switch to the ON position.

d. Arrange the TS–760 TEST PANEL to measure the signal at the REC AMP OUT jack of the RT–280 ORDER WIRE PANEL as described below.

(1) Operate the MEASURE switch to the TRANSMISSION position.

(2) Operate the MEASURE SELECTIVE switch to the OFF position.

(3) Operate the MEASURE NON-SELECTIVE switch to the OW REC AMP position.
(4) Insert the MEASURE plug into the REC AMP OUT jack on the RT–280 ORDER WIRE PANEL.
(5) The reading on the TEST PANEL meter should be between 0 and +7 db.

e. Connect a TS–712 test set to the AN/TCC–11 repeater by inserting plug P1 of the test set into connector J3 of the repeater. Connect the L1 and L2 terminals of a Telephone EE–8–( ) to the L1 and L2 (TEL) binding posts of the TS–712 test set. Use the TS–712 test set to measure the 1-kc output of amplifier AR1 in the AN/TCC–11 repeater as described below.

(1) Operate the POWER switch on the TS–712 test set to the ON position.
(2) Operate the MEASURE switch to the A BAT position and adjust the A BAT control to obtain a reading at the BAT mark on the test set meter.
(3) Operate the MEASURE switch to the B BAT position and adjust the B BAT control to obtain a reading at the BAT mark on the test set meter.
(4) Operate the MEASURE switch to the TRANS position.
(5) Operate the SELECTOR switch to the AMP 1, OUT 1 KC position.
(6) Operate the 1 KC SENS switch in the LOW position. The test set meter should read between +2 and +8 db.

f. Restore the SEND OW lever switch on the RT–280 ORDER WIRE PANEL to the non-operated position.

g. Arrange the TS–712 test set as follows:

(1) Operate the ORDER WIRE switch to the TALK position.
(2) Operate the OW Gain switch to the LOW position.

h. Use the EE–8–( ) telephone to talk to an attendant using the telephone set supplied with the AN/TCC–7 equipment. Check that the volume and intelligibility of speech are satisfactory.

i. Restore the ORDER WIRE lever switch on the RT–280 ORDER WIRE PANEL to the non-operated position.

34. Carrier Frequency Measurements of AN/TCC–11 at AN/TCC–7 Point

The following measurements check the transmission of the AN/TCC–11 repeater at 68 kc.

a. Measure the d-c voltage across the AN/TCC–11 repeater with the TS–712 test set as described below.

(1) Operate the MEASURE switch on the TS–712 test set to REP VOLTS position.
(2) The TS–712 test set meter should read within .5 db of the BAT mark, which represents 150 volts ±10 volts.

b. Use the TS–712 test set to measure the 68-kc output of amplifier AR1 in the AN/TCC–11 repeater as described below.

(1) Operate the POWER switch to the ON position and adjust the A and B BAT controls (par. 33*e*(2) and (3)).
(2) Operate the MEASURE switch to the TRANS position.
(3) Operate the SELECTOR switch to the AMP 1, OUT 68 KC position.
(4) The test set meter should read between +3 and +7 db.

c. Use the TS–760 TEST PANEL to measure the 68-kc output at the REC IN jack on the GROUP PANEL as described below.

(1) Connect the MEASURE plug to REC IN jack of the GROUP PANEL.
(2) Operate the MEASURE switch to the TRANSMISSION position.
(3) Operate the MEASURE SELECTIVE switch to the 68 KC position.
(4) Operate the MEASURE NON-SELECTIVE switch to the OFF position.
(5) Adjust the FINE TUNE control on TEST PANEL for maximum meter reading.
(6) Depress the 10 db ATTENUATOR push button. The reading on the TEST PANEL meter will be between +2 db and +7 db.

d. Operate the GAIN AMP 1 switch on the AN/TCC–11 repeater to the following positions and check that the TS–760 TEST PANEL meter reads within the indicated limits.

(1) GAIN AMP 1 switch operated to the HIGH position: 2.5 db ±0.5 db greater than the reading in subparagraph *c* above.
(2) GAIN AMP 1 switch operated to the LOW position: 2.5 db ±0.5 db less than the reading in *c* above.

e. Restore the GAIN AMP 1 switch to the AVG position. Operate the GAIN AMP 2 switch to the following positions and check to see that the TS–760 TEST PANEL meter reads within the indicated limits.

(1) GAIN AMP 2 switch at HIGH: 2.5 db ±0.5 db greater than the reading in *c* above.

(2) GAIN AMP 2 switch at LOW: 2.5 db ±0.5 db less than the reading in *c* above.

f. Restore the GAIN AMP 2 switch to the AVG position.

35. Check of Looping Filter of AN/TCC–11 at AN/TCC–7 Point

The following tests check the looping filter in the AN/TCC–11 repeater. This filter is used in a repeater fault location test procedure.

a. Disconnect the artificial cable from the AN/TCC–11 repeater.

b. Arrange the TS–760 TEST PANEL to send 99 kc as described below.

(1) Operate the SEND switch to the 65 KC TR OR FAULT TEST position.

(2) Operate the FAULT TEST REP 1 push button.

(3) Connect the MEASURE plug to the TR AMP OUT jack of the GROUP PANEL.

(4) Operate the MEASURE switch to the TRANSMISSION position.

(5) Operate the MEASURE SELECTIVE switch to the OFF position.

(6) Operate the MEASURE NON-SELECTIVE switch to the FAULT TEST position.

(7) Adjust the 65 KC TR OR FAULT TEST control to obtain a reading of 0 db on the TS–760 TEST PANEL meter.

c. Arrange the TS–760 TEST PANEL to measure the signal at the REC IN jack on the GROUP PANEL as described below.

(1) Connect the MEASURE plug to the REC IN jack of the GROUP PANEL.

(2) Operate the MEASURE switch to the TRANSMISSION position.

(3) Operate the MEASURE SELECTIVE switch to the OFF position.

(4) Operate the MEASURE NON-SELECTIVE switch to the FAULT TEST position.

(5) Depress the 20-db ATTENUATOR push button.

(6) The TS–760 TEST PANEL meter should read between −3 and +7 db.

d. Operate the REP switch on the AN/TCC–11 repeater to position 2. Release the FAULT TEST REP 1 pushbutton and operate the FAULT TEST REP 2 pushbutton on the TS–760 TEST PANEL. Continue to measure the signal at the REC IN jack on the GROUP PANEL. Depress the 20-db ATTENUATOR pushbutton. The TS–760 TEST PANEL meter should read between −3 db and +7 db.

e. Operate the REP switch on the AN/TCC–11 repeater to position 3. Release the FAULT TEST REP 2 pushbutton and operate the FAULT TEST REP 3 pushbutton on the TS–760 TEST PANEL. Measure the signal at the REC IN jack on the GROUP PANEL. Depress the 20-db ATTENUATOR pushbutton. The TS–760 TEST PANEL meter should read between −3 db and + 7 db.

36. Completion of Test of AN/TCC–11 at AN/TCC–7 Point

a. After completion of the tests above, remove power from the PP–826 600 VOLT POWER SUPPLY by operating the AC POWER switch to the OFF position.

b. Disconnect the equipment used in the test.

c. Restore the two controls covers and the TEST cover to the ends of the AN/TCC–11 repeater (figs. 4 and 5).

37. Test of AN/TCC–11 at AN/TCC–8 Point, General

The AN/TCC–11 repeaters that are delivered to an AN/TCC–8 point should be tested with the use of the AN/TCC–8 repeater before being transported to their final locations along the cable route. Paragraphs 38 through 43 describe the test procedures at an AN/TCC–8 point.

38. Adjustments of AN/TCC–11 for Testing at AN/TCC–8 Point

a. Use Telephone Cable Assembly CX–1606/G to connect from the B cable connector on the AM–708 REPEATER PANEL of the AN/TCC–8 to the J1 cable connector at one end of the AN/TCC–11 repeater.

b. Follow the procedure given in paragraph 31*b* through *e*.

39. Adjustment of AN/TCC–8 for Testing AN/TCC–11 at AN/TCC–8 Points

The adjustment of the AN/TCC–8 should be completed as described in the installation procedure and tests covered in the AN/TCC–8 equipment instruction book. The following readjustments should be made to prepare the equipment for testing an AN/TCC–11 repeater.

a. Operate the CABLE REELS TO FIRST AN/TCC–11 TOWARD B TERM switches (BA IN) and (AB OUT) to the positions marked 2.

b. Operate the AC POWER switch of the PP–827 200 VOLT POWER SUPPLY to the ON position.

c. Follow the procedures outlined in paragraph 32 to make adjustments on the PP–826 600 VOLT POWER SUPPLY that feeds power to the cable in the AB direction (connected to POWER TOWARD B connector on the AM–708 REPEATER PANEL).

40. Test of AN/TCC–11 Order Wire Circuit at AN/TCC–8 Point

a. Adjust controls on the RT–281 ORDER WIRE PANEL as follows:

(1) Operate the AB TR GAIN and BA REC GAIN controls to their maximum clockwise positions.

(2) Operate the AB CABLE REELS TO NEXT AN/TCC–7 OR AN/TCC–8 switch to the 0–11 position.

b. Listen to the receiver of the telephone handset provided with Telephone Repeater AN/TCC–8. Singing tone should not be heard.

c. Connect a TS–712 test set to the AN/TCC–11 repeater by inserting plug P1 of the test set into connector J3 of the repeater. Connect the L1 and L2 terminals of the EE–8 telephone to the L1 and L2 (TEL) binding posts of the TS–712 test set. Operate the RING lever switch on the ORDER WIRE PANEL. Use the TS–712 test set to measure the 1,600-cps output of amplifier AR1 in the AN/TCC–11 repeater (par. 33*e*(1) through (3)). Operate the 1 KC SENS switch to the LOW position. The test set meter should read between +3 db and off scale high. Release the RING lever switch.

d. Arrange the TS–712 test set as follows:

(1) Operate the ORDER WIRE switch to the TALK position.

(2) Operate the OW GAIN switch to the LOW position.

e. Use Telephone EE–8(–) to talk to an attendant using the telephone handset supplied with the AN/TCC–8. Check to see that the volume and intelligibility of speech are satisfactory.

41. Carrier Frequency Measurements of AN/TCC–11 at AN/TCC–8 Point

The following measurements check the transmission of the AN/TCC–11 repeater at 68 kc.

a. Measure the d-c voltage across the AN/TCC–11 with the TS–712 test set (par. 34*a*). The TS–712 test set meter should read within 0.5 db of the BAT mark.

b. Arrange the TS–761 TEST PANEL to send 68 kc in the AB direction as described below.

(1) Operate the SEND switch to the AB position.

(2) Operate the FREQUENCY switch to the 68 KC position.

c. Measure the 68-kc output at the AB AMP 1 OUT jack on the AM–708 REPEATER PANEL as described below.

(1) Connect the MEASURE plug to the AB AMP 1 OUT jack on the AM–708 REPEATER PANEL.

(2) Operate the MEASURE switch to the TRANSMISSION position.

(3) Operate the MEASURE SELECTIVE switch to the 68 KC position.

(4) Operate the MEASURE NON-SELECTIVE switch to the OFF position.

(5) Adjust the FINE TUNE control for maximum meter reading.

d. Adjust the SEND control to obtain a reading of 0 db on the TS–761 TEST PANEL meter. Measure the 68-kc output at the AB AMP 2 OUT jack as described below.

(1) Connect the MEASURE plug to the AB AMP 2 OUT jack of the AM–708 REPEATER PANEL.

(2) Operate the MEASURE switch to the TRANSMISSION position.

(3) Operate the MEASURE SELECTIVE SWITCH to the 68 KC position.

(4) Operate the MEASURE NON-SELECTIVE switch to the OFF position.

(5) Adjust the FINE TUNE control for maximum meter reading.

e. Operate the AB REGULATOR lever switch on the chassis of the AM–708 REPEATER PANEL to the MAN position. Adjust the AB MAN REG OUTPUT control to obtain a reading of 0 db on the TEST PANEL meter.

f. Use the TS–712 test set to measure the 68-kc output of amplifier AR1 in the AN/TCC–11 repeater (par. 34*b*(1) through (3)). The test set meter should read between +3 and +7 db.

g. Use the TS–761 TEST PANEL to measure the 68-kc output at the BA IN jack on the AM–708 REPEATER PANEL as described below.

(1) Connect the MEASURE plug to the BA IN jack on the AM–708 REPEATER PANEL.

(2) Operate the MEASURE switch to the TRANSMISSION position.
(3) Operate the MEASURE SELECTIVE switch to the 68 KC position.
(4) Operate the MEASURE NON-SELECTIVE switch to the OFF position.
(5) Adjust the FINE TUNE control for maximum meter reading.
(6) Depress the 10 db ATTENUATOR pushbutton.
(7) The reading on the TEST PANEL meter will be between +2 db and +7 db.

h. Operate the GAIN AMP 1 switch on the AN/TCC–11 repeater to the following positions and check that the TS–761 TEST PANEL meter reads within the indicated limits.

(1) GAIN AMP 1 switch operated to the HIGH position: 2.5 db ±0.5 db greater than the reading in *e* above.
(2) GAIN AMP 1 switch operated to the LOW position: 2.5 db ±0.5 db less than the reading in *e* above.

i. Restore the GAIN AMP 1 switch to the AVG position. Operate GAIN AMP 2 switch to the following positions and check that the TS–761 test set meter reads within the indicated limits.

(1) GAIN AMP 2 switch operated to the HIGH position: 2.5 db ±0.5 db greater than the reading in *e* above.
(2) GAIN AMP 2 switch operated to the LOW position: 2.5 db ±0.5 db less than the reading in *e* above.

j. Restore the GAIN AMP 2 switch to the AVG position.

42. Check of Looping Filter of AN/TCC–11 at AN/TCC–8 Point

The following tests check the louping filter in the AN/TCC–11 that is used in repeater fault location test procedure.

a. Disconnect the artificial cable from the AN/TCC–11 repeater.

b. Arrange the TS–761 TEST PANEL to send 99 kc in the AB direction as described below.

(1) Operate the SEND DIRECTION switch to the AB position.
(2) Operate the SEND FREQUENCY switch to the FAULT TEST position.

c. Arrange the TS–761 TEST PANEL to measure the output at the AB AMP 2 OUT jack as described below.

(1) Connect the MEASURE plug to the AB AMP 2 OUT jack on the AM–708 REPEATER PANEL.
(2) Operate the MEASURE switch to the TRANSMISSION position.
(3) Operate the MEASURE SELECTIVE switch to the OFF position.
(4) Operate the MEASURE NON-SELECTIVE switch to the FAULT TEST position.

d. Depress the FAULT TEST REP 1 pushbutton.

e. Adjust the 65 KC TR OR FAULT TEST control on the TS–761 TEST PANEL for a meter reading of 0 db.

f. Measure the signal at the BA IN jack on the AM–708 REPEATER PANEL as described below.

(1) Connect the MEASURE plug to the BA IN jack of the AM–708 REPEATER PANEL.
(2) Operate the MEASURE switch to the TRANSMISSION position.
(3) Operate the MEASURE SELECTIVE switch to the OFF position.
(4) Operate the MEASURE NON-SELECTIVE switch to the FAULT TEST position.
(5) Depress the 20 db ATTENUATOR pushbutton.
(6) The TS–761 TEST PANEL meter should read between −3 db and +7 db.

g. Operate the REP switch on the AN/TCC–11 repeater to position 2. Release the FAULT TEST REP 1 pushbutton and operate the FAULT TEST REP 2 pushbutton. Continue to measure the signal at the BA IN jack on the AM–708 REPEATER PANEL. Depress the 20 db ATTENUATOR pushbutton. The TS–761 TEST PANEL meter should read between −3 db and +7 db.

h. Operate the REP switch on the AN/TCC–11 repeater to position 3. Release the FAULT TEST REP 2 pushbutton and operate the FAULT TEST REP 3 pushbutton. Continue to measure the signal at the BA IN jack on the AM–708 REPEATER PANEL. Depress the 20 db ATTEN-

UATOR pushbutton. The TS–761 TEST PANEL meter should read between −3 db and +7 db.

43. Completion of Test of AN/TCC–11 at AN/TCC–8 Point

a. After completion of the above tests, remove the power from the PP–826 600 VOLT POWER SUPPLY by operating the AC POWER switch to the OFF position.

b. Disconnect the equipment used in the test.

c. Restore the two controls covers and the TEST cover to the ends of the AN/TCC–11 repeater (figs. 4 and 5).

Section III. CONTROLS AND INSTRUMENTS

44. General

Haphazard operation or improper setting of controls can cause improper operation and misleading test indications. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in chapter 3.

45. Telephone Repeater ANT/CC–11 Controls and Their Uses

(figs. 15 and 16)

The following charts list the controls of the repeater and describe their functions.

a. J1 End Panel Controls.

Control	Function
GAIN AMP 1 (S1)	Three-position rotary switch to adjust gain of line amplifier AR1 by varying amount of negative feedback in amplifier. In LOW position, increases negative feedback to reduce amplifier gain by 2.5 db. In AVG position, provides sufficient feedback to maintain nominal gain of amplifier. In HIGH position, decreases amount of feedback to increase amplifier gain by 2.5 db.
Spiral-four receptacle J1.	Four-contact receptacle that connects with spiral-four cable from attended station supplying power to repeater.
GND	Binding post with wingnut that connects Telephone Repeater AN/TCC–11 with earth ground.

b. J2 End Panel Controls.

Control	Function
PWR LOOP-PWR THRU (S1).	Two-position rotary switch. For repeaters located at junction point of power loops, switch permits d-c power to be looped back through equipment toward its source. For repeaters between attended point and junction point, switch permits d-c power to be continued through equipment toward junction point. In PWR LOOP position, switch returns power back through equipment toward power source after supplying amplifier load (tube heaters, plate, and screen circuits), and permits power from next power loop to enter Telephone Repeater AN/TCC–11 and to be routed back toward its source without supplying power to amplifier load. In PWR THRU position, switch permits power to continue through equipment toward junction point after supplying amplifier load, and provides a d-c path to attended point for power returning from junction point.
REP (S2)	Three-position rotary switch to adjust looping filter FL5 to select one of three different fault-locating frequencies. In position 1, switch adjusts filter FL5 to select 99 kc.

b. J2 End Panel Controls—Continued

Control	Function
	In position 2, switch adjusts filter FL5 to select 91 kc. In position 3, switch adjusts filter FL5 to select 83 kc.
GAIN AMP 2 (S1)	Three-position rotary switch is identical with GAIN AMP 1 switch and adjusts gain of line amplifier AR2 in the same manner.

b. J2 End Panel Controls—Continued

Control	Function
Spiral-four receptacle J2.	Four-contact receptacle that connects with spiral-four cable from attended station not supplying power to repeater.
Test receptacle J3	A multicontact receptacle that connects AN/TCC–11 to Telephone Test Set TS–712/TCC-11 for test purposes and local order wire operation.

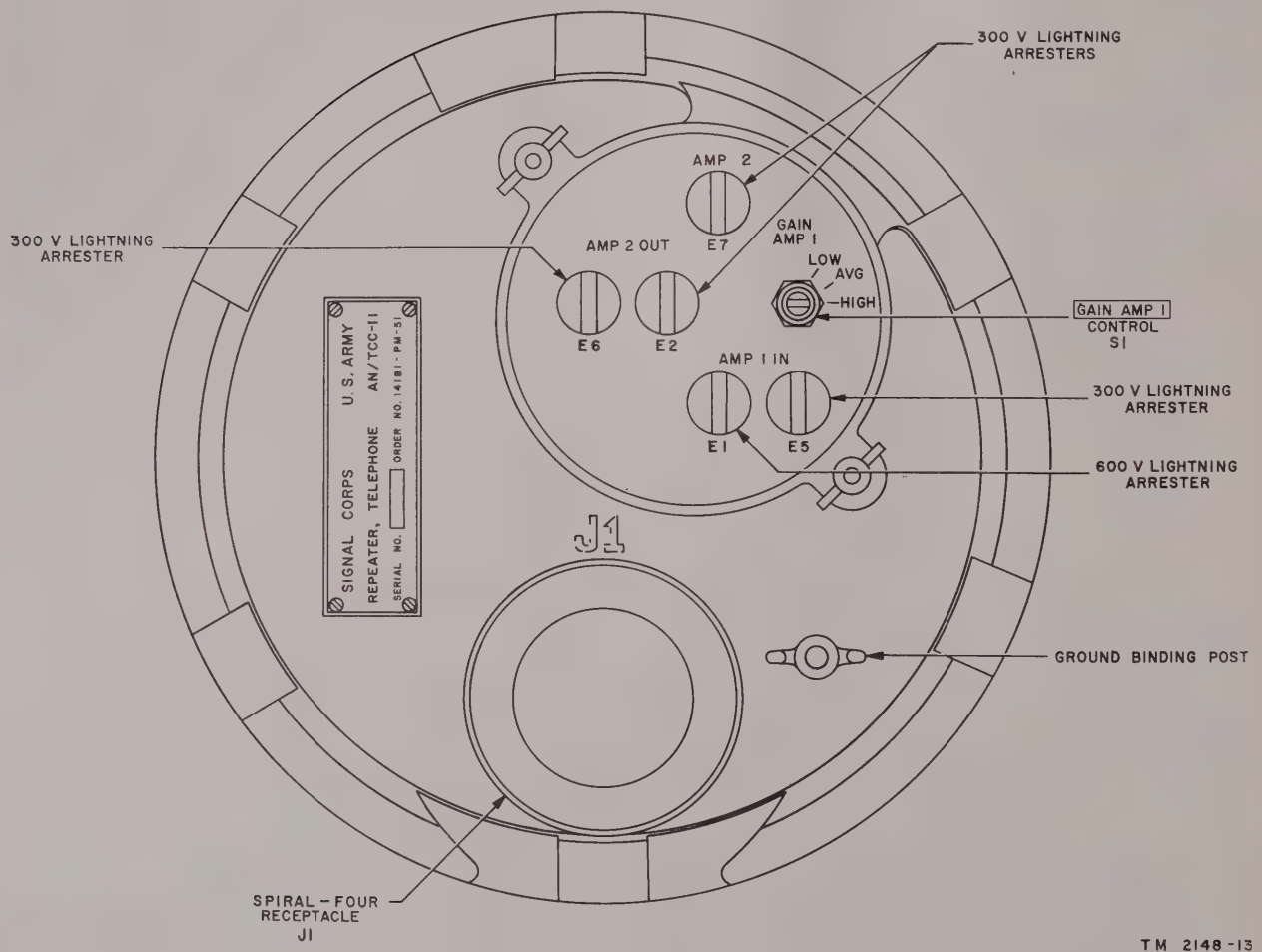


Figure 15. Telephone Repeater AN/TCC–11, J1 end panel controls.

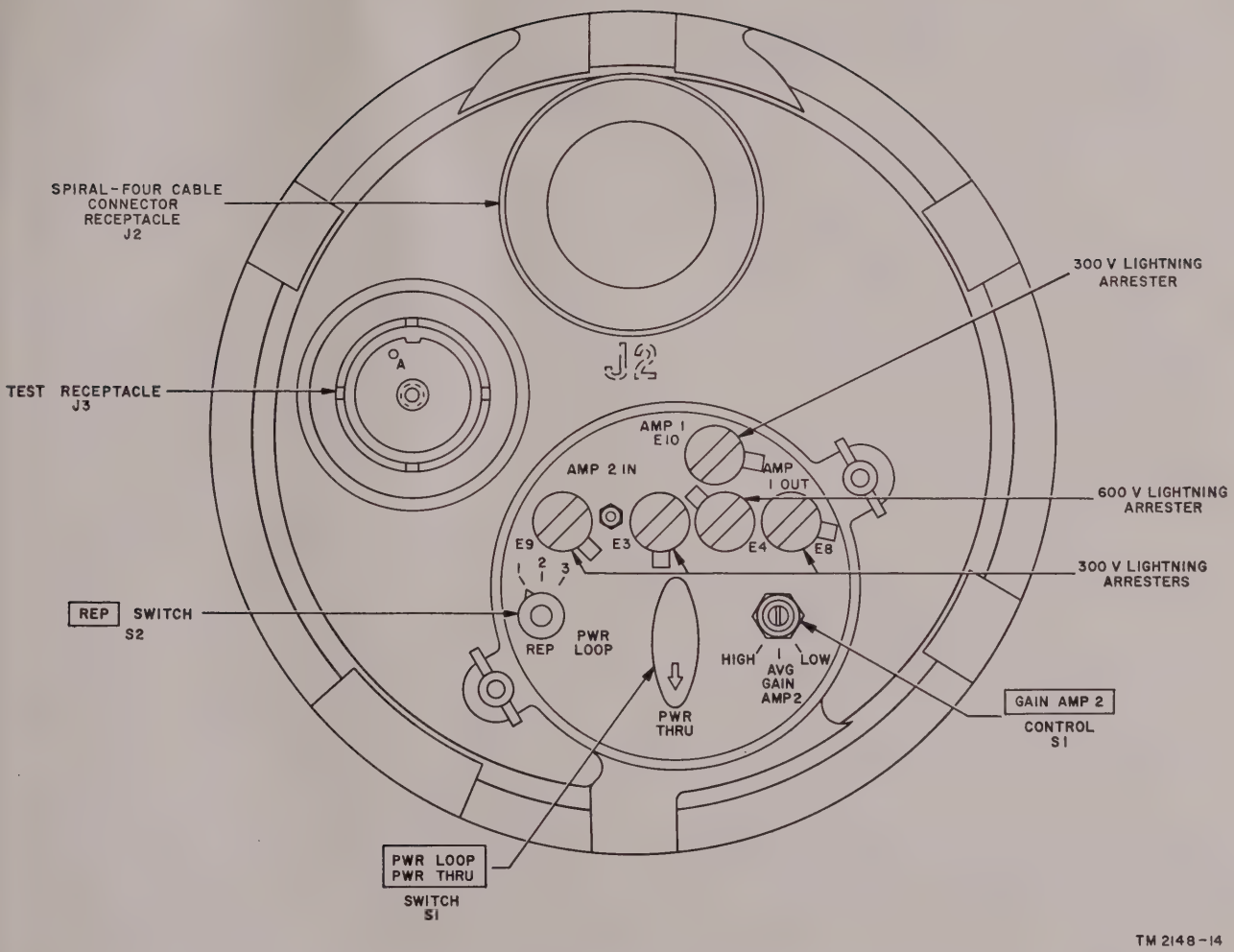


Figure 16. Telephone Repeater AN/TCC–11, J2 end panel controls.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. OPERATION UNDER USUAL CONDITIONS

46. Initial Tests and Preliminary Starting Procedures

a. Initial Tests. After Telephone Repeater AN/TCC–11 has been preset and connected through the spiral-four cable to the attended point supplying power, initial testing of the equipment is accomplished by use of a calibrated Telephone Test Set TS–712/TCC–11 and a Telephone EE–8–( ). Instructions for calibrating the test set at attended points are given in the instruction book for Telephone Test Set TS–712/TCC–11. Testing procedures are given below:

(1) Connect Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ) to the repeater (par. 28*a*, fig. 13).

(2) Operate the OW GAIN switch on Telephone Test Set TS–712/TCC–11 to the HIGH, MED, or LOW positions (par. 49*b*), depending on the location of the repeater from the attended point.

(3) Operate the PWR switch on Telephone Test Set TS–712/TCC–11 to the ON position.

(4) Establish communication (par. 49*c* through *g*) with the attended point on the order wire, and request the transmission of 1-kc test tone and the 68-kc pilot frequency in both directions.

(5) Operate the MEASURE switch on Telephone Test Set TS–712/TCC–11 to the TRANS position.

(6) Operate the SELECTOR switch on Telephone Test Set TS–712/TCC–11, in turn, to the IN 1 KC and the OUT 1 KC positions under the AMP 1 notation on the panel. Note the meter reading in each position. The two readings should not differ by more than 5db.

(7) Operate the SELECTOR switch, in turn, to the IN 1 KC and the OUT 1 KC positions under the AMP 2 notation on the panel. Note the meter reading in each position. The two readings should not differ by more than 5 db.

(8) If the readings, in *f* or *g* above, are off the scale of the meter in Telephone Test Set TS–712/TCC–11, operate the 1 KC SENS switch on Telephone Test Set TS–712/TCC–11 to the LOW position to obtain on-scale readings.

(9) Operate the SELECTOR switch to the IN 68 KC position under the AMP 1 notation and note the meter reading. Operate the SELECTOR switch to the IN 68 KC position under the AMP 2 notation and note the meter reading. The two readings must be within the range of −7 db to +7 db.

(10) Operate the SELECTOR switch to the OUT 68 KC position under the AMP 1 notation and note the meter reading. Operate the SELECTOR switch to the OUT 68 KC position under the AMP 2 notation and note the meter reading. The two readings must be within the range of −5 db to +5 db.

b. Preliminary Starting Procedures. Telephone Repeater AN/TCC–11 normally functions without the attention of an operator for through transmission of carrier frequency message channels and order wire frequencies. To perform the following preliminary starting procedures, an operator is required.

(1) Make the transmission check at the attended point as described in TM 11–2150.

(2) Operate the GAIN AMP 1 and GAIN AMP 2 controls to the LOW, AVG, or HIGH positions for the desired condition of the repeater gain.

(3) Operate the REP switch to positions 1, 2, or 3 to correspond with the location of the repeater from the attended point supplying its power.

(4) Operate the PWR LOOP-PWR THRU switch to the PWR LOOP position for a repeater at the junction point of the power loops, or to the PWR THRU position for repeaters located between the attended point and the junction point.

(5) Connect Telephone Repeater AN/TCC–11 into the 12-channel system (par. 27).

47. Starting Procedure

After the preliminary starting procedures (par. 46*b*) have been made, an operator is not required at the unattended repeater. Telephone Repeater AN/TCC–11 is ready for carrier frequency and order wire transmission as soon as d-c power is received from the attended point. No starting procedure is required at the unattended repeater, since the supply of power to the equipment is accomplished at the attended point. In order to effect local operation on the order wire (par. 48*b*(2)) at a particular AN/TCC–11, an operator is needed at that repeater with the required auxiliary equipment (Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( )).

48. Types of Operation

a. Carrier Frequency Operation. In normal carrier frequency operation, Telephone Repeater AN/TCC–11 amplifies, equalizes, and regulates the carrier and pilot frequencies without requiring the attention of an operator. An operator or a lineman must be sent from the attended point to make the required routine operational checks, or to make such adjustments as are required by changes in the environment of the repeater or the spiral-four cable.

b. Order Wire Operation.

(1) *Through transmission.* Order wire voice frequencies which originate at other points in the system, at either attended points or at other Telephone Repeaters AN/TCC–11, pass through a particular AN/TCC–11 automatically, and do not require the attention of the operator. Circuits in the repeater bypass the order wire voice frequencies around the amplification circuits so that these frequencies are unamplified, unequalized, and unregulated between the attended points.

(2) *Local operation.* Talking and ringing on the order wire from a particular AN/TCC–11 requires a Telephone Test Set TS–712/TCC–11 and a Telephone EE–8–( ) connected together and to the AN/TCC–11 (par. 28*a* and fig. 13). Because the test set and the telephone are bridged across the A to B and B to A directions of transmission, talking and ringing may be heard at attended points in both directions, depending on local conditions. Because of the greater distance to the other attended points, the lineman talking on the order wire can be sure of reaching only the attended point which is supplying power to the repeater from which he is calling.

Caution: Incorrect setting of the OW GAIN control on the TS–712/TCC–11 may result in a singing loop between the AN/TCC–11 and the attended point which is supplying power. This singing will be heard as a tone in the telephone receiver when the RING-TALK switch on the TS–712/TCC–11 is in the TALK position. To correct this condition, operate the OW GAIN control counterclockwise to the next position.

49. Method of Talking and Ringing at Telephone Repeater AN TCC–11

Proceed as follows when talking and ringing to the attended points from a particular AN/TCC–11.

a. Connect Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ) to Telephone Repeater AN/TCC–11 (par. 28*a*).

b. Operate the OW GAIN control on Telephone Test Set TS–712/TCC–11 to the HIGH, the MED, or the LOW position, depending on the location of the repeater from the attended point in the power loop.

(1) When the AN/TCC–11 that is being tested is the only one in the power loop, the proper switch position is HIGH.

(2) When there are two AN/TCC–11 repeaters in a power loop, the proper switch position for the repeater nearest the attended point is MED. For the more distant repeater, the switch position is HIGH.

(3) When there are three repeaters in a power loop, the switch position for the repeater nearest the attended point is LOW. For the second repeater away from the attended point, the switch position is MED. For the most distant repeater from the attended point, the switch position is HIGH.

(4) When the location of the repeater in the power loop is not known, operate the OW GAIN switch to the LOW position. If the operator is unable to signal or communicate successfully with the attended point, operate the OW GAIN switch to the MED and the HIGH positions successively until satisfactory communication is established.

c. Operate the RING-TALK switch on Telephone Test Set TS–712/TCC–11 to the TALK position and listen on the order wire to determine whether or not the circuit is idle. When the order wire is idle, proceed as outlined in *d* below.

d. Operate the RING-TALK switch to the RING position.

e. Turn the handcrank on the generator of Telephone EE–8–( ).

Note.—The turning of the crank on Telephone EE–8–( ) must be rapid and steady. Ringing circuits at attended points will not respond to signals of less than .2-second duration.

f. Operate the RING-TALK switch to the TALK position to talk to the attended point.

g. If the attended point does not answer the call, repeat the procedures given in *c*, *d*, and *e* above.

h. Disconnect Telephone Test Set TS–712/TCC–11 from the repeater by removing plug P1 on Telephone Test Set TS–712/TCC–11 from test receptacle J3 on Telephone Repeater AN/TCC–11.

i. Replace the receptacle cover on J3, and turn the wing screw clockwise to secure it.

50. Stopping Procedure

Telephone Repeater AN/TCC–11 will operate as long as it is connected to a normally operating system. Stopping any AN/TCC–11 in the system will stop the entire 12-channel carrier system. The three types of stopping procedures are—a stopping procedure for Telephone Repeater AN/TCC–11 when it is desired to shut down the entire system (par. 51); a stopping procedure when it is desired to replace the AN/TCC–11 equipment (par. 52); and an emergency stopping procedure (par. 53).

Caution: Do not remove the spiral-four connectors from receptacles J1 or J2 of the repeater without obtaining permission from the attended point. Removing these connectors will stop the operation of the entire system and bring in power alarms at the attended point.

51. Stopping Procedure for Telephone Repeater AN/TCC–11 in System Shut-Down

When the 12-channel carrier system is being shut down, the stopping procedure for Telephone Repeater AN/TCC–11 is effected at the attended point by removing the d-c power from the cable.

52. Stopping Procedure for Replacing Telephone Repeater AN/TCC–11

Telephone Repeater AN/TCC–11 normally is allowed to remain in operation until a lineman is available at the AN/TCC–11 which requires replacement. The following procedures are used in the temporary stopping of the equipment for replacement.

a. Upon arrival at the AN/TCC–11 location, contact the attended point (par. 49), and request that power be removed from the power loop in which the repeater is located.

b. Perform the replacement procedures given in paragraph 76.

c. Request the attended point to resupply power to the power loop.

d. Perform equipment performance checks (par. 74), if required.

53. Emergency Stopping Procedures

In an emergency, the procedures in *a* or *b* below should be adapted for use.

a. Emergency Stopping of Telephone Repeater AN/TCC–11, System Shut-Down. If the emergency is such that the emergency stopping of the AN/TCC–11 will result in a system shut-down, the following procedure should be used.

(1) Contact the attended point, if possible, and request that power be removed from the power loop.

(2) Remove the spiral-four connectors from connectors J1 and J2 on the AN/TCC–11 with permission of the attended point.

b. Emergency Stopping of Telephone Repeater AN/TCC–11, System Maintained. If the situa-

tion requires the 12-channel carrier system to be maintained in operation at all costs without Telephone Repeater AN/TCC–11, which requires emergency stopping, use the following procedure. For detailed instructions in emergency stoppage of Telephone Repeater AN/TCC–11 with the system maintained, refer to TM 11–2150.

(1) Obtain permission from the attended point to couple the system around the repeater requiring stopping.
(2) Request the attended point to remove power from the power loop.
(3) Remove the spiral-four cable connectors from connectors J1 and J2 on Telephone Repeater AN/TCC–11.
(4) Couple both spiral-four cable connectors.
(5) If the PWR LOOP-PWR THRU switch was operated to the PWR LOOP position on the removed repeater, operate the switch to PWR LOOP at either of the adjacent AN/TCC–11 repeaters.
(6) Request the attended point to make any required readjustments in the PP–826 600 VOLT POWER SUPPLIES which supply power from the two ends of the attended repeater section to the power loops affected by the removal of the AN/TCC–11 repeater.
(7) Tag the connection to indicate that the AN/TCC–11 has been withdrawn from the system at that point, and must be replaced as soon as possible.

Section II. OPERATION UNDER UNUSUAL CONDITIONS

54. General

The operation of electronic equipment may be difficult in regions where extreme cold, heat, humidity, moisture, or sand conditions prevail. Telephone Repeater AN/TCC–11 operates at temperatures from —65° F. to 150° F. The following paragraphs contain instructions for minimizing the effect of unusual operating conditions.

55. Operation in Arctic Climates

The weatherproof case protects Telephone Repeater AN/TCC–11 from subzero temperatures and climatic conditions associated with cold weather. The following precautions should be taken to minimize the effect of adverse temperature conditions.

a. Handle the equipment carefully.

b. Telephone Repeater AN/TCC–11 is weatherproof. Shelters for equipment need not be used.

c. Telephone Repeater AN/TCC–11 should be located in the same environment as the spiral-four cable. If the cable and repeater are located in the snow, protect the repeater with canvas or other material.

d. When equipment which has been exposed to the cold is brought into a warm room, moisture will condense on all cold surfaces, and will continue to do so until the equipment reaches room temperature. Allow the AN/TCC–11 to reach room temperature before removing the end covers.

56. Operation in Tropical Climates

When the AN/TCC–11 is connected in an operating system, the tube filaments are always on and supply enough heat to keep the temperature inside the equipment from becoming lower than the temperature of the ambient air. This prevents condensation of moisture due to the high relative humidity in tropical areas. When an installation is made in swampy areas, the gaskets in the cover assemblies must be inspected carefully for deterioration to make certain that they still preserve a waterproof seal. Spare equipment should be kept in a heated shelter to minimize condensation of moisture on the equipment.

57. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates (par. 56) often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The most serious problem that arises with operation in desert areas is that of keeping sand and dust from entering the equipment. Be careful when opening the access ports to get at the controls, or in removing the cover assemblies for maintenance purposes. Use shelter halves, sacking, heavy paper, or other improvised means of keeping sand and dust from entering the case. Wipe off the assemblies with a clean, dry cloth before reinserting them into the case. Wipe out

the connector covers before attaching them to the connectors.

c. Never tie power cords, signal cords, or other wiring connections to any part of tents or other temporary shelters. Desert areas are subject to sudden wind squalls which may jerk connections loose or break the lines.

d. Be careful to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (ch. 4). This equipment does not need lubrication and should be kept free from oil and grease. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit which will damage the equipment.

CHAPTER 4
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

58. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair since its object is to prevent certain troubles from occurring. Refer to AR 750–5.

59. Tools, Materials, and Test Equipment Required

The tools, materials, and test equipment listed in the table below are issued for use in performing organizational maintenance. These items are necessary to perform preventive maintenance and for use in organizational troubleshooting.

Tool, material, or test equipment	Signal Corps stock No.
Tool Equipment TE–123	6R38123
Tube Puller TL–201	6R7442
Orangestick	6Z7360
Cheesecloth, bleached, lint-free	6Z1989
Paper, sand, flint, No. 0000	6Z7500–0000
Carbon tetrachloride	6G184. 2
Solvent, Dry Cleaning (SD)	QM 51S–4385–1
Screwdriver TL–205	6R16410
Telephone Test Set TS–712/TCC–11	3F4325–712
Telephone EE–8–( )	4B5008
Multimeter TS–297/U	3F4325. 297
Electron Tube Test Set TV–2/U	3F3952–2
Telephone Cable Assembly CX–1512/U	3E5999–2. 14
Telephone Cable Assembly CX–1606/G	3E5999–2. 15

60. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

Caution: Do not use emery cloth or steel wool. Minute particles frequently enter the connector receptacles and cause harmful shorting or grounding of circuits.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for connector receptacles, moisten the cloth or brush with solvent (SD); then wipe the parts dry with a dry cloth.

(2) Clean the connector receptacles with a cloth moistened with carbon tetrachloride, then wipe them dry with a dry cloth.

Caution: Repeated contact of carbon tetrachloride with the skin, or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 psi to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

61. Use of Preventive Maintenance Forms (fig. 17 and 18)

a. The decision as to which items on DA AGO Forms 11–238 and 11–239 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items in figures 17 and 18 are partially or totally applicable to Telephone Repeater AN/TCC–11 at the unattended point and at the attended point. Items marked with an asterisk (*) are to be performed at the attended point only. References in the ITEM block refer to paragraphs in text which contain additional maintenance information.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; Ⓧ Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* (PAR. 7)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. (PAR. 18)							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. (PAR. 60)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. (PAR. 77)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. (PAR. 66)							
6	CHECK FOR NORMAL OPERATION. (PAR. 74)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. (PAR. 60)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. (PAR. 64)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. (PAR. 66)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER-PROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING. (PAR. 66)		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. (PAR. 66)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA AGO FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 2148-80

Figure 17. DA AGO Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE | EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* (PAR. 7)	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. (PAR. 18)	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. (PAR. 60)	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. (PAR. 66)	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. (PAR. 66)	
6	CHECK FOR NORMAL OPERATION. (PAR. 74)	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. (PAR. 60)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. (PAR. 64)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. (PAR. 66)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING. (PAR. 66)	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. (PAR. 66)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	
19 *	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. (PAR. 66)	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21 *	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. (PAR. 66)	
22 *	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS. (PAR. 66)	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
24 *	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. (PAR. 66)	
25 *	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. (PAR. 66)	
26 *	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. (PAR. 60)	
27 *	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. (PAR. 66)	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
31 *	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. (PAR. 60)	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE.	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
36 *	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS. (PAR. 66)	
37	MOISTURE AND FUNGIPROOF.	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.	

NOTE: * INDICATES ITEMS TO BE CHECKED AT ATTENDED POINTS ONLY.

DA AGO FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 46—16—44483-1

TM 2148-81

Figure 18. DA AGO Form 11-239.

Section II. LUBRICATION AND WEATHERPROOFING

62. Lubrication

None of the moving parts of the AN/TCC–11 require lubrication. All moving parts are inclosed within a watertight seal.

63. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. Special moistureproofing and fungiproofing treatment usually will not be needed. Keep the equipment dry and clean. For instructions covering tropical maintenance under extreme conditions, refer to TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance of equipment at extremely low temperatures are fully explained in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are fully explained in TB SIG 75.

e. Moistureproofing and Fungiproofing. Fungiproofing is done during manufacture and does not have to be repeated unless the parts are repaired or replaced. The only moistureproofing that need be done is the application of silicone grease to the O-shaped rubber gaskets on the CONTROLS access port covers whenever the rubber gaskets appear dry. This will help preserve a watertight seal and keep the rubber from drying out.

64. Rustproofing and Painting

a. Rustproofing. When the finish on exposed metal surfaces has been scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do *not* use steel wool or emery cloth. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. Painting. When a touch-up job is necessary, apply paint with a small brush. Remove corrosion from the surface to be painted by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandapper to complete the preparation for painting. Paint used will be authorized and consistent with existent regulations.

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

65. General

a. The troubleshooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment and replaceable parts issued, and the existing tactical situation.

b. Troubleshooting a Telephone Repeater AN/TCC–11 at the organizational level is divided into two additional levels, troubleshooting at an unattended point, and troubleshooting at an attended point.

c. Troubleshooting at the unattended point consists of the following procedures:

(1) Use Telephone Test Set TS–712/TCC–11 to check the repeater and to determine trouble symptoms.

(2) Make minor repairs that do not involve disassembling the equipment. If the fault cannot be repaired at the unattended point, the repeater is replaced with a good one. The faulty repeater is returned to the attended point for more detailed troubleshooting.

d. Troubleshooting at the attended point consists of locating the fault to a defective tube, line amplifier, end cover assembly, or filter assembly. The defective item is replaced with a good one and is sent back to higher echelons for field maintenance level troubleshooting.

66. Visual Inspection

a. Failure of equipment to operate properly usually will be caused by one or more of the following faults:

(1) Defective tubes.
(2) Shorted lightning arresters.
(3) Worn, broken, or disconnected cords and plugs.
(4) Broken wires.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the component parts of the system. If possible, obtain information regarding performance at the time trouble occurred.

67. Definitions of Terms

The definitions of terms used in referring to all or any part of this equipment are given below:

a. Equipment—AN/TCC–7, AN/TCC–8, AN/TCC–11, TS–712.

b. Component—An integral part of equipment that has its own nomenclature.

c. Panel—A section of a component; it may or may not have nomenclature.

d. Assembly—Unitized section of a component or panel (example, plug-in chassis).

e. Subassembly—Unitized section of an assembly.

f. Stage—Associated group of parts that perform circuit functions.

g. Part—Capacitor, resistor, or similar item.

Section IV. TROUBLESHOOTING AT THE UNATTENDED POINT

68. General

Warning: Voltages that are dangerous to life may be present on the AN/TCC–11 repeater. Whenever a procedure exposes the tester to a high voltage the necessary safety precautions will be indicated in the instructions.

The following paragraphs describe the procedures to follow when troubleshooting at an unattended AN/TCC–11 repeater point.

Caution: Do not follow any procedure that causes interruption of the system transmission unless permission is granted by the control point.

69. Equipment Required

At the attended point, a repairman will assemble the following equipment for servicing the AN/TCC–11 and will take the equipment to the unattended point.

a. Telephone Test Set TS–712/TCC–11.
b. Telephone EE–8–( ).
c. Multimeter TS–297/U.
d. Spare Telephone Repeater AN/TCC–11.

70. General Instructions at AN TCC–11 Repeater Point

a. Upon arriving at the AN/TCC–11 point, first use the order wire to call the attended point. This procedure is described in paragraph 49.

b. Remain in continuous communication with an attended point and carry out the instructions sent from that point.

c. Be sure to prevent dirt and moisture from entering the repeater through any openings from which covers are removed during the tests.

d. Replace all covers securely on the AN/TCC–11 repeater before leaving the repeater.

71. Tagging A Defective Repeater

When a defective repeater is replaced, attach a tag describing trouble symptoms to help expedite troubleshooting at the attended point. The tag should indicate whether the trouble is in a power circuit or a transmission circuit. If the trouble is in the power circuit, mark the tag *power circuit trouble*. If the trouble is in the transmission circuit, mark the tag *transmission circuit trouble* and give a brief description of the trouble symptoms. Examples of the type of description to use are shown in the *Symptoms* column of the troubleshooting chart in paragraph 88.

72. Troubleshooting Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 74) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of various switch and control settings under which the item is to be checked. For other items it represents an action that must be taken to check the *Normal indications* column.

c. Normal Indications. The normal indications listed include the visible and audible indications that should be perceived when each item is checked. If the indications are not normal, apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those that can be applied without turning in the equipment for repairs. The only corrective measures that can be made on Telephone Repeater AN/TCC–11 equipment, while it is connected into the system, are to change control settings, ascertain that the spiral-four cable connectors are seated firmly in the correct receptacles, and to check the lightning arresters. The lineman cannot take corrective measures beyond this without replacing Telephone Repeater AN/TCC–11 with a repeater known to be good. A reference in the table to chapter 6, or to a paragraph in that chapter, indicates that troubleshooting by an experienced repairman is necessary, and the equipment must be replaced. However, if the tactical situation requires that communication be maintained, and no Telephone Repeater AN/TCC–11 replacement is immediately available, the lineman must maintain the equipment in operation as long as it is possible to do so. In extreme cases, the repeater may be taken completely out of the system and the two spiral-four cables connected together. For instructions covering emergency measures needed to maintain the system, refer to TM 11–2150.

73. Auxiliary Equipment Required for Equipment Performance Checks

Equipment performance checks on Telephone Repeater AN/TCC–11 require use of a Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ), or equivalent. Because of the nature of the unattended repeater and the fact that operational checks must not interrupt the normal operation of the system, the lineman must perform the preparatory steps that have not been done and assume that the starting procedures have been accomplished.

74. Equipment Performance Checklist

Perform the items given in the equipment performance checklist in the following order:

	Item No.	Item	Action or condition	Normal indications	Corrective measures
Preparatory	1	Spiral-four cable connector supplying power.	Inserted in connector J1		
	2	Remaining spiral-four cable connector.	Inserted in connector J2		
	3	Controls access port covers and J3 receptacle cover on AN/TCC–11.	Remove		
	4	REP switch (S2) on AN/TCC–11.	Operated to position 1 on first repeater in power loop.		
			Operated to position 2 on second repeater in power loop.		
			Operated to position 3 on third repeater in power loop.		
	5	PWR LOOP-PWR THRU switch (S1) on AN/TCC–11.	Operated to PWR THRU position for repeater not at junction point of power loop.		
			Operated to PWR LOOP position for repeater at junction point of power loop.		
	6	OW GAIN control on Telephone Test Set TS–712/TCC–11.	Operated to LOW, MED, or HIGH position to agree with location of repeater from attended point (par. 49*b*).		
	7	Telephone Test Set TS–712/TCC–11.	Connect Telephone Test Set TS–712/TCC–11 to Telephone Repeater AN/TCC–11. Mate connector P1 of test set to connector J3 on repeater.		

	Item No.	Item	Action or condition	Normal indications	Corrective measures
	8	Telephone EE–8–( )	Connect Telephone EE–8–( ) to Telephone Test Set TS–712/TCC–11 (fig. 13).		
	9	PWR switch on Telephone Test Set TS–712/TCC–11.	Operate to ON position	Meter indicates readings determined by positions of MEASURE switch.	Refer to the instruction book, for Telephone Test Set TS–712/TCC–11.
	10	Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ).	Establish communication with attended point (par. 49). Request that 1 kc and 68 kc be sent over cable.		Check lightning arresters (par. 77). If trouble still exists, replace Telephone Repeater AN/TCC–11 (par. 76).
	11	MEASURE switch on TS–712/TCC–11.	Operated to A BAT position.	Meter deflection to BAT mark.	Refer to item 12 below.
	12	A BAT control on Telephone Test Set TS–712/TCC–11.	Adjust to obtain meter reading at BAT mark.		Refer to instruction book for Telephone Test Set TS–712/TCC–11.
	13	MEASURE switch on TS–712/TCC–11.	Operate to B BAT position.	Meter deflection to BAT mark.	Refer to item 14 below.
	14	B BAT control on Telephone Test Set TS–712/TCC–11.	Adjust to obtain meter reading at BAT mark.		Refer to instruction book for Telephone Test Set TS–712/TCC–11.
START	15	Telephone Repeater AN/TCC–11.	Starting is effected at attended points.		
EQUIPMENT PERFORMANCE	16	MEASURE switch on TS–712/TCC–11.	Operate to REP VOLTS position.	Meter deflection to BAT mark.	Refer to par. 75, items 3, 5, and 6.
	17	MEASURE switch on TS–712/TCC–11.	Operate to TRANS position.	Meter indicates readings as determined by position of SELECTOR switch.	Refer to instruction book for Telephone Test Set TS–712/TCC–11.
	18	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 1, IN 68 KC position.	Meter reads between −7 db and +7 db.	Refer to par. 75, item 3.
	19	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 1, OUT 68 KC position.	Meter reads between −5 db and +5 db.	Adjust GAIN AMP 1 control. Refer to par. 75, item 4.
	20	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 2, IN 68 KC position.	Meter reads between −7 db and +7 db.	Refer to par. 75, item 5.
	21	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 2, OUT 68 KC position.	Meter reads between −5 db and +5 db.	Adjust GAIN AMP 2 control. Refer to par. 75, item 6.
	22	SELECTOR switch on Telephone Test Set TS–712/TCC–11.	Operate to AMP 1, IN 1 KC and AMP 1, OUT 1 KC positions in turn.	If reading appears on meter, AMP 1 is carrying direction of transmission from attended point with which communication has been established. For values of readings under all conditions see par. 80.	If reading is off scale operate OW GAIN switch to LOW position. If trouble still exists, refer to par. 75, items 3 and 4.

Item No.	Item	Action or condition	Normal indications	Corrective measures
23	SELECTOR switch on Telephone Test Set TS–712/TCC–11.	Operate to AMP 2, IN 1 KC, and AMP 2, OUT 1 KC positions in turn.	If reading appears on meter, AMP 2 is carrying direction of transmission from attended point with which communication has been established. For values of readings under all conditions see par. 80.	If reading is off scale operate OW GAIN switch to LOW position. If trouble still exists, refer to par. 75, items 5 and 6.
24	MEASURE switch on Telephone Test Set TS–712/TCC–11.	Operate to V1 AMP 1, V2 AMP 1, V1 AMP 2, and V2 AMP 2 positions in turn.	Meter reads between −2 db and +5 db in each case.	Mark TUBE ACT and replace AN/TCC–11.
25	V ACT switch on Telephone Test Set TS–712/TCC–11.	Operate to TEST position, hold for 1 minute, note reading, release to NORMAL position for each position of MEASURE switch in item 24.	Meter reads between −5 db and +5 db. Readings should be within 5 db of readings obtained in item 24.	Mark TUBE ACT and replace AN/TCC–11.
26	PWR switch on TS–712/TCC–11.	Operate to OFF position	----------	
27	Plug P1 on Telephone Test Set TS–712/TCC–11.	Remove connector P1 of Telephone Test Set TS–712/TCC–11 from connector J3 on AN/TCC–11.	----------	
28	Access port covers and J3 connector cover on AN/TCC–11.	Replace and tighten securely.	----------	
29	Telephone EE–8–(–).	Disconnect from Telephone Test Set TS–712/TCC–11 (par. 49).	----------	
30	Telephone Test Set TS–712/TCC–11.	Replace cover.	----------	

75. Organizational Level Troubleshooting Chart for Use at Unattended Point

The troubleshooting instructions given in this organizational level troubleshooting chart are to be applied only after trouble has been localized to a particular repeater. For instructions in localizing trouble to a repeater, refer to TM 11–2150. This organizational level troubleshooting chart lists only trouble symptoms that can be corrected at the unattended point. If trouble symptoms occur which are not listed, replace Telephone Repeater AN/TCC–11. Obtain permission from the attended point before performing any of the corrective measures listed in the chart.

Symptom	Probable trouble	Correction
1. Low voltage power alarm at attended point. Resistance measurements indicate a particular Telephone Repeater AN/TCC–11 in trouble. (Refer to TM 11–2150).	Defective arrester	Check arresters E1, E2, E3, E4, E7, and E10 (par. 77). If arresters are not defective and trouble still exists, replace Telephone Repeater AN/TCC–11 (par. 76).
2. High voltage power alarm at attended point. Resistance measurements indicate a particular Telephone Repeater AN/TCC–11 in trouble. (Refer to TM 11–2150).	Faulty connection at connectors J1 or J2.	Check that spiral-four cable connectors are seated securely in connectors J1 and J2.
	Dirty connector contacts	Clean connector contacts with solvent (SD) (par. 60*b*).

Symptom	Probable trouble	Correction
		If connectors are seated securely, clean, and in good condition, but trouble persists, replace Telephone Repeater AN/TCC–11 (par. 76).
3. No 68 kc (par. 74, item 18) or 1-kc input (par. 74, item 22) to AMP 1; repeater voltage normal (par. 74, item 16).	Defective arrester E5	Check arrester E5 (par. 77). If arrester E5 is not defective, replace Telephone Repeater AN/TCC–11 (par. 76).
4. No 68 kc (par. 74, item 19) or 1 kc (par. 74, item 22) output from AMP 1; normal 68 kc and 1 kc input.	Defective arrester E8	Check arrester E8 (par. 77). If arrester E8 is not defective, replace Telephone Repeater AN/TCC–11 (par. 76).
5. No 68 kc (par. 74, item 20) or 1 kc (par. 74, item 23) input to AMP 2; repeater voltage normal (par. 74, item 16).	Defective arrester E9	Check arrester E9 (par. 77). If arrester E9 is not defective, replace Telephone Repeater AN/TCC–11 (par. 76).
6. No 68 kc (par. 74, item 21) or 1 kc (par. 74, item 23) output from AMP 2; normal 68 kc and 1 kc input; repeater voltage normal (par. 74, item 16).	Defective arrester E6	Check arrester E6 (par. 77). If arrester E6 is not defective, replace Telephone Repeater AN/TCC–11 (par. 76).

76. Replacing Telephone Repeater AN/TCC–11

To replace a Telephone Repeater AN/TCC–11 in an operating system, use the procedures outlined in *a* through *i* below.

a. Operate all controls on the substitute repeater to the same positions used on the repeater being replaced.

b. Tag or otherwise identify the spiral-four cable connectors to prevent insertion into the wrong receptacles on the substitute repeater.

c. Establish contact with the attended point and obtain permission to interrupt service.

d. Request that the power supply which feeds the power loop in which the repeater is located be turned off.

e. Disconnect the spiral-four cable connectors from connectors J1 and J2.

f. Insert the spiral-four cable connectors into corresponding connectors J1 and J2 on the new repeater.

g. Establish contact with the attended point and request that power be restored to the power loop.

h. Perform the equipment performance checks (par. 74).

i. Tag the replaced repeater as described in paragraph 71 and bring it back to the attended point for repair.

77. Replacing Lightning Arresters

Lightning arresters in Telephone Repeater AN/TCC–11 may become damaged by the passage of surges of current, induced in the cable by lightning or other sources. A damaged lightning arrester may cause transmission or power failure. The lightning arresters contain two carbon blocks. Both blocks are mounted with proper spacing in a removable bayonet-based container. When a lightning arrester becomes damaged, the removable portion is replaced by one of the spares carried in Telephone Test Set TS–712/TCC–11. The procedure for replacing the removable portion of the arrester is given in *a* through *i* below.

Warning: High voltage exists at the sockets of lightning arresters marked with red lettering. Use extreme care when working around the sockets of these arresters.

a. Obtain permission from the attended point before removing any lightning arrester. Removing a lightning arrester can create a short circuit across the circuit to which the lightning socket is connected.

b. Loosen the cap of the lightning arrester holder by rotating it counterclockwise. Remove the cap and the lightning arrester.

c. Measure the resistance of the lightning arrester with the TS–297/U multimeter or equivalent. Measure between the metal sleeve of the lightning arrester and the outer carbon block. Push against the carbon block with the multimeter prod to be sure that the carbon block is seated normally. The normal resistance of a good arrester is greater than 2 megohms. When using the TS–297/U multimeter, the meter reading should read between the 100,000 ohm mark and the infinity mark on the meter scale.

d. Inspect the lightning arrester for evidence of

damage, loose particles of carbon, and pitted surfaces.

e. Discard the removable portion of the lightning arrester, if defective.

f. Replace Telephone Repeater AN/TCC–11 (par. 76) if the portion of the lightning arrester which cannot be removed is defective.

g. Select a new lightning arrester from the spares in Telephone Test Set TS–712/TCC–11.

h. Measure resistance of the new lightning arrester (*c* above).

i. Match the color of the dot on the spare lightning arrester to the color of the washer on the arrester socket in Telephone Repeater AN/TCC–11, to make certain that the spare has the same voltage rating as the replaced lightning arrester.

j. Insert bayonet-type mounting of the lightning arrester into the lightning arrester socket.

78. Vacuum-Tube Activity Test

Telephone Test Set TS–712/TCC–11 provides a test for checking the tubes in Telephone Repeater AN/TCC–11 without removing the repeater from service. The test measures the cathode emission as an indication of the aging of the tube. Aged tubes with decreased emission cause distortion and unwanted modulation products, and they must be replaced. The procedure for making the test is given in *a* through *h* below.

a. Obtain permission for the vacuum-tube activity test from the attended point because the test may increase distortion if the tube under test is bad.

b. Operate the MEASURE switch on Telephone Test Set TS–712/TCC–11 to the V1 AMP 1 position.

c. Note the meter reading on Telephone Test Set TS–712/TCC–11 to the nearest .5 db.

(1) If the reading is within the range from −2 db to +5 db, proceed as described in *d* below.

(2) If reading is not within the −2-db to +5-db range, replace Telephone Repeater AN/TCC–11 and attach a tag marked TUBE ACT, giving the tube number and the amplifier number.

d. Hold the V ACT lever switch in the TEST position for 1 minute and note the reading at the end of that time.

(1) If the reading is within the range −5 to +5 db, and has not changed more than 5 db from the reading shown in *c* above, the tube under test is good. Proceed as directed in *e* below.

(2) If the reading is outside the range of −5 to +5 db, or the change in reading from *c* above is greater than 5 db, replace Telephone Repeater AN/TCC–11 and attach a tag marked TUBE ACT, giving the tube number and the amplifier number.

e. Release the V ACT lever switch and wait 1 minute before proceeding with additional tests.

f. Operate the MEASURE switch to the V2 AMP 1 position and repeat steps described in *a* through *e* above.

g. Operate the MEASURE switch to the V1 AMP 2 position and repeat steps described in *a* through *e* above.

h. Operate the MEASURE switch to the V2 AMP 2 position and repeat steps described in *a* through *e* above.

79. Identification of Line Amplifiers

a. When Repeater Location Is Known. When Telephone Repeater AN/TCC–11 is located in a power loop fed from the *A* attended point (fig. 24), line amplifier AR1 is operating in the *A* to *B* direction, and line amplifier AR1 is operating in the *B* to *A* direction. When Telephone Repeater AN/TCC–11 is located in a power loop fed from the *B* attended point, line amplifier AR1 is operating in the *B* to *A* direction, and line amplifier AR2 is operating in the *A* to *B* direction.

b. When Repeater Location Is Not Known. When it is necessary to identify a particular line amplifier with the direction of transmission in which it is operating, use the following procedure:

(1) Connect Telephone Test Set TS–712/TCC–11 to Telephone Set EE–8–( ). Connect this arrangement to Telephone Repeater AN/TCC–11 (par. 28*a*, fig. 13).

(2) Establish communication with one attended point (par. 49) and request that the 1-kc test tone be sent over the line.

(3) Operate the MEASURE switch on test set TS–712/TCC–11 to the TRANS position.

(4) Operate the SELECTOR switch on the test set to AMP 1 IN 1 kc position and note the reading on the test set meter.

(5) If a reading is obtained in (4) above, request that the 1 kc be stopped and sent several times. If the meter reading shows a deflection each time, then line amplifier AR1 is operating in the direction from the attended point which is sending out the test tone (*A* to *B* when 1 kc is sent from the *A* attended point, and *B* to *A* when 1 kc is sent from the *B* attended point).

(6) If no reading is obtained in (4) above, operate the SELECTOR switch to the AMP 2 IN 1 kc position on the test set and note the reading on the test set meter.

(7) A 1,600 cycle tone may be used if the attended point is unable to supply 1 kc. Measure the 1,600-cycle tone on the test-set meter. Use the procedures given in (1) through (6) above to identify the amplifier.

80. Performing 1 Kc (or 1,600 cps) Test

The readings under item 22 and 23 of the equipment performance checklist (par. 74) vary with the number of repeaters in a power loop, the position of the repeater in the power loop, the number of cable reels between the attended point and the first repeater, and positions of the OW GAIN and 1 KC SENS switches on Telephone Test Set TS–712/TCC–11. The readings that may be expected under all conditions are given in the table below.

Number of repeaters in power loop fed by attended point from which test tone is received	Adjustment of TS–712 test set and meter reading											
	First AN/TCC–11 (nearest sending point)				Second AN/TCC–11				Third AN/TCC–11			
	Test set switches		Meter reading		Test set switches		Meter reading		Test set switches		Meter reading	
	Ow. gain	1 Kc. sens.	Amp. in	Amp. out	Ow. gain	1 Kc. sens.	Amp. in	Amp. out	Ow. gain	1 Kc. sens.	Amp. in	Amp. out
0	High	High	−4. 5	−3. 0	High	High	−13. 5	−12. 0				
1	High	High	+5. 0	+6. 5	High	High	−4. 0	−2. 5	High	High	−13. 0	−11. 5
2	Med	Low	−7. 5	−5. 0	High	High	+4. 0	+5. 5	High	High	−5. 0	−3. 5
3	Low	Low	+1. 5	+5. 5	Med	Low	−6. 5	−4. 0	High	High	+5. 0	+6. 5

Note. Above table gives approximate readings of 1-kc test tone. When 1,600 cps is measured, the readings should be approximately 1 db higher.

Section V. TROUBLESHOOTING AT THE ATTENDED POINT

81. General Procedures

When a faulty Telephone Repeater AN/TCC–11 is brought in from the line, check the tag on the repeater and proceed with the testing instructions which correspond with the information on the tag. For power circuit trouble, use the procedure described in paragraph 84. For transmission circuit trouble, use the procedure described in paragraphs 85, 86, and 87. When the tag is marked TUBE ACT follow the instructions of paragraph 91. For any other symptoms see the organizational troubleshooting chart (par. 88).

82. Special Instructions for Making Resistance Measurements

a. When resistance measurements are made involving connectors, extreme care must be taken to avoid damaging the contacts. When making resistance measurements on the 21-pin female connectors, never insert the test probe directly into the female contact. Hold the test probe at an angle of approximately 45° with respect to the flat surface of the connector and bear lightly against the side of the contact with the probe. This will avoid spreading the contact or pushing it through the base of the connector.

b. When making a resistance measurement on the J3 test connector, always use a test probe which is smaller than the contact hole. If all the test probes available are too large, insert a fine wire in the desired contact to obtain a connection.

c. When making resistance measurements on connectors J1 and J2 of the repeater, use Telephone Cable Assembly CX–1512/U. Make continuity tests on the cable assembly to determine which wires will connect to the male and female contacts on the repeater connectors.

83. Tools and Test Equipment Required

The tools and test equipment required for troubleshooting a Telephone Repeater AN/TCC–11 at an attended point are listed below.

Item	Quantity
Telephone Cable Assembly CX–1512/U	2
Multimeter TS–297/U	1
Telephone Test Set TS–712/TCC–11 including Artificial Cable.	1
Telephone Terminal AN/TCC–7 or Telephone Repeater AN/TCC–8.	1
Telephone Cable Assembly CX–1606/G	1
Screwdriver TL–105	1

84. Power Circuit Test

The procedure for checking the power circuit of the AN/TCC–11 repeater is given in *a* through *f* below.

a. Set up the test circuit as follows:

(1) Connect a Telephone Cable Assembly CX–1512/U to connector J1 of the repeater.

(2) Connect a Telephone Cable Assembly CX–1512/U to connector J2 of the repeater.

b. Remove the CONTROLS cover from the J2 end of the repeater and operate the PWR LOOP-PWR THRU switch to the PWR THRU position.

c. The d-c resistances with the PWR LOOP-PWR THRU switch in the PWR THRU position are shown in the chart below.

Item being checked	Measure between—				D-c resistance (avg.) (ohms)
	Contact	Connector	Contact	Connector	
Power circuit resistance	Male	J1	Female	J2	1,200.
Power circuit insulation resistance	Female	J1	Male	J1	100K.
Power return circuit resistance	Male	J2	Female	J1	34.
Panel ground to case ground resistance	M	J3	D	J3	Greater than 100K.

d. Operate the PWR LOOP-PWR THRU to the PWR LOOP position.

e. The d-c resistances with the PWR LOOP-PWR THRU switch in the PWR LOOP position are shown in the chart below.

Item being checked	Measure between—				D-c resistance (avg.) (ohms)
	Contact	Connector	Contact	Connector	
Power circuit resistance	Female	J1	Male	J1	1,200.
Power circuit insulation resistance	Female	J1	Male	J2	Greater than 100K.
Power return circuit resistance	Female	J2	Male	J2	4.5.
	M	J3	D	J3	Greater than 100K.

f. If any of the resistance measurements in *c* or *e* above indicate trouble, see the organizational level troubleshooting chart (par. 88).

85. Transmission Circuit Tests

a. General. Transmission circuit tests at an attended point involves the use of a Telephone Terminal AN/TCC–7 or a Telephone Repeater AN/TCC–8. If there is a spare of either of these available at the attended point, it should be used to make the transmission tests on the repeater. If no spare equipment is available, it will be necessary to obtain permission from the control point to shut down the system so that the terminal or repeater equipment can be used for troubleshooting purposes.

b. Troubleshooting Procedure. Note the symptoms on the tag and refer to the organizational troubleshooting chart (par. 88). If there is any doubt that the symptoms given on the tag are correct or not clear, perform the transmission circuit test as described in paragraph 86 or 87, and

use the equipment performance checklist (par. 74) to determine the symptoms of the trouble.

86. Transmission Test of Telephone Repeater AN/TCC–11 Using Telephone Terminal AN/TCC–7

a. Adjustments of Telephone Repeater AN/TCC–11.

(1) Use Telephone Cable Assembly CX–1606/G to connect from the cable connector on the JUNCTION PANEL of the AN/TCC–7 equipment to connector J1 at one end of the AN/TCC–11 repeater.

(2) Connect the artificial cable to the AN/TCC–11 repeater by connecting the cable from the artificial cable to the J2 cable connector of the AN/TCC–11 repeater.

(3) Remove the two covers marked CONTROLS and TEST at the J2 end of the repeater and the cover marked CONTROLS at the J1 end of the repeater (figs. 4 and 5).

(4) Operate the GAIN AMP 1 switch at the J1 end of the repeater to the AVG position.

(5) Operate the GAIN AMP 2 switch at the J2 end of the repeater to the AVG position. Operate the REP switch to position 1. Operate the PWR LOOP-PWR THRU switch to the PWR THRU position.

b. Adjustments of Telephone Terminal AN/TCC-7. The adjustment of the AN/TCC–7 should be completed as described in the installation procedure and test covered in the AN/TCC–7 instruction book. The following readjustments should be made to prepare the AN/TCC–7 for testing the AN/TCC–11 repeater.

(1) Operate the CABLE REELS TO FIRST AN/TCC–11 switches (REC and TR) to the positions marked 2.

(2) Operate the AC POWER switch of the PP–827 200-VOLT POWER SUPPLY to the ON position.

(3) Make the following adjustments on the PP–826 600-VOLT POWER SUPPLY:

(*a*) Operate the REPEATER switch to position 1.

(*b*) The 600 VOLT ADJ, LOAD CURRENT, HIGH-VOLT ALARM, and LOW-VOLT ALARM controls should be left as adjusted in the installation test procedure described in the equipment instruction book.

(*c*) Arrange the TS–760 TEST PANEL to measure the PP–826 600 VOLT POWER SUPPLY output voltage.

(*d*) Operate the AC POWER switch to the ON position. The LOAD ALARM lamp will light and the buzzer will sound.

(*e*) Observe the reading on the TS–760 TEST PANEL meter. After several seconds it should rise to a value near 0 db and stop. Adjust the 600 VOLT ADJ control to obtain a reading of 0 db on the meter. If the 600 VOLT ADJ control is considerably out of adjustment, a power alarm may be received (the HIGH VOLTAGE or LOW VOLTAGE lamp will light and the TEST PANEL meter reading will decrease). If this happens, operate the RESTORE lever switch momentarily to restore power. When the TEST PANEL meter reading has risen again and stops increasing, quickly adjust the 600 VOLT ADJ control to obtain a reading of 0 db. (There is a delay of several seconds before the alarm is received.) The LOAD ALARM lamp will be extinguished and the buzzer will be silenced when the 600 VOLT ADJ control is adjusted correctly.

(*f*) Observe the reading on the CURRENT meter on the PP–826 600 VOLT POWER SUPPLY. Adjust the LOAD CURRENT control, if necessary, to obtain a reading of 100 ma (milliamperes). Then readjust the 600 VOLT ADJ control, if necessary, to obtain a reading of 0 db on the TEST PANEL meter.

(*g*) Operate the PWR LOOP-PWR THRU switch on the AN/TCC–11 repeater to the PWR LOOP position. The reading on the TEST PANEL meter of the AN/TCC–7 should be reduced less than 0.5 db.

(*h*) If it is impossible to keep power on the equipment, check the power circuit of Telephone Repeater AN/TCC–11 as described in paragraph 84.

c. Adjustments of TEST PANEL TS–760. Use the test panel to measure the 68-kc output at the REC IN jack on the GROUP PANEL. (See TM 11–2150.) The reading on the TEST PANEL meter should be between +2 db and +7 db with the 10 db ATTENUATOR push button depressed. If the reading is not correct, use the Telephone Test Set TS–712/TCC–11 to determine the trouble symptoms. Perform the actions given in items 7, 9, 11, 12, 13, 14, and 16 through 21 of the equipment performance checklist (par. 74). When the symptoms are known, refer to the organizational level troubleshooting chart (par. 88).

87. Transmission Test of Telephone Repeater AN/TCC–11 Using Telephone Repeater AN/TCC–8

a. Adjustment of Telephone Repeater AN/TCC–11.

(1) Use Telephone Cable Assembly CX–1606/G to connect from the B cable connector on the AM–708 REPEATER PANEL of the Telephone Repeater AN/TCC–8 to connector J1 at one end of the AN/TCC–11 repeater.

(2) Follow the procedure given in paragraph 86*a*(2) through (5).

b. Adjustment of Telephone Repeater AN/TCC–8. The adjustment of the Telephone Repeater AN/TCC–8 should be completed as described in the installation procedure and tests covered in the instruction book for Telephone Repeater AN/TCC–8. The following readjustments should be made to prepare the equipment for testing an AN/TCC–11 repeater.

(1) Set the CABLE REELS TO FIRST AN/TCC–11 TOWARD B TERM switches (BA IN) and (AB OUT) to the positions marked 2.

(2) Operate the AC POWER switch of the PP–827 200 VOLT POWER SUPPLY to the ON position.

(3) Make adjustments on the PP–826 600 VOLT POWER SUPPLY which feeds power to the cable in the AB direction (connected to POWER TOWARD B connector on the AM–708 REPEATER PANEL). The adjustments are the same as described in paragraph 86*a*(2)(*g*) through (*h*). Use TEST PANEL TS–761 to measure the output voltage.

c. Test Procedures. Arrange TEST PANEL TS–761 to send 68 kc in the AB direction. Measure the 68-kc output at the AB AMP 1 OUT jack on the AM–708 REPEATER PANEL (see TM 11–2150). Adjust the SEND control to obtain a reading of 0 db on the TEST PANEL TS–761 meter.

(1) Measure the 68-kc output at the AB AMP 2 OUT jack. Operate the AB REGULATOR lever switch on the chassis of the AM–708 REPEATER PANEL to the MAN position. Adjust the AB MAN REG OUTPUT control to obtain a reading of 0 db on the test panel meter.

(2) Use TEST PANEL TS–761 to measure the 68-kc output at the BA IN jack on the AM–708 REPEATER PANEL. The reading on the TEST PANEL meter shall be between +2 db and +7 db with the 10-db ATTENUATOR push button depressed. If the reading is not correct, use the Telephone Test Set TS–712/TCC–11 to determine the trouble symptoms. Perform the actions in items 7, 9, 11, 12, 13, 14, and 16 through 21 of the equipment performance checklist (par. 74).

(3) When the symptoms are known, refer to the organizational level troubleshooting chart (par. 88).

88. Organizational Level Troubleshooting Chart (Attended Points)

a. General. The following chart is to be used at attended points to locate trouble with the defective tube, line amplifier, end cover assembly, or filter section of the repeater. To use this chart, disassemble the equipment according to the instructions given in paragraph 89. After the trouble has been located in a defective tube, line amplifier, or assembly and the defective item replaced, reassemble the repeater (par. 90). Perform the pre-installation tests given in paragraphs 31 through 36 or paragraphs 37 through 43 before placing the repeater back in operation.

Symptom	Probable trouble	Corrective measure
1. Power circuit resistance incorrect on power circuit test with S1 in both PWR THRU and PWR LOOP positions.	Defective tube heater	Remove both line amplifiers and check heater resistance of each tube. Use TS-297/U multimeter to measure resistance between pins 3 and 4 on all tube sockets. Typical heater resistance is 60 ohms. Replace defective tubes.
	Defective amplifier	Check to see that resistance from pin 8 to pin 5 on P1 of both line amplifiers is greater than 100K. If not, replace the amplifier.
	Defective J1 end cover assembly	Check resistance from male contacts on connector J1 to pin 15 of connector P1. Typical resistance is 2.2 ohms. If resistance is incorrect, replace J1 end cover assembly.
	Defective J2 end cover assembly	With switch S1 in PWR THRU position, check resistance from pin 15 of connector P3 to either female contact of connector J2. This measurement should indicate a short circuit. With switch S1 in the PWR LOOP position, check resistance from pin 15 of connector P3 to pin 13 of connector P3. This measurement should indicate a short circuit. If either of these measurements indicates any resistance, replace the J2 end cover assembly.
	Defective filter section	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
2. Power circuit resistance incorrect when S1 is in PWR THRU position only.	Defective J2 end cover assembly	Check resistance from pin 15 of connector P3 to a female contact of connector J2. Typical resistance is 2.2 ohms. If resistance is incorrect, replace J2 end cover assembly.
3. Power circuit resistance incorrect when S1 is in PWR LOOP position only.	Defective J1 end cover assembly	Check resistance from either male contact of connector J1 to either female contact of connector J1. If the resistance is not greater than 100 K, replace the J1 end cover assembly.
	Defective J2 end cover assembly	Check resistance from pin 15 of connector P3 to pin 13 of connector P3 with switch S1 in the PWR LOOP position. If this measurement does not indicate a short circuit, replace the J2 end cover assembly.
	Defective filter section	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
4. Incorrect power insulation resistance when S1 is in PWR THRU position.	Defective J1 end cover assembly	Check resistance from either male contact to either female contact of connector J1. If resistance is not greater than 100 K, replace the J1 end assembly.
	Defective J2 end cover assembly	Check resistance from either male contact to either female contact of connector J2. If resistance is not greater than 5 megohms, replace the J2 end cover assembly.
5. Incorrect power insulation resistance when S1 is in PWR LOOP position.	Defective J2 end cover assembly	Check resistance from pin 15 of connector P3 to all contacts of connector J2. If resistance is not greater than 100 K, in all cases, replace the J2 end cover assembly.

b. Chart for Use at Attended Points—Continued

Symptom	Probable trouble	Corrective measure
	Defective filter section	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
6. Power return resistance incorrect when S1 is in PWR THRU position.	Defective J1 end cover assembly	Check resistance from either female contact of connector J1 to pin 5 of connector P4. Typical resistance is 2.2 ohms. If resistance is incorrect, replace J1 end cover assembly.
	Defective J2 end cover assembly	Check resistance from either male contact of connector J2 to pin 13 of connector P3. Typical resistance is 2.2 ohms. If resistance is incorrect, replace J2 end cover assembly.
	Defective filter section	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
7. Power return resistance incorrect when S1 is in PWR LOOP position.	Defective J2 end cover assembly	Replace J2 end cover assembly.
8. Panel ground to case ground insulation resistance incorrect.	Defective J1 end cover assembly	Check resistance from pin 0 to pin 17 of connector P4. If this resistance is not greater than 100 K, replace the J1 end cover assembly.
	Defective J2 end cover assembly	Check resistance from pin 17 to pin 0 of connector P2. If this resistance is not greater than 100 K, replace the J2 end cover assembly.
	Mechanical contact causing short	Inspect equipment for mechanical defect.
9. 68 kc input to line amplifier AR1 incorrect.	Defective J1 end cover assembly	Check resistance between male contacts of connector J1. Typical resistance is 4.5 ohms. If resistance is incorrect, replace J1 end cover assembly. Check resistance between pin 3 and pin 0 of connector P1. Typical resistance is 22 ohms. If resistance is incorrect, replace J1 end cover assembly.
	Defective J2 end cover assembly	Check resistance between pin 9 of connector P2 and pin A of connector J3. If this measurement does not indicate a short circuit, replace J2 end cover assembly. Check resistance between pin 15 of connector P3 and pin M of connector J3. If this measurement does not indicate a short circuit, replace the J2 end cover assembly.
	Defective filter section	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
10. 68 KC input to line amplifier AR1 normal. 68 KC output from line amplifier AR1 incorrect.	Defective tube line amplifier in AR1.	Replace tubes in line amplifier AR1 and perform transmission tests (pars. 86 and and 87).
	Defective line amplifier in AR1	Interchange positions of line amplifiers and perform transmission test (pars. 86 and 87). If this corrects the trouble but introduces the symptom of item 12 of this table, the amplifier which was originally in the AR1 position is defective and must be replaced.

b. Chart for Use at Attended Points—Continued

Symptom	Probable trouble	Corrective measure
	Defective J2 end cover assembly	Check the resistance between pin 3 and pin 0 of connector P2. Typical resistance is 22 ohms. If this resistance is incorrect, replace the J2 end cover assembly. Check resistance between female contacts on connector J2. Typical resistance is 4.5 ohms. If resistance is incorrect, replace the J2 end cover assembly. Check the resistance between pin 5 of connector P2 and pin C of connector J3. If this measurement does not indicate a short circuit, replace the J2 end cover assembly.
	Defective J1 end cover assembly	Measure the resistances between pin 9 and pin 6 of connector P1. Typical values for various temperatures are indicated below. *Resistance (ohms)* — *Temperature (° F.)* 825 — 40 643 — 50 599 — 60 326 — 70 294 — 80 237 — 90 196 — 100 160 — 110 If the resistance is not correct, replace the J1 end cover assembly.
	Defective filter section	If the above checks do not locate the trouble, the filter assembly is defective and must be replaced.
11. Transmission through line amplifier AR1 normal. No. 68 KC input to line amplifier AR2.	Defective J2 end cover assembly	Check resistance between the male contacts of connector J2. Typical resistance is 4.5 ohms. If this resistance is incorrect, replace the J2 end cover assembly. Check the resistance between pin 5 of connector P3 and pin R of connector J3. If this measurement does not indicate a short circuit, replace the J2 end cover assembly.
	Defective filter assembly	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
12. 68 KC transmission through line amplifier AR1 normal. 68 KC input to line amplifier AR2 normal. 68 KC output from line amplifier AR2 incorrect.	Defective tube in line amplifier AR2.	Replace tubes in line amplifier AR2 and perform transmission test (pars. 86 and 87).
	Defective line amplifier AR2	Interchange positions of line amplifiers and perform transmission test (pars. 86 and 87). If this causes the symptoms of item 11, the line amplifier which was originally in position AR2 is defective and must be replaced.
	Defective J1 end cover assembly	Check resistance from pin 14 to pin 17 of connector P4. Typical resistance is 22 ohms. If this resistance is incorrect, replace J1 end cover assembly. Check resistance between female contacts of connector J1. Typical resistance is 4.5 ohms. If this resistance is incorrect, replace J1 end cover assembly.

b. Chart for Use at Attended Points—Continued

Symptom	Probable trouble	Correct measure
	Defective J2 end cover assembly	Check resistance between pin 14 of connector P3 and pin E of connector J3. If this measurement does not indicate a short circuit, replace the J2 end cover assembly. Measure the resistance between pin 9 and pin 6 of connector P3. Typical value for various temperatures are given below.

Resistance (ohms)	*Temperature (°F.)*
825	40
643	50
599	60
326	70
294	80
237	90
196	100
160	110

		If the resistance is not correct, replace the J2 end cover assembly.
	Defective filter section	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
13. Order wire circuit inoperative. 68 KC transmission normal in both directions of transmissions.	Defective J2 end cover assembly	Check resistance between pin 16 of connector P3 and pin N of connector J3. If this measurement does not indicate a short circuit, replace the J2 end cover assembly. Check the resistance between pin 11 of connector P2 and pin L of connector J3. If this measurement does not indicate a short circuit, replace the J2 end cover assembly.
	Defective filter section	If the above checks do not locate the trouble, the filter section is defective and must be replaced.
14. Incorrect indication on fault location test. 68 KC transmission normal in both directions of transmission. Order wire operation normal.	Defective J2 end cover assembly	Replace J2 end cover assembly.

89. Disassembly of Telephone Repeater AN/TCC–11

Disassemble Telephone Repeater AN/TCC–11 in a sheltered location free from rain and windblown dust. When the repeater is disassembled, take extreme care to prevent dirt and moisture from coming in contacts with any parts of the repeater. The disassembly instructions for Telephone Repeater AN/TCC–11 are detailed below.

a. Stand the repeater on end with the J1 end on top.

b. Unscrew the three captive mounting screws (fig. 4) located on the rim of the J1 end cover assembly.

c. Pry loose the J1 end cover assembly with a screwdriver or other tool (fig. 60). Slide the screwdriver blade into the prying notch located under the end cover assembly rim and work the blade around between the cover assembly and the repeater case. Remove the J1 end cover assembly.

d. Remove connectors J4 and J9 from their retaining brackets on the interior wall of the repeater case (fig. 63) and allow them to dangle over the edge of the repeater case so that the line amplifier cover may be removed.

e. Turn the line amplifier cover fastener (fig. 61) counterclockwise to release it.

f. Remove the line amplifier cover by grasping the four holes in the cover and pulling it vertically.

g. Unscrew the two amplifier mounting screws (fig. 62). These screws are identified with a black circle.

h. Remove the line amplifier by pulling it vertically.

i. Turn the repeater end-for-end so that the J2 end is on top.

j. Unscrew the three captive mounting screws on the J2 end cover assembly.

k. Repeat procedure in subparagraph *d* above for connectors J5 and J6.

l. Repeat procedures in subparagraphs *e* through *h* above at the J2 end.

m. Depress the filter section catch release and push the filter section as far as it will go (fig. 63).

Caution: Make sure that the cables and connectors associated with the filter section do not get caught on the mounting rails.

n. Place the repeater on its side and remove the filter section from the case by pulling it along the mounting rails.

90. Assembly of Telephone Repeater AN/TCC–11

The assembly procedures for the Telephone Repeater AN/TCC–11 are detailed below:

a. Set the repeater case on end on the floor.

b. Arrange the case so that the slotted guide rail faces the repairman. A red dot should be visible on the interior wall of the case above the slotted guide rail. If the red dot is not visible, reverse the case end-for-end to obtain the end with the red dot.

c. Arrange the filter section so that the red dot on the end of the filter section chassis is on the same end as the dot on the interior case wall. Aline the red dot on the filter section so that it corresponds with the dot on the case. The filter section catch will be alined with the slotted guide rail.

d. Insert the filter section in the case and push it down until the filter section catch engages the slot in the mounting rail.

e. Place connectors J5 and J6 so that they dangle over the rim of the repeater case.

f. Arrange a line amplifier so that plug P1 of the amplifier lines up with connector J8 of the filter section.

g. Insert the line amplifier in the repeater case and push it down until it rests on the filter section.

h. Tighten the two-line amplifier mounting screws (fig. 62).

i. Place the cover on the line amplifier. Be sure that the gain switch flexible shaft extension passes through the proper hole (fig. 47) in the cover.

j. Fasten the line amplifier cover fastener (fig. 61) by turning it clockwise.

k. Insert connectors J5 and J6 in the mounting brackets on the interior wall of the case, and place the cables in the clips on the sides of the line amplifier cover.

l. Arrange the J2 end cover assembly so that the positioning stud enters the hole on the cover assembly, and the three mounting screws engage their respective holes in the end cover assembly.

m. Place the end cover assembly on the case and push it down as far as possible. Be sure that the line amplifier gain switch flexible shaft extension enters the guide tube on the end panel.

n. Tighten the three captive-mounting screws on the end cover assembly.

o. Turn the repeater end-for-end.

p. Place connectors J4 and J9 so that they dangle over the rim of the repeater case.

q. Arrange a line amplifier so that plug P1 lines up with connector J7 on the filter section. Insert the line amplifier in the repeater case. Push down until the line amplifier rests on the filter section.

r. Repeat instructions in *h*, *i*, and *j* above.

s. Repeat the procedure in *k* above for connectors J4 and J9.

t. Repeat the procedure in *l*, *m*, and *n* above for the J1 end.

91. Replacing Tubes in Telephone Repeater AN TCC–11

a. When a repeater is returned from the unattended point tagged TUBE ACT V__AMP__, remove the end cover assembly and the amplifier cover from the amplifier involved and replace the tube noted on tag. For AMP 1, remove the J1 end cover assembly. For AMP 2, remove the J2 end cover assembly.

b. Assemble the repeater (par. 90) and perform preinstallation tests at a Telephone Terminal AN/TCC–7 or a Telephone Repeater AN/TCC–8 as described in paragraph 30 or 37.

CHAPTER 5

THEORY OF TELEPHONE REPEATER AN/TCC–11

Section I. INTRODUCTION

92. General

Telephone Repeater AN/TCC–11 is an unattended carrier telephone repeater that amplifies, equalizes, and regulates carrier-frequency signals transmitted over systems using Telephone Terminal AN/TCC–7 and Telephone Repeater AN/TCC–8 at the attended points. The carrier-frequency signals are amplified, equalized, and regulated at intervals of 5¾ miles of spiral-four cable to compensate for attenuation produced by the cable. Order wire voice signals are transmitted through the repeater in two directions without amplifications, equalization, or regulation. Repeater operation can be tested from attended points by transmission of fault-locating frequencies from those points. Repeater operation can be tested at the repeater location by use of Telephone Test Set TS–712/TCC–11. Connections on Telephone Test Set TS–712/TCC–11 permit maintenance personnel at the repeater location to talk over the order wire circuit to attended points. Power to energize the repeater circuits is supplied over the spiral-four cable from attended Telephone Terminal AN/TCC–7 or attended Telephone Repeater AN/TCC–8.

93. Block Diagram
(fig. 19)

Figure 19 is a block diagram of Telephone Repeater AN/TCC–11. The repeater always is installed so that the fault-locating frequencies and power obtained from the attended point (Telephone Terminal AN/TCC–7 or Telephone Repeater AN/TCC–8) are applied to the repeater through the J1 end. The designations J1 and J2 are embossed on the end cover assemblies. This relationship is indicated on the block diagram.

94. Telephone Repeater AN/TCC–11 Circuits
(fig. 19)

Telephone Repeater AN/TCC–11 consists of the following principal circuits:

a. Transmission Circuits (par. 103). Transmission circuits 1 and 2 perform identical functions of carrier-frequency signal amplification and order wire signal transmission (without amplification) through the repeater. Transmission circuit 1 operates in a direction opposite to that of transmission circuit 2.

b. Fault-locating Circuit (par. 123). A fault-locating circuit enables an attendant at a remote terminal or attended repeater to check the operations of Telephone Repeater AN/TCC–11.

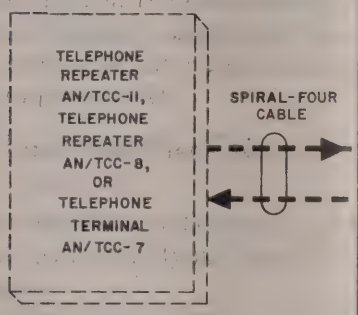
c. Power Distributing Circuit (par. 125). A power distributing circuit provides the proper operating voltages for the circuits of Telephone Repeater AN/TCC–11.

95. Transmission Circuits
(fig. 19)

Transmission circuits 1 and 2 each consist of an input circuit, an equalizing circuit, an amplifying circuit, a regulating circuit, an output circuit, and an order wire circuit. Except for the directions of transmission, the function of transmission circuits 1 and 2 are identical.

a. All signals (carrier-frequency and order wire) and 100 mils (milliamperes) dc entering the J1 end of the repeater are applied to transmission circuit 1. The carrier-frequency signals (message channel, pilot, and fault-locating frequencies) are equalized, amplified, and passed to the outgoing cable pair at the J2 end of the repeater. The order wire signals are transmitted unamplified and unequalized to the same outgoing cable pair. The 100 mils dc is used for the operation of the repeater. Paragraphs 96 through 98 describe the functional operation of transmission circuit 1.

b. Transmission circuit 2 operates in a direction opposite to that of transmission circuit 1. All signals and 100 mils dc entering at the J2 end of the repeater are applied to transmission circuit 2. The carrier-frequency signals (message channel, pilot, and fault-locating frequencies) are equalized,


TELEPHONE
REPEATER
AN/TCC-11,
TELEPHONE
REPEATER
AN/TCC-8,
OR
TELEPHONE
TERMINAL
AN/TCC-7
SPIRAL-FOUR
CABLE

CHAPTER 5

THEORY OF TELEPHONE REPEATER AN/TCC–11

Section I. INTRODUCTION

92. General

Telephone Repeater AN/TCC–11 is an unattended carrier telephone repeater that amplifies, equalizes, and regulates carrier-frequency signals transmitted over systems using Telephone Terminal AN/TCC–7 and Telephone Repeater AN/TCC–8 at the attended points. The carrier-frequency signals are amplified, equalized, and regulated at intervals of 5¾ miles of spiral-four cable to compensate for attenuation produced by the cable. Order wire voice signals are transmitted through the repeater in two directions without amplifications, equalization, or regulation. Repeater operation can be tested from attended points by transmission of fault-locating frequencies from those points. Repeater operation can be tested at the repeater location by use of Telephone Test Set TS–712/TCC–11. Connections on Telephone Test Set TS–712/TCC–11 permit maintenance personnel at the repeater location to talk over the order wire circuit to attended points. Power to energize the repeater circuits is supplied over the spiral-four cable from attended Telephone Terminal AN/TCC–7 or attended Telephone Repeater AN/TCC–8.

93. Block Diagram
(fig. 19)

Figure 19 is a block diagram of Telephone Repeater AN/TCC–11. The repeater always is installed so that the fault-locating frequencies and power obtained from the attended point (Telephone Terminal AN/TCC–7 or Telephone Repeater AN/TCC–8) are applied to the repeater through the J1 end. The designations J1 and J2 are embossed on the end cover assemblies. This relationship is indicated on the block diagram.

94. Telephone Repeater AN/TCC–11 Circuits
(fig. 19)

Telephone Repeater AN/TCC–11 consists of the following principal circuits:

a. Transmission Circuits (par. 103). Transmission circuits 1 and 2 perform identical functions of carrier-frequency signal amplification and order wire signal transmission (without amplification) through the repeater. Transmission circuit 1 operates in a direction opposite to that of transmission circuit 2.

b. Fault-locating Circuit (par. 123). A fault-locating circuit enables an attendant at a remote terminal or attended repeater to check the operations of Telephone Repeater AN/TCC–11.

c. Power Distributing Circuit (par. 125). A power distributing circuit provides the proper operating voltages for the circuits of Telephone Repeater AN/TCC–11.

95. Transmission Circuits
(fig. 19)

Transmission circuits 1 and 2 each consist of an input circuit, an equalizing circuit, an amplifying circuit, a regulating circuit, an output circuit, and an order wire circuit. Except for the directions of transmission, the function of transmission circuits 1 and 2 are identical.

a. All signals (carrier-frequency and order wire) and 100 mils (milliamperes) dc entering the J1 end of the repeater are applied to transmission circuit 1. The carrier-frequency signals (message channel, pilot, and fault-locating frequencies) are equalized, amplified, and passed to the outgoing cable pair at the J2 end of the repeater. The order wire signals are transmitted unamplified and unequalized to the same outgoing cable pair. The 100 mils dc is used for the operation of the repeater. Paragraphs 96 through 98 describe the functional operation of transmission circuit 1.

b. Transmission circuit 2 operates in a direction opposite to that of transmission circuit 1. All signals and 100 mils dc entering at the J2 end of the repeater are applied to transmission circuit 2. The carrier-frequency signals (message channel, pilot, and fault-locating frequencies) are equalized,

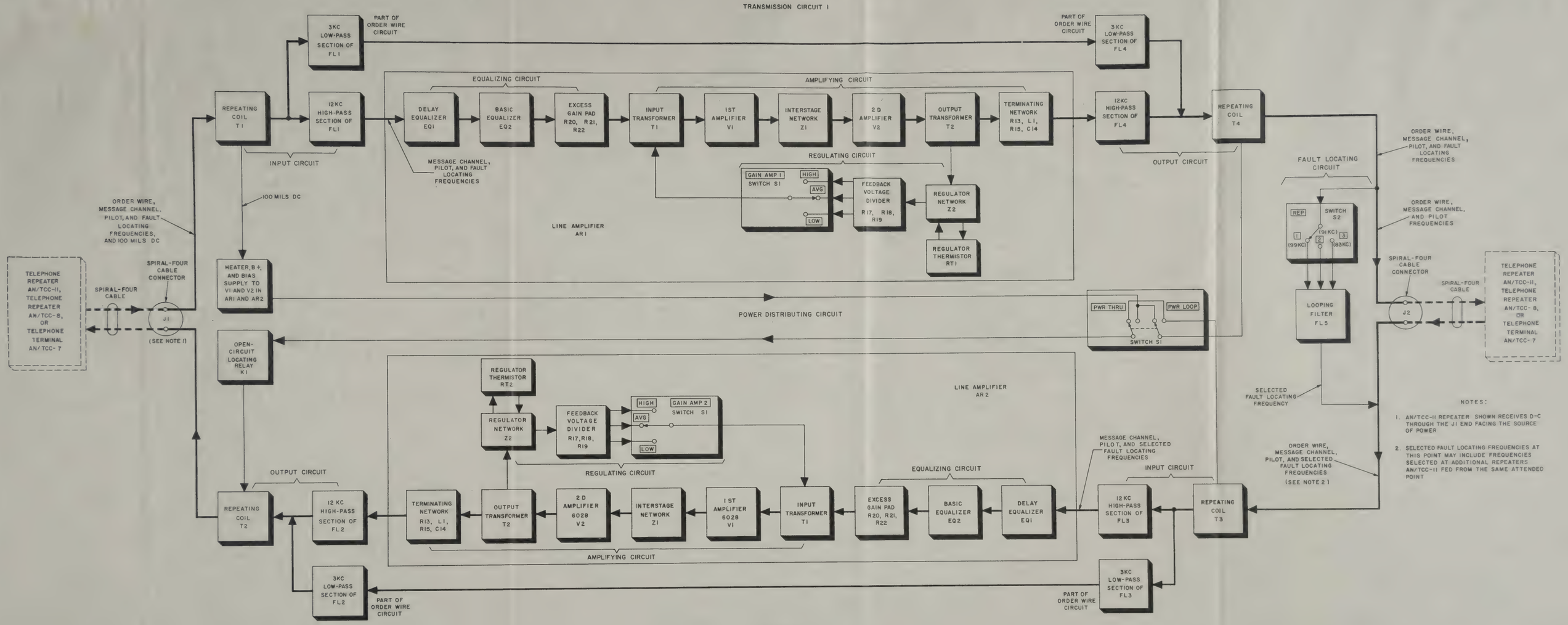


Figure 19.—Telephone Repeater AN/TCC–11, block diagram.



amplified, and passed to the outgoing cable pair at the J1 end of the repeater. The order wire signals are transmitted unamplified and unequalized to the same outgoing cable pair. The 100 mils dc is returned to its source at the attended point through open-circuit locating relay K1.

96. Input Circuit, Transmission Circuit 1

The input circuit (fig. 19) consists of repeating coil T1 and low-pass, high-pass filter FL1. Order wire signals, carrier-frequency signals, and current from the positive side of the d-c power supply enter through connector J1 and are applied to repeating coil T1. The d-c power lead is taken from a center tap of the repeating coil and applied to the power distributing circuit (par. 101). Order wire and carrier-frequency signals appear at the output of repeating coil T1 and are applied to low-pass, high-pass filter FL1 which separates the order wire signals from the carrier-frequency signals. The order wire signals are taken from the output of the low-pass section and applied to the low-pass section of FL4 in the output circuit (par. 98). The carrier-frequency signals are taken from the high-pass section of filter FL1 and applied to input of line amplifier AR1.

97. Line Amplifier Circuits
(fig. 19)

Line amplifier AR1 is composed of an equalizing circuit, an amplifying circuit, and a regulating circuit.

a. Equalizing Circuit. The equalizing circuit consists of delay equalizer EQ1, basic equalizer EQ2, and excess gain pad R20, R21, R22. The carrier-frequency signals (message channel, pilot, and fault-locating frequencies) from filter FL1 are applied to delay equalizer EQ1 which corrects the signals for phase distortion. The signals from EQ1 are applied to basic equalizer EQ2 which corrects for differences in the attenuation of the carrier-frequency signals caused by the cable characteristics. The signals from the basic equalizer are applied to excess gain pad R20, R21, R22 which inserts the loss required for proper circuit operation.

b. Amplifying Circuit.

(1) Line amplifier AR1 amplifying circuit is composed of input transformer T1, first amplifier V1, interstage network Z1, second amplifier V2, output transformer T2, and terminating network R13, L1, R15, C14. Carrier-frequency signals from the excess gain pad are applied to input transformer T1 which, in turn, applies these signals to first amplifier VI. The amplifier output of VI is coupled to the input of second amplifier V2 through interstage network Z1. The signals from network Z1 are amplified further in second amplifier V2. The output of V2 is applied to output transformer T2. A small portion of the output is applied to the regulating circuit, while the remaining output is applied to the terminating network. The terminating network presents a satisfactory terminating impedance across the secondary of output transformer T2 so that the amplifier will not oscillate, or *sing*, as a result of an improper terminating impedance. The output that is applied to the regulating network is fed back to the input of the first amplifier V1 approximately 180° out of phase with the incoming signals from the equalizing circuit. This inverse feedback is used to stabilize the gain of the complete amplifier (AR1) against manufacturing variations or aging effects of vacuum tubes, and to reduce distortion produced by the tubes in the amplifier. The gain of the amplifier is adjusted by varying the amount of feedback.

c. Regulating Circuit. Line amplifier 1 regulating circuit consists of regulator network Z2, regulator thermistor RT1, feedback voltage divider R17, R18, R19, and GAIN AMP 1 control S1.

(1) *Purpose.* Telephone Repeater AN/TCC–11 normally is connected to other repeaters or terminal equipment by 5¾ miles of spiral-four cable extending from the J1 and the J2 ends of the repeater. Ambient temperature changes, such as those which occur between day and night or from season to season, produce changes in the attenuation characteristics of the interconnecting spiral-four cable. Such changes, if uncorrected, produce undesired operating characteristics on the telephone carrier system in which Telephone Repeaters AN/TCC–11 are installed. The line amplifier regulating circuit is provided to adjust automatically the line amplifier gain to compensate for changes in cable losses produced by changes in the ambient

temperature of the spiral-four cable.

(2) *Function.* The feedback path of line amplifier AR1 can be traced from the output side of output transformer T2, through the regulating circuit to input transformer T1. Any variation in the elements of the regulating circuit changes the feedback, and consequently the gain of the amplifying circuit.

(3) *Regulator thermistor RT1.* Regulator thermistor RT1 is a temperature-sensitive resistor located inside the repeater on the back of the J1 end panel. A change in the ambient temperature of the repeater changes the thermistor resistance. The resistance change is applied to regulator network Z2, changing the feedback and gain of the amplifier to compensate for the effect of ambient temperature increase or decrease. Variations in the makeup of the telephone carrier system links may require a manual adjustment of the repeater gain. GAIN AMP 1 control and feedback voltage divider R17, R18, R19 are included in the feedback circuit to permit this manual adjustment of amplifier gain.

98. Output Circuit, Transmission Circuit 1

The output circuit of transmission circuit 1 consists of high-pass, low-pass filter FL4 and repeating coil T4. Carrier-frequency signals from the terminating network are applied to the high-pass section of filter FL4. The order wire signals are applied to the low-pass section of FL4. The order wire and the carrier-frequency signals are recombined at the output of FL4 and passed on the repeating coil T4. The output of T4 is applied to the outgoing spiral-four cable pair.

99. Transmission Circuit 2, Function

Transmission circuit 2 functions in the same manner as transmission circuit 1 with the following exception. The input order wire and carrier-frequency signals to transmission circuit 2 enter through connector J2 of Telephone Repeater AN/TCC–11. Transmission circuit 2 output takes place through connector J1.

100. Fault-locating Circuit

To check the operation of an unattended Telephone Repeater AN/TCC–11, three fault-locating frequencies of 99, 91, or 83 kc are sent from an attended Telephone Terminal AN/TCC–7 or Telephone Repeater AN/TCC–8. These frequencies are transmitted over the spiral-four cable, one at a time.

a. The transmitted fault-locating frequencies enter Telephone Repeater AN/TCC–11 through the J1 end, are amplified in transmission circuit 1, and then are applied to the outgoing cable pair and to the fault-locating circuit consisting of REP switch S2 and looping filter FL5.

b. The fault-locating circuit provides a low-loss transmission path for the fault-locating frequency for which the REP switch is set and applies this signal to the input of transmission circuit 2.

c. The selected fault-locating frequency is amplified in transmission circuit 2 and returned, for measurement, to the attended point that sent the signal.

101. Power Distributing Circuit

The power distributing circuit of Telephone Repeater AN/TCC–11 consists of the resistor network providing the proper B+, bias, and heater voltages for line amplifiers AR1 and AR2, PWR THRU-PWR LOOP switch S1, and open circuit locating relay K1.

a. The 100 mils dc for the tubes and circuits enters through J1, and is applied to a network of resistors that reduces the applied voltage to the proper values required for the circuits of the repeater.

b. Open circuit locating relay K1 is included in the power circuit for maintenance purposes. If a cable fault occurs that opens or short circuits the d-c power circuit, personnel at the attended point from which the power is delivered to the interrupted circuit can determine the location of the unattended repeater section in which the fault has occurred. A resistance measurement at the attended point provides the required indication.

102. Detailed Circuit Descriptions, General

A detailed description of the transmission circuits appears in the next section of this chapter. A detailed description of the auxiliary circuits (fault-locating, power distributing) appears in paragraphs 121 through 131. An overall schematic diagram of Telephone Repeater AN/TCC–11 appears in figure 68.

103. Transmission Circuits

Transmission circuits 1 and 2 are identical in function. Transmission Circuit 1 is described stage-by-stage in paragraphs 104 through 114. The important points of transmission circuit 2 are detailed in paragraph 115 of this section. The order wire circuit is described separately in paragraphs 116 through 120.

104. Input Circuit, Transmission Circuit 1
(fig. 68)

Carrier-frequency and order wire signals are received from the cable through spiral-four cable connector J1. All frequencies are applied through connector J1 to primary terminals 1 and 4 of repeating coil T1. Coil T1 couples the balanced line to the unbalanced circuits of the repeater. The induced signals are taken off the secondary of T1 at terminals 5 and 8 and are applied to terminals 1 and 2 of input filter FL1 through pins 3, 4, and 0, 1 of plug P1 which mates with connector J4. Multiple contacts are used to provide more reliable connections in the signal transmission path. The voice-frequency order wire is passed through the 3-kc low-pass section of FL1 from terminals 3 and 4 to corresponding terminals 3 and 4 of the low-pass section of output filter FL4 in the output circuit. The 12- to 99-kc frequencies are passed through the high-pass section of FL1 from terminals 5 and 6 to pins 3, 4, and 0, 1 of connector J7 which mates with plug P1 of line amplifier AR1.

105. Line Amplifier AR1
(figs. 68 and 69)

The 12- to 99-kc frequencies received through plug P1 are applied to the equalizing, amplifying and regulating circuits of the line amplifier. The equalizing circuit (par. 106) corrects for phase and amplitude distortion in the transmitted frequency band. The amplifying circuit (pars. 107 through 110) increases the signal voltage. The regulating circuit (pars. 111 through 113) keeps the amplifier output level constant despite changes in the line attenuation caused by temperature changes.

106. Equalizing Circuit

The equalizing circuit consists of delay equalizer EQ1, basic equalizer EQ2, excess gain pad R20, R21, R22, and temperature-compensating resistor R23. Figure 20 is a schematic diagram of the equalizing circuit showing the elements within each equalizer.

a. Delay Equalizer EQ1. The delay equalizer receives signals in the 12- to 99-kc band from pins 3, 4, and 0, 1 of connector P1 (fig. 69) at terminals 1 and 2 of delay equalizer EQ1. The delay equalizer corrects for the delay distortion introduced by the high-pass sections of filters FL1 and FL4 (fig. 19). These filters delay the low frequencies more

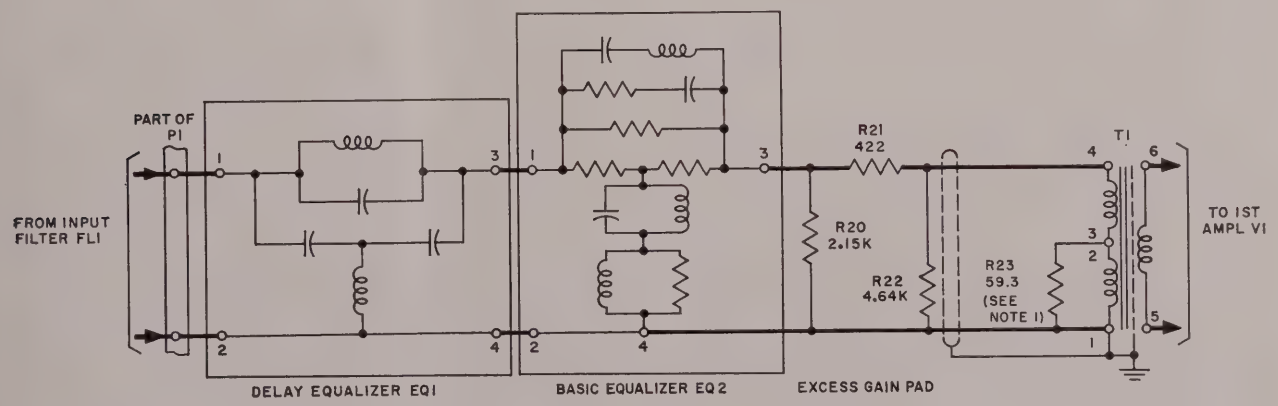


Figure 20. Equalizing circuit, schematic diagram.

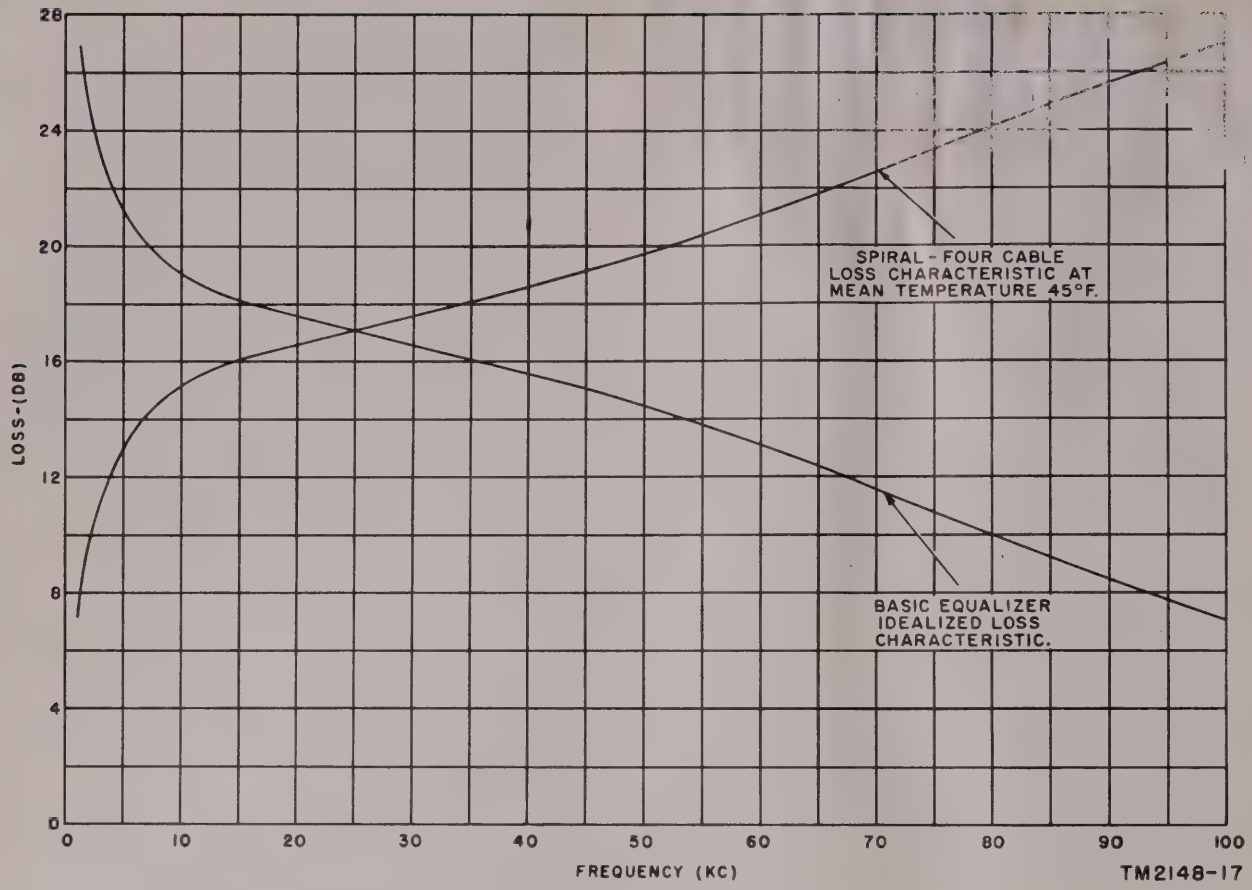


Figure 21. Cable loss and basic equalizer characteristics.

than the high frequencies. The delay equalizer corrects for this delay distortion by delaying the high frequencies more than the low frequencies so that all frequencies are delayed the same amount. The uniformly-delayed signals are taken from terminals 3 and 4 of delay equalizer EQ1 and applied to basic equalizer EQ2.

b. Basic Equalizer EQ2. The uniformly delayed signals enter basic equalizer EQ2 at terminals 1 and 2. The basic equalizer has a loss characteristic opposite to the loss characteristic of the spiral-four cable at a mean cable temperature of 45° F. Figure 21 is a plot of the cable loss characteristic and the basic equalizer loss characteristic at the mean temperature of 45° F. The characteristic of the basic equalizer corrects for the loss characteristics of the cable, line repeating coils T1 and T4, and filters FL1 and FL4, and for the gain characteristic of amplifier AR1. When the temperature deviates from 45° F., additional correction is required. This correction is provided by the regulating circuit (par. 112). The equalized frequencies are taken from terminals 3 and 4 and applied to input transformer T1 through the excess gain pad.

c. Excess Gain Pad and Temperature-Compensating Resistor. Excess gain pad R20, R21, R22 attenuates the signals received from the equalizers 3.6 db to compensate for the 3.6-db excess gain of the amplification circuit. The pad also builds out the impedance looking into the line amplifier to match the impedance looking back into basic equalizer EQ2. Resistor R23 is a temperature-sensitive resistor that compensates for changes in the repeating coil and transformer loss caused by variations in the operating temperature. As the temperature increases, the resistance of R23 increases. Consequently, the bridging loss across terminals 1 and 2 of transformer T1 decreases. The decreased loss compensates for the increased repeating coil and transformer loss in the transmission circuit that results from the increase of the winding resistances. The reverse action takes place when the temperature decreases.

107. First Amplifier Stage
(fig. 69)

a. The equalized carrier-frequency signals are coupled into the first amplifier stage through input transformer T1. Resistor R1 is the terminating resistor for input transformer T1. Capacitor C1 is required for proper operation of the feedback circuit. The signals are impressed on the grid of V1, a type 6028 tube. Resistor R2 prevents undesired oscillations from occuring in the grid circuit. The amplified signal is taken off the plate through interstage network Z1 (par. 108). The plate voltage for the stage is applied through interstage network Z1. Resistor R11 and capacitor C11 decouple the signal present on the plate from the B+ line.

b. Positive grid bias voltage for V1 is supplied through resistor R6, winding 5–6 of transformer T1, and resistor R2 to the grid of tube V1. The magnitude of this grid bias voltage is about +16 volts above chassis ground. The cathode is self-biased +18 volts above the chassis ground by means of resistor R4. Therefore, the grid to the cathode voltage is approximately −2 volts. This arrangement, whereby positive biases are applied to both grid and cathode of the tube (with the cathode bias being larger than the grid bias by the desired cathode-grid potential), aids in stabilizing the d-c plate current against manufacturing deviation of vacuum tubes. The network in the cathode circuit of V1 composed of R3, R4, C2, and C3 helps maintain proper phase and transmission relationships in the feedback loop for stable operation of the amplifier. This network provides shaping above and below the 12- to 68-kc frequency range. In the region of 1 kc, the effect of C3 shunting R3 across R4 produces an increase in gain over a short frequency range. In the region of 100 kc, the effect of C2 shunting R3 produces another increase in gain over a short frequency range.

c. For test purposes, a connection (to Telephone Test Set TS–712/TCC–11) is taken from the cathode circuit through meter current-limiting resistor R5. Capacitor C5 provides filtering that prevents signal variations on the cathode from affecting the meter reading on Telephone Test Set TS–712/TCC–11.

108. Interstage Network Z1

Interstage network Z1 is inserted into the plate circuit of V1 as the plate load for the stage. This network presents an impedance versus frequency characteristic to the tube that gives the stage maximum gain in the 12- to 68-kc frequency range. Outside this frequency band the impedance characteristic of the network shapes the feedback loop characteristics to aid in obtaining the proper transmission and phase relationships required for stable operation of the amplifier.

109. Second Amplifier Stage
(fig. 69)

The amplified signal from the plate circuit of V1 is impressed on the grid of V2, the second amplifier stage, which is also a type 6028 tube. The amplified signal is taken off the plate of V2 and applied to the primary winding of transformer T2. The plate supply for V2 is brought from pin 8 of connector P1 to terminal 5 of transformer T2, passed through the primary winding of T2, and applied to the plate of V2. Resistor R12 and capacitor C12 form the decoupling network for this stage. A shaping network formed by resistor R10 and capacitor C10 is used to improve the transmission properties above 68 kc. The grid bias for the stage is taken from terminal 16 of P1. This voltage is supplied through a high resistance located internally in interstage network Z1, and is applied to the grid of V2. Resistor R7 suppresses any tendency for undesired oscillations in the grid circuit. In the cathode circuit of V2, resistor R8 is the cathode resistor, and capacitor C8 is the cathode bypass. Resistor R9 is the meter current-limiting resistor for the meter in Telephone Test Set TS–712/TCC–11. Capacitor C9 provides filtering that prevents signal variations on the cathode from causing fluctuations in the meter reading on Telephone Test Set TS–712/TCC–11.

110. Output Transformer T2 and Terminating Network
(fig. 69)

a. Output Transformer T2. The output of the second amplifier stage is developed between terminals 5 and 6 of output transformer T2. The induced signals from secondary winding 3–4 of transformer T2 are applied to the output circuit of transmission circuit 1 through the terminating network. A second part of the signal voltage developed across secondary winding 2–1 of T2 is fed back to the regulating circuit (par. 112) and ultimately back to the first amplifier stage through input transformer T1.

b. Terminating Network. This network is composed of inductance L1, resistors R13 and R15, and capacitors C13 and C14. It provides a satisfactory impedance match between the amplifier and the output circuit above the 12- to 99-kc frequency range. The network terminates the amplifier so that open circuit, short circuit, or a wide range of terminating conditions will not cause undesired high-frequency oscillations in the amplifier. Resistor R14 provides the proper resistance to obtain a 600-ohm output impedance for the amplifier.

111. Regulating Circuit, General Functioning

The regulating circuit (fig. 22) consists of feedback coupling network R16 and C15, regulator network Z2, regulator thermistor RT1, gain switch S1, and feedback coupling capacitor C6. A portion of the output voltage that appears across the secondary winding of T2 is fed from T2 through the feedback coupling network to the regulator network, adjustable gain switch, and input transformer T1. The gain of the [illegible] loop (that is, the [illegible] path [illegible] through the two amplifier stages and back t through the feedback coupling network, regul[illegible] ing network, gain switch, and C6) is normally 42 db in the 12- to 68-kc range. (It is customary to speak of this amplifier as having 42-db negative feedback over the 12- to 68-kc frequency range.) When the temperature changes, the gain of the feedback loop changes so that the output level of the amplifier remains practically constant. A detailed description of the regulating circuit is given in paragraphs 112 and 113.

112. Detailed Functioning of Regulating Circuit

The regulating circuit (fig. 22) corrects for changes in the loss characteristic of the spiral-four cable that occur with changes in cable temperature. When the temperature of the spiral-four cable

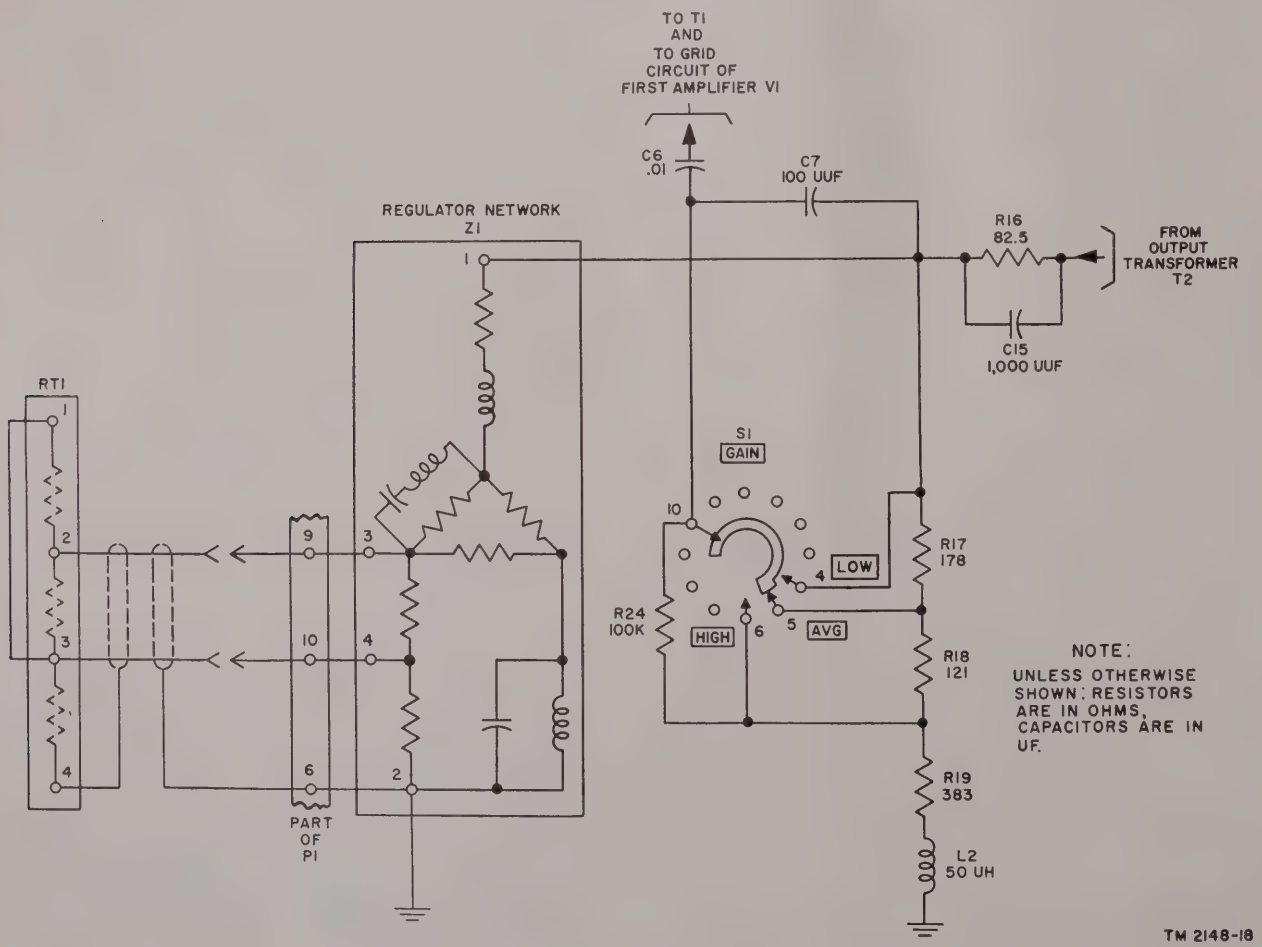


Figure 22. Regulating circuit, schematic diagram.

changes, the loss characteristic, which varies with frequency, also changes. Figure 22 shows the loss characteristic plotted against the frequency of the signal passing through the cable for three typical values of cable temperature. Basic equalizer EQ2 compensates for loss variations throughout the frequency range at the mean temperature of 45° F. At temperatures other than 45° F. the loss characteristic is different and must be corrected. The regulating circuit corrects for the change in cable temperature by increasing or decreasing the gain of the line amplifier throughout the frequency range by the amount that the spiral-four cable loss increases or decreases. The ambient temperature in the vicinity of the repeater is considered a good measure of the spiral-four cable temperature. Under unusual conditions the ambient temperature may not correspond to the cable temperature, but usually it will reach the same temperature if the conditions persist. When the ambient temperature varies, the resistance of thermistor RT1 changes. The thermistor is the terminating element of regulator network Z2. Changes in the resistance of the thermistor change the characteristic of regulator network Z2. The regulating circuit is in the feedback loop in the amplifier, and changes in the loss characteristic of the regulating circuit change the gain characteristic of the amplifier. The resistance bridged across terminals 2, 4 and 3, 4 in regulator network Z2, together with the resistance of the terminating thermistor, give the regulating circuit a nominal impedance of 100 ohms between terminals 1 and 2 at mean cable termperature. As the ambient temperature increases, the resistance of the thermistor decreases, the impedance of regulator network Z2 decreases, and the loss of the regulator network increases. When the loss of the regulator network increases, less of the amplifier output voltage is fed back to the input, and the gain

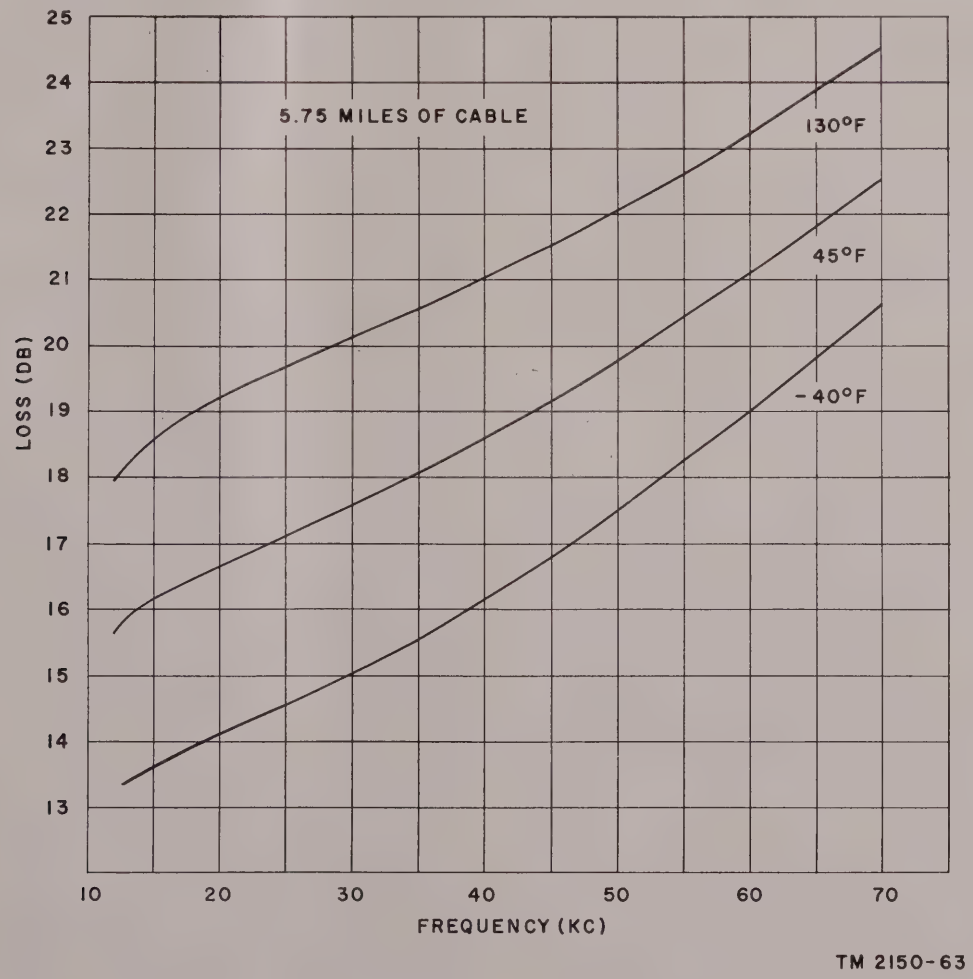


Figure 23. Spiral-four cable loss characteristic at different temperatures.

of the amplifier increases. Conversely, as the ambient temperature decreases, the resistance of the thermistor increases, the loss of regulator network Z2 decreases, more feedback is introduced into the amplifier, and the gain of the amplifier is decreased. Therefore, the signals passing through the spiral-four cable and the line amplifier are transmitted from the output of the amplifier at an essentially constant power regardless of variations of cable temperature.

113. Gain Switch
(fig. 22)

Gain switch S1 is located in the feedback path between the regulator network and input transformer T1. This switch compensates for manufacturing variations between equipment and small errors in the lineup of a system by permitting adjustment of the gain of the amplifier 2.5 db above or below the normal value. This is accomplished by passing varying amounts of the nominal 42 db of negative feedback received from the regulating circuit. The feedback voltage from the gain switch is applied through d-c blocking capacitor C6 to terminal 5 of transformer T1. Resistors R17, R18, and R19 act as a signal voltage divider, with the LOW, AVG, and HIGH positions of the gain switch serving as taps.

a. In the LOW position of the gain switch, the feedback voltage is taken directly from the output of regulator network Z2, giving the greatest amount of negative feedback and consequent low gain.

b. In the AVG position, the feedback is taken off the low side of R17, giving a condition of average feedback for average gain.

c. In the HIGH position, the feedback voltage is taken off between R18 and R19 which allows the passage of the least amount of feedback with resultant high gain for the amplifier. Capacitor C7, inductor L2, capacitor C15, and resistor R16 are inserted in the feedback path to produce the proper feedback characteristics of the amplifier. Resistor R24 bridges the gain switch to limit the amplifier gain to within 1 db, or less, above minimum in case of switch contact failure.

114. Output Circuit
(fig. 68)

After amplification, equalization, and regulation, the message channel, pilot, and fault-locating frequencies enter the high-pass section of output filter FL4 through terminals 5 and 6. The unamplified, unequalized, and unregulated order wire signals enter the low-pass section of filter FL4 through terminals 3 and 4. All frequencies are recombined at terminals 1 and 2 and applied to primary winding 5–8 of output repeating coil T4 through pins 3, 4; 0, 1; and 2, 3 of plug P1. Repeating coil T4 couples signals from an unbalanced circuit connected to its primary winding to a balanced circuit connected to its secondary winding. The induced signals are taken off the secondary winding terminals 1 and 4 and sent over one pair of the cable to the next location in the system through spiral-four cable connector J2.

115. Transmission Circuit 2

Transmission circuit 2 is identical in function with transmission circuit 1 except for the direction of transmission, which always is opposite to that of transmission circuit 1. Transmission circuit 2 consists of the input circuit, line amplifier AR2, and the output circuit.

a. Input Circuit (fig. 68). The message channel frequencies, pilot frequency, fault-locating frequencies (when used), and the order wire frequencies are received from the cable through spiral-four cable connector J2. All frequencies are applied to the primary of repeating coil T3 at terminals 1 and 4. Coil T3 converts signals from a balanced circuit connected to the primary windings to an unbalanced circuit connected to the secondary windings. The induced signals are taken off the primary at terminals 5 and 8 and applied to terminals 1 and 2 of input filter FL3, through pins 3, 4 and 0, 1 of plug P3. The voice-frequency order wire is passed through the 3-kc low-pass section of FL3 from terminals 3 and 4 to corresponding terminals 3 and 4 of the low-pass section of output filter FL2 in the output circuit. The 12- to 99-kc frequencies are passed through the high-pass section of filter FL3 from terminals 5 and 6 to pins 3, 4 and 0, 1 of connector J8, which mates with plug P1 of line amplifier AR2.

b. Line Amplifier AR2. Line amplifier AR2 is identical electrically and interchangeable with line amplifier AR1. For a detailed description of the line amplifier stages, refer to paragraphs 106 to 113.

c. Output Circuit. After amplification, equalization, and regulation, the message channel, pilot, and fault-locating frequencies enter the high-pass section of filter FL2 through terminals 5 and 6. The unamplified, unequalized, and unregulated order wire frequencies enter the low-pass section

of filter FL2 through terminals 3 and 4. All frequencies are recombined at terminals 1 and 2, and are applied to the primary winding of output repeating coil T2 through pins 14, 15 and 17, 18 of plug P4. Repeating coil T2 connects an unbalanced circuit connected to its primary windings to a balanced circuit connected to the secondary winding. The signals are passed on from the secondary winding terminals 1 and 4 to the line to the next location in the system through spiral-four cable connector J1.

116. Order Wire Circuit
(fig. 68).

The order wire circuit of Telephone Repeater AN/TCC–11 is a part of the transmission circuits. The order wire circuit uses both the input and output circuits of transmission circuits 1 and 2. In addition, connections to test receptacle J3 permit maintenance personnel using Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ) to plug into Telephone Repeater AN/TCC–11 to ring and talk over the order wire circuit. No provision is made for receiving ringing signals at Telephone Repeater AN/TCC–11.

117. Order Wire Transmission, Connector J1 to Connector J2

Carrier-frequency, order wire, and ringing signals that enter Telephone Repeater AN/TCC-11 through spiral-four cable connector J1 are applied to the primary winding of repeating coil T1. From repeating coil T1 secondary, all the signals are applied to input terminals 1 and 2 of filter FL1. The order wire and ringing signals are separated in the 3-kc low-pass section of filter FL1 and are bypassed around the line amplifier circuits without receiving amplification, equalization, or regulation. The bypassed order wire signals are applied to the low-pass section of filter FL4 in the output circuit. At the output of this filter the order wire signals are recombined with the carrier-frequency signals, and all signals are applied to the spiral-four cable through repeating coil T4 and spiral-four cable connector J2.

118. Order Wire Transmission, Connector J2 to Connector J1

Carrier-frequency signals that enter Telephone Repeater AN/TCC–11 through spiral-four connector J2 are applied to the primary winding of repeating coil T3. From the secondary of repeating coil T3 the signals are applied to input terminals 1 and 2 of filter FL3. The order wire signals are separated in the 3-kc low-pass section of FL3, and are bypassed around the line amplifier circuits as described in paragraph 117. The bypassed order wire signals arrive at the low-pass section of filter FL2 in the output circuit of transmission circuit 2. Here, the frequencies are recombined with the carrier-frequency signals, and are applied to the cable through repeating coil T2 and spiral-four connector J1.

119. Order Wire Operation from Unattended Repeater Location

To talk, listen, or ring on the order wire circuit at a remote unattended Telephone Repeater AN/TCC–11 location, Telephone Test Set TS–712/TCC–11 and Telephone EE–8( ) (or equivalent) are required. For detailed instructions covering the operation of Telephone EE–8–( ) refer to TM 11–333.

a. Connections. A plug on the end of Telephone Test Set TS–712/TCC–11 connector cable is plugged into TEST receptacle J3, located on the J2 end of Telephone Repeater AN/TCC–11. Two binding posts on Telephone EE–8–( ) are connected to two posts on Telephone Test Set TS–712/TCC–11 (fig. 13). When these connections are made, Telephone EE–8–( ) can be bridged across the order wire circuits in Telephone Repeater AN/TCC–11 through circuits in Telephone Test Set TS–712/TCC–11.

b. Ringing Over the Order Wire. To ring over the order wire, the RING-TALK switch on Telephone Test Set TS–712/TCC–11 is operated to the RING position. Ringing then is accomplished by turning the hand generator crank on Telephone EE–8–( ). The ringing output of Telephone EE–8–( ) is approximately 100 volts, 20 cps ac. This voltage is rectified and energizes a transistor oscillator in the test set. The transitor oscillator produces a 1,600 cps ringing signal that is transmitted through the order wire circuit of the repeater and over the cable to the attended points.

c. Talking Over the Order Wire. To talk over the order wire circuit, the RING-TALK switch on Telephone Test Set TS–712/TCC–11 is operated to the TALK position, and the thumbswitch on Telephone EE–8–( ) is pressed.

120. Order Wire Operation at Remote Location

Ringing and talking signals are applied from

Telephone Test Set TS–712/TCC–11 to TEST receptacle J3 on Telephone Repeater AN/TCC–11. The signals applied to transmission circuit 1 are received on terminals L and M of receptacle J3 and are transmitted to the low-pass sections of input filter FL1 and output filter FL4. The signals applied to transmission circuit 2 are received on terminals N and M of receptacle J3 and are transmitted to the low-pass sections of input filter FL3 and output filter FL2. Telephone Test Set TS–712/TCC–11 and Telephone EE–8-( ) are bridged across both directions of transmission at the same time and talking and ringing take place in both directions of transmission. Amplification for the order wire frequencies is provided only at the attended points. The amplification circuits for the order wire in Telephone Repeater AN/TCC–8 faces the same electrical direction as the message channels carried on the corresponding cable pair.

Section III. THEORY OF AUXILIARY CIRCUITS

121. Fault-locating Procedures

To test the operation of an unattended Telephone Repeater AN/TCC–11 from an attended point, one of three fault-locating frequencies (99, 91, or 83 kc) is sent out over the cable. The frequency enters the J1 connector of the repeater and is amplified in transmission circuit 1, provided that the circuit is operating properly. The amplified fault-locating frequency is applied to the fault-locating circuit. The fault-locating circuit is a selective filter that provides a low-loss transmission path between the output of transmission circuit 1 and the input of transmission circuit 2 at the frequency for which the circuit has been adjusted. The fault-locating frequency again is amplified by a properly operating transmission circuit 2, and is returned to the attended point through the outgoing cable path of the J1 connector. Measurement of the returned fault-locating frequency signal provides an indication of proper, or improper operation of the repeater or the cable to the J1 connector of the repeater being tested.

122. Necessity for Three Fault-locating Frequencies

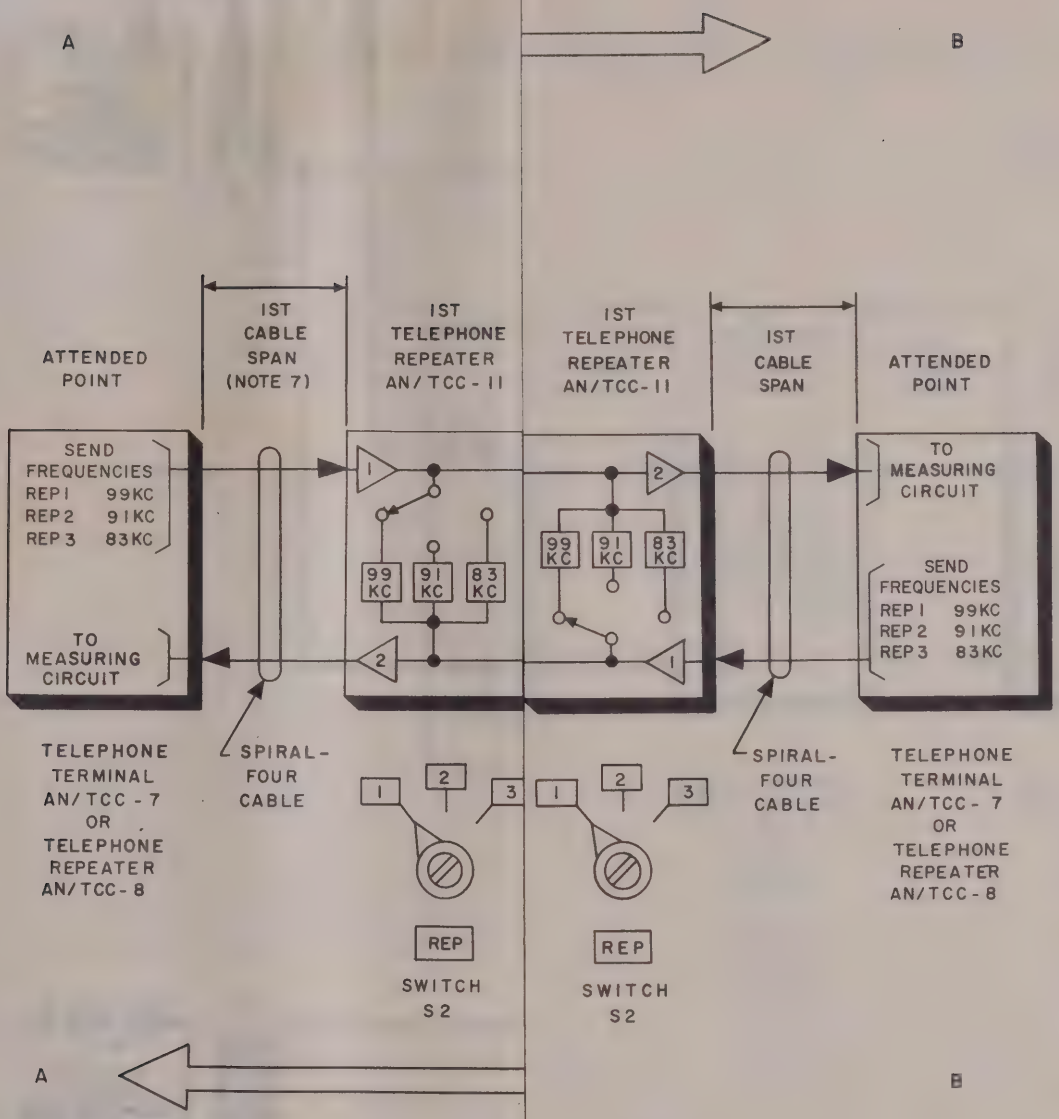
a. Three fault-locating frequencies are required so that one to three repeaters may be tested by personnel at the attended point supplying power to those repeaters. The REP switch of the first repeater is operated to position 1, which returns the 99-kc signal. The REP switch of the second repeater is operated to position 2, which returns the 91-kc signal. The REP switch of the third repeater is operated to position 3, which returns the 83-kc signal.

b. The fourth, fifth, or sixth repeaters in a string, counting from the first attended point, are supplied power by the next attended point in the system. The fault-locating frequencies used to test those repeaters are sent from the attended point supplying power to those repeaters.

123. Fault-locating Circuit

(figs. 24 and 25)

The fault-locating circuit consists of looping filter FL5 and REP switch S2. Looping filter FL5 is bridged between the output of transmission circuit 1 and the input of transmission circuit 2, providing a low-loss return path for the 83-, 91-, or 99-kc fault-locating frequency selected by the REP switch. This return path has a minimum of 20-db loss for the fault-locating frequencies. The return path offers a loss of more than 70 db to the 12- to 69-kc frequency range so that the message channel and pilot frequencies are effectively kept from becoming fed back to the opposite direction of transmission. Looping filter FL5 contains three networks connected through REP switch S2. Positions 1, 2, and 3 of the REP switch select the network arrangement that will provide a return path for 99, 91, and 83 kc, respectively. Positions 1, 2, and 3 correspond to the placement of the repeater away from the attended point. The corresponding fault-locating frequency selected by these positions is used to locate a one-wire break in a cable span preceding the tested repeater in the system, or failure of either amplifier in that repeater. Testing is accomplished by measurement of the selected fault-locating frequency returned to the attended point. Each fault-locating frequency is put on the line in turn at the attended point. The frequencies not returned indicate failure of cable spans or repeater amplifiers. The fault-locating frequency originates at the attended point supplying power to the loop in which the particular Telephone Repeater AN/TCC–11 is located.



FREQUE
NOT
RETURN
99 KC
91 KC
83 KC

OOP IS DETERMINED BY COUNTING FROM THE

INE AMPLIFIER AR2.

SENT OUT, IN TURN, FROM THE ATTENDED POINT

ONE POWER LOOP, TEST ONLY THE REPEATERS
REQUENCY WHICH PASSES FROM ONE POWER LOOP TO
NED TO THE ORIGINAL POWER LOOP.

G AN AN/TCC-11 REPEATER WILL GIVE THE SAME
ING FREQUENCIES AS FAULTY AMPLIFICATION IN THAT

T BE LOCATED BY MEANS OF THE FAULT LOCATING

EELS (± 1 REEL) OF SPIRAL-FOUR CABLE. BETWEEN AN
EELS MAY BE SIMULATED BY ATTENUATION NETWORKS

Telephone Test Set TS–712/TCC–11 to TEST receptacle J3 on Telephone Repeater AN/TCC–11. The signals applied to transmission circuit 1 are received on terminals L and M of receptacle J3 and are transmitted to the low-pass sections of input filter FL1 and output filter FL4. The signals applied to transmission circuit 2 are received on terminals N and M of receptacle J3 and are transmitted to the low-pass sections of input filter FL3 and output filter FL2. Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ) are bridged across both directions of transmission at the same time and talking and ringing take place in both directions of transmission. Amplification for the order wire frequencies is provided only at the attended points. The amplification circuits for the order wire in Telephone Repeater AN/TCC–8 faces the same electrical direction as the message channels carried on the corresponding cable pair.

Section III. THEORY OF AUXILIARY CIRCUITS

121. Fault-locating Procedures

To test the operation of an unattended Telephone Repeater AN/TCC–11 from an attended point, one of three fault-locating frequencies (99, 91, or 83 kc) is sent out over the cable. The frequency enters the J1 connector of the repeater and is amplified in transmission circuit 1, provided that the circuit is operating properly. The amplified fault-locating frequency is applied to the fault-locating circuit. The fault-locating circuit is a selective filter that provides a low-loss transmission path between the output of transmission circuit 1 and the input of transmission circuit 2 at the frequency for which the circuit has been adjusted. The fault-locating frequency again is amplified by a properly operating transmission circuit 2, and is returned to the attended point through the outgoing cable path of the J1 connector. Measurement of the returned fault-locating frequency signal provides an indication of proper, or improper operation of the repeater or the cable to the J1 connector of the repeater being tested.

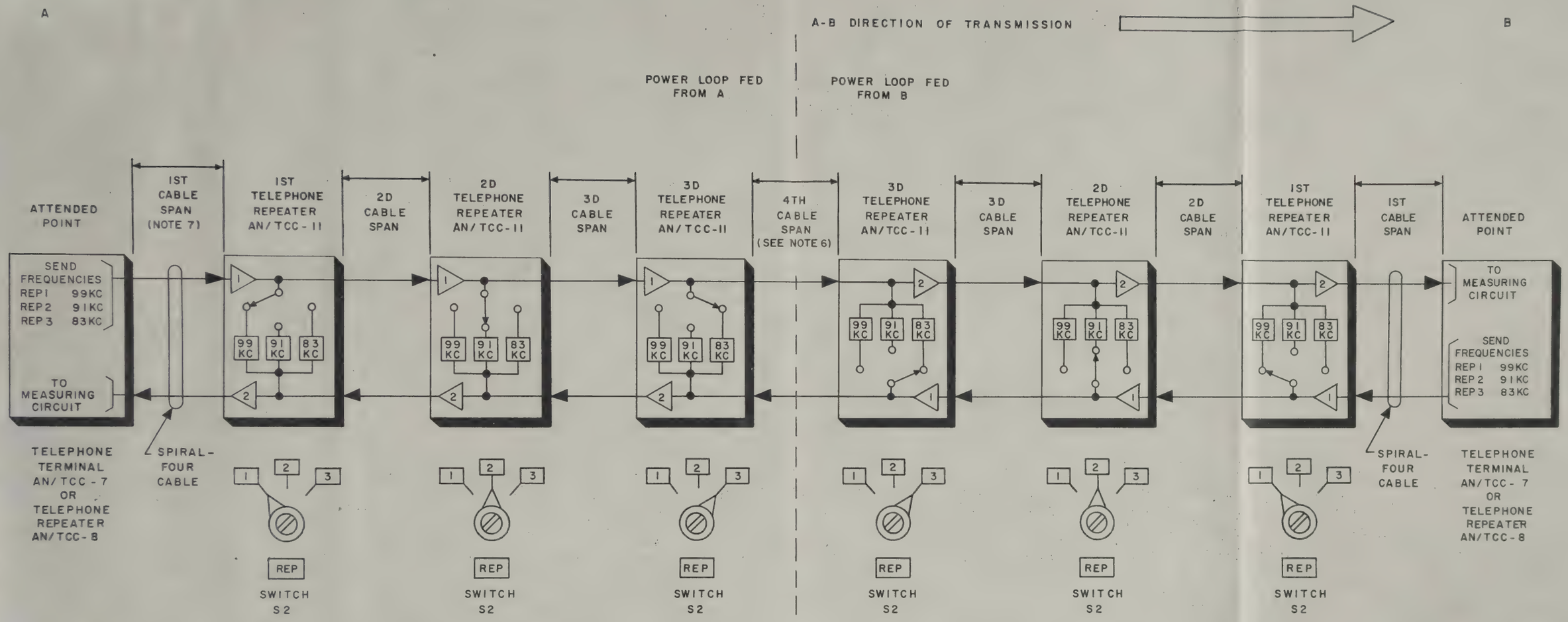
122. Necessity for Three Fault-locating Frequencies

a. Three fault-locating frequencies are required so that one to three repeaters may be tested by personnel at the attended point supplying power to those repeaters. The REP switch of the first repeater is operated to position 1, which returns the 99-kc signal. The REP switch of the second repeater is operated to position 2, which returns the 91-kc signal. The REP switch of the third repeater is operated to position 3, which returns the 83-kc signal.

b. The fourth, fifth, or sixth repeaters in a string, counting from the first attended point, are supplied power by the next attended point in the system. The fault-locating frequencies used to test those repeaters are sent from the attended point supplying power to those repeaters.

123. Fault-locating Circuit
(figs. 24 and 25)

The fault-locating circuit consists of looping filter FL5 and REP switch S2. Looping filter FL5 is bridged between the output of transmission circuit 1 and the input of transmission circuit 2, providing a low-loss return path for the 83-, 91-, or 99-kc fault-locating frequency selected by the REP switch. This return path has a minimum of 20-db loss for the fault-locating frequencies. The return path offers a loss of more than 70 db to the 12- to 69-kc frequency range so that the message channel and pilot frequencies are effectively kept from becoming fed back to the opposite direction of transmission. Looping filter FL5 contains three networks connected through REP switch S2. Positions 1, 2, and 3 of the REP switch select the network arrangement that will provide a return path for 99, 91, and 83 kc, respectively. Positions 1, 2, and 3 correspond to the placement of the repeater away from the attended point. The corresponding fault-locating frequency selected by these positions is used to locate a one-wire break in a cable span preceding the tested repeater in the system, or failure of either amplifier in that repeater. Testing is accomplished by measurement of the selected fault-locating frequency returned to the attended point. Each fault-locating frequency is put on the line in turn at the attended point. The frequencies not returned indicate failure of cable spans or repeater amplifiers. The fault-locating frequency originates at the attended point supplying power to the loop in which the particular Telephone Repeater AN/TCC–11 is located.



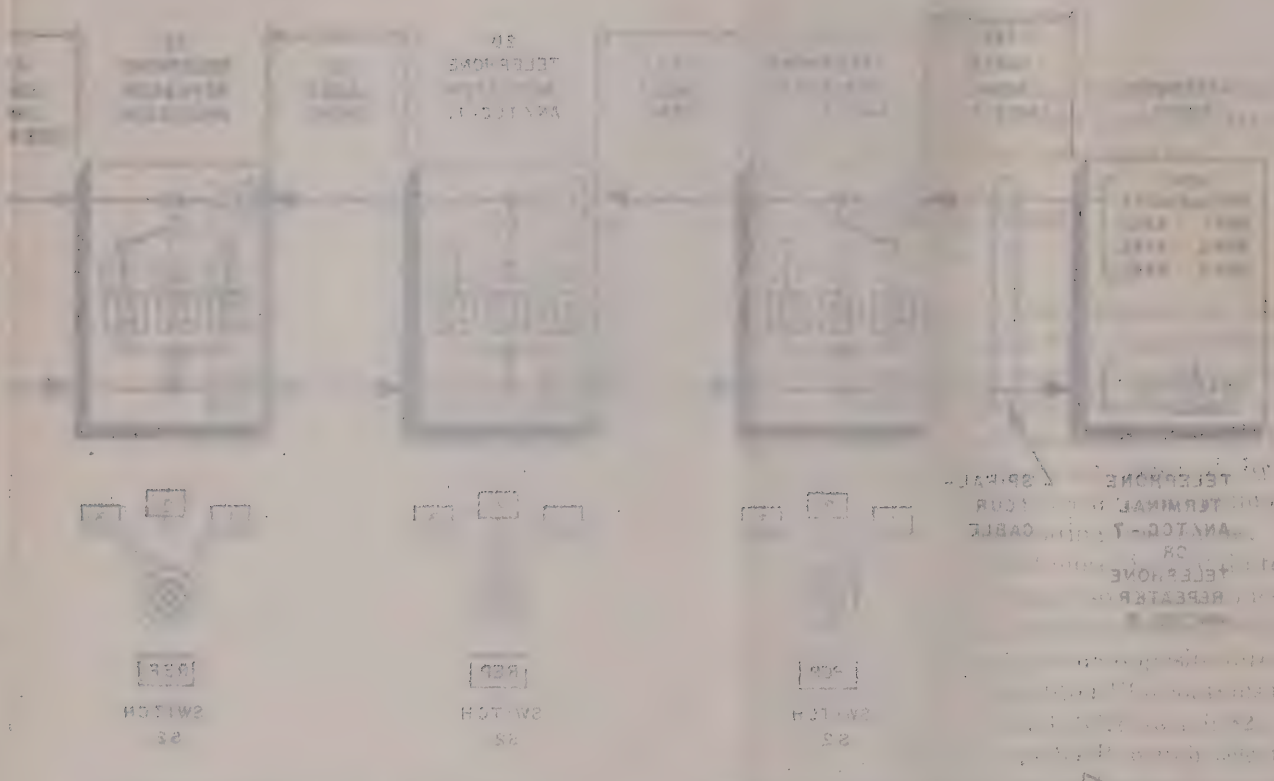
FREQUENCY NOT RETURNED	TROUBLE LOCATION
99 KC	1ST REPEATER OR 1ST CABLE SPAN
91 KC	2ND REPEATER OR 2ND CABLE SPAN
83 KC	3RD REPEATER OR 3RD CABLE SPAN

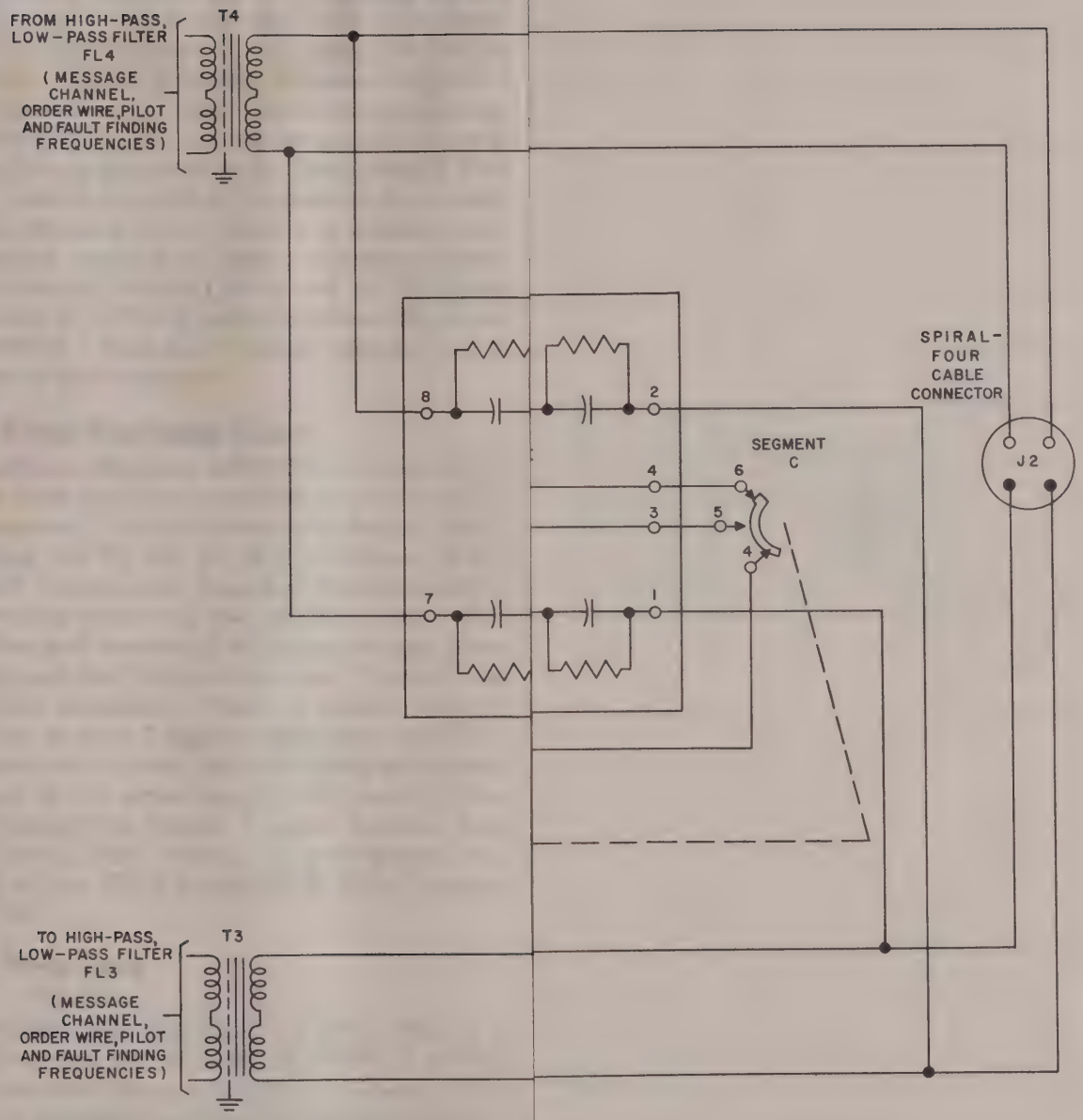
NOTES:

1. POSITION OF REPEATERS OR CABLE SPANS IN A POWER LOOP IS DETERMINED BY COUNTING FROM THE ATTENDED POINT SUPPLYING POWER TO THE LOOP.
2. NUMERALS 1 AND 2 INDICATE LINE AMPLIFIER AR1 AND LINE AMPLIFIER AR2.
3. FAULT LOCATING FREQUENCIES 83KC, 91KC, AND 99KC ARE SENT OUT, IN TURN, FROM THE ATTENDED POINT SUPPLYING POWER TO THE SECTION.
4. THE FAULT LOCATING FREQUENCIES WHICH ORIGINATE IN ONE POWER LOOP, TEST ONLY THE REPEATERS IN THAT LOOP. THAT PART OF EACH FAULT LOCATING FREQUENCY WHICH PASSES FROM ONE POWER LOOP TO THE NEXT IS ATTENUATED 46db BEFORE BEING RETURNED TO THE ORIGINAL POWER LOOP.
5. A ONE-WIRE BREAK IN THE SPIRAL—FOUR CABLE PRECEDING AN AN/TCC-11 REPEATER WILL GIVE THE SAME TROUBLE INDICATION WHEN TESTED BY THE FAULT LOCATING FREQUENCIES AS FAULTY AMPLIFICATION IN THAT REPEATER.
6. A ONE-WIRE BREAK IN THE FOURTH CABLE SPAN CANNOT BE LOCATED BY MEANS OF THE FAULT LOCATING FREQUENCIES.
7. A CABLE SPAN CONSISTS OF TWENTY-THREE 1/4 MILE REELS (±1 REEL) OF SPIRAL-FOUR CABLE. BETWEEN AN AN/TCC-11 REPEATER AND AN ATTENDED POINT, CABLE REELS MAY BE SIMULATED BY ATTENUATION NETWORKS AT THE ATTENDED POINT.

TM 2148-19

Figure 24.—Telephone Repeater AN/TCC-11, use of fault-locating frequencies.

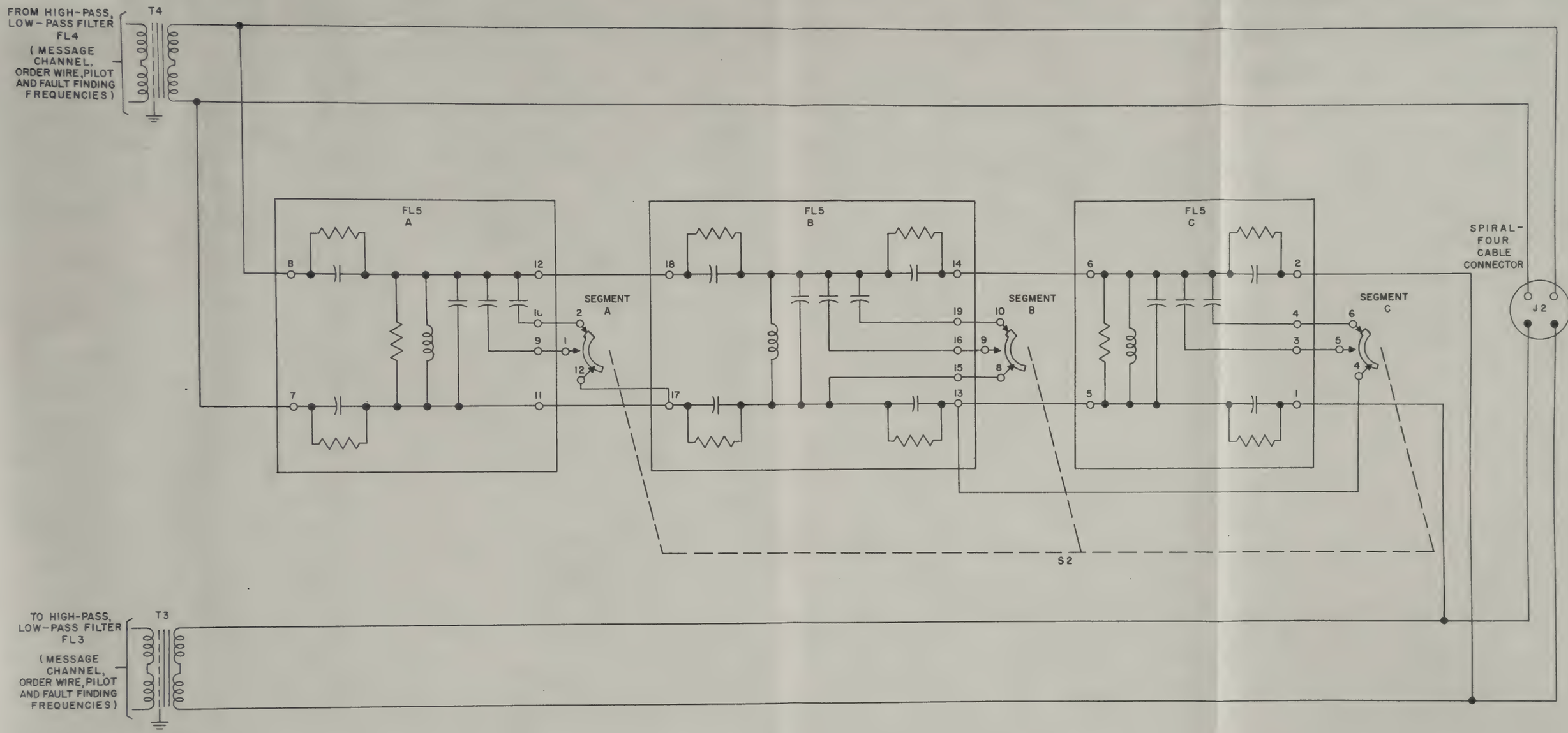


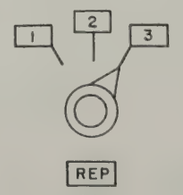


FILTER CONNECTIONS		FREQUENCY PASSED
FROM TERMINAL	TO TERMINAL	
—	—	99 KC
9	17	91 KC
15	16	
13	3	
10	17	83 KC
15	19	
13	4	

TM 2148-20







REP SWITCH POSITION	SWITCH SEGMENT	FILTER CONNECTIONS FROM TERMINAL	FILTER CONNECTIONS TO TERMINAL	FREQUENCY PASSED
1	A B C	—	—	99 KC
2	A B C	9 15 13	17 16 3	91 KC
3	A B C	10 15 13	17 19 4	83 KC

TM 2148-20

Figure 25.—Telephone Repeater AN/TCC-11, action of REP switch.



124. Repeater Power Requirements

Telephone Repeater AN/TCC–11 requires a d-c power supply of normally 150 volts at an accurately regulated current of 0.1 ampere (100 milliamperes). When Telephone Repeater AN/TCC–11 is connected in a string of two or three repeaters, power is supplied to the repeaters in series. Power is supplied to the repeaters by Power Supply PP–826/U, which provides 0.1 ampere at the overall voltage required by the repeater or repeaters and connecting spiral-four cable resistance losses. Power Supply PP–826/U is located at Telephone Terminal AN/TCC–7 and Telephone Repeater AN/TCC–8. Each power supply provides power for one to three repeaters.

125. Power Distributing Circuit

Telephone Repeater AN/TCC–11 receives d-c power from the cable connected to the J1 end of the repeater. The d-c power is picked off input repeating coil T1 (fig. 27) at the midpoint of the primary winding, and is applied through a power distributing circuit to the amplifier load. The amplifier load consists of the heater voltage, plate supply, and bias volatges for tubes V1 and V2 in both line amplifiers. Power is passed through one, two, or three Telephone Repeaters AN/TCC–11 connected in series, and is returned at the last repeater of the series string to the source. The series string thus formed is called a power loop (par. 126). This routing is accomplished by means of the PWR LOOP-PWR THRU switch (par. 127).

126. Power Loop

(fig. 26)

a. Power Loop, Definition. A power loop is a path from the 600 V POWER SUPPLY at the attended point through Telephone Repeater AN/TCC–11 equipment and back to the point of origin. The power loop may contain one to three repeaters. For information on the various combinations of power loops under all conditions, refer to TM 11–2150.

b. Junction Point. A particular repeater location is selected as the division between power loops by operating the PWR LOOP-PWR THRU switch (par. 127) to the PWR LOOP position at that repeater. The d-c power fed from (A, fig. 26) is applied to the power distributing circuit in the repeater at the junction point and is looped back to the source through preceding equipment in the system. The dc from the power loop fed from B is allowed to proceed to the repeater at the junction point. At the junction point this power is looped back to point B without supplying any power to the repeater at the junction point.

127. PWR LOOP-PWR THRU Switch S1

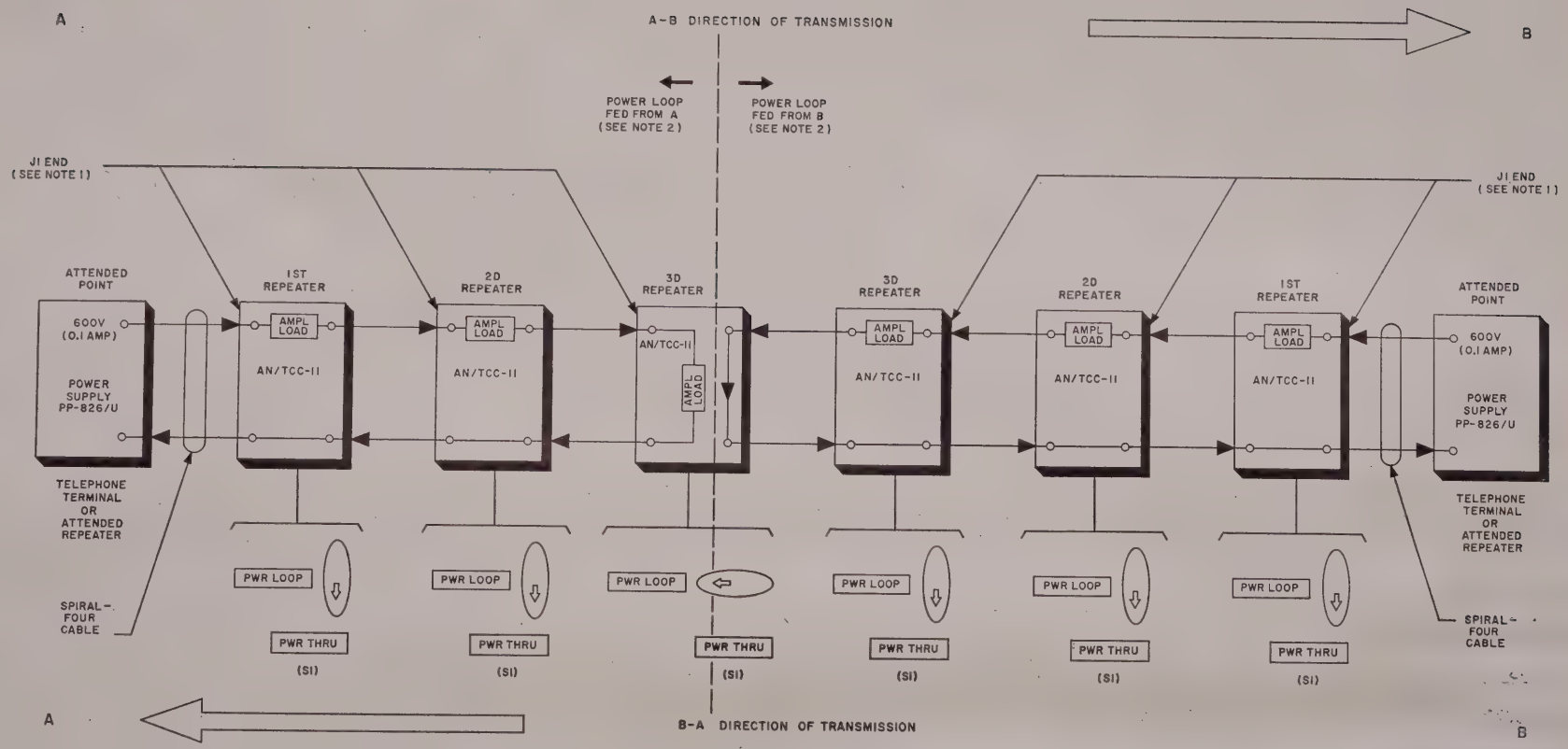
a. PWR THRU Position. In the PWR THRU switch position (A, fig. 27) the d-c power is applied to the amplifier load and then is delivered to terminals 5 and 2 of S1. Terminal 2 connects with terminal 1 and the dc is applied from terminal 1 to the midpoint of repeating coil T4. From this point the dc is sent over the cable to the next repeater in the power loop. The dc returning from the next repeater in the power loop is taken off the midpoint of repeating coil T3, and is applied to terminal 3 of S2. Terminal 3 connects with terminals 4 and 6. The returning dc continues through the winding of open circuit locating relay K1 to the midpoint of the secondary winding of repeating coil T2. From the midpoint of T2, the dc is sent over the cable to the preceding repeater in the power loop.

b. PWR LOOP Position. In the PWR LOOP position (B, fig. 27), the d-c voltage is applied through the power distribution sytem to terminals 5 and 2 of S1. Terminal 5 connects with terminal 6. The d-c power is looped back through the winding of open circuit locating relay K1 to the midpoint of repeating coil T2 and is returned over the cable to the preceding repeater in the system. The midpoints of repeating coils T3 and T4 are connected together through terminals 1 and 3 of S1 when S1 is in the PWR LOOP position. This is done to provide a return path for the power that reaches the J2 end of a junction point repeater from a repeater connected in an adjacent power loop. This arrangement permits dc to flow through all spiral-four cable connections, thereby keeping contact resistance low.

128. Line Amplifier Power Distribution

(fig. 56)

The incoming d-c power is taken off the midpoint of repeating coil T1 and is applied to capacitor C5 through connectors P1 and J4. Capacitors C5, C6 and C7 form a filter network to suppress, any 60-cycle noise or other line noise that may be present in the d-c supply, and to offer crosstalk filtering between amplifiers. Capacitors C8, C9, and C10, in the plate supply of line amplifier AR1, form a crosstalk filter between line amplifiers. A similar filter arrangement for the plate supply of

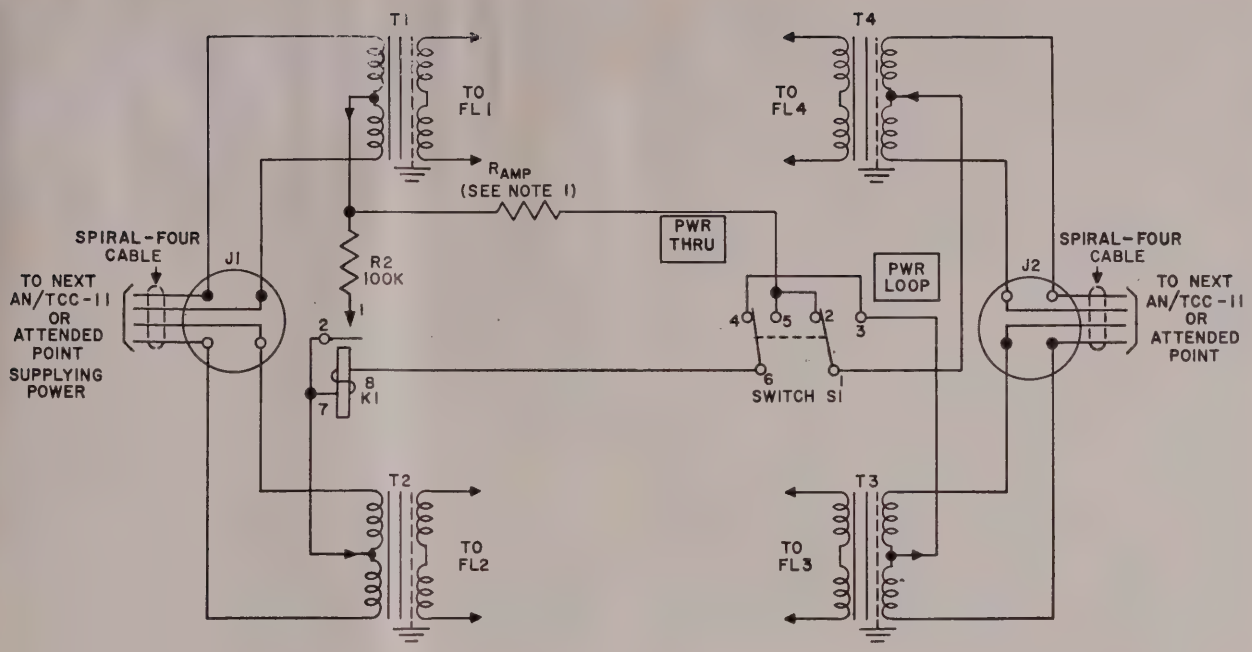


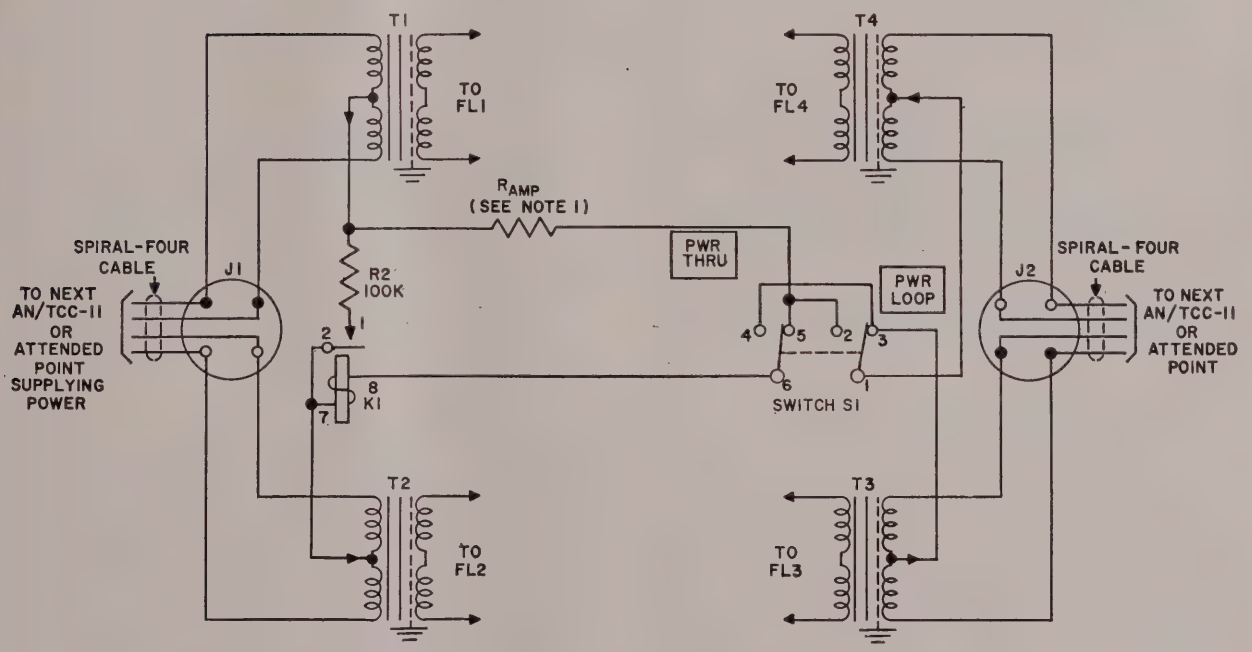
NOTES:

1. ALL REPEATERS IN SYSTEM HAVE JI END FACING POWER SOURCE.
2. ANY POWER LOOP MAY USE 0, 1, 2, OR 3 REPEATERS AN/TCC-11.
3. AMPL LOAD CONSISTS OF B+, BIAS, AND HEATER VOLTAGES FOR LINE AMPLIFIERS AR1 AND AR2 IN EACH TELEPHONE REPEATER AN/TCC-11.

TM 2148-21

Figure 26. Telephone Repeater AN/TCC-11, arrangement of repeaters into power loops.





NOTES:

1. R_{AMP} INDICATES AMPLIFIER LOAD (TUBE HEATERS, PLATE, AND SCREEN CIRCUITS.)
2. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS.

TM 2148-22

Figure 27. Telephone Repeater AN/TCC-11, action of PWR LOOP-PWR THRU switch.

line amplifier AR2 is provided by capacitors C11, C12, and C13. The voltage for the plates of the tubes in line amplifier AR1 is passed through voltage-dropping resistor R3. The voltage for the plates of the tubes in line amplifier AR2 is passed through voltage-dropping resistor R4. Resistor R5 is the dropping resistor for the tube heaters. Resistors R8, R9, R10, and R11 parallel the tube heater filaments providing for continuity of d-c power in the event one of the heaters fail. Capacitors C14, C15, and C16 offer crosstalk separation between amplifiers. The negative end of the voltage divider R5 to R11 is brought to panel ground (B—) at pin 5 of plug 1 in each line amplifier. Since the voltage required by a single repeater is approximately 150 volts from B+ to B— (panel ground), the voltage on panel ground can be high as —350 volts when the power loop contains three repeaters. Because of this high B— voltage on panel ground, insulation must be provided between panel ground and the outer case of the repeater, which is connected to earth ground, to keep the B— from shorting to earth ground. Insulated mountings between the panel and the outer case provide the necessary protection. The midpoints of repeating coils T1, T2, T3, and T4 are brought to earth ground through capacitors C1, C2, C3, and C4. This circuit provides a low-impedance path to ground for a-c transients that may be present in the d-c supply from induced voltages or other sources. The grid bias for both amplifiers is derived from the voltage divider formed by R6 and R7 and applied to pin 16 of plug P1 of each line amplifier.

129. Locating and Protection Circuits

The locating and protection circuits of Telephone Repeater AN/TCC–11 include the open circuit locating system (par. 130) and the lightning protection circuit (par. 131). The open circuit locating system provides a means of determining at an attended point the location of a two-wire, power interrupting cable break. The lightning protection circuit is used to divert to ground high voltages induced by lightning or power line disturbances, thereby protecting the spiral-four cable and the repeater equipment.

130. Open Circuit Locating Relay K1

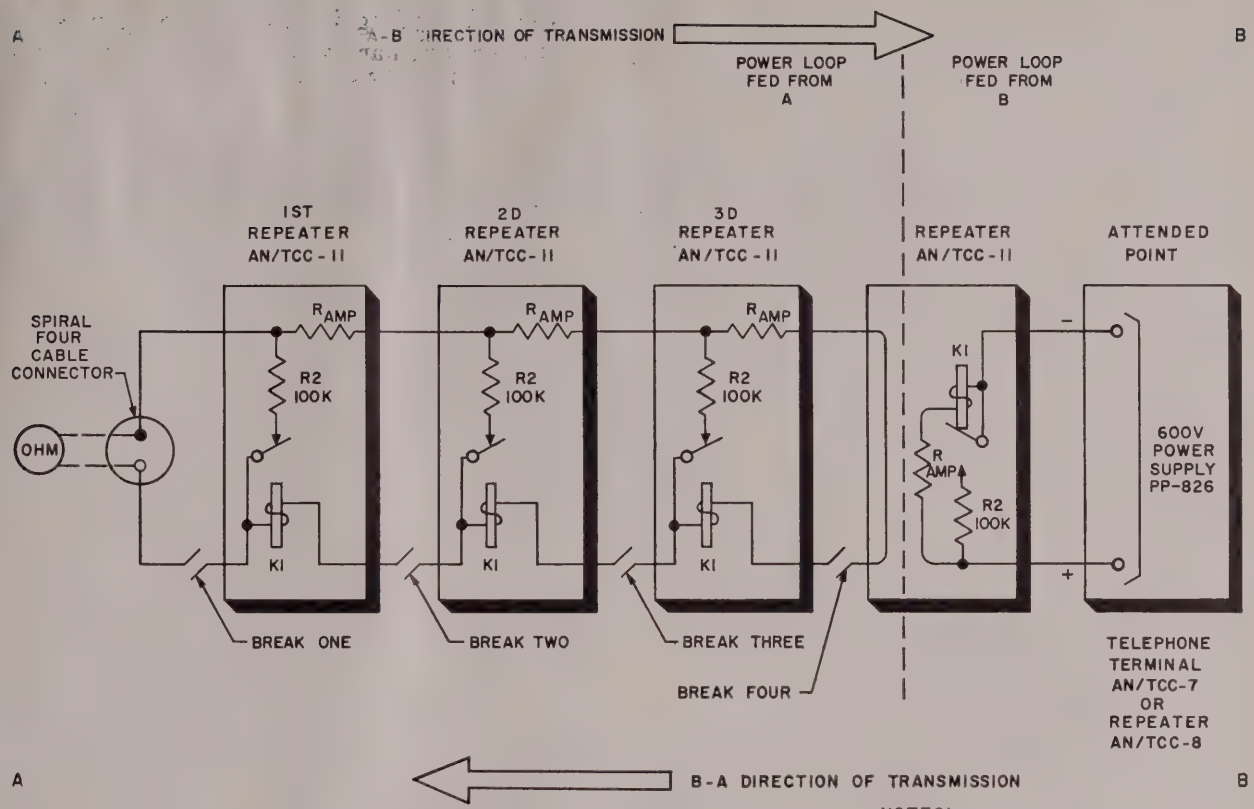
(fig. 56)

Relay K1 performs the function of an open circuit locating relay. The current passing through its solenoid winding is sufficient to operate the relay. A particular type of two-wire break will cause the failure of power supplied to the equipment. When the current ceases to flow through the winding of K1, the relay releases. The released contact bridges a large resistance (R2) between cable pairs connected to connector J1. All K1 relays in the power loop that contain the wire break release and bridge the R2 resistors across the cable pairs connected to connector J1 at each repeater location. The location of the break is determined at the attended point by measuring the resistances of the bridging resistors on a meter in shunt between the cable pairs (fig. 28). A break between the attended point and the first repeater will cause an infinite resistance reading. The reading for a break between the first and second repeaters will be the value of the first bridging resistor R2, or 100,000 ohms. The reading for a break between the second and third repeaters will be the value of two 100,000-ohm resistors in parallel, or 50,000 ohms. The reading for a break beyond the third repeater will be the value of three 100,000-ohm resistors in parallel, or 33,000 ohms. This open circuit indicating system will function only for a two-wire power interrupting break. A one-wire break ordinarily will not cause sufficient loss of voltage to allow relay K1 to become deenergized. The method of locating a one-wire break is described in paragraph 123. Capacitor C17 is bridged across the winding of relay K1 to reduce crosstalk coupling between the two-line amplifiers.

131. Lightning Protection

(fig. 29)

Carbon block lightning arresters are provided to protect Telephone Repeater AN/TCC–11 circuits from damage caused by surges induced in the cable as a result of nearby lightning strokes. Lightning arresters E5, E6, E8, and E9 (300 v) are bridged across the secondary windings of repeating coils T1 and T2, and across the primary windings of repeating coils T3 and T4. Lightning arresters E1 and E4 (600 v) and E2 and E3 (300 v) are connected between the center tap of the line windings of the above repeating coils and earth ground. Lightning arrester E10 (300 v) is bridged between the midpoints of input repeating coil T1 and output repeating coil T4. Lightning arrester E7 (300 v.) is bridged between the midpoint of input repeating coil T3 and output repeating coil T2.



BREAK LOCATION	METER READING OHMS
BREAK ONE	OVER 200,000
BREAK TWO	100,000
BREAK THREE	50,000
BREAK FOUR	33,000

NOTES:

1. R_{AMP} INCLUDES THE TUBE HEATER, B+, AND BIAS VOLTAGES FOR LINE AMPLIFIERS AR-1 AND AR-2.
2. RELAYS K1 ARE DE-ENERGIZED BY LOSS OF D-C CAUSED BY LINE BREAKS IN THE POWER LOOP IN WHICH RELAY IS LOCATED. RELAYS ARE NOT AFFECTED BY LINE BREAKS IN THE ADJACENT POWER LOOP.
3. ALL BREAKS SHOWN ARE BREAKS IN TWO WIRES OF SAME PAIR. VOLTAGE LOSS OF ONE-WIRE BREAK IS TOO SMALL TO DE-ENERGIZE OPEN CIRCUIT RELAYS.

TM 2148-23

Figure 28. Telephone Repeater AN/TCC–11, operation of open circuit locating system.

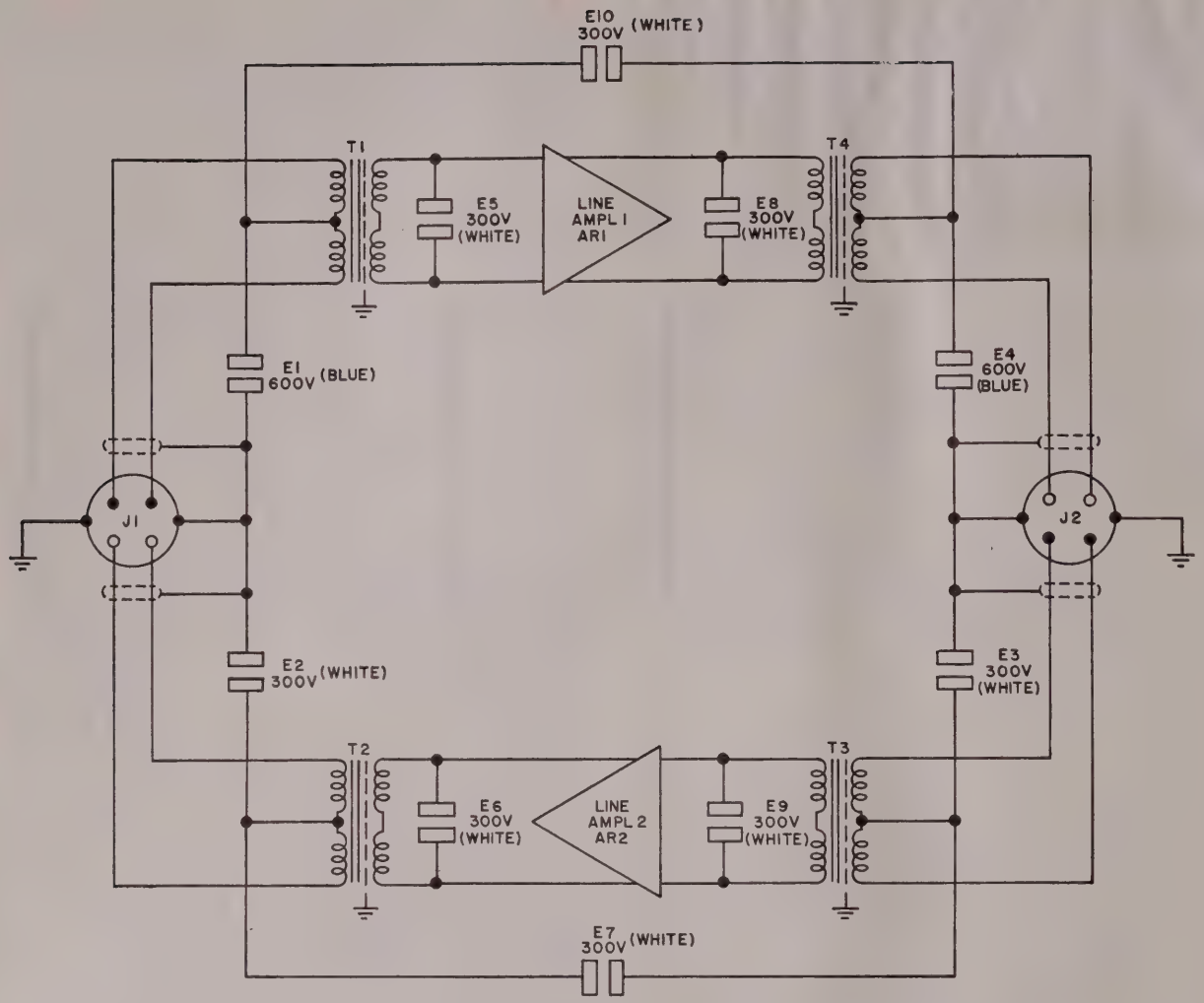


Figure 29. Telephone Repeater AN/TCC–11, arrangement of lightning arresters, functional schematic diagram.

CHAPTER 6
FIELD MAINTENANCE INSTRUCTIONS

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing Telephone Repeater AN/TCC–11, be extremely careful because of the high voltages exposed. Keep one hand in the pocket when measuring socket voltages with the probe. With the high voltage off, potentials as great as 600 volts still may be present in the equipment. Before touching any part after the voltage is shut off, short the part to ground. Always disconnect the spiral-four cable connectors and discharge capacitors C1, C2, C3, and C4 before making resistance measurements.

132. Troubleshooting Procedures

The first step in servicing defective equipment is to sectionalize the fault to the assembly responsible for the abnormal operation of the system. The second step is to localize the fault. Localization means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults, such as burned-out resistors, often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by making voltage and resistance measurements.

a. System Sectionalization. System sectionalization is discussed in TM 11–2150.

b. Assembly Sectionalization and Localization. The tests listed below aid in isolating the source of trouble. To be effective the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the equipment. First the trouble should be localized to a single stage or circuit. Then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

(1) *Visual inspection.* The purpose of visual inspection (par. 66) is to locate any visible trouble. Through this inspection alone, the repairman frequently may discover the trouble, or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the equipment which might occur through improper servicing methods and in forestalling future failures.

(2) *Power circuit test.* These measurements (par. 140) prevent further damage to the equipment from possible short circuits. Since this test gives an indication of the condition of the power circuits, its function is more than preventive.

(3) *Operational tests.* The operational tests (pars. 139 and 150) are important because they frequently indicate the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. To utilize this information fully, all symptoms must be interpreted in relation to each other.

(4) *Troubleshooting chart.* The trouble symptoms listed in this chart (par. 151) will aid greatly in localizing trouble.

(5) *Signal substitution.* The principal advantage of the signal substitution method (pars. 156, 157, and 158) is that it usually enables the repairman to localize a trouble accurately and quickly to a given stage when the general location of the trouble is not immediately evident from the above tests.

(6) *Intermittents.* In all these tests the possibility of intermittents should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the suspected component. It is possible that the trouble is not in the equipment itself but in the installation, or the trouble may be due

to external conditions. In this event, test the installation, if possible.

133. Troubleshooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the troubleshooting data in the table below.

Note. Throughout this chapter, the diagrams showing the test jigs and test cable assemblies will use the short term AN/TCC–11 repeater or the short term AN/TCC–11 instead of Telephone Repeater AN/TCC–11 to identify the test jigs and test cable assemblies.

Fig. No.	Description
68	Telephone Repeater AN/TCC–11, schematic diagram.
69	Telephone Repeater AN/TCC–11, line amplifier, schematic diagram.
56	Telephone Repeater AN/TCC–11, power distributing circuit, B plus and positive bias voltage distribution, schematic diagram.
10	Telephone Repeater AN/TCC–11, tube location diagram.
42	Telephone Repeater AN/TCC–11, line amplifier, tube socket d-c voltage and resistance measurements.
57	Telephone Repeater AN/TCC–11, line amplifier tube socket d-c voltage and resistance measurements as part of Telephone Repeater AN/TCC–11.
43	Telephone Repeater AN/TCC–11, J1 end cover assembly, rear view.
44	Telephone Repeater AN/TCC–11, J1 end cover assembly, rear view, parts removed to show thermistor RT1.
45	Telephone Repeater AN/TCC–11, J2 end cover assembly, rear view.
46	Telephone Repeater AN/TCC–11, J2 end cover assembly, rear view, parts removed to show thermistor RT2.
47	Telephone Repeater AN/TCC–11, line amplifier, top view, cover in place.
48	Telephone Repeater AN/TCC–11, line amplifier, top view, cover removed.
49	Telephone Repeater AN/TCC–11, line amplifier, bottom view.
50	Telephone Repeater AN/TCC–11, filter section, J7 end.
51	Telephone Repeater AN/TCC–11, filter section, J8 end.
52	Telephone Repeater AN/TCC–11, filter section, top view.
53	Telephone Repeater AN/TCC–11, filter section, bottom view.
54	Telephone Repeater AN/TCC–11, filter section, right side view.
55	Telephone Repeater AN/TCC–11, filter section, left side view.
70	Telephone Repeater AN/TCC–11, wiring diagram.
71	Telephone Repeater AN/TCC–11, line amplifier, wiring diagram.

134. Tools and Test Equipment Required for Troubleshooting and Testing

The tools and test equipment required for troubleshooting Telephone Repeater AN/TCC–11 are listed below. The technical manuals associated with the test equipment also are listed where applicable.

Item	Test equipment and tools	Technical manual or instruction book	Figure No.	Amount required
1	Attenuator TS–402/U	TM 11–2044		1
2	Multimeter TS–352/U	TM 11–5527		1
3	Signal Generator SG–71	Manufacturer's instruction book		1
4	Electron Tube Test Set TV–2/U			1
5	Electronic Multimeter ME–6/U	Manufacturer's instruction book for Ballentine 300.		1
6	Capacity Analyzer ZM–3/U	TM 11–5043		1
7	Power Supply PP–827/U (200 v at 100 ma)			1
8	Tool Equipment TE–123			1
9	Screwdriver TL–105 (6R16410)			1
	The following items are a part of Telephone Carrier Test Facilities Kit MK–155( )/TCC:			
10	Telephone Repeater AN/TCC–11, test jig		34	1
11	Telephone Repeater AN/TCC–11, line amplifier test jig		35	1
12	Telephone Repeater AN/TCC–11, repeater transmission test cable assembly.		30	2
13	Telephone Repeater AN/TCC–11, line amplifier test cable assembly.		32	1

Item	Test equipment and tools	Technical manual or instruction book	Figure No.	Amount required
14	Telephone Repeater AN/TCC–11, line amplifier extension test cable assembly.		33	1
15	Telephone Repeater AN/TCC–11, voltage-resistance test cable assembly.		31	1
16	Resistor, 600 ohms ±1%, ½ w (GA50083A6000)			2
17	Resistor, 6800 ohms ±5%, ½ w (RC20BF682J)			2
18	Resistor, 2000 ohms ±20%, 25 w (RW34G202)			1
19	Resistor, 20,000 ohms ±20%, 2 w (RC42BF203M)			1
20	Resistor, 135 ohms ±1%, ½ w (GA50083A1350)			1
21	Repeating coil (GA51071)			1

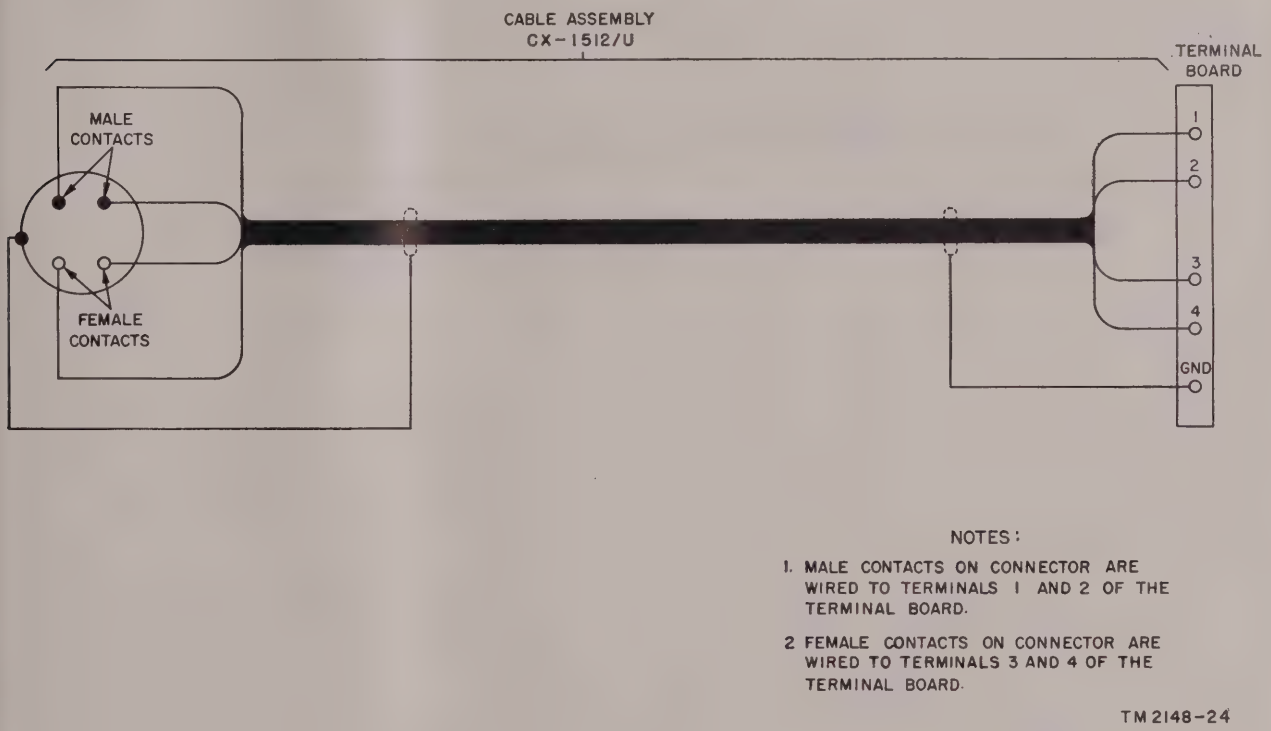


Figure 30. Telephone Repeater AN/TCC–11, repeater transmission test cable assembly.

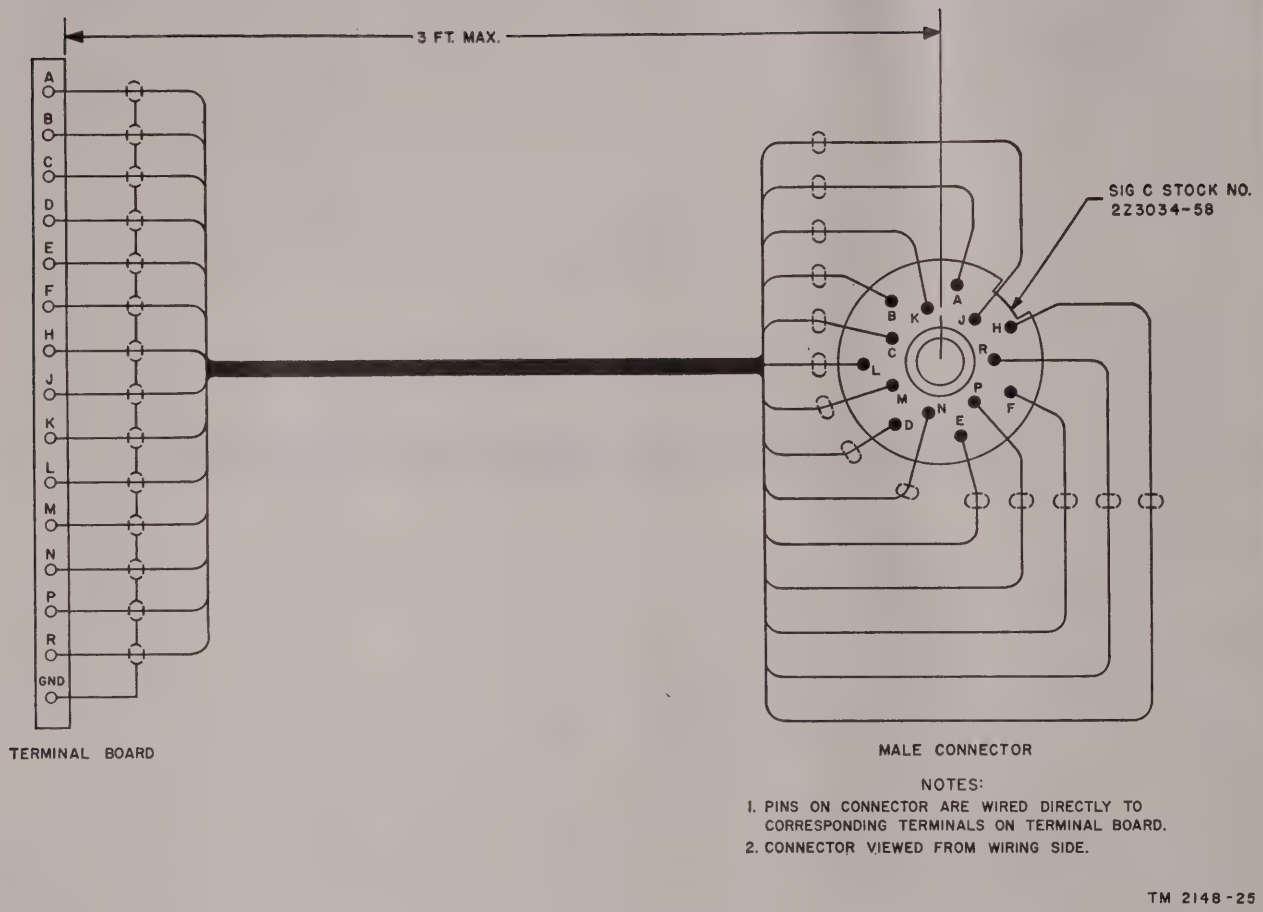


Figure 31. Telephone Repeater AN/TCC–11, voltage-resistance test cable assembly.

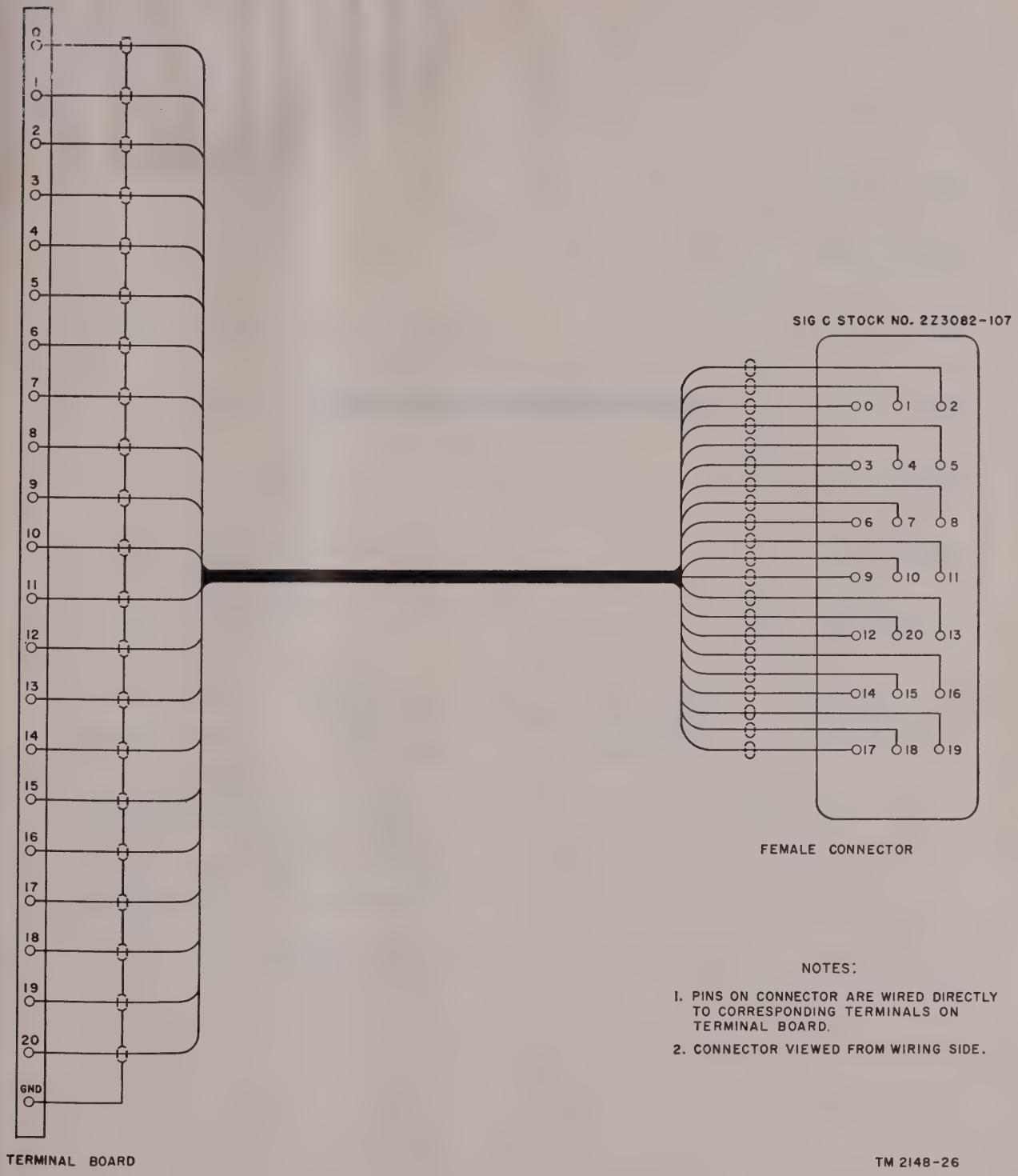


Figure 32. Telephone Repeater AN/TCC–11, line amplifier test cable assembly.

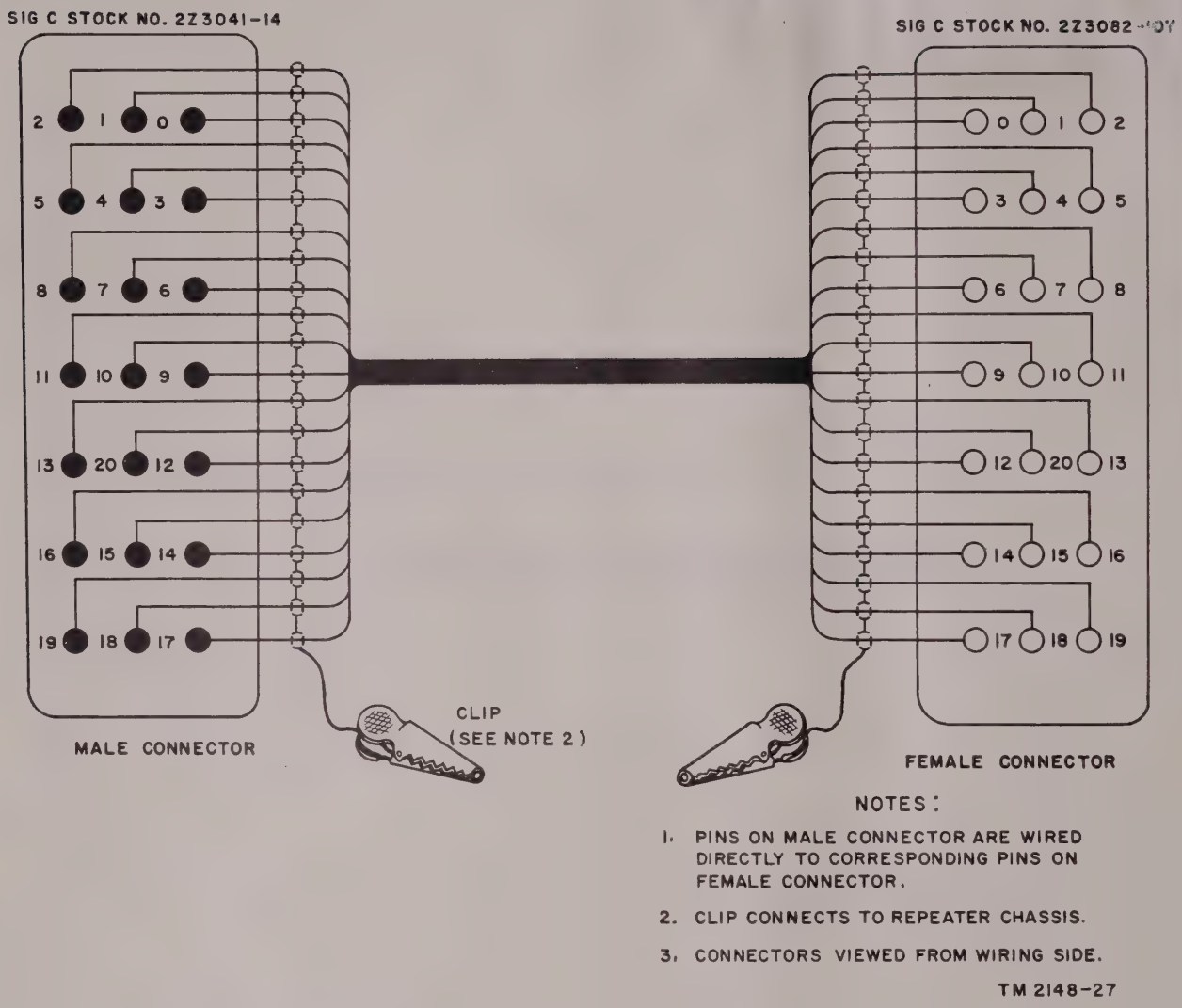


Figure 33. Telephone Repeater AN/TCC–11, line amplifier extension test cable assembly.

135. Telephone Repeater AN/TCC–11, Test Jig

(fig. 34)

a. Use. The Telephone Repeater AN/TCC–11 test jig is used for making the following tests:

(1) Power circuit test.
(2) Transmission test.
(3) Measuring circuit test.
(4) Gain control test.
(5) Order wire test.
(6) Looping filter test.
(7) Relay test.

b. Parts List. The parts for the Telephone Repeater AN/TCC–11 test jig are listed in the table below. Figure 34 shows the test jig connected to an AN/TCC–11.

Item	Part	Number required
1	Repeating coil (GA51071)	4
2	AN/TCC–11 repeater transmission test cable assembly.	2
3	Resistor, 600 ohms +1%, ½ w (GA50083A6000).	2
4	Resistor, 500 ohms ±5%, 8 w (RW30G501).	1
5	Terminal boards	2
6	Chassis or panel, and hardware as required.	------

136. Telephone Repeater AN/TCC–11, Line Amplifier Test Jig

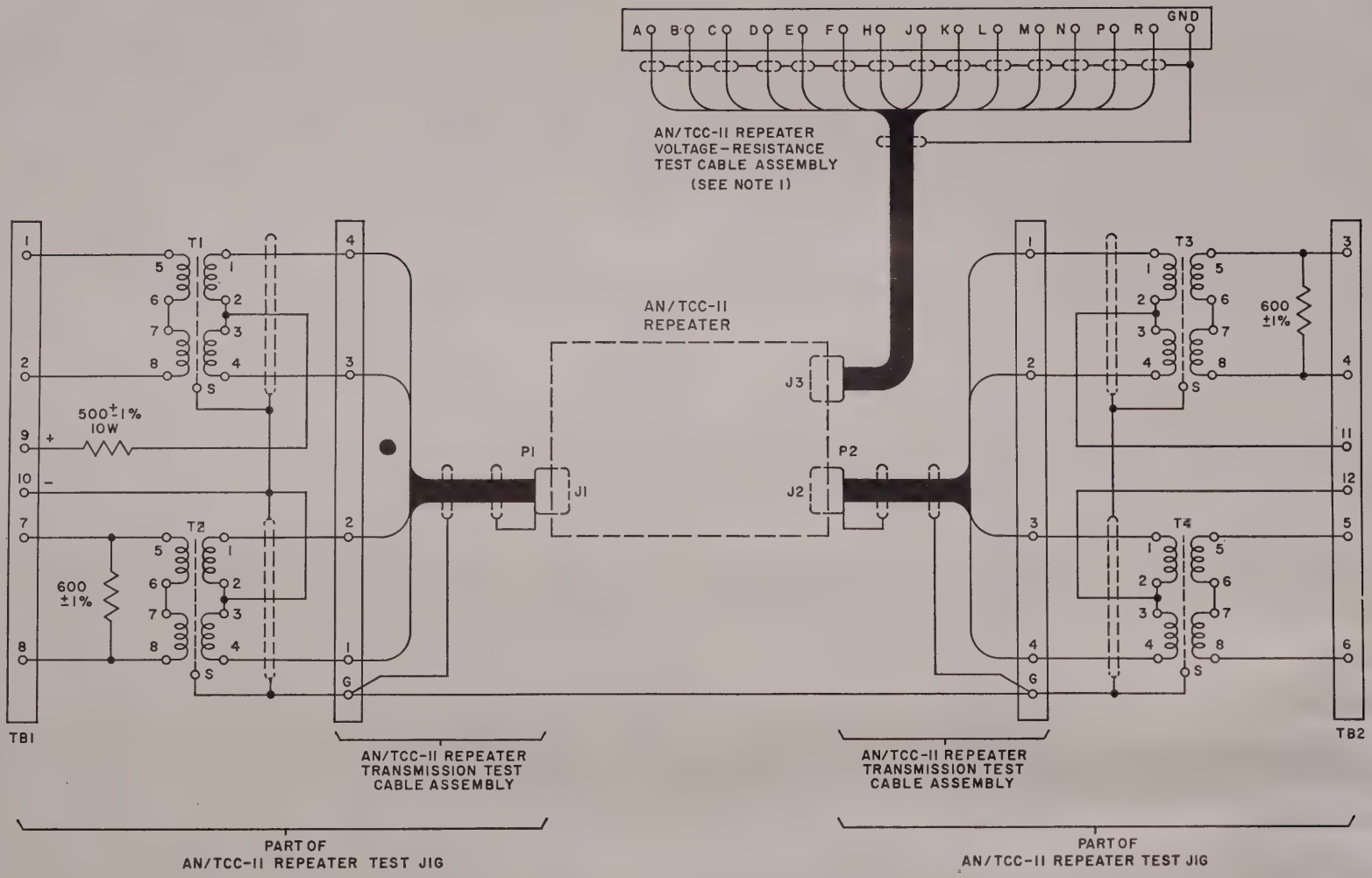
(fig. 35)

a. Use. The Telephone Repeater AN/TCC–11 line amplifier test jig is used to make the following tests on the line amplifiers:

(1) D-c voltage measurements (par. 149).
(2) Signal substitution (par. 158).

b. Parts List. The parts used in the Telephone Repeater AN/TCC–11 line amplifier test jig are listed in the table below.

Item	Ref. symbol	Part	Number required
1	R12, R13	Resistor, 600 ohms ±1%, ½ w (GA50083A6000).	2
2	R4	Resistor, 135 ohms ±1%, ½ w (GA50083A1350).	1
3	R5	Resistor, 1000 ohms ±5%, 10 w (RW31G102).	1
4	R8, R9	Resistor, 1200 ohms ±5%, 2 w (RC42BF1221).	2
5	R6, R7	Resistor, 1200 ohms ±5%, 10 w (RW31G122).	2
6	R10, R11	Resistor, 18,000 ohms ±5%, 2 w (RC42B183J).	2
7	R2	Resistor, 130,000 ohms ±1%, ¼ w (GA50083A-1303).	1
8	R14	Resistor, 15,000 ohms ±10%, ½ w (RC20BF-153J).	1
9	R15, R16	Resistor, 316 ohms ±1%, ½ w (GA50083A3160).	2
10	R17	Resistor, 422 ohms ±1%, ½ w (GA50083A4220).	1
11	R1	Resistor, 500 ohms ±5%, 8 w (RW30G501).	1
12	R3	Resistor, 16,000 ohms ±1%, ½ w (GA50083A1602).	1
13	C1	Capacitor, electrolytic, 8μf, 300 v.	1
14	C2	Capacitor, 0.47 μf, 300 v (181P47403T5).	1
15	TB1	Terminal block	1
16	----------	Panel or chassis and hardware as required.	
17	----------	AN/TCC–11 line amplifier test cable assembly.	1

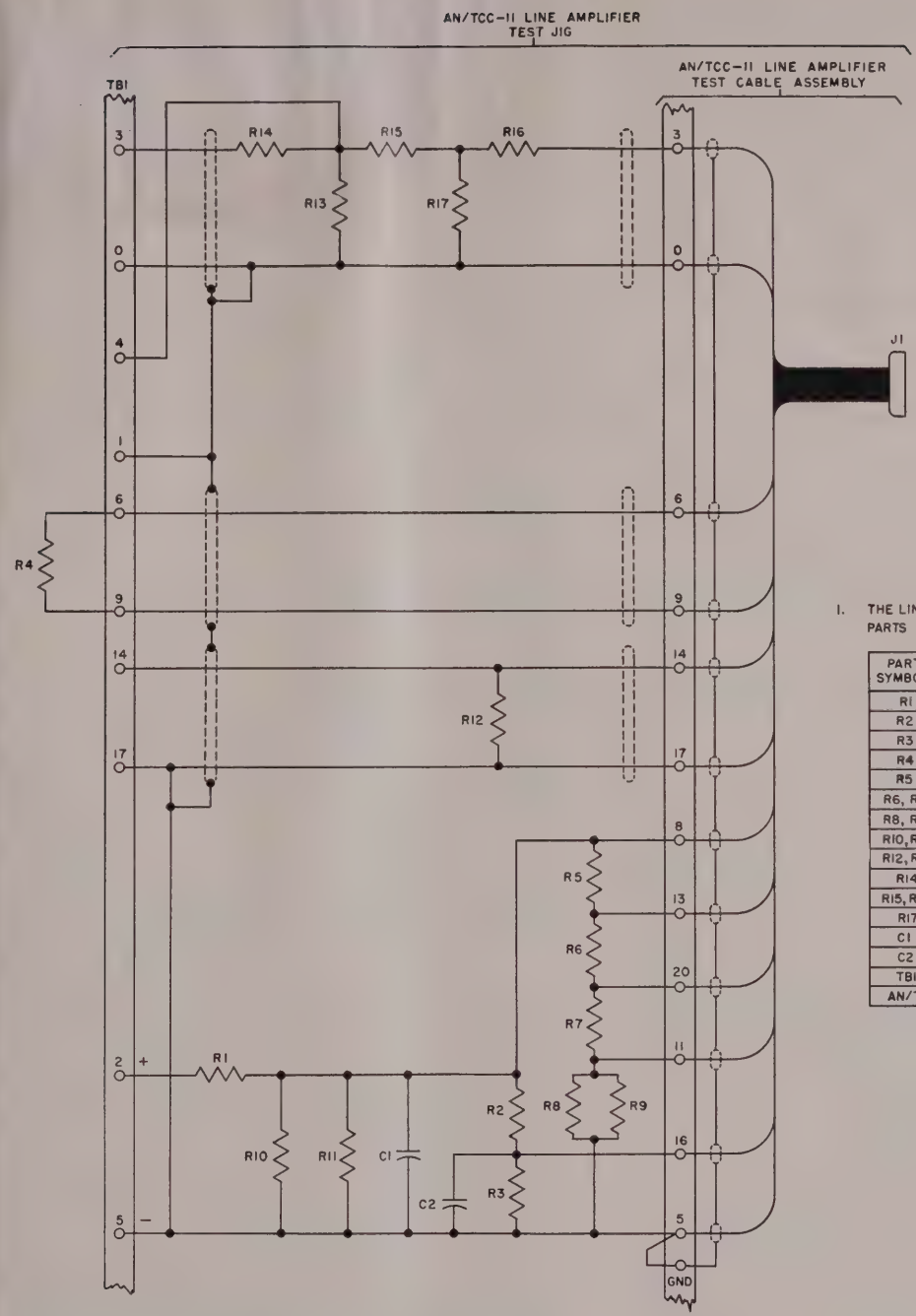


NOTES:

1. AN/TCC-II REPEATER VOLTAGE-RESISTANCE TEST CABLE ASSEMBLY USED FOR A-C VOLTAGE MEASUREMENTS.
2. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS.

TM 2148-25

Figure 34. Telephone Repeater AN/TCC-11, test jig and voltage-resistance test cable assembly shown connected to repeater.



NOTES:

1. THE LINE AMPLIFIER TEST JIG IS COMPRISED OF THE PARTS LISTED BELOW:

PART SYMBOL	VALUE AND TOLERANCE	WATTAGE OR VOLTAGE RATING
R1	500 OHMS ±5%	8 WATTS
R2	130K ±1%	1/2 WATT
R3	16K ±1%	1/2 WATT
R4	135 OHMS ± 1%	1/2 WATT
R5	1000 OHMS ± 5%	10 WATTS
R6, R7	1200 OHMS ± 5%	10 WATTS
R8, R9	1200 OHMS ± 5%	2 WATTS
R10, R11	18K ±5%	2 WATTS
R12, R13	600 OHMS ± 1%	1/2 WATT
R14	15K ±10%	1/2 WATT
R15, R16	316 OHMS ± 1%	1/2 WATT
R17	422 OHMS ± 1%	1/2 WATT
C1	8UF ELECTROLYTIC	300V
C2	0.47UF	200V
TBI	TERMINAL BOARD	
AN/TCC-11 LINE AMPLIFIER TEST CABLE ASSEMBLY		

TM 2148-29

Figure 35. Telephone Repeater AN/TCC–11, line amplifier test jig.

137. General Precautions

Whenever the repeater is serviced, observe the following precautions very carefully:

a. Be careful when the end panels are removed; dangerous voltages are exposed.

b. Careless replacement of parts often makes new faults inevitable. Note the following points:

(1) Before leads are unsoldered from a part, note the position of the leads. If the part, such as a transformer, has a number of connections, tag each of the leads to it.

(2) Be careful not to damage other leads by pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the assemblies; they may cause short circuits.

(4) A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints; a poorly soldered joint is one of the most difficult faults to find.

(5) When a part is replaced in the line amplifier circuits, be sure to use an exact duplicate of the original part. A part with the same electrical value but different physical size may cause trouble. Give particular attention to proper grounding when replacing a part. Use the same ground as in the original wiring. Failure to observe these precautions may result in a change in gain or may cause undesired oscillations in the circuit.

Section II. TROUBLESHOOTING TELEPHONE REPEATER AN/TCC–11

138. Telephone Repeater AN/TCC–11, General Troubleshooting Procedures

a. Procedure When Trouble Is Known. When an AN/TCC–11 is received by field maintenance personnel and the defective part is known, use the following procedures:

(1) Disassemble the equipment (par. 169) if required.

(2) Perform resistance measurements to verify the location of the trouble.

(3) Replace the defective part.

(4) Assemble the repeater (par. 170).

(5) Perform the operational tests (par. 139).

b. Procedure When Trouble Is Not Known. When an AN/TCC–11 is received by field maintenance personnel and the nature of the trouble is not known, use the following procedures:

(1) Perform operational tests to locate trouble symptoms.

(2) Use the troubleshooting chart (par. 151) to locate trouble to a particular assembly or part. It will probably be necessary to disassemble the repeater (par. 169) at this point.

(3) Replace defective assembly or part.

(4) Assemble the repeater (par. 170).

(5) Perform operational tests (par. 139).

139. Telephone Repeater AN/TCC–11, Operational Tests

The operational tests are used to check the functioning of Telephone Repeater AN/TCC–11. The following operational tests are used.

a. Power circuit test (par. 140).

b. Transmission test (par. 141).

c. Measuring circuit test (par. 142).

d. Gain switch test (par. 143).

e. Order wire test (par. 144).

f. Looping filter test (par. 145).

g. Relay test (par. 146).

140. Power Circuit Test

a. Switch S1 in PWR THRU Position. The power circuit test for Telephone Repeater AN/TCC–11 for the PWR THRU position of the PWR LOOP-PWR THRU switch S1 is made in the following manner:

(1) Arrange the test set-up shown in figure 36.

(*a*) Connect an AN/TCC–11 repeater transmission test cable assembly (fig. 30) to connector J1 of Telephone Repeater AN/TCC–11.

(*b*) Connect an AN/TCC–11 repeater transmission test cable assembly to connector J2 of Telephone Repeater AN/TCC–11.

(*c*) Connect a voltage-resistance test cable assembly to connector J3 of Telephone Repeater AN/TCC–11.

(2) Remove the CONTROLS access port cover from the J2 end of the repeater.

(3) Operate the PWR LOOP-PWR THRU switch to the PWR THRU position.

(c) Make the resistance measurements detailed in the table below. If any of the measurements indicate trouble, refer to the troubleshooting chart (par. 151).

Item checked	Measured between—				Normal resistance (ohms)
	Terminal	Test cable into jack	Terminal	Test cable into jack	
Power-circuit resistance	3	J1	1	J2	1, 200. ±300.
Power-circuit insulation resistance	3	J1	1	J1	100K. ±25K.
Power-return-circuit resistance	3	J2	1	J1	35. ±20.
Panel-ground to case ground resistance	M	J3	D	J3	Greater than 5 megohms.

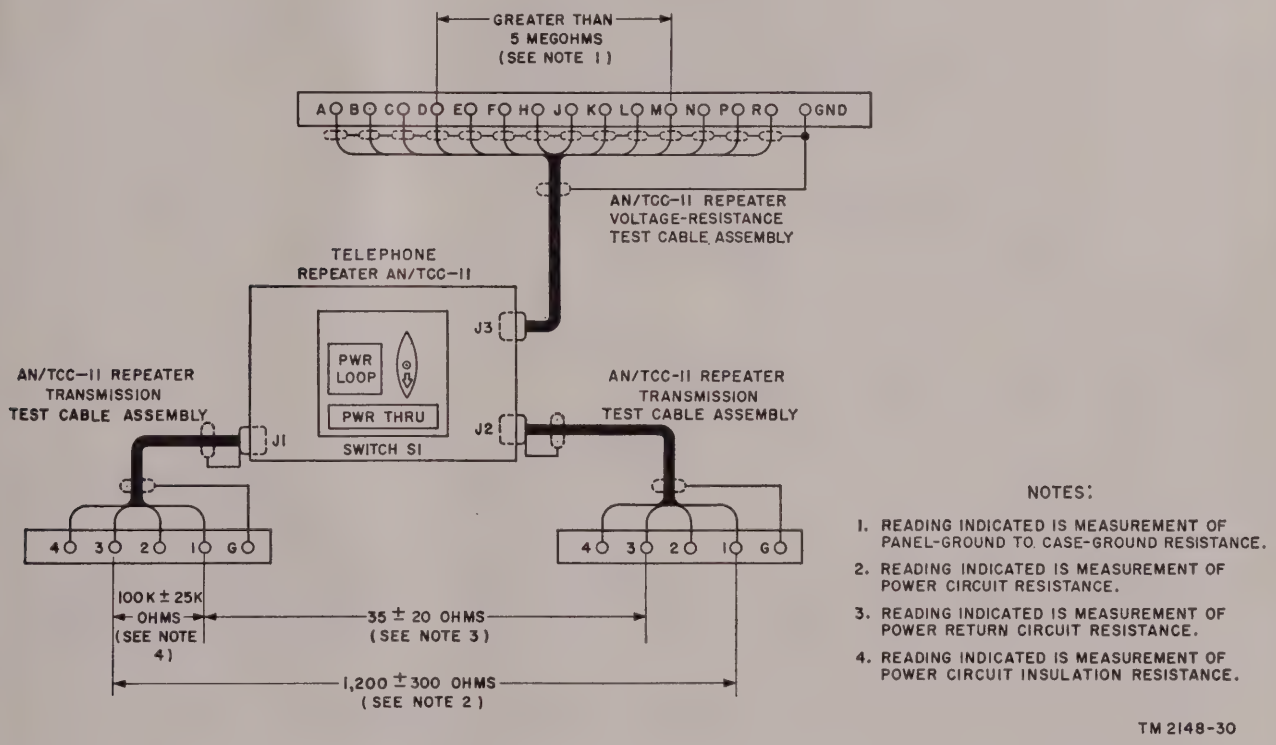


Figure 36. Telephone Repeater AN/TCC–11, test set-up for power circuit test, S1 in PWR THRU position.

b. Switch S1 PWR LOOP Position (fig. 37). The power circuit test for Telephone Repeater AN/TCC–11 for the PWR LOOP position of PWR LOOP-PWR THRU switch S1 is made in the following manner:

(1) Use the test set-up and test cable assemblies described in *a*(1) above.

(2) Operate the PWR LOOP-PWR THRU switch S1 to the PWR LOOP position.

(3) Make the resistance measurements shown in the table below. If any of the measurements indicate trouble, refer to the troubleshooting chart (par. 151).

Item checked	Measure between—				Normal resistance (ohms)
	Terminal	Test cable into jack	Terminal	Test cable into jack	
Power-circuit resistance	3	J1	1	J1	1, 200. ±300.
Power-circuit insulation resistance	3	J1	1	J2	Greater than 5 megohms.
Power-return-circuit resistance	3	J2	1	J2	4.5±2.
Panel-ground to case-ground resistance	M	J3	D	J3	Greater than 5 megohms.

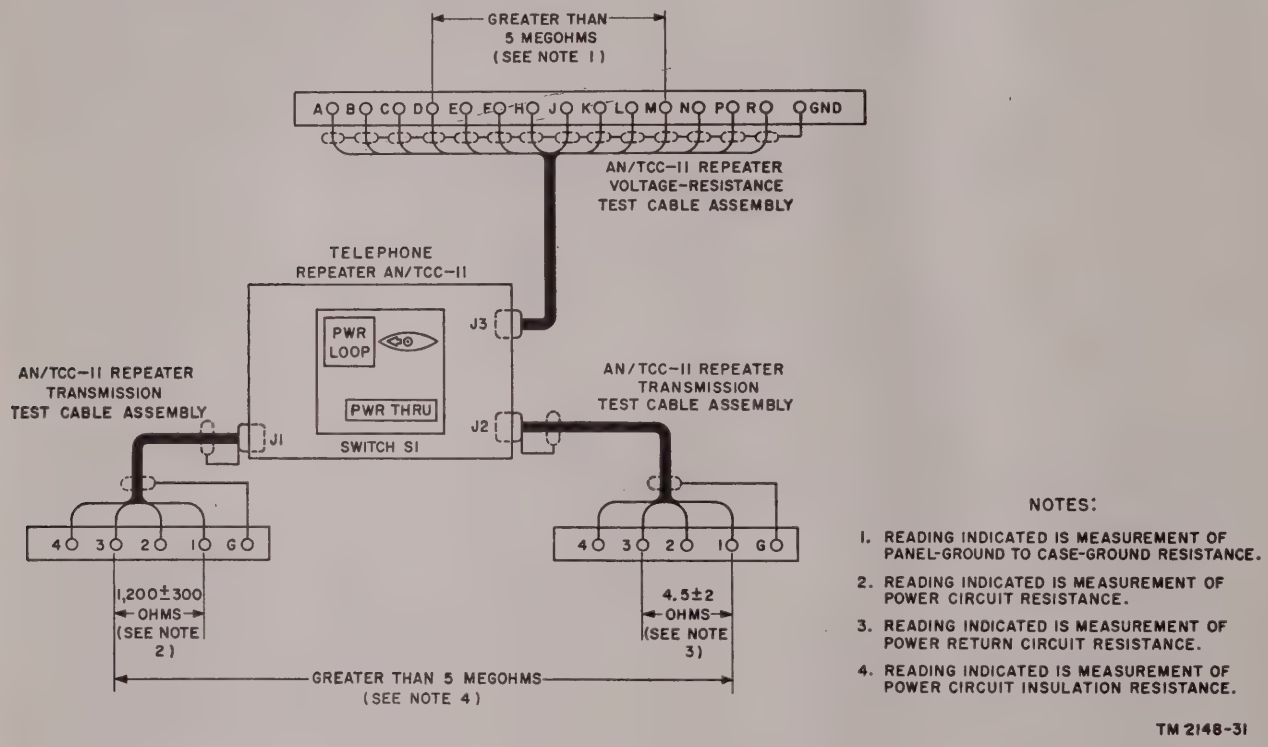


Figure 37. Telephone Repeater AN/TCC–11, test set-up for power circuit test, S1 in PWR LOOP position.

141. Transmission Test

a. Arrange the test circuit as shown in figure 38.

b. Make the connections detailed in the table below.

From—		To—	
Unit	Connecting point	Unit	Connecting point
Telephone Repeater AN/TCC–11 test jig (fig. 34).	Connector P1	Telephone Repeater AN/TCC–11	J1.
Telephone Repeater AN/TCC–11 test jig (fig. 34).	Connector P2	Telephone Repeater AN/TCC–11	J2.
AN/TCC–11 repeater voltage-resistance test cable assembly.		Telephone Repeater AN/TCC–11	J3.
Telephone Repeater AN/TCC–11 test jig (fig. 34).	Terminals 9 and 10 of TB1.	Power Supply PP–826/U	
Signal Generator SG–71/FCC	Output No. 1	Protection pad	
Protection pad		Repeating coil (GA51071)	Terminals 1 and 4.
Repeating coil (GA51071)	Terminals 5 & 8	Attenuator TS–402/U	IN terminals.
Telephone Repeater AN/TCC–11 test jig (fig. 34).	Terminals 1 and 2 of TB1.	Attenuator TS–402/U	OUT terminals.
Resistor, 600 ohms		Telephone Repeater AN/TCC–11 test jig.	Terminals 5 and 6 of TB1.
Telephone Repeater AN/TCC–11 test jig.	Terminal 10 of TB1	Signal Generator SG–71/FCC	Ground terminal.
Telephone Repeater AN/TCC–11 test jig.	Terminal 10 of TB1	Attenuator TS–402/U	Ground terminal.
Telephone Repeater AN/TCC–11 test jig.	Terminal 10 of TB1	Electronic Multimeter ME–6/U	Ground terminal.

c. Operate the controls as shown in the table below.

Unit	Control	Location	Position
Signal Generator SG–71/FCC	Amplitude controls		Adjusted for minimum output.
Signal Generator SG–71/FCC	Power		ON.
Telephone Repeater AN/TCC–11	GAIN AMP 1	J1 end panel	AVG.
Telephone Repeater AN/TCC–11	GAIN AMP 2	J2 end panel	AVG.
Telephone Repeater AN/TCC–11	PWR LOOP—PWR THRU	J2 end panel	PWR LOOP.
Telephone Repeater AN/TCC–11	REP	J2 end panel	1.

d. Operate the AC POWER switch on Power Supply PP–826/U to the ON position. Adjust the 200V ADJ control to obtain a reading of 200 volts on the test panel meter.

e. Use Multimeter TS–352/U on the 50-volt range and measure the d-c grid bias voltage from pin J to pin M on the test cable connected to connector J3. This voltage should be approximately 16 volts.

f. Adjust the frequency dial on Signal Generator SG–71/FCC in turn to each of the frequency settings shown in the table below for the conditions in *g* and *h* below.

g. Adjust Attenuator TS–402/U to the db settings corresponding to the ambient temperature at the time of the test for each of the frequencies listed in the table below.

h. Connect Electronic Multimeter ME–6/U across the IN terminals of Attenuator TS–402/U and adjust the SG–71/FCC amplitude controls for a reading of 0.25 volts on the ME–6/U for each frequency setting.

i. Connect the probes on the ME–6/U to terminals 3 and 4 of TB2 of the Telephone Repeater AN/TCC–11 test jig and note the readings on the meter. Meter readings for normal transmission are given in the table below.

Frequency (kc)	Ambient temperature at time of test			Typical ME–6/U reading (volts)
	50° F.	80° F.	110° F.	
	Attenuator TS–402/U setting (db)			
68	19	20	21	0. 28±0. 1
28	14	15	16	. 3 ± . 1
12	12	13	14	. 3 ± . 1

j. Remove the wires connected to terminals 1 and 2 of TB1 of the Telephone Repeater AN/TCC–11 test jig and connect them to terminals 5 and 6 of TB2 of the test jig. Remove the 600-ohm termination from terminals 5 and 6 of TB2 and connect it across terminals 1 and 2 of TB1 (fig. 39).

k. Repeat the instructions given in *f*, *g*, and *h*, above.

l. Connect the probes on the Electronic Multimeter ME–6/U to terminals 7 and 8 of TB1 of the Telephone Repeater AN/TCC–11 test jig.

m. The readings on the Electronic Multimeter ME–6/U for typical operation are the same as given in the table associated with *i* above.

142. Measuring Circuit Test

The test set-up for the measuring circuit test is the same as for the transmission test (fig. 38). The measuring circuit test is performed in the manner given below.

a. Repeat the steps given in paragraph 141*a*, *b*, *c*, and *d*.

b. Adjust the frequency output of Signal Generator SG–71/FCC to 68 kc.

c. Adjust Attenuator TS–402/U for 19 db, 20 db, or 21 db of attenuation to correspond to the ambient temperatures of 50° F., 80° F., or 110° F., respectively, at the time of the test.

d. Connect the ME–6/U across the Attenuator TS–402/U input and adjust the output of the SG–71/FCC to obtain a reading of 0.25 volts on the meter of the ME–6/U.

e. Use the ME–6/U to measure the voltages on the voltage-resistance test cable assembly connected to J3 of the Telephone Repeater AN/TCC–11 as shown in the table below.

Item tested	Positive probe on terminal	Negative probe on terminal	Typical ME–6/U reading (volts)
In amp. 1	A	M	0. 021±0. 01
Out amp. 1	C	M	. 38 ± . 15

f. Remove the wires connected to terminals 1 and 2 of TB1 of Telephone Repeater AN/TCC–11 test jig and connect them to terminals 5 and 6 of TB2 of the test jig. Change the 600-ohm termination from terminals 5 and 6 of TB2 to terminals 1 and 2 of TB1 (fig. 39).

g. Repeat the procedures in *b*, *c*, and *d* above.

h. Use Electronic Multimeter ME–6/U to measure the voltages on the voltage-resistance test cable assembly connected to J3 of Telephone Repeater AN/TCC–11 as shown in the table below.

Item tested	Positive probe on terminal	Negative probe on terminal	Typical ME–6/U reading (volts)
In amp. 2	R	M	0. 021±0. 01
Out amp. 2	E	M	. 38 ± . 15

143. Gain Switch Test

The gain switch test set-up is the same as for the transmission test (fig. 38). The gain switch test is performed in the following manner.

a. Repeat the steps described in paragraph 141*a*, *b*, *c*, and *d*.

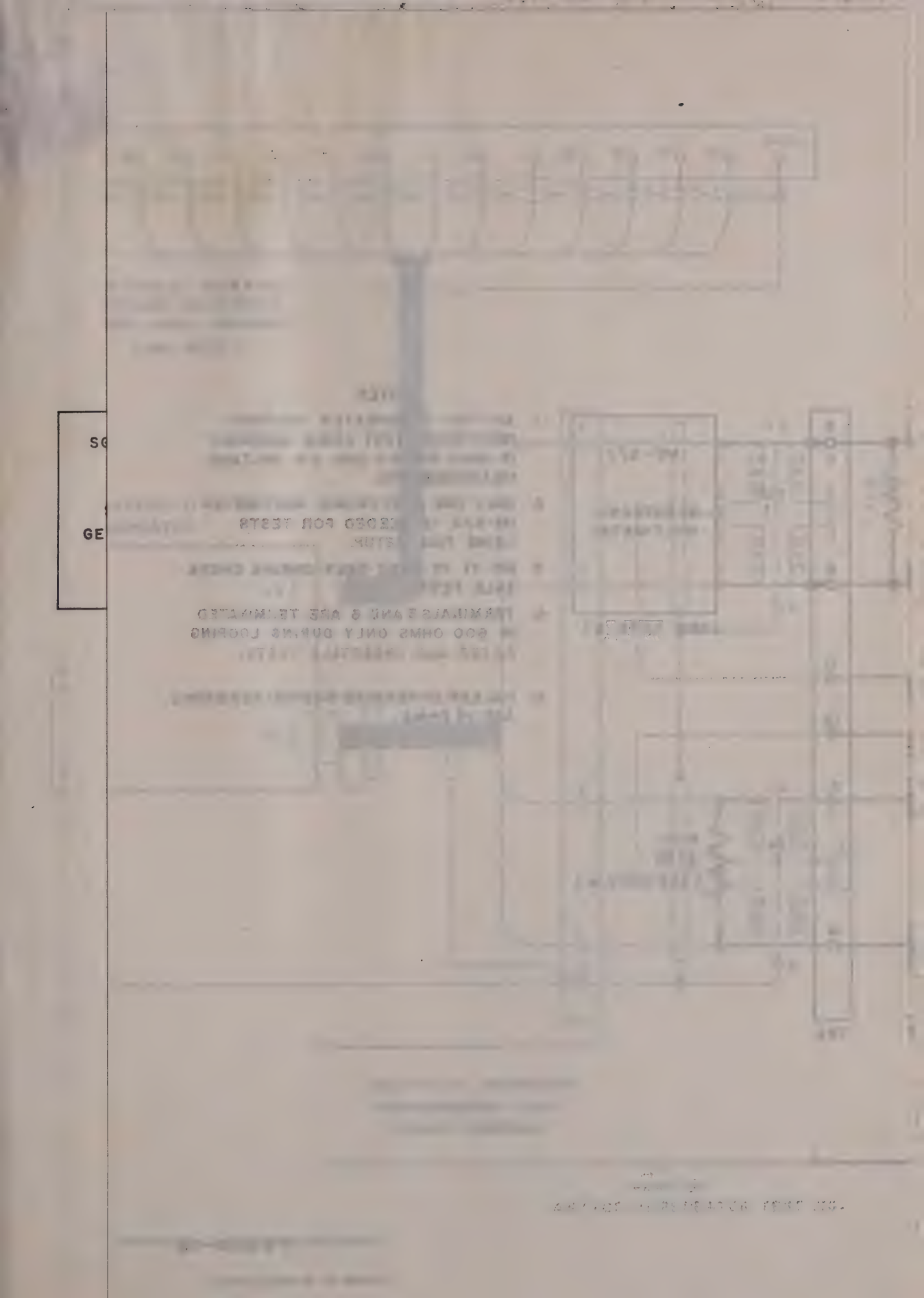
b. Repeat the steps described in paragraph 142*b*, *c*, and *d*. Connect the ME–6/U to terminals 3 and 4 of TB2 and note the meter reading on the db scale.

c. Operate the GAIN AMP 1 switch to the LOW position. The meter reading should be 2.5 db ±0.5 db less than the meter reading of *b* above.

d. Operate the GAIN AMP 1 switch to the HIGH position. The meter reading should be 2.5 db ±0.5 db greater than the meter reading of step *b* above.

e. Operate the GAIN AMP 1 switch to the AVG position.

f. Remove the wires connected to terminals 1 and 2 of TB1 of the Telephone Repeater AN/TCC–11 test jig and connect them to terminals 5 and 6 of TB1 of the test jig. Remove the



i. Connect the probes on the ME–6/U to terminals 3 and 4 of TB2 of the Telephone Repeater AN/TCC–11 test jig and note the readings on the meter. Meter readings for normal transmission are given in the table below.

Frequency (kc)	Ambient temperature at time of test			Typical ME–6/U reading (volts)
	50° F.	80° F.	110° F.	
	Attenuator TS–402/U setting (db)			
68	19	20	21	0.28±0.1
28	14	15	16	.3 ± .1
12	12	13	14	.3 ± .1

j. Remove the wires connected to terminals 1 and 2 of TB1 of the Telephone Repeater AN/TCC–11 test jig and connect them to terminals 5 and 6 of TB2 of the test jig. Remove the 600-ohm termination from terminals 5 and 6 of TB2 and connect it across terminals 1 and 2 of TB1 (fig. 39).

k. Repeat the instructions given in *f*, *g*, and *h*, above.

l. Connect the probes on the Electronic Multimeter ME–6/U to terminals 7 and 8 of TB1 of the Telephone Repeater AN/TCC–11 test jig.

m. The readings on the Electronic Multimeter ME–6/U for typical operation are the same as given in the table associated with *i* above.

142. Measuring Circuit Test

The test set-up for the measuring circuit test is the same as for the transmission test (fig. 38). The measuring circuit test is performed in the manner given below.

a. Repeat the steps given in paragraph 141*a*, *b*, *c*, and *d*.

b. Adjust the frequency output of Signal Generator SG–71/FCC to 68 kc.

c. Adjust Attenuator TS–402/U for 19 db, 20 db, or 21 db of attenuation to correspond to the ambient temperatures of 50° F., 80° F., or 110° F., respectively, at the time of the test.

d. Connect the ME–6/U across the Attenuator TS–402/U input and adjust the output of the SG–71/FCC to obtain a reading of 0.25 volts on the meter of the ME–6/U.

e. Use the ME–6/U to measure the voltages on the voltage-resistance test cable assembly connected to J3 of the Telephone Repeater AN/TCC–11 as shown in the table below.

Item tested	Positive probe on terminal	Negative probe on terminal	Typical ME–6/U reading (volts)
In amp. 1	A	M	0.021±0.01
Out amp. 1	C	M	.38 ± .15

f. Remove the wires connected to terminals 1 and 2 of TB1 of Telephone Repeater AN/TCC–11 test jig and connect them to terminals 5 and 6 of TB2 of the test jig. Change the 600-ohm termination from terminals 5 and 6 of TB2 to terminals 1 and 2 of TB1 (fig. 39).

g. Repeat the procedures in *b*, *c*, and *d* above.

h. Use Electronic Multimeter ME–6/U to measure the voltages on the voltage-resistance test cable assembly connected to J3 of Telephone Repeater AN/TCC–11 as shown in the table below.

Item tested	Positive probe on terminal	Negative probe on terminal	Typical ME–6/U reading (volts)
In amp. 2	R	M	0.021±0.01
Out amp. 2	E	M	.38 ± .15

143. Gain Switch Test

The gain switch test set-up is the same as for the transmission test (fig. 38). The gain switch test is performed in the following manner.

a. Repeat the steps described in paragraph 141*a*, *b*, *c*, and *d*.

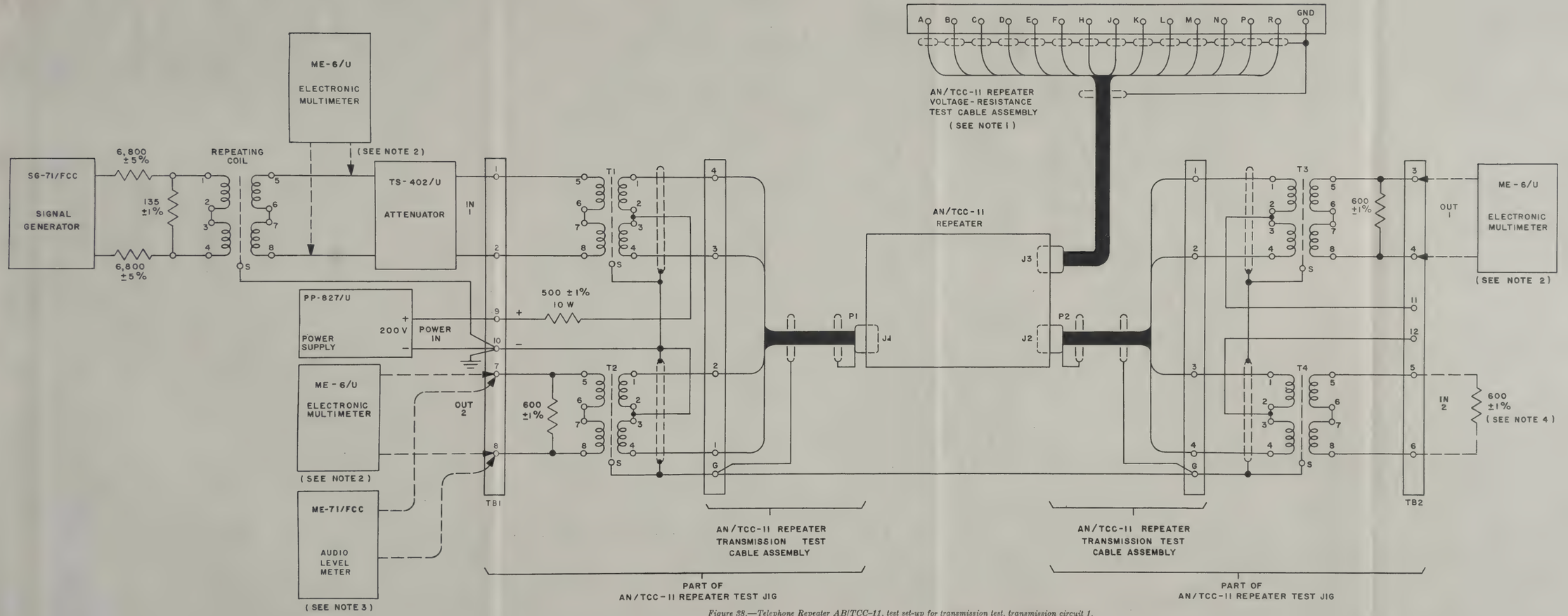
b. Repeat the steps described in paragraph 142*b*, *c*, and *d*. Connect the ME–6/U to terminals 3 and 4 of TB2 and note the meter reading on the db scale.

c. Operate the GAIN AMP 1 switch to the LOW position. The meter reading should be 2.5 db ±0.5 db less than the meter reading of *b* above.

d. Operate the GAIN AMP 1 switch to the HIGH position. The meter reading should be 2.5 db ±0.5 db greater than the meter reading of step *b* above.

e. Operate the GAIN AMP 1 switch to the AVG position.

f. Remove the wires connected to terminals 1 and 2 of TB1 of the Telephone Repeater AN/TCC–11 test jig and connect them to terminals 5 and 6 of TB1 of the test jig. Remove the



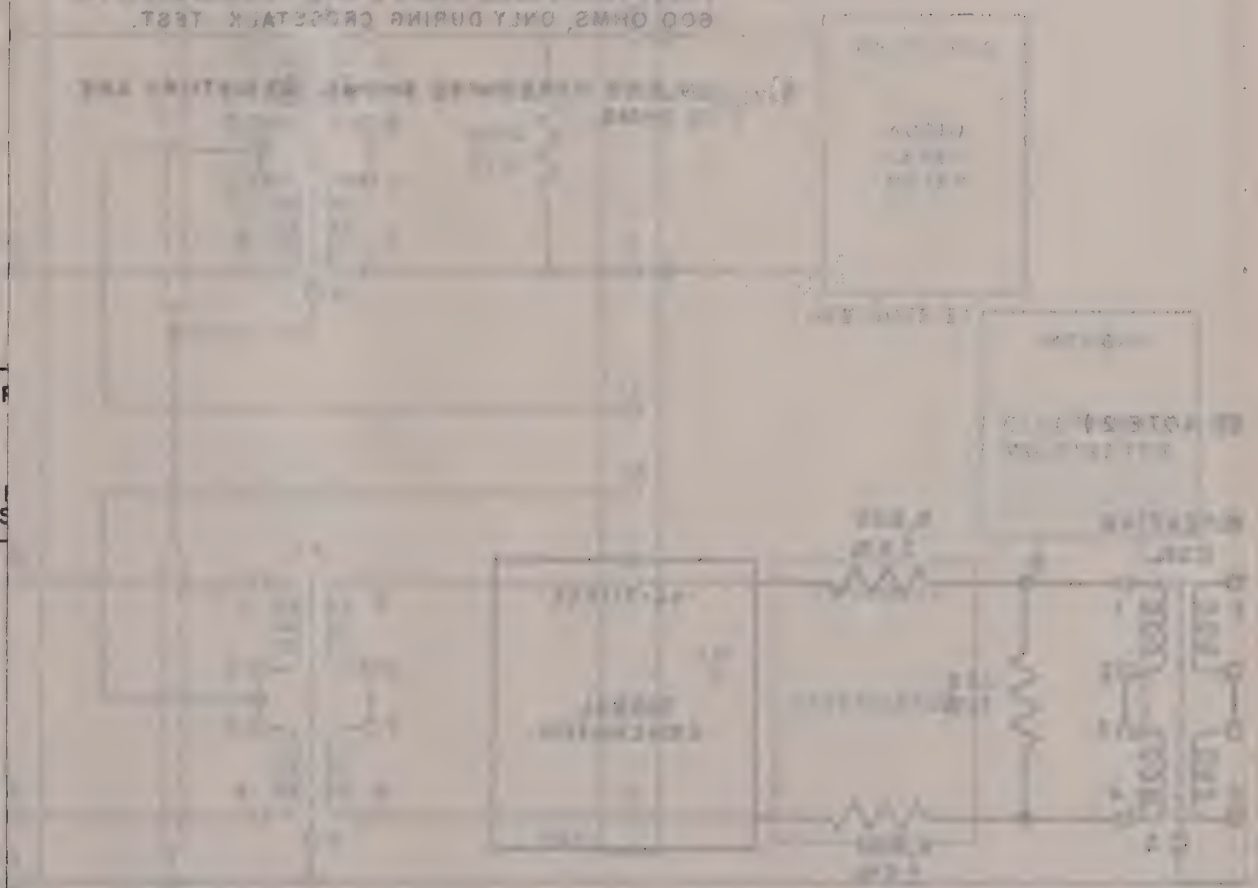
NOTES:

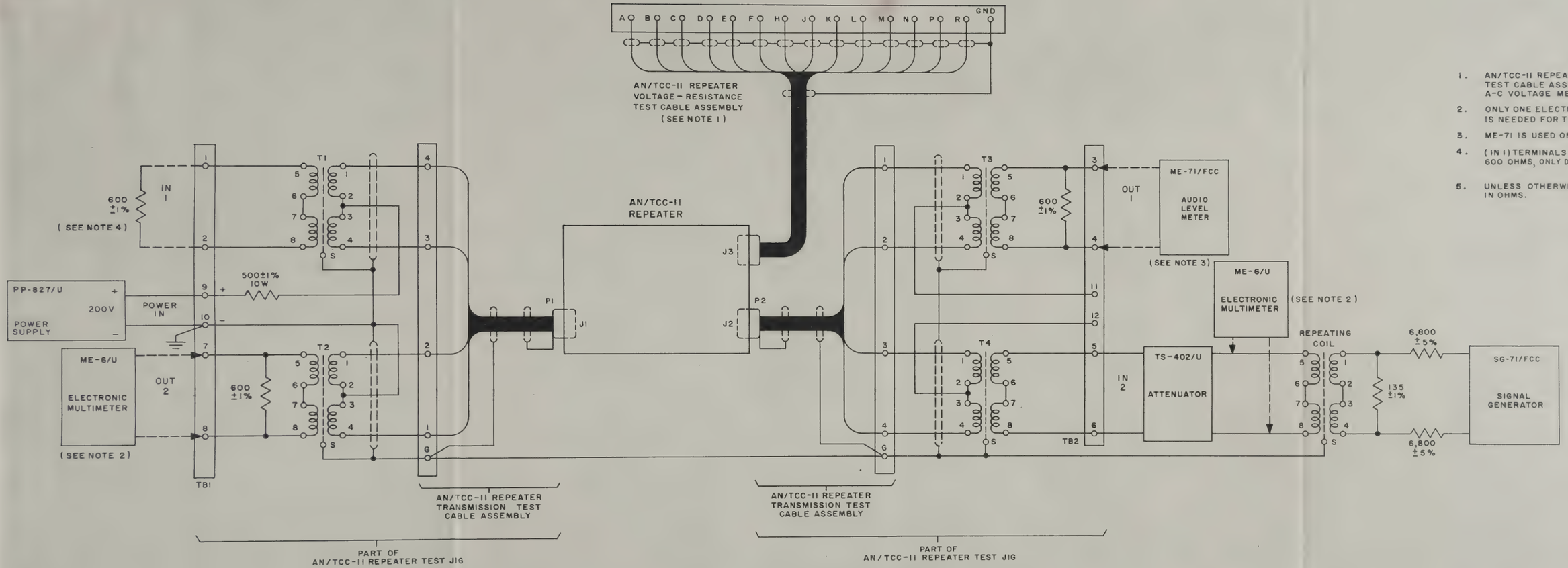
1. AN/TCC-11 REPEATER VOLTAGE-RESISTANCE TEST CABLE ASSEMBLY IS USED FOR A-C AND D-C VOLTAGE MEASUREMENTS.
2. ONLY ONE ELECTRONIC MULTIMETER ME-6/U IS NEEDED FOR TESTS USING THIS SETUP.
3. ME-71 IS USED ONLY DURING CROSS TALK TEST.
4. TERMINALS 5 AND 6 ARE TERMINATED IN 600 OHMS ONLY DURING LOOPING FILTER AND CROSSTALK TESTS.
5. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS.

Figure 38.—Telephone Repeater AB/TCC-11, test set-up for transmission test, transmission circuit 1.

TM 2148-32

273209 O - 53 (Face p. 88) No. 1





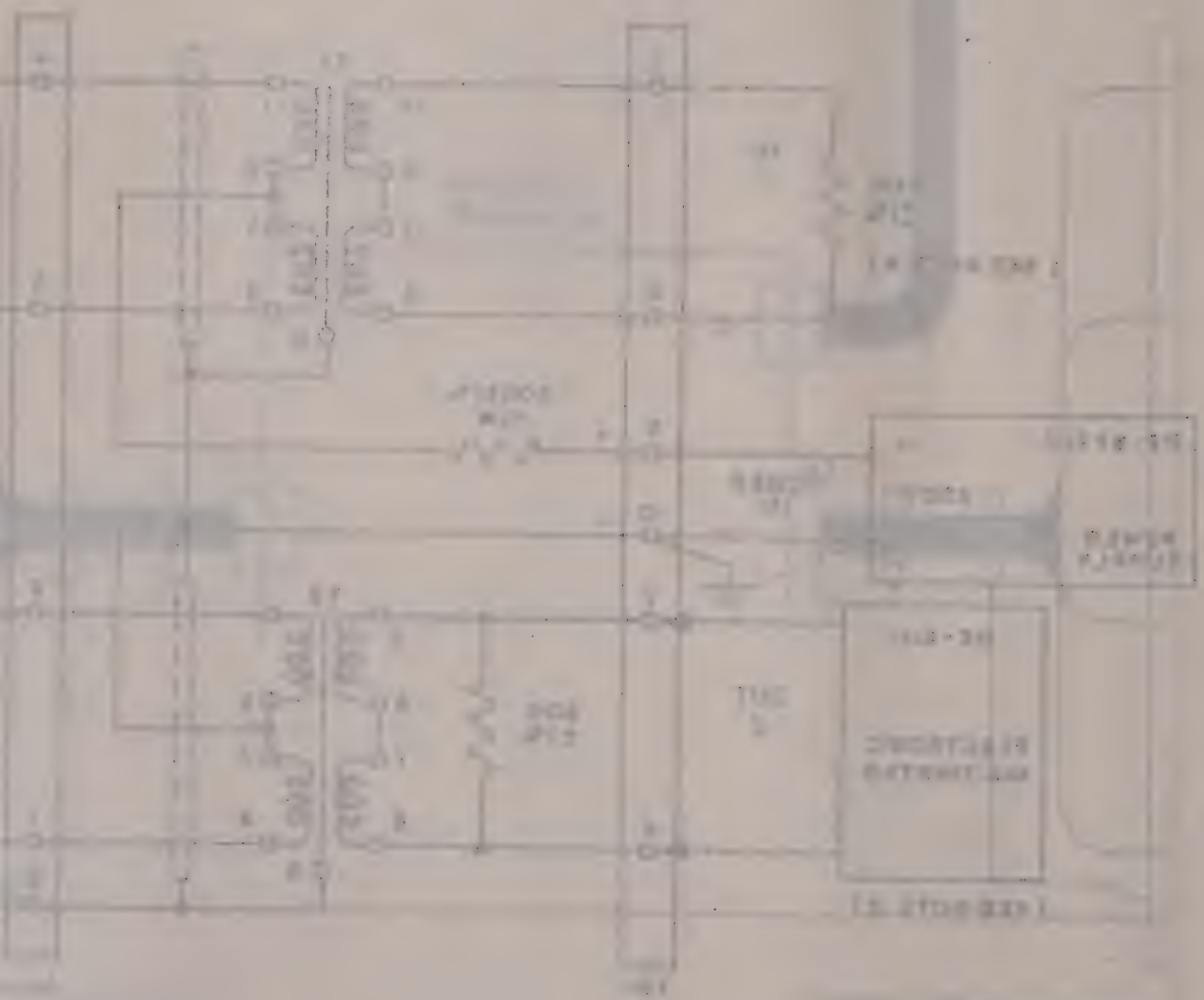
NOTES:

1. AN/TCC-11 REPEATER VOLTAGE-RESISTANCE TEST CABLE ASSEMBLY IS USED FOR A-C VOLTAGE MEASUREMENTS.
2. ONLY ONE ELECTRONIC MULTIMETER ME-6/U IS NEEDED FOR TESTS USING THIS SETUP.
3. ME-71 IS USED ONLY DURING CROSS TALK TEST.
4. (IN 1) TERMINALS 1 AND 2 ARE TERMINATED IN 600 OHMS, ONLY DURING CROSSTALK TEST.
5. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS.

Figure 39.—Telephone Repeater AN/TCC-11, test set-up for transmission test, transmission circuit 20.

TM 2148-33

273209 O - 53 (Face p. 88) No. 2



600-ohm termination from terminals 5 and 6 of TB1 and connect it across terminals 1 and 2 of TB1.

g. Connect the probes on the Electronic Multimeter ME–6/U to terminals 7 and 8 of TB1 of the Telephone Repeater AN/TCC–11 test jig. Note the meter reading on the db scale.

h. Operate the GAIN AMP 2 switch to the LOW position. The meter reading should be 2.5 db ±0.5 db less than the meter reading indicated in *g* above.

i. Operate the GAIN AMP 2 switch to the HIGH position. The meter reading should be 2.5 db ±0.5 db greater than the meter reading indicated in *g* above.

j. Operate the GAIN AMP 2 switch to the AVG position.

144. Order Wire Test

The test set-up for the order wire test is the same as for the transmission test (fig. 38). The order wire test is performed in the following manner.

a. Repeat the steps outlined in paragraph 141*a*, *b*, *c*, and *d*.

b. Adjust the frequency output of Signal Generator SG–71/FCC to 1 kc.

c. Connect the Electronic Multimeter ME–6/U across the Attenuator TS–402/U input and adjust the SG–71/FCC output control to obtain a reading of 0.25 volts on the ME–6/U.

d. Adjust the Attenuator TS–402/U for 10 db of attenuation.

e. Connect the ME–6/U to terminals 3 and 4 of TB2 of the AN/TCC–11 repeater test jig.

f. The reading on the ME–6/U for typical order wire operation is 0.052 ±0.015 volts.

g. Connect the ME–6/U to pin L and pin M (ground) on the voltage-resistance test cable assembly connected to connector J3 of Telephone Repeater AN/TCC–11.

h. The reading on the ME–6/U for typical order wire operation is 0.08 ±0.025 volts.

i. Remove the wires connected to terminals 1 and 2 of TB1 of the AN/TCC–11 repeater test jig; change the 600-ohm termination from terminals 5 and 6 of TB2 to terminals 1 and 2 of TB1; and connect the wires removed from terminals 1 and 2 of TB1 to terminals 5 and 6 of TB2 of the test jig (fig. 39).

j. Repeat the procedure described in *c* above.

k. Connect the Electronic Multimeter ME–6/U to terminals 7 and 8 of TB1 of the AN/TCC–11 repeater test jig.

l. The reading on the Electronic Multimeter ME–6/U for typical order wire operation is 0.052 ±0.015 volts.

m. Connect the Electronic Multimeter ME–6/U to pin N and pin M (ground) of the voltage-resistance test cable assembly connected to connector J3 of the Telephone Repeater AN/TCC–11.

n. The reading on the ME–6/U for typical order wire operation is 0.08±0.025 volts.

145. Looping Filter Test

The test set-up for the looping filter test is the same as for the transmission test (par. 141).

a. Repeat the steps outlined in paragraph 141*a*, *b*, and *c*.

b. Operate the AC POWER switch on Power Supply PP–827/U to the ON position. Adjust the 200V ADJ control to obtain a reading of 200 volts on the test panel meter.

c. Operate the frequency dial on the Signal Generator SG–71/FCC, the REP switch on the Telephone Repeater AN/TCC–11, and the push buttons on Attenuator TS–402/U as shown in the table below.

d. Connect Electronic Multimeter ME–6/U across the Attenuator TS–402/U input.

e. Adjust the input to the TS–402/U to obtain a reading of 0.25 volts on the ME–6/U for each setting of the frequency dial of the SG–71/FCC.

f. Connect the Electronic Multimeter ME–6/U probes to terminals 7 and 8 of TB2 of the AN/TCC–11 repeater test jig.

g. Meter readings for proper looping filter transmission are given in the table below.

SG–71/FCC frequency (kc)	TS–402/U attenuation (db)	REP switch positions	ME–6/U readings (volts)
68	10	3	Less than 0.0012.
83	10	3	1.2 ±0.8.
83	10	2	Less than 0.012.
91	10	3	Less than 0.012.
91	10	2	1.75 ±1.0.
91	10	1	Less than 0.04.
99	10	2	Less than 0.04.
99	10	1	2.1 ±1.2.
110	10	1	Less than 0.04.

146. Relay Test

The test setup for the relay test of Telephone Repeater AN/TCC–11 is shown in figure 40. The

relay test is performed in the following manner:

a. Connections and Settings. Make the connections and settings described in (1) through (5) below.

(1) Connect the repeater transmission test cable assemblies to connectors J1 and J2 of Telephone Repeater AN/TCC–11.

(2) Connect a 2,000-ohm, 25-watt resistor between the 200-volt terminal of Power Supply PP–827/U and terminals 3 and 4 of the test cable connected to connector J2.

(3) Connect a 20K, 5-watt resistor between terminals 3 and 4 of the test cable connected to connector J2 and power supply ground.

(4) Connect terminals 1 and 2 of the test cable connected to connector J1 to power supply ground.

(5) Operate the POWER LOOP-POWER THRU switch to the POWER THRU position.

b. Measurements. Make the measurements described in (1) to (4) below.

(1) Use Multimeter TS–352/U to measure the resistance between terminals 1 and 4 of connector J1 with the power off.

(2) The resistance measured in (1) above should be approximately 100K.

(3) Apply power to the test setup and measure the resistance between terminals 1 and 4 of connector J1 with Multimeter TS–352/U.

(4) The resistance obtained in (3) above should be greater than 2 megohms.

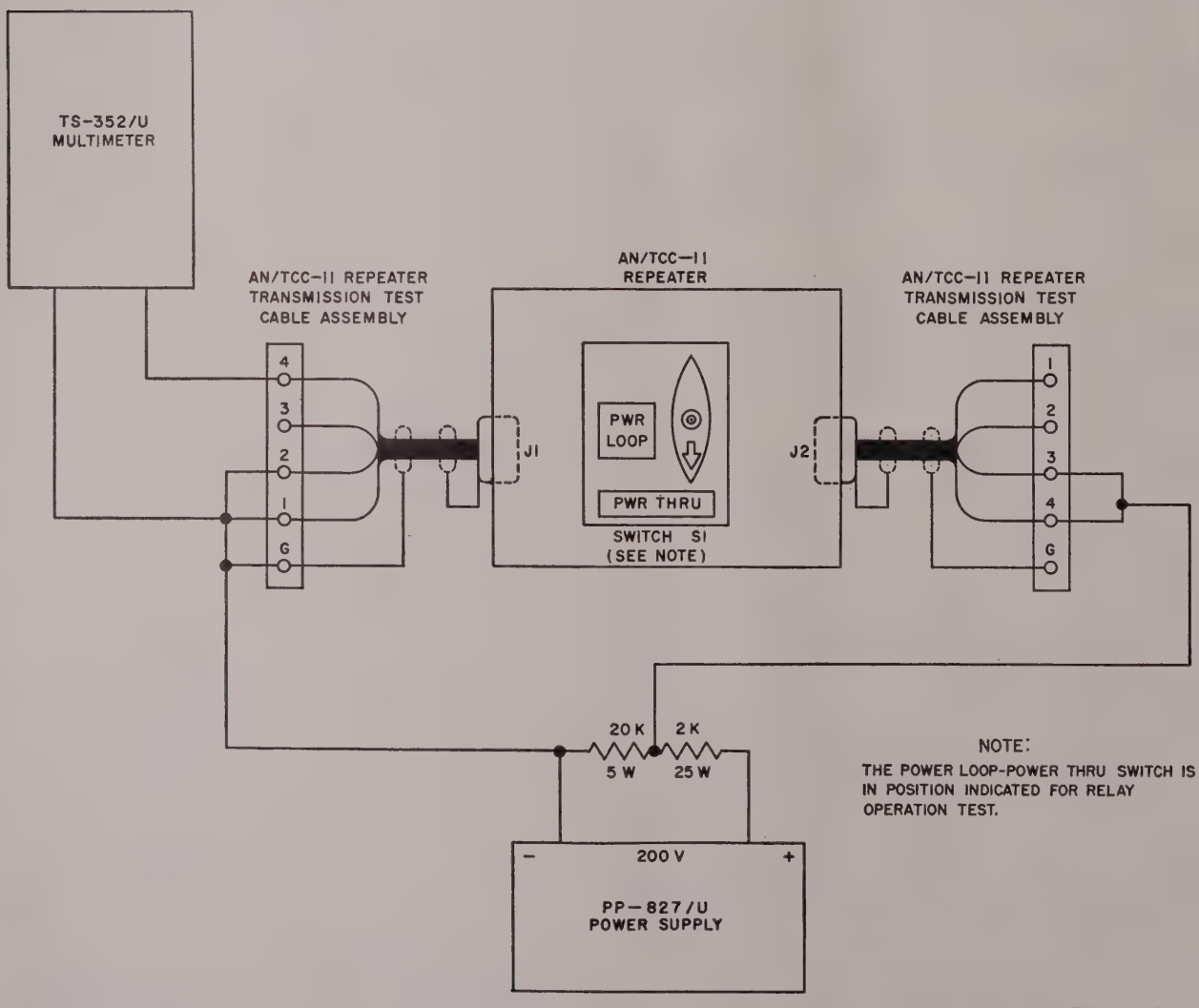
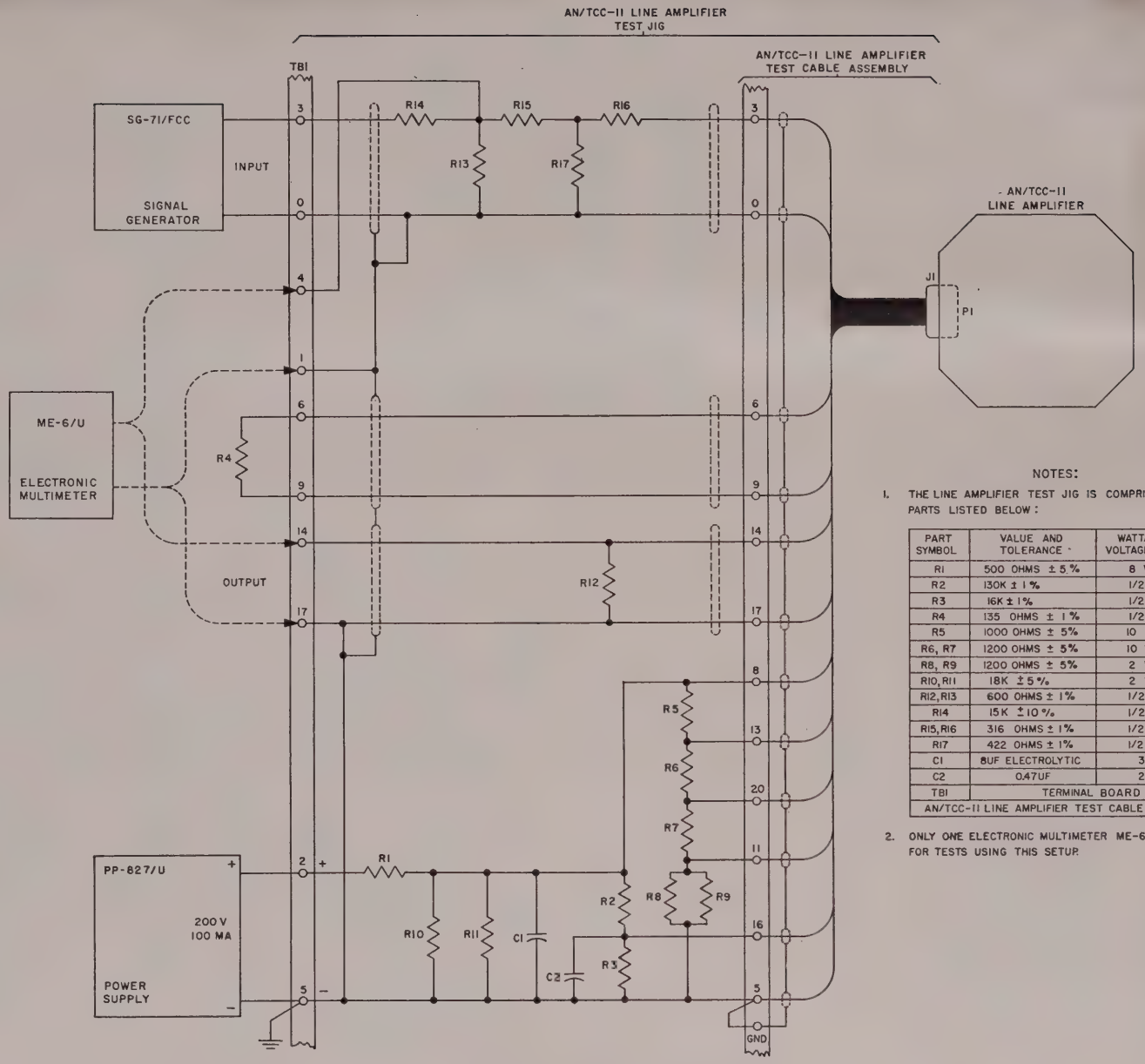


Figure 40. Telephone Repeater AN/TCC–11, test set-up for relay test.



NOTES:

1. THE LINE AMPLIFIER TEST JIG IS COMPRISED OF THE PARTS LISTED BELOW:

PART SYMBOL	VALUE AND TOLERANCE	WATTAGE OR VOLTAGE RATING
R1	500 OHMS ±5%	8 WATTS
R2	130K ± 1%	1/2 WATT
R3	16K ± 1%	1/2 WATT
R4	135 OHMS ± 1%	1/2 WATT
R5	1000 OHMS ± 5%	10 WATTS
R6, R7	1200 OHMS ± 5%	10 WATTS
R8, R9	1200 OHMS ± 5%	2 WATTS
R10, R11	18K ±5%	2 WATTS
R12, R13	600 OHMS ± 1%	1/2 WATT
R14	15K ±10%	1/2 WATT
R15, R16	316 OHMS ± 1%	1/2 WATT
R17	422 OHMS ± 1%	1/2 WATT
C1	8UF ELECTROLYTIC	300V
C2	0.47UF	200V
TB1	TERMINAL BOARD	
AN/TCC-11 LINE AMPLIFIER TEST CABLE ASSEMBLY		

2. ONLY ONE ELECTRONIC MULTIMETER ME-6/U IS NEEDED FOR TESTS USING THIS SETUP.

TM 2148-35

Figure 41. Telephone Repeater AN/TCC–11, line amplifier test set-up.

147. AN/TCC–11 Line Amplifier, Trouble-shooting Procedure

When trouble has been localized to the line amplifier, remove the line amplifier from the AN/TCC–11 repeater. If this has been done already proceed as described below.

a. Test all tubes.

b. Use Multimeter TS–352/U to make the resistance measurements outlined in *h* below to insure that the equipment will not be damaged when power is applied.

c. Measure the tube socket d-c resistance with the line amplifier disconnected from any associated equipment (fig. 42).

d. Set up the test circuit (par. 148).

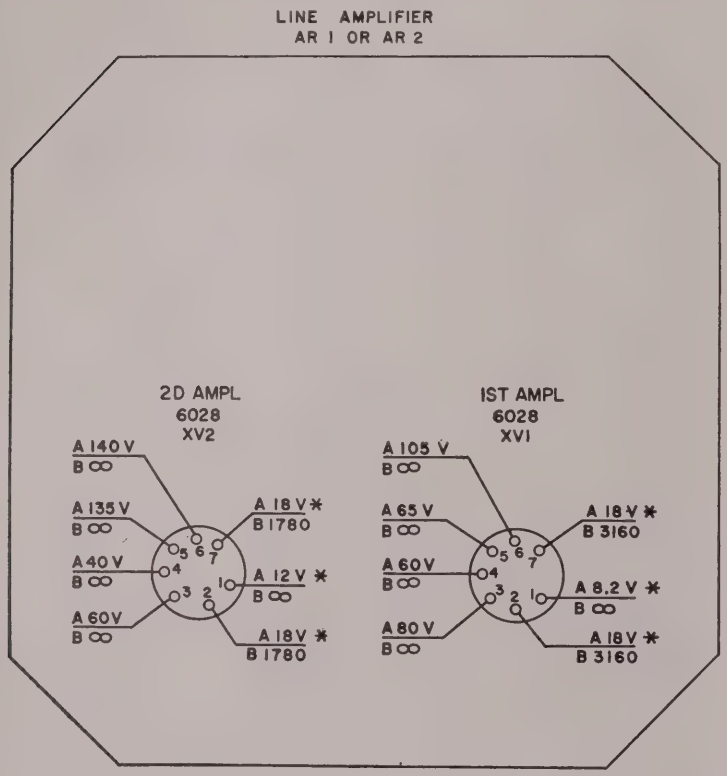
e. Measure the tube socket d-c voltages (par. 149).

f. Perform the signal substitution procedures (par. 158).

g. Locate and replace the defective part.

h. Perform the operational tests (par. 150).

Item tested	Measure between—	Typical resistance (ohms)
B plus to ground insulation.	Pins 8 and 5 of plug P1.	Over 20 megohms.
Filament string	Pins 11 and 13 of plug P1.	120.



NOTES:

1. A, INDICATES VOLTAGE MEASUREMENTS WITH EACH LINE AMPLIFIER TESTED AS A SEPARATE UNIT IN LINE AMPLIFIER TEST JIG.
2. B, INDICATES RESISTANCE MEASUREMENTS WITH LINE AMPLIFIERS DISCONNECTED FROM ASSOCIATED EQUIPMENT.
3. USE 20,000 OHMS PER VOLT MULTIMETER.
4. VOLTAGE READINGS ARE SHOWN ABOVE LINE; RESISTANCE READINGS ARE SHOWN BELOW LINE.
5. ALL RESISTANCES IN OHMS.
6. ALL MEASUREMENTS MADE FROM TUBE PIN TO CHASSIS GROUND.
7. *, INDICATES THAT 50-VOLT RANGE MUST BE USED.

TM 2148-36

Figure 42. Telephone Repeater AN/TCC–11, line amplifier, d-c voltage and resistance measurements.

148. AN/TCC–11 Line Amplifier Test Setup (fig. 41)

The line amplifier test setup is made in the manner described in *a* through *d* below.

a. Connect J1 of the AN/TCC–11 line amplifier test jig to plug P1 of the line amplifier being tested.

b. Operate the line amplifier gain switch (S1) to the middle position corresponding to the AVG position.

c. Connect terminals 2 and 5 of TB1 of the test jig to the output of the Power Supply PP–827/U being used for the test.

d. Connect Signal Generator SG–71/FCC output No. 1 to terminals 3 and 0 of TB1 on the test jig.

149. AN/TCC–11 Line Amplifier, D-C Voltage Measurements

The AN/TCC–11 line amplifier d-c voltage measurements are made in the following manner:

a. Set up the test circuit (par. 148 and fig. 41).

b. Turn the test power supply on and adjust it to 200 volts (par. 145*b*).

c. Measure tube socket d-c voltages on the line amplifier using the AN/TCC–11 line amplifier test jig (fig. 42).

d. If the measurements obtained in *c* above indicate trouble, locate the defective part by checking the resistors and capacitors involved in the measurement.

150. AN/TCC–11 Line Amplifier, Operational Tests

a. Transmission Test. The AN/TCC–11 line amplifier transmission test is performed in the manner described below:

(1) Set up the test circuit (par. 148 and fig. 41). Operate the gain switch on the line amplifier to the center (AVG) position.

(2) Turn the test power supply on and adjust it to 200 volts (par. 145*b*).

(3) Operate the power switch on Signal Generator SG–71/FCC to the ON position and allow a 2-minute warmup time before using it.

(4) Connect the ME–6/U to terminals 4 and 1 (ground) of TB1 of the line amplifier test jig, and adjust the SG–71/FCC output controls to obtain the readings on the ME–6/U indicated in the second column in (6) below.

(5) Connect the ME–6/U to terminals 14 and 17 (ground) of TB1 on the AN/TCC–11 line amplifier test jig, and adjust the SG–71/FCC output controls to obtain the readings on the ME–6/U indicated in the third column in (6) below.

(6) The ME–6/U readings for normal transmission are shown in the chart below.

Frequency	Voltage readings ME–6/U connected to terminals 4 and 1 (volts)	Voltage readings ME–6/U connected to terminals 14 and 17 (volts)
68	0. 17	0. 77 ±0. 3
28	. 30	. 77 ± . 3
12	. 36	. 77 ± . 3

b. Gain Switch Test. The AN/TCC–11 line amplifier gain switch test is made in the manner described below:

(1) Repeat the steps outlined in *a*(1), (2), and (3) above.

(2) Connect the ME–6/U to terminals 4 and 1 (ground) of TB1 of the test jig, and adjust the SG–71/FCC output controls to obtain a reading of 0.17 volts on the ME–6/U when the SG–71/FCC is transmitting 68 kc.

(3) Connect the ME–6/U to terminals 14 and 17 (ground) of TB1 on the AN/TCC–11 line amplifier test jig and note the meter reading on the ME–6/U.

(4) The reading on the ME–6/U obtained in (3) above should be 0.77 volt ±0.3 volt. Record the db reading which corresponds to this reading.

(5) Operate the gain switch (S1) to its full counterclockwise position.

(6) The ME–6/U reading should decrease 2.5 db ±0.5 db with respect to the reading taken in (4) above.

(7) Operate the gain switch (S1) to its full clockwise position.

(8) The ME–6/U reading should increase 2.5 db ±0.5 db with respect to the reading in (4) above.

151. Field Level Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in Telephone Repeater AN/TCC–11. This chart lists the symptoms which the repairman observes while making tests. The

chart also indicates how to localize trouble quickly to the plug-in assemblies and parts. The signal substitution tests outlined in paragraphs 153 and 154 are used to supplement this procedure. When the trouble has been localized to a stage or a circuit, a tube check and voltage and resistance measurements should be sufficient to isolate the defective part.

Symptom	Probable trouble	Correction
1. Power circuit resistance incorrect on power circuit test with S1 in both the PWR THRU and PWR LOOP positions.	Defective tube heater	Check all tubes, replace defective tube.
	Defective amplifier	Check to see that resistance from pin 8 to pin 5 on P1 of both line amplifiers is greater than 2 megohms. If not, replace the amplifier.
	Defective resistor	Check resistors R5, R8, R9, R10, and R11 on filter section. Replace any found to be defective.
	Defective capacitor	Check capacitors C8, C9, C10, C11, C12, C13, C14, and C15 on filter section. Replace any found to be defective.
	Defective power switch	Check power switch. Check continuity through switch contacts. Repair or replace, if defective.
	Defective transformer T1	Check transformer T1 (par. 153). Replace, if defective.
	Defective connection between connectors P1 and J4 or connectors J6 and P3.	Check continuity through pins 15 on connectors P1 and J4, and through pins 13 and 15 on connectors J6 and P3. Repair or replace, if defective.
2. Power circuit resistances incorrect, S1 in POWER THRU position only.	Defective arrester E10	Check arrester E10 (par. 77). Replace, if defective.
	Defective transformer T4	Check transformer T4 (par. 153). Replace, if defective.
3. Power circuit resistances incorrect, S1 in POWER LOOP position only.	Defective transformer T2	Check transformer T2 (par. 153). Replace, if defective.
	Defective connection between connectors P4 and J9.	Check continuity through pin 5 on connectors P4 and J9. Replace, if defective.
	Open winding on relay K1	Check resistance of relay winding K1 terminals 7–8. Typical resistance is 30 ohms. Replace, if defective.
	Defective connection between connectors J6 and P3.	Check continuity, through pin 13 on connectors J6 and P3. Repair or replace, if defective.
4. Power return resistance incorrect, S1 in POWER THRU position.	Defective transformer T2 or T3	Check transformers T2 and T3 (par. 153). Replace, if defective.
	Defective connection between connectors P4 and J9 or connectors J6 and P3.	Check continuity through pins 5 of connectors J4 and P9 and through pin 13 of connectors J6 and P3. Repair or replace, if defective.
	Defective arrester E7	Check arrester E7 (par. 77). Replace, if defective.
	Defective relay K1	Check winding resistance of relay K1 (terminals 7 and 8). Typical resistance is 30 ohms. Replace, if defective.
	Defective capacitor C17	Check capacitor C17. Replace, if defective.
	Defective power switch S1	Check continuity through power switch. Repair or replace, if defective.

Symptom	Probable trouble	Correction
5. Power return resistance incorrect, S1 in POWER LOOP position.	Defective transformer T3 or T4	Check transformers T3 and T4 (par. 153). Replace, if defective.
	Defective power switch S1	Check continuity through power switch S1. Repair or replace, if defective.
6. Incorrect power insulation resistance, S1 in POWER THRU position.	Defective resistor R2	Check resistor R2. Replace, if defective.
	Defective power switch	Check insulation resistance between switch contacts. Repair or replace, if defective.
	Defective looping filter	Check looping filter FL5. Replace, if defective.
	Defective transformer T2 or T3	Check transformers T2 and T3 (par. 153). Replace, if defective.
	Defective relay K1	Check relay K1. Replace, if defective.
7. Incorrect power insulating resistance, S1 in POWER LOOP position.	Defective transformer T3 or T4	Check transformers T3 and T4 (par. 153). Replace, if defective.
	Defective power switch	Check insulation resistance between power switch contacts. Repair or replace switch, if defective.
	Defective arrester E7 or E10	Check arresters E7 and E10 (par. 77). Replace, if defective.
8. Panel ground to case insulation resistance low.	Mechanical contact causing short	Check to see that the short is still present with the repeater assembled without case. If it is still present, inspect equipment for mechanical defect.
	Defective arrester	Check arresters E1, E2, E3, and E4 (par. 77). Replace, if defective.
	Defective capacitor	Check capacitor C1, C2, C3, and C4. Replace, if defective.
	Defective transformer	Check transformers T1, T2, T3 and T4 (par. 153). Replace, if defective.
9. Incorrect transmission at any or all of the test frequencies 1, 12, 28, 68 kc (power circuit normal).	Defective components in transmission circuit.	Use signal substitution to locate defective component (pars. 156 through 158).
10. Order wire inoperative (1-kc transmission normal).	Defect in wiring	Make continuity tests on wiring from terminal N of J3 to terminal 3 of FL 3 and from terminal L of J3 to terminal 3 of FL 4. Replace defective wire.
11. Incorrect positive grid bias voltage.	Defective resistor	Check R6 and R7. Replace, if defective.
	Defective capacitor	Check C16. Replace, if defective.
12. Incorrect a-c voltage reading at test jack J3 (68-kc transmission normal).	Defective wiring to test jack J3	Make continuity test on wiring associated with measurement. Replace defective wiring.
13. Gain switch not functioning (68-kc transmission normal).	Mechanical breakage in shaft coupling.	Check switch shaft couplings. Replace, if defective.
14. Looping filter transmission incorrect (1-, 12-, 28-, and 68-kc transmission normal).	Looping filter FL 5 defective	Check looping filter (par. 145). Replace, if defective.
15. Relay K1 does not operate	Defective arrester E7	Check arrester E7 (par. 77). Replace, if defective.
	Defective capacitor C17	Check capacitor C17. Replace, if defective.
	Defective relay K1	Replace relay K1.

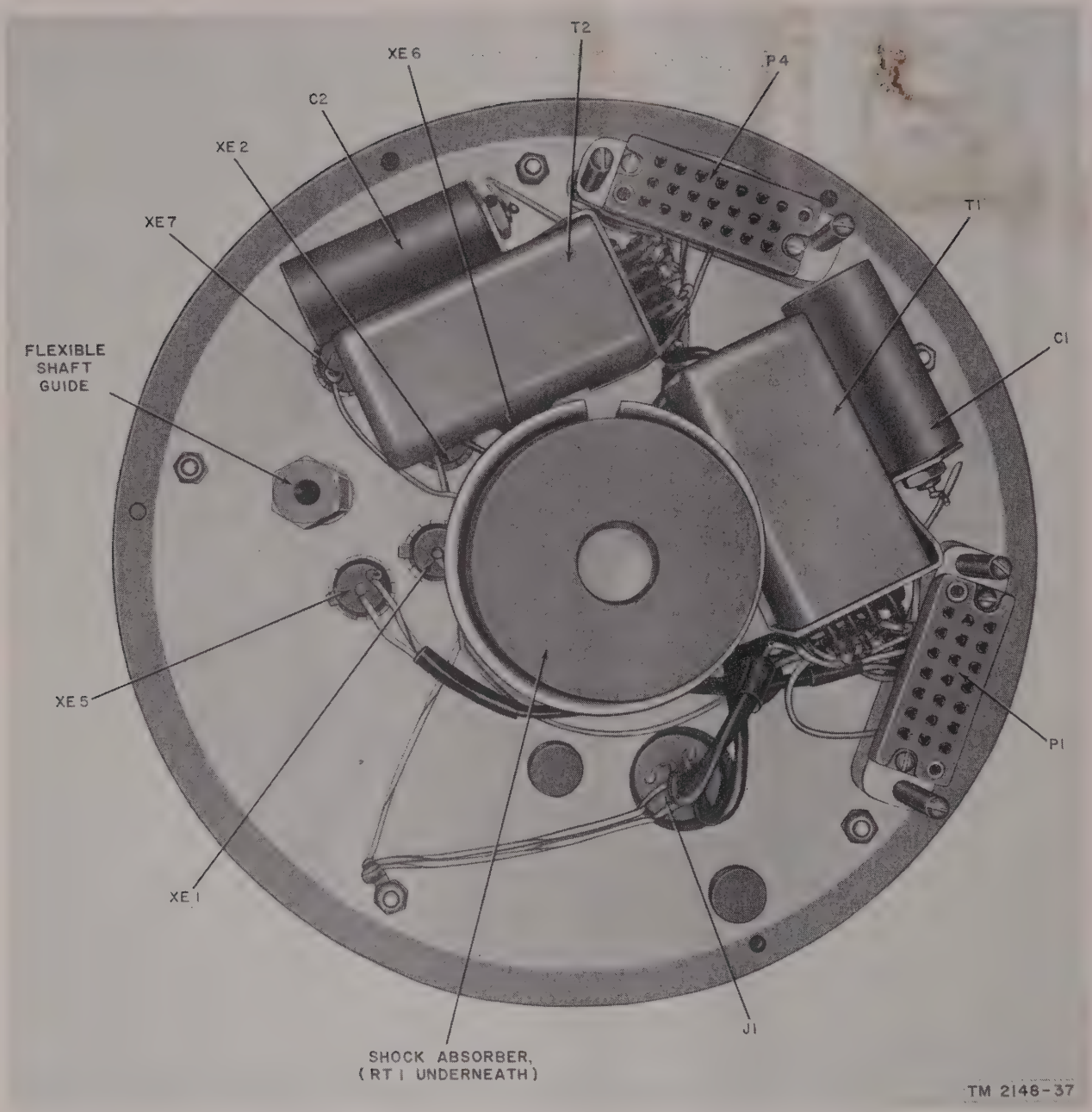


Figure 43. Telephone Repeater AN/TCC–11, J1 end cover assembly, rear view.

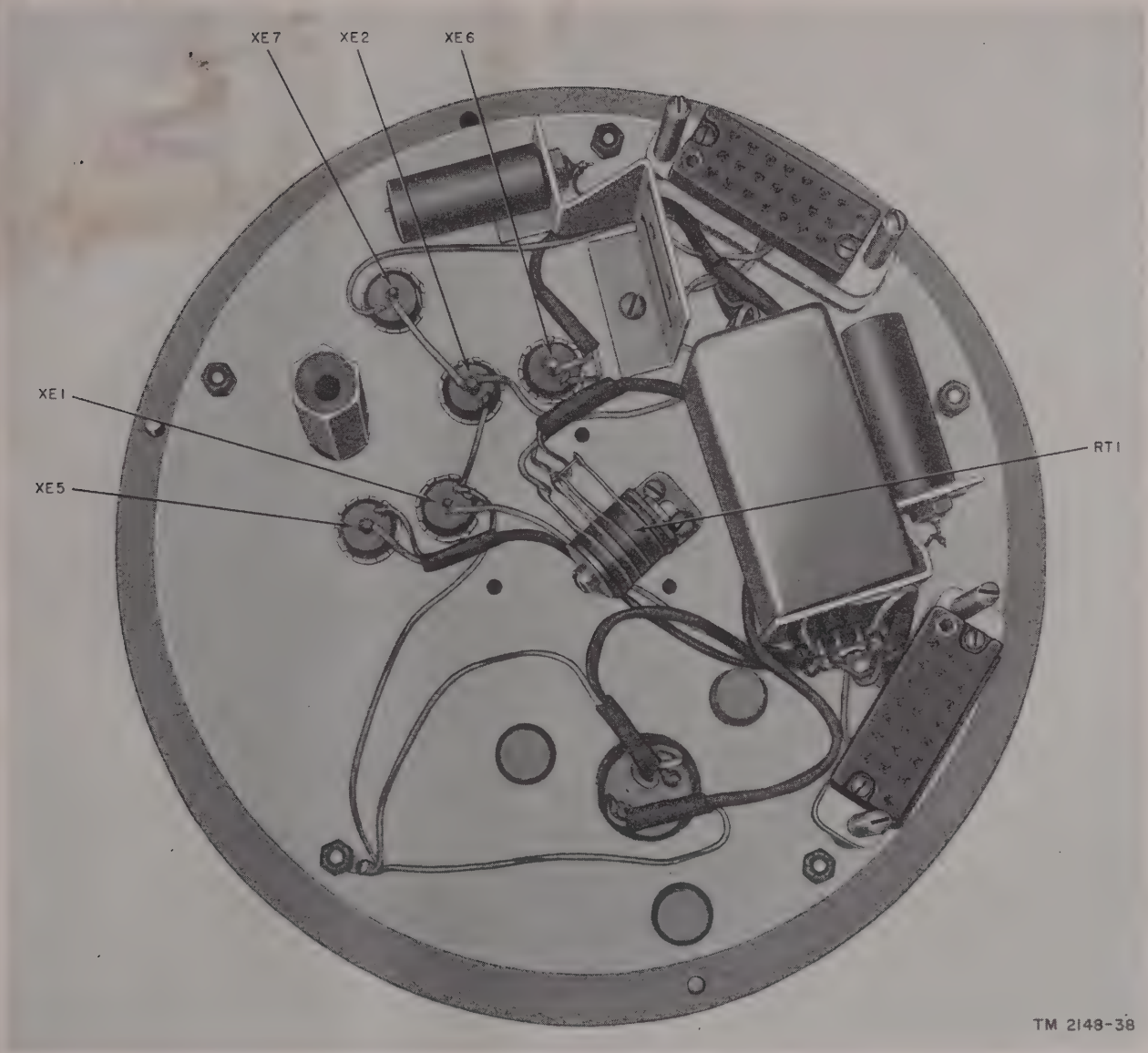


Figure 44. Telephone Repeater AN/TCC–11, J1 end cover assembly, rear view, parts removed to show thermistor RT1.

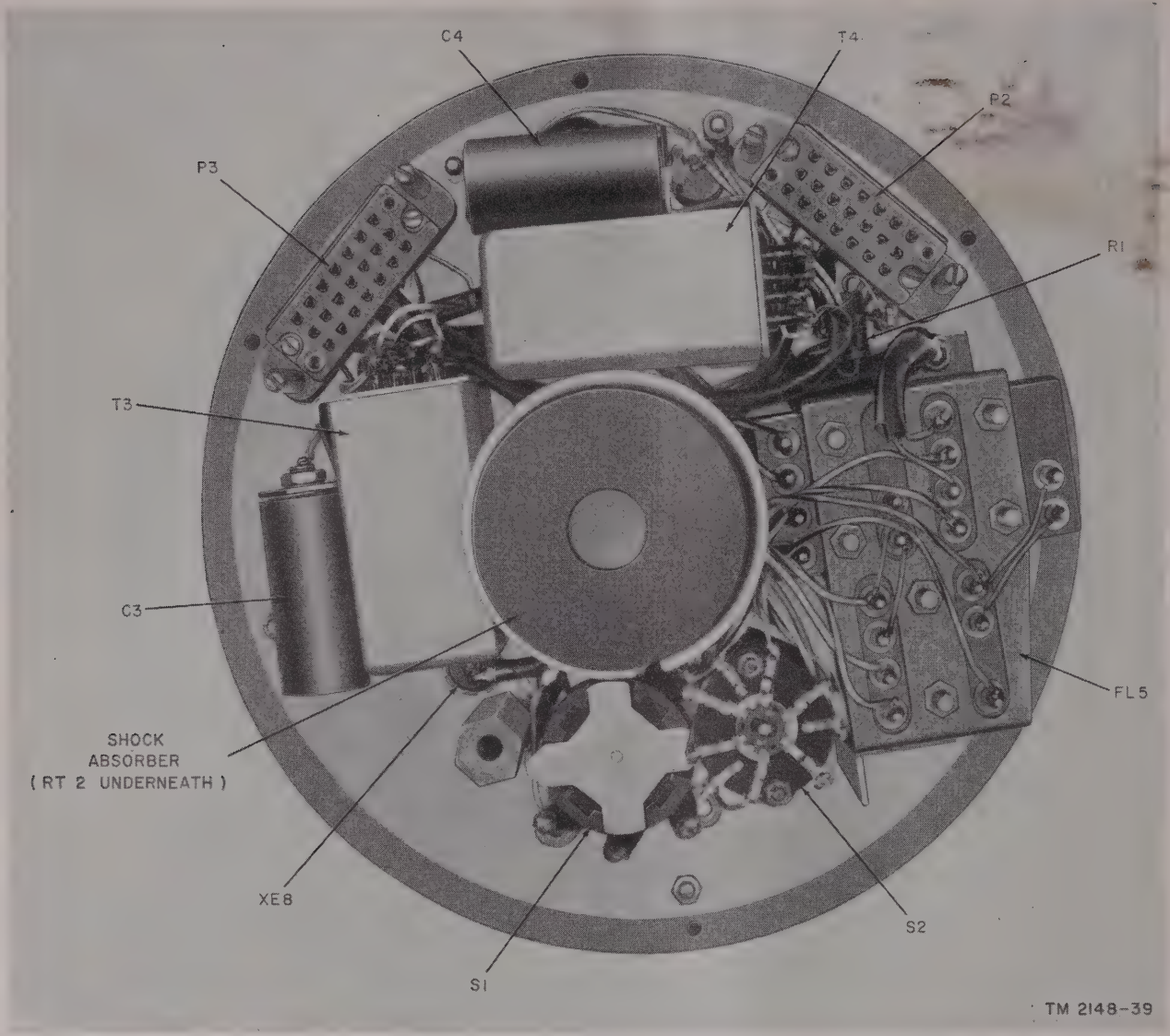


Figure 45. Telephone Repeater AN/TCC–11, J2 end cover assembly, rear view.

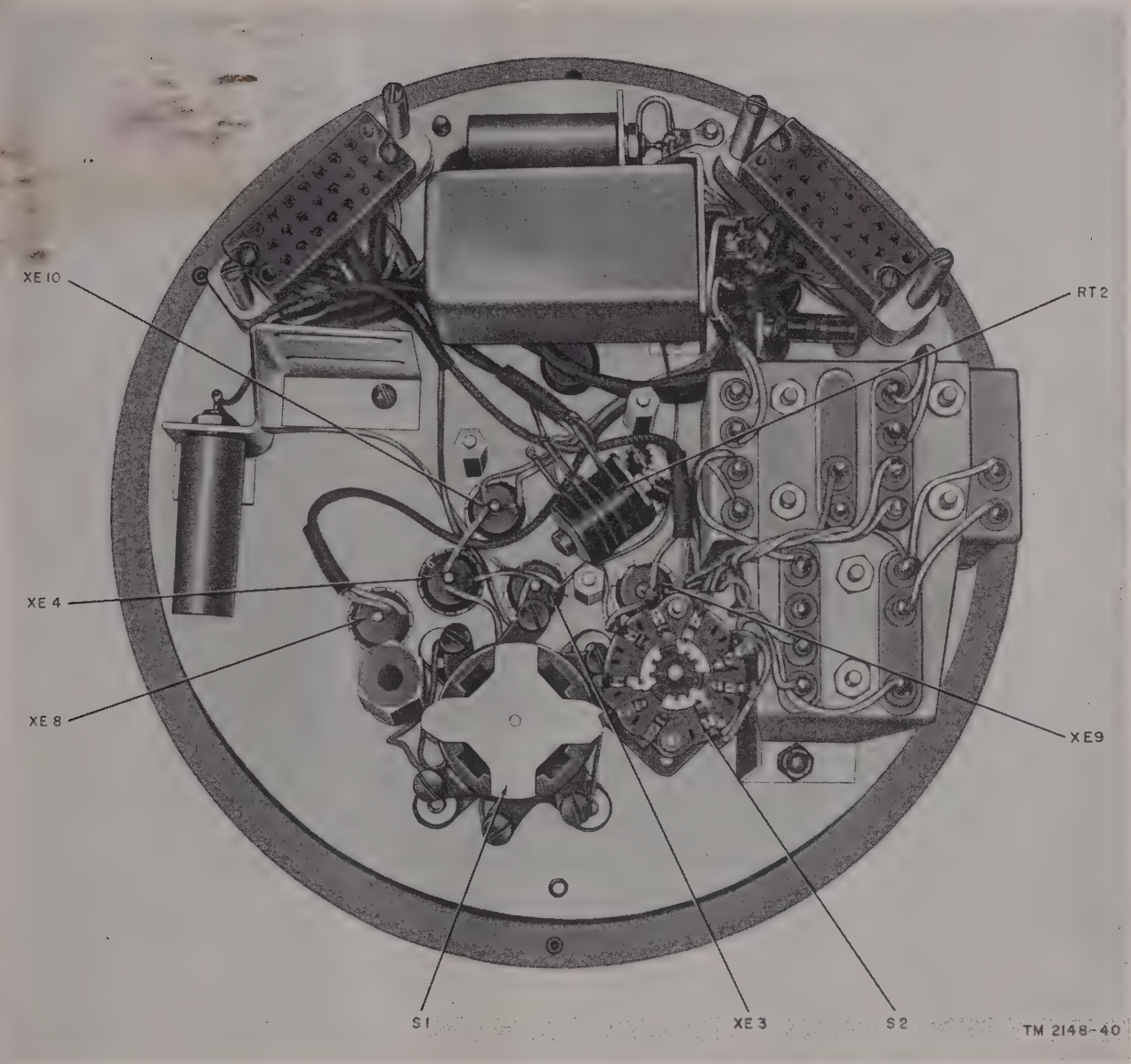


Figure 46. Telephone Repeater AN/TCC–11, J2 end cover assembly, rear view, parts removed to show thermistor RT2.

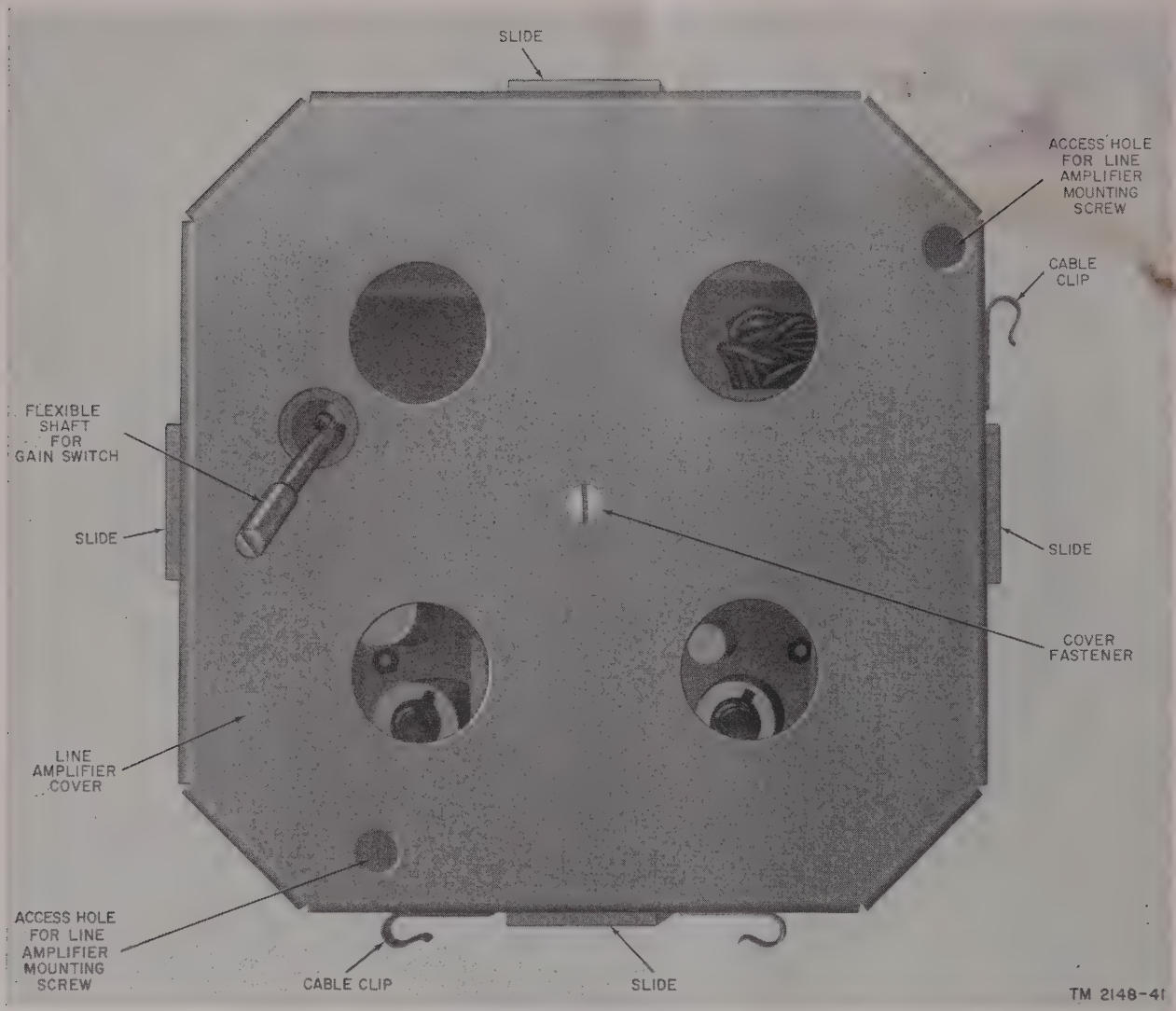


Figure 47. Telephone Repeater AN/TCC–11, line amplifier, top view, cover in place.

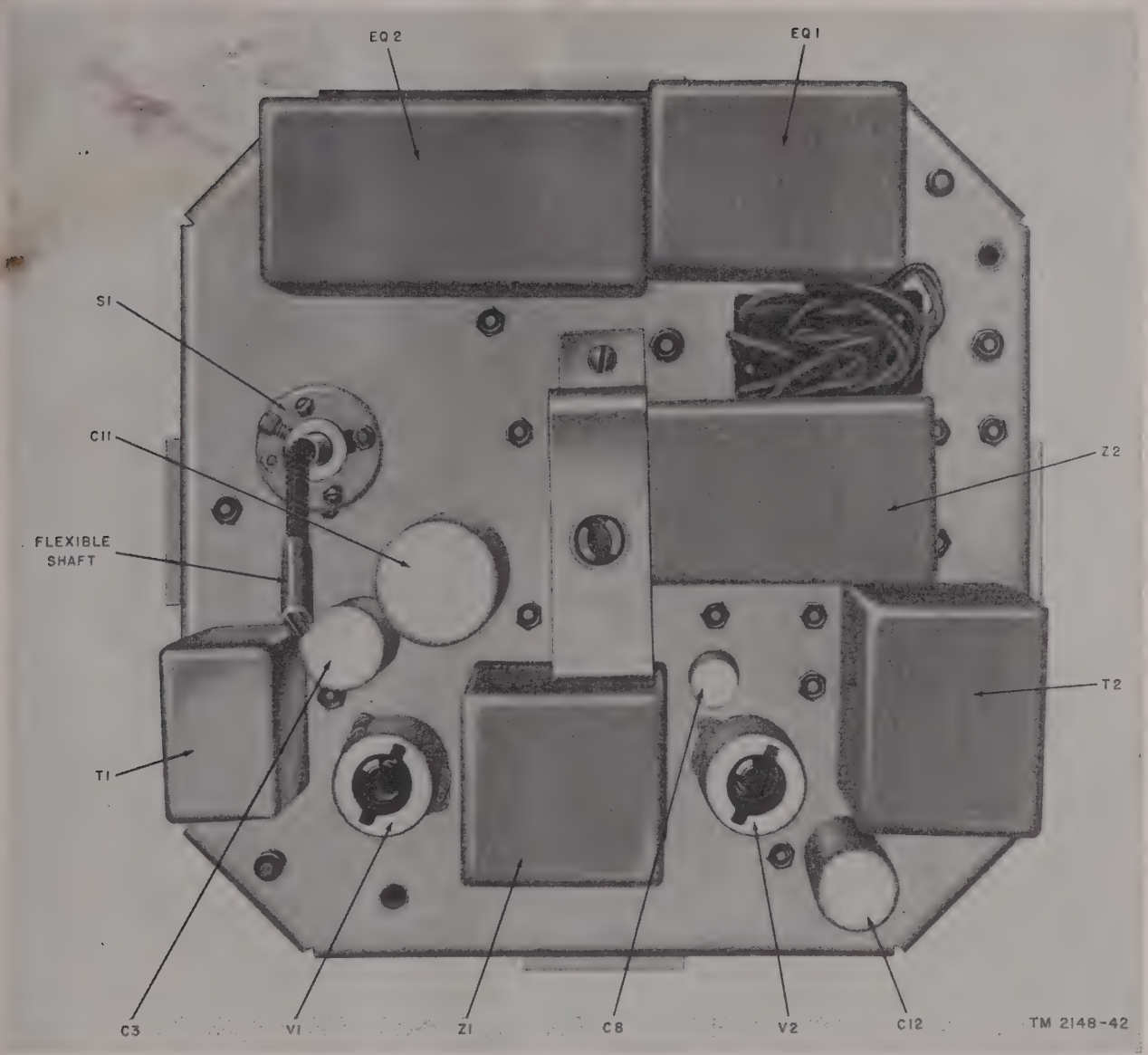


Figure 48. Telephone Repeater AN/TCC–11, line amplifier, top view, cover removed.

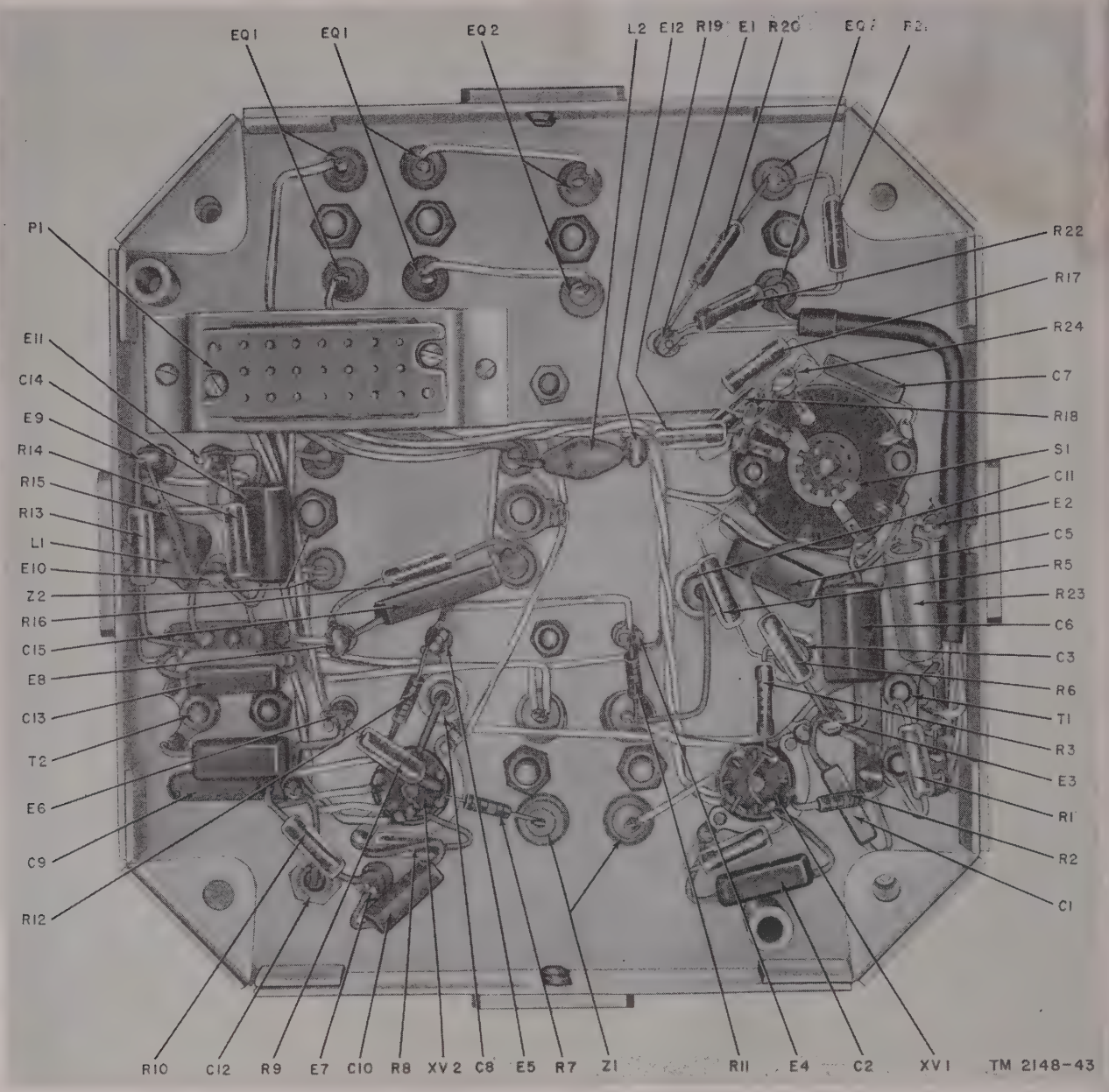


Figure 49. Telephone Repeater AN/TCC–11, line amplifier, bottom view.

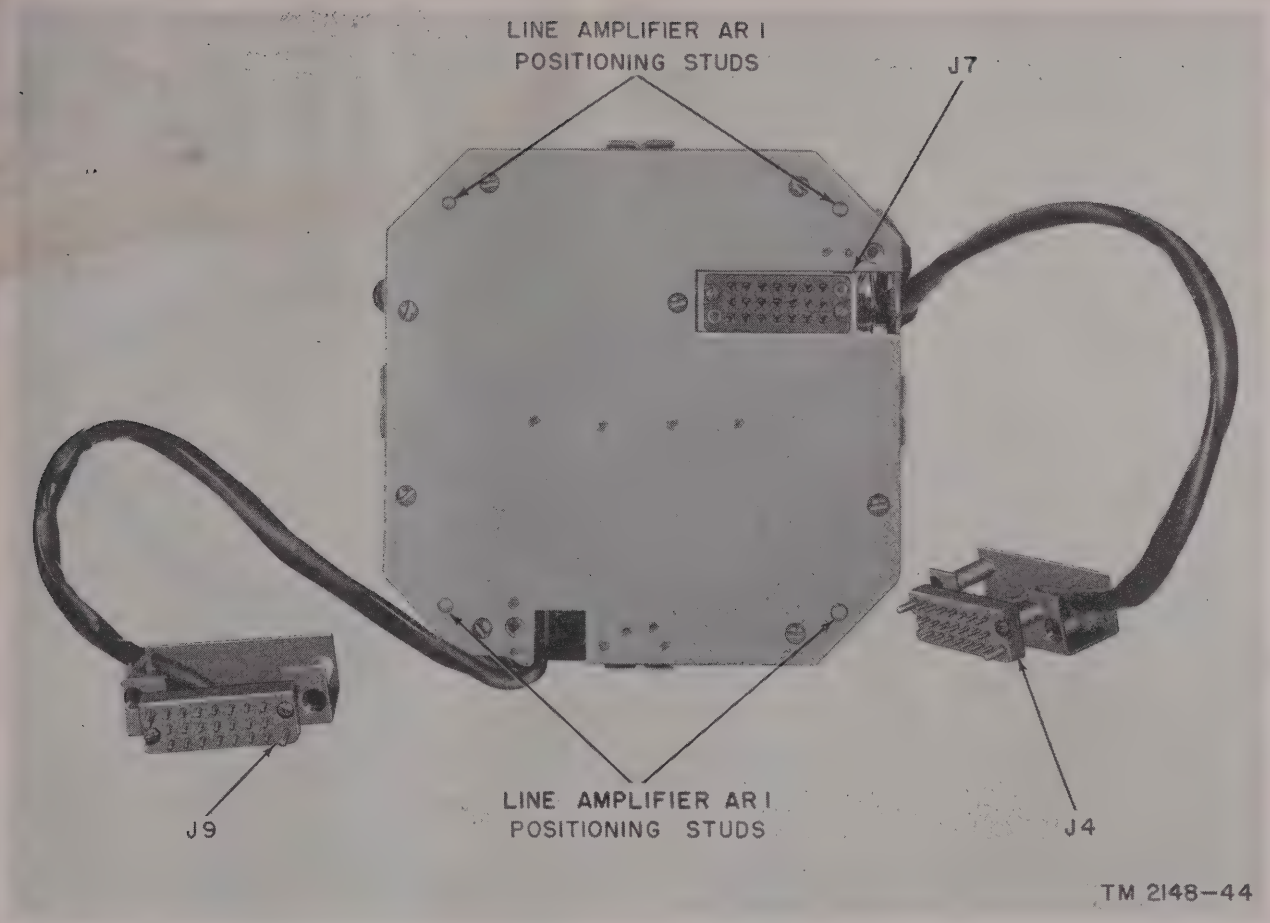


Figure 50. Telephone Repeater AN/TCC–11, filter section, J7 end.

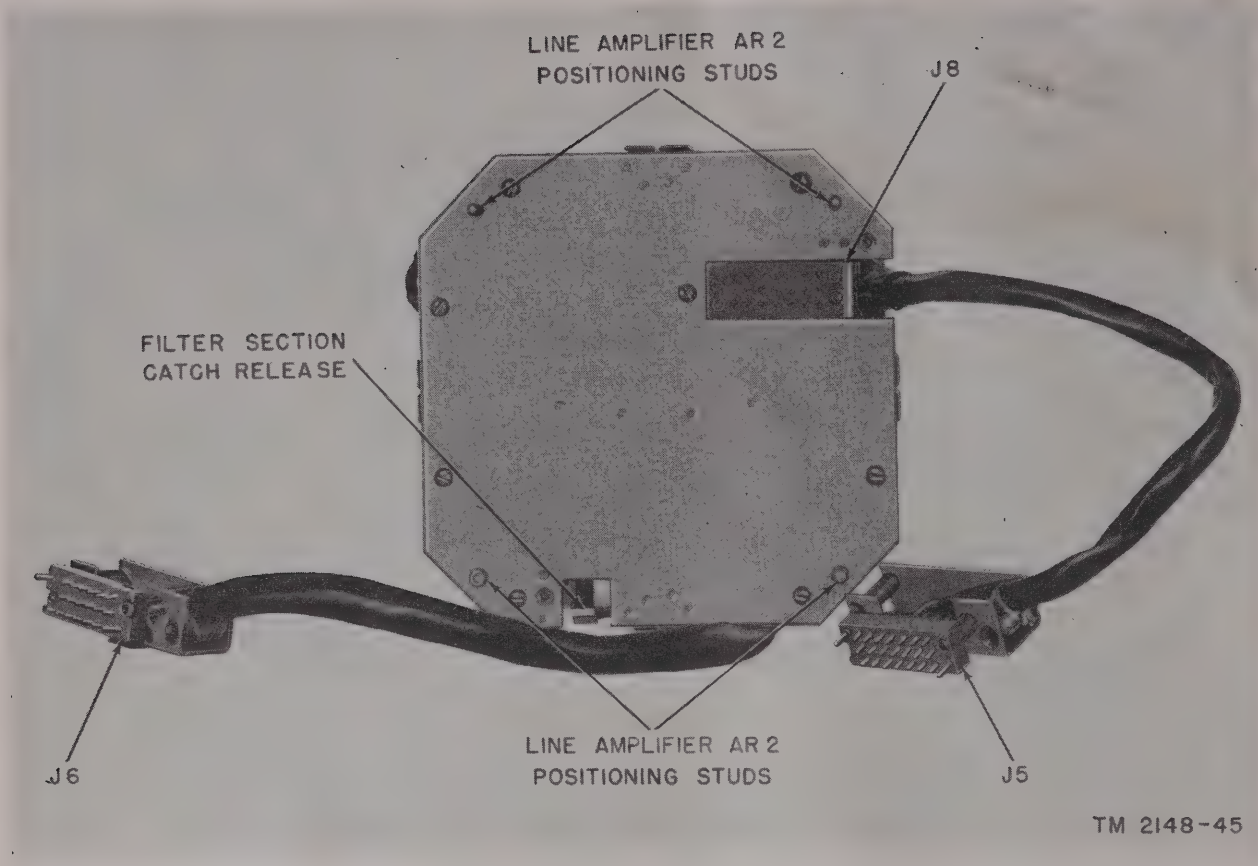


Figure 51. Telephone Repeater AN/TCC–11, filter section, J8 end.

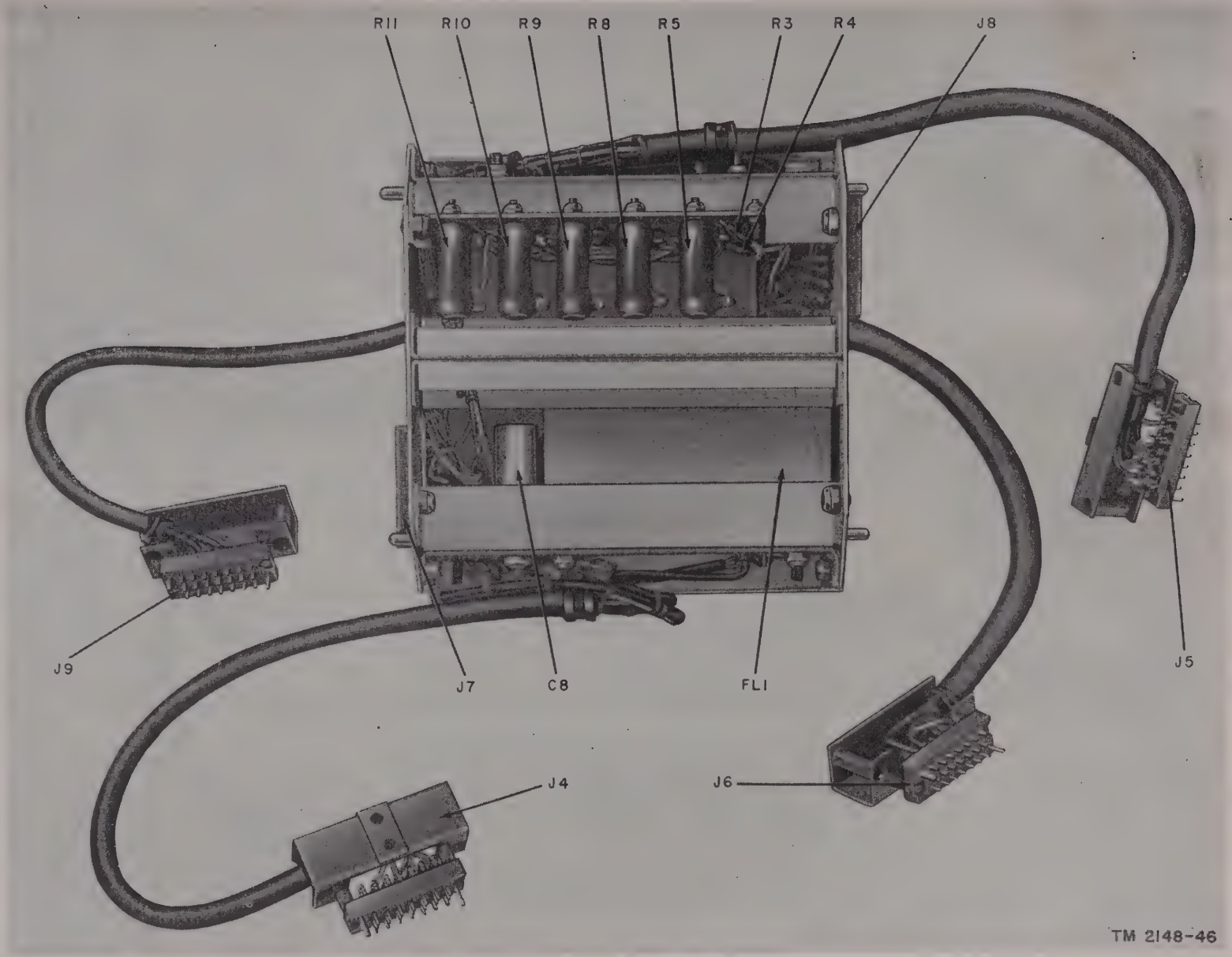


Figure 52. Telephone Repeater AN/TCC-11, filter section, top view.

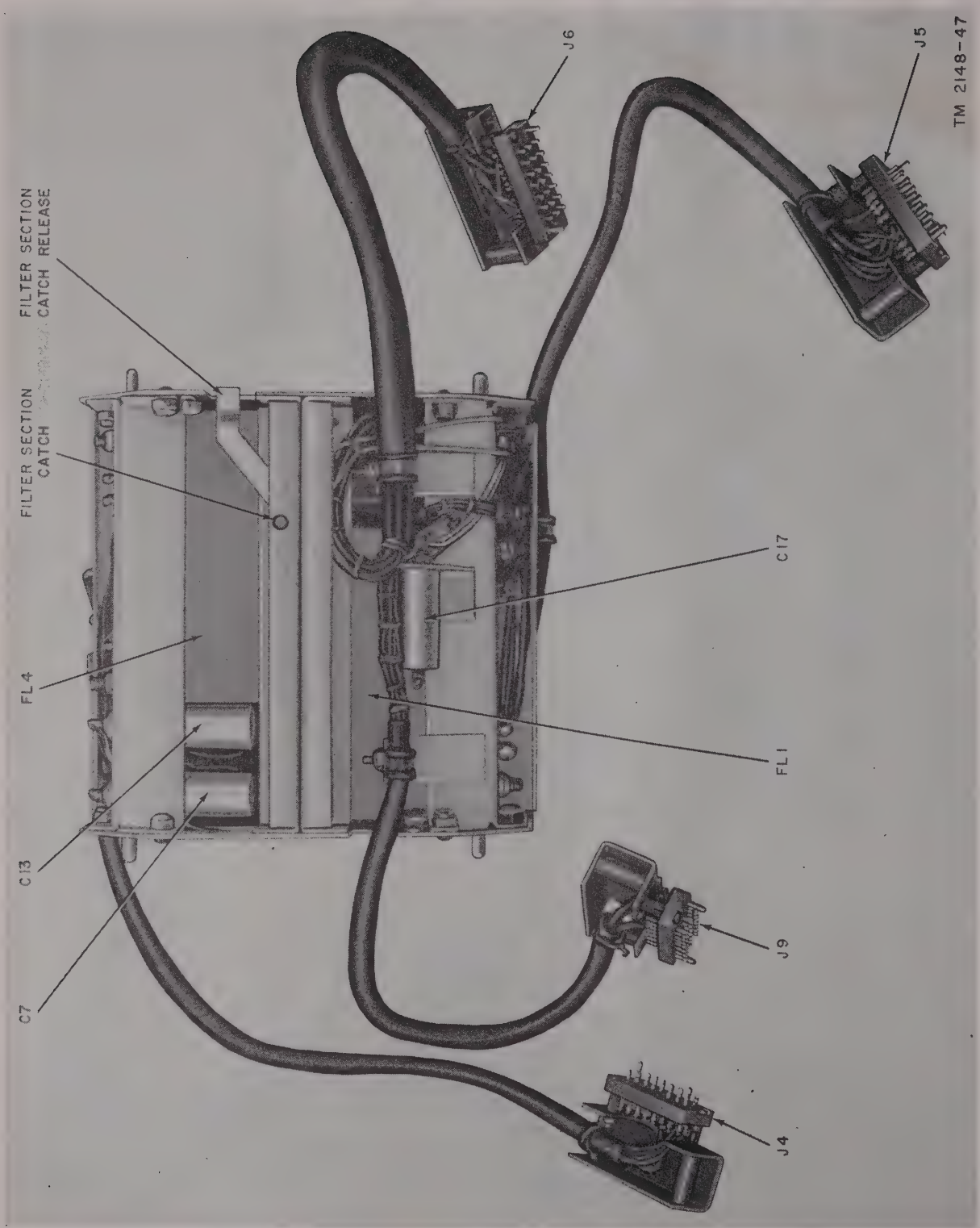


Figure 53. Telephone Repeater AN/TCC–11, filter section, bottom view.

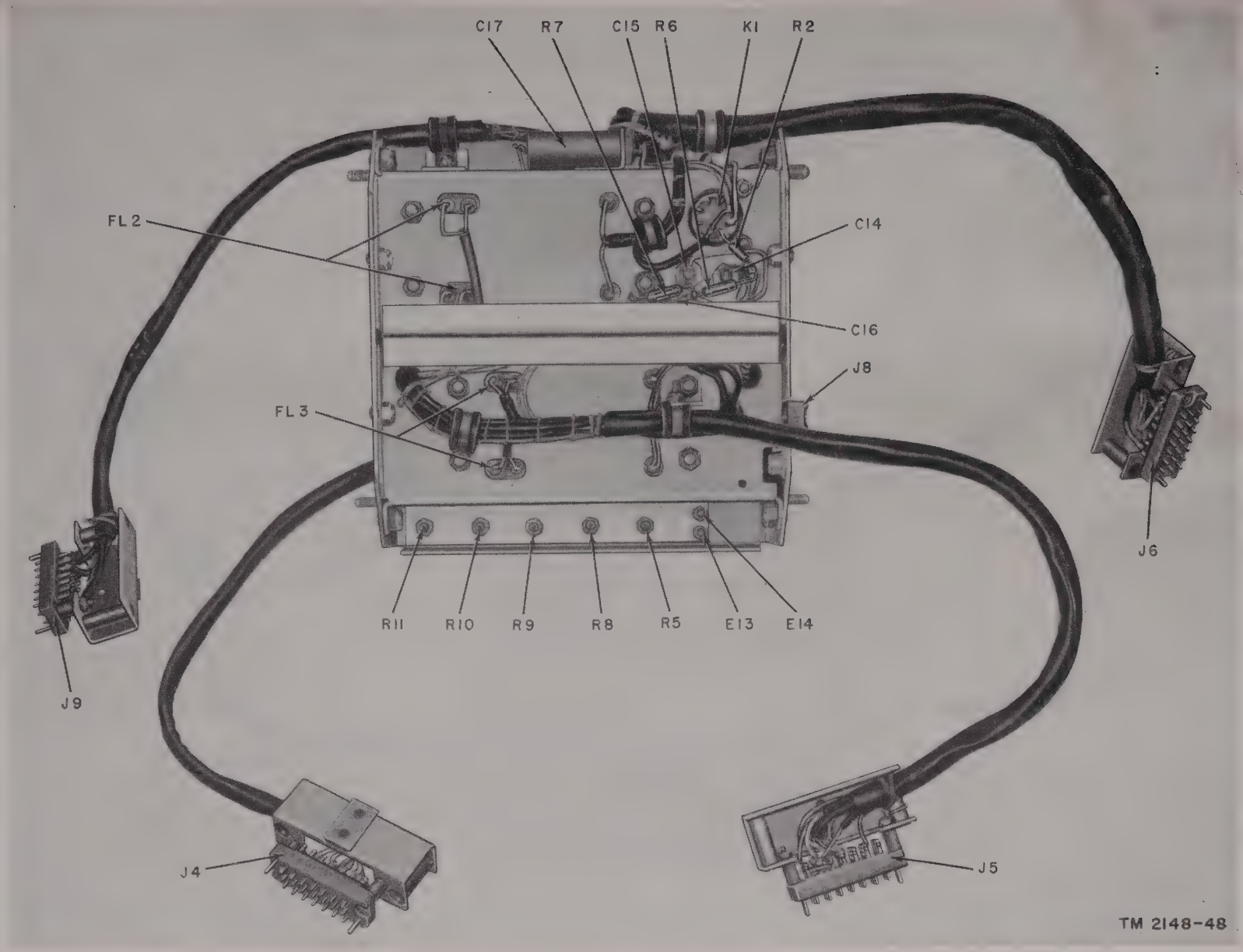


Figure 54. Telephone Repeater AN/TCC–11, filter section, right side view.

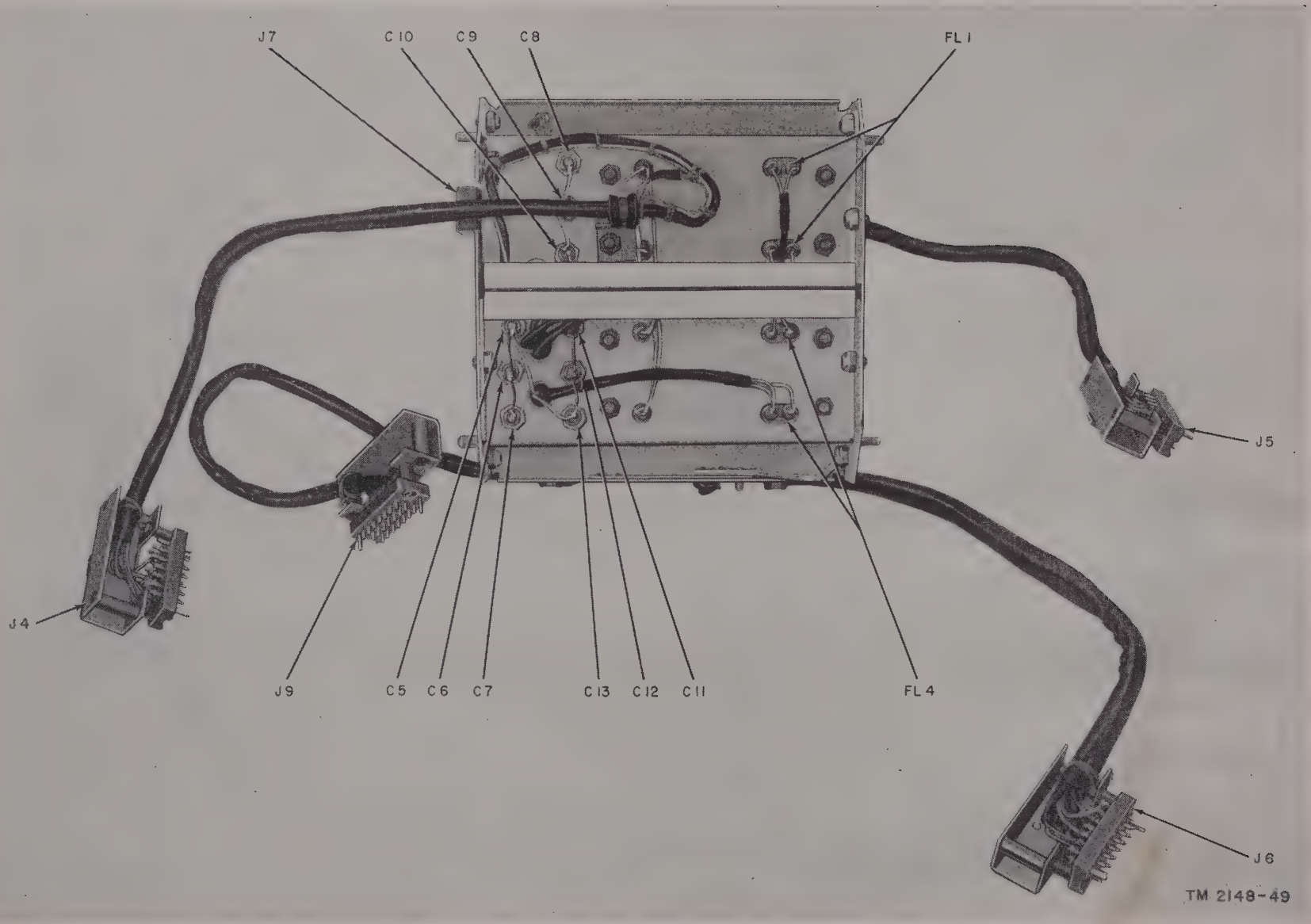
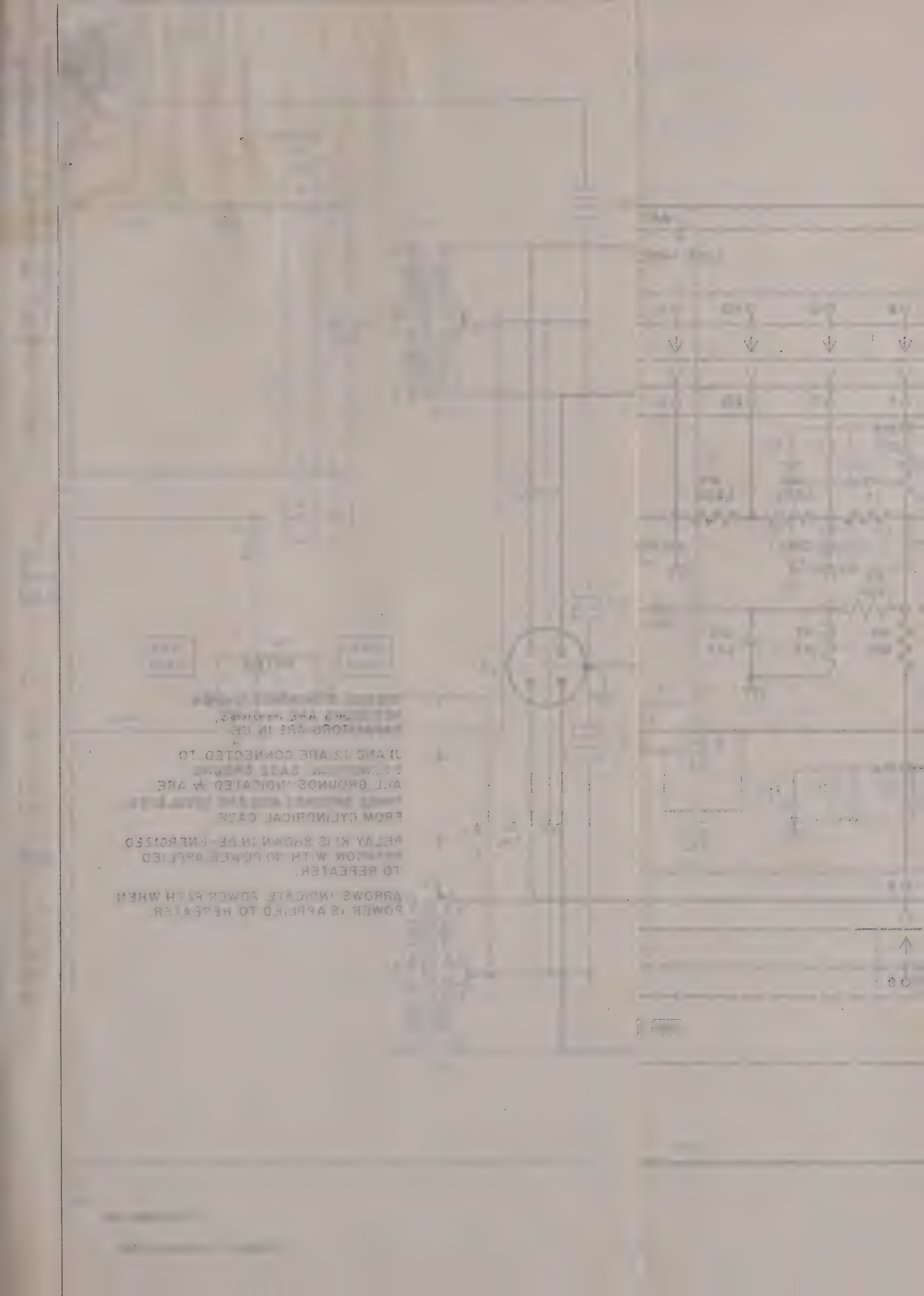
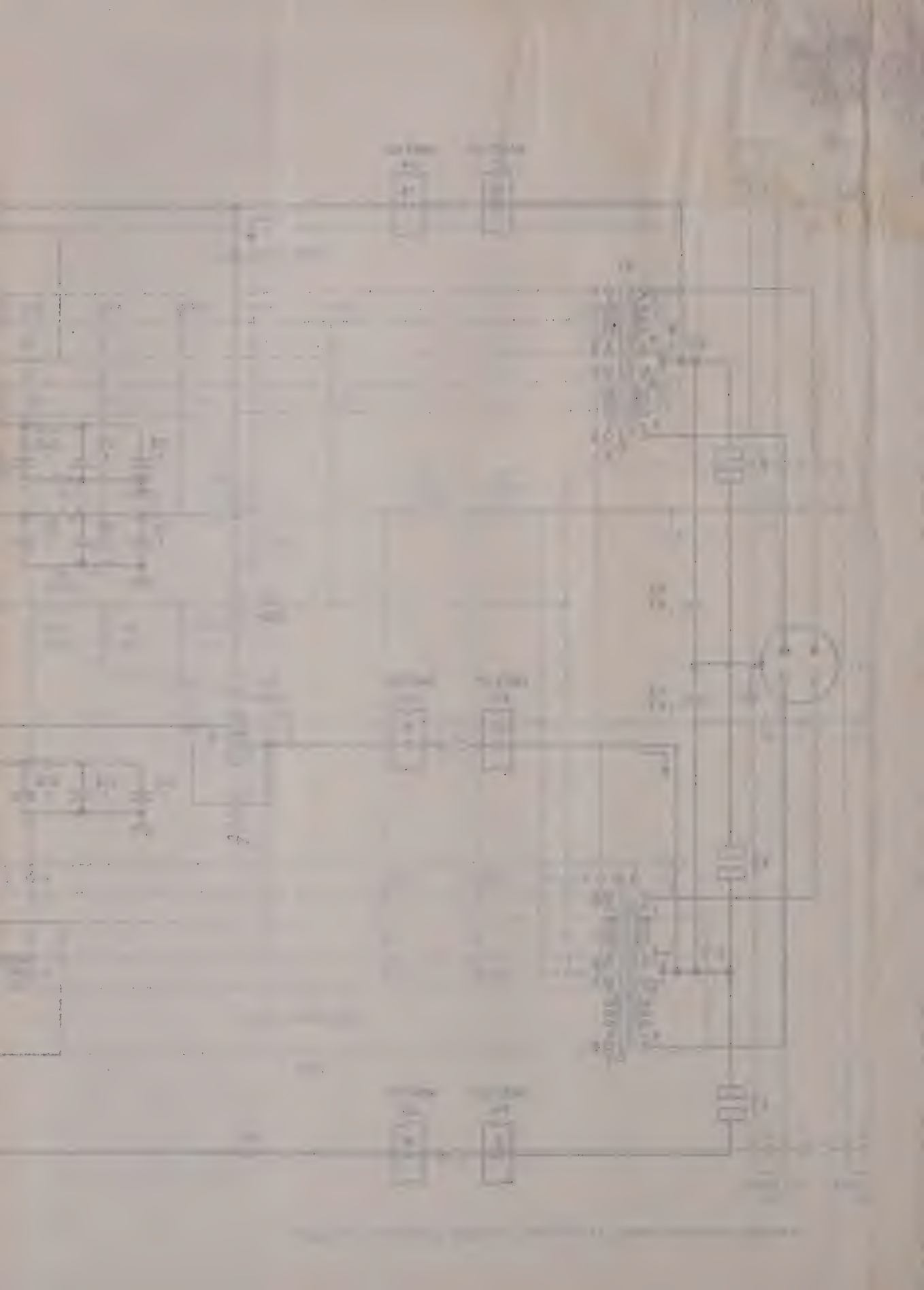


Figure 55. Telephone Repeater AN/TCC–11, filter section, left side view.





Section III. ADDITIONAL TROUBLESHOOTING INFORMATION

152. General

Additional troubleshooting information included in this manual consists of d-c resistances of transformers and coils (par. 153), voltage measurements (par. 154), and d-c voltage and resistance measurements of the line amplifier as part of AN/TCC–11 (par. 155).

153. D-c Resistances of Transformers and Coils

a. The d-c resistances of transformers and coils in Telephone Repeater AN/TCC–11 are shown in the chart below:

Transformer or coil	Terminals	Ohms
T1, T2, T3, or T4	1–2	2. 2
	3–4	2. 2
	5–6	11. 2
	7–8	11. 2

b. The d-c resistances of transformers and coils in line amplifiers AR1 and AR2 of Telephone Repeater AN/TCC–11 are shown in the chart below:

Transformer or coil	Terminals	Ohms
T1	1–2	7. 8
	3–4	43. 0
	5–6	242. 0
T2	1–2	3. 8
	3–4	12. 4
	5–6	216. 0
L1		3. 5
L2		2. 0

154. Telephone Repeater AN/TCC–11, Voltage Measurements

Voltage measurements on Telephone Repeater AN/TCC–11 are made with the same test setup used for the transmission test of transmission circuit 1 (par. 141 and fig. 38). The measurements are made in the following manner:

a. Operate the power switch on Signal Generator SG–71/FCC to the off position.

b. Turn on the power supply and adjust it to 200 volts (par. 145*b*).

c. Use Multimeter TS–352/U to make the voltage measurements indicated in the chart below.

Voltage measured	Measure between—		TS–352/U reading (volts)
	Pin	Pin	
Grid	J	M (gnd)	16
AR1	B	M (gnd)	16. 5
V1, cathode			
V2, cathode	K	M (gnd)	17
AR2	F	M (gnd)	17
V1, cathode			
V2, cathode	P	M (gnd)	17. 2
REP VOLTS	H	M (gnd)	144

155. D-c Voltage and Resistance Measurements of Line Amplifier as Part of AN/TCC–11.

a. Assemble the repeater without the cylindrical case (fig. 58). Attach the line amplifier AR1 to the filter section by means of the line amplifier extension test cable assembly (fig. 33).

b. Use the same test set-up that was used for the transmission test (par. 141 and fig. 38).

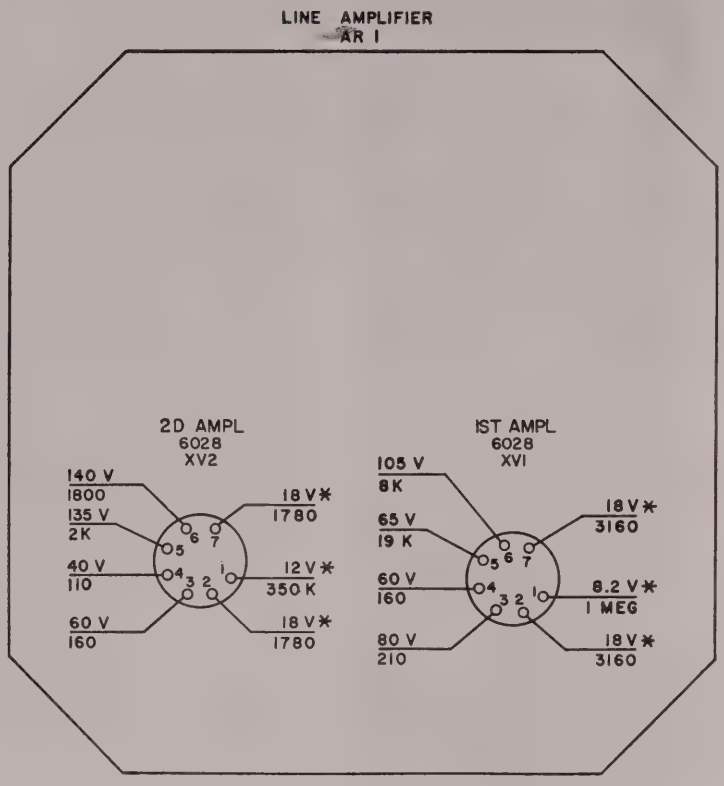
c. Turn the power supply on and adjust it to 200 volts (par. 145*b*).

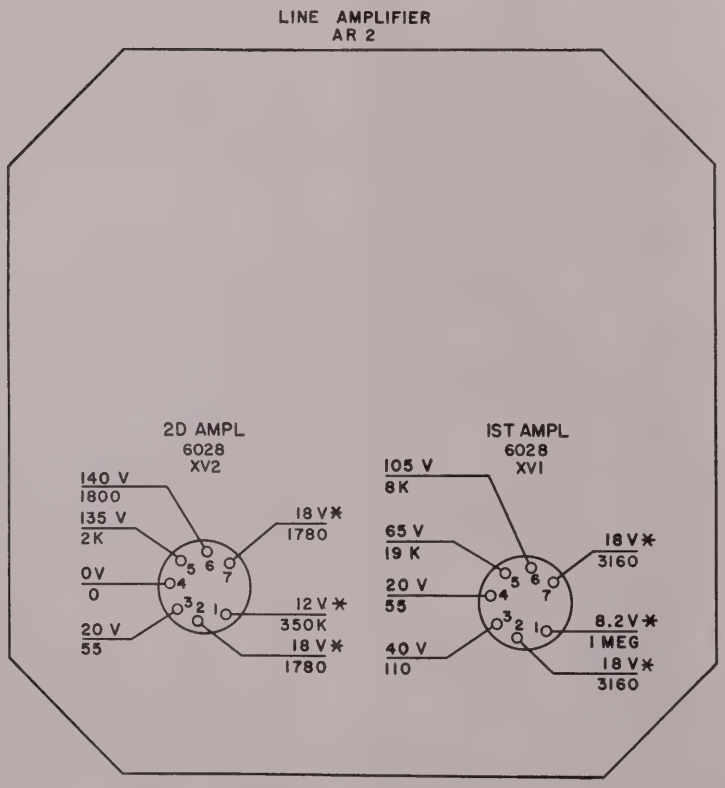
d. Use Multimeter TS–352/U to make the voltage measurements shown in figure 57.

e. Turn the power supply off and make the resistance measurements shown in figure 57.

f. Remove the line amplifier extension test cable assembly and connect P1 on line amplifier AR1 to J7 on the filter section. Connect line amplifier AR2 to the filter section by means of the line amplifier extension test cable assembly.

g. Repeat the steps outlined in *c*, *d*, and *e* above for line amplifier AR2.





NOTES:

1. MEASUREMENTS ARE MADE WITH LINE AMPLIFIERS CONNECTED TO TELEPHONE REPEATER AN/TCC-11.
2. CONNECT AMPLIFIER TO FILTER SECTION WITH EXTENSION TEST CABLE ASSEMBLY.
3. USE 20,000 OHMS PER VOLT MULTIMETER.
4. VOLTAGE READINGS ARE GIVEN ABOVE LINE, RESISTANCE READINGS ARE GIVEN BELOW LINE.
5. UNLESS OTHERWISE SHOWN RESISTANCES ARE IN OHMS.
6. ALL MEASUREMENTS MADE FROM TUBE PIN TO CHASSIS GROUND.
7. * INDICATES THAT 50V RANGE MUST BE USED.

TM 2148-51

Figure 57. Telephone Repeater AN/TCC–11, line amplifier, tube socket d-c voltages and resistance measurements as part of repeater.

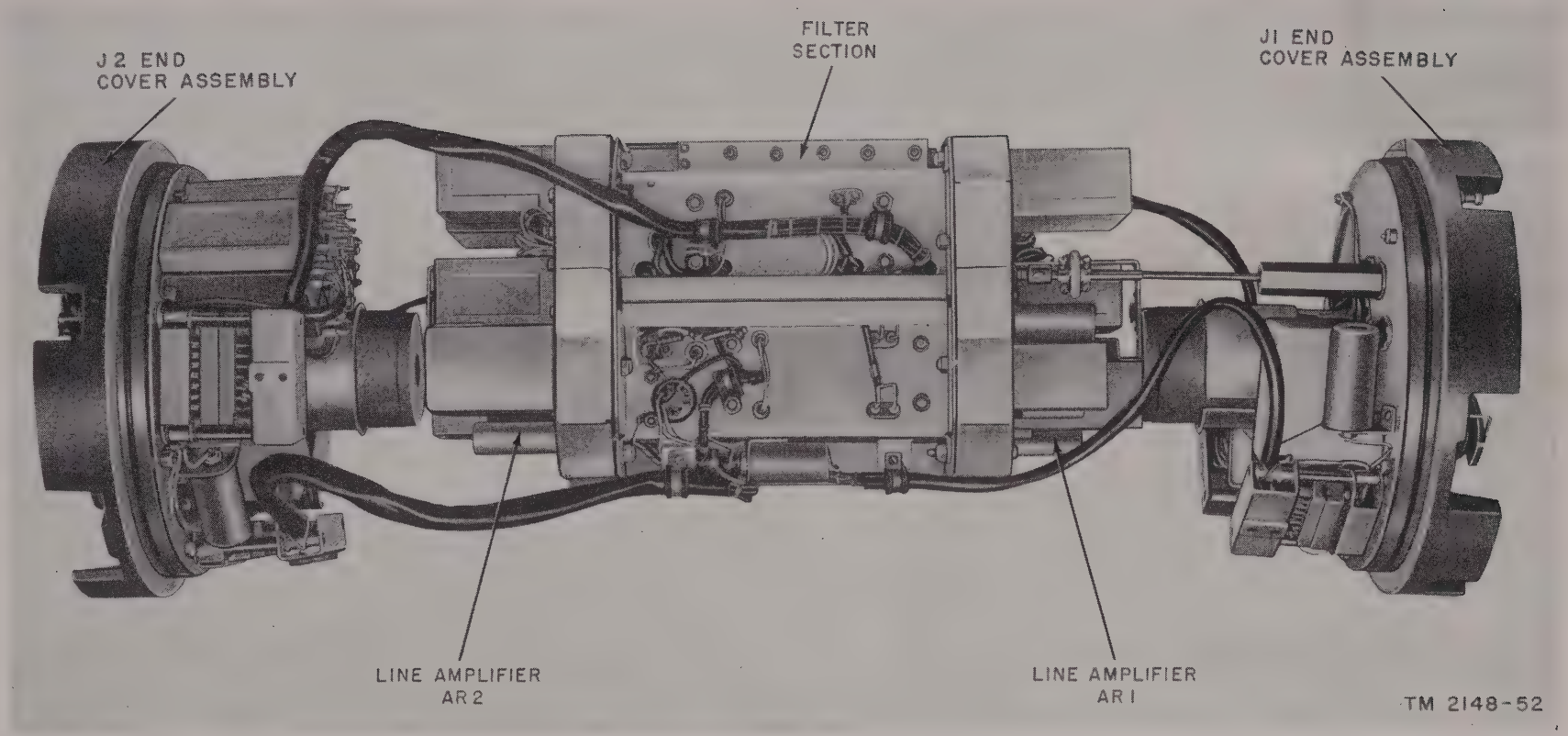


Figure 58. Telephone Repeater AN/TCC–11, assembly for signal substitution.

Section IV. SIGNAL SUBSTITUTION

156. Telephone Repeater AN/TCC–11, Signal Substitution

a. Transmission Circuit 1. Telephone Repeater AN/TCC–11 signal substitution chart is used to locate trouble in transmission circuit 1 of Telephone Repeater AN/TCC–11. The test set-up is the same as for the transmission test (par. 141 and fig. 38) except that Telephone Repeater AN/TCC–11 is assembled without the cylindrical case (fig. 58). The signal substitution procedures are given below:

(1) Repeat the transmission test outlined in paragraph 141*a* through *d*, *f* and *g*.

(2) Use the ME–6/U to perform the signal substitution as described in the chart below:

Telephone Repeater AN/TCC–11, Transmission Circuit 1, Signal Substitution Chart

ME–6/U connections				Typical ME–6/U reading (volts)			Corrective measures
Positive probe to—		Negative probe to—					
Component	Terminal	Component	Terminal	68 kc	28 kc	12 kc	
T1	5	T1	8	0.021	0.038	0.045	Check T1 (par. 153). Check arrester E5 (par. 77). Check connections through J1. Check FL1 (par. 161).
FL1	1	FL1	2	.021	.038	.045	Check connections through P1 and J4. Check FL1 (par. 161).
FL1	5	FL1	6	.021	.038	.045	Check FL1 (par. 161). Check AR1 (par. 158).
FL4	5	FL4	6	.38	.36	.36	Check AR1 (par. 158). Check FL4 (par. 161). Check connections through J7. Check thermistor RT1 (par. 167).
FL4	1	FL4	2	.38	.36	.36	Check FL4 (par. 161). Check T4 (par. 153). Check arrester E8 (par. 77).
T4	5	T4	8	.38	.36	.36	Check T4 (par. 153). Check arrester E8 (par. 77). Check connections through J5 and P2.

b. Transmission Circuit 2 (fig. 39). The test set-up for signal substitution of transmission circuit 2 is the same as for transmission circuit 1. The signal substitution procedures are given below.

(1) Remove the wires connected to terminals 1 and 2 of TB1 of the AN/TCC–11 repeater test jig and connect them to terminals 5 and 6 of TB2 of the test jig. Remove the 600-ohms resistor from terminals 5 and 6 of TB2 and connect it to terminals 1 and 2 of TB1.

(2) Repeat the transmission test outlined in paragraph 141*f*, *g*, and *h*.

(3) Use the ME–6/U to perform the signal substitution as described in the chart below.

ME–6/U connections				Typical ME–6/U reading (volts)			Corrective measures
Positive probe to—		Negative probe to—					
Component	Terminal	Component	Terminal	68 kc	28 kc	12 kc	
T3	5	T3	8	0. 021	0. 038	0. 045	Check connections through J2. Check T3 (par. 153). Check looping filter FL5 (par. 161). Check arrester E9 (par. 77).
FL3	1	FL3	2	. 021	. 038	. 045	Check FL3 (par. 161). Check FL3 (par. 161). Check connections through P3 and J6.
FL3	5	FL3	6	. 021	. 038	. 045	Check arrester E9 (par. 77). Check FL3 (par. 161). Check AR2 (par. 158).
FL2	5	FL2	6	. 38	. 36	. 36	Check AR2 (par. 158). Check FL2 (par. 161). Check connections through J8. Check thermistor RT2 (par. 167).
FL2	1	FL2	2	. 38	. 36	. 36	Check FL2 (par. 161). Check arrester E6.
T2	5	T2	8	. 38	. 36	. 36	Check T2 (par. 153). Check T4 (par. 153). Check arrester E6 (par. 77). Check connections through J9 and P4.

157. Telephone Repeater AN/TCC–11, 1-kc Signal Substitution

Note. Locate and repair any trouble in the carrier frequency transmission circuits before making any 1-kc signal substitution.

a. Transmission Circuit 1.

(1) Repeat the steps outlined in paragraph 141*a* through *d* of the transmission test.

(2) Adjust the frequency output of Signal Generator SG–71/FCC to 1 kc. Adjust the TS–402/U attenuator to 10 db.

(3) Connect the ME–6/U across the TS–402/U input and adjust the SG–71/FCC output control for a reading of 0.25 volt on the ME–6/U.

(4) Perform the signal tracing procedures outlined in the chart below.

1-kc Signal Substitution Chart Transmission Circuit 1

ME–6/U connections				Typical ME–6/U reading (volts)	Corrective measures
Positive probe to—		Negative probe to—			
Component	Terminal	Component	Terminal		
FL1	3	FL1	4	0. 08	Check FL1 (par. 161). Check FL2 (par. 161).
FL2	3	FL2	4	. 08	Check FL4 (par. 161). Check wiring to FL1.

b. Transmission Circuit 2 (fig. 39).

(1) Remove the wires connected to terminals 1 and 2 of T1 of the AN/TCC–11 repeater test jig and connect them to terminals 5 and 6 of TB2 of the test jig.

(2) Remove the 600-ohm resistor connected to terminals 5 and 6 of TB2 and connect it to terminals 1 and 2 of TB1.

(3) Connect the ME–6/U across the TS–402/U input and adjust the SG–71/FCC output control for a reading of 0.25 volt on the ME–6/U.

(4) Perform the signal tracing procedures detailed in the chart below:

1-kc Signal Substitution Chart Transmission Circuit 2

ME–6/U connections				Typical ME–6/U reading (volts)	Corrective measures
Positive probe to—		Negative probe to—			
Component	Terminal	Component	Terminal		
FL3	3	FL3	4	0. 08	Check FL3 (par. 161). Check FL4 (par. 161).
FL2	3	FL2	4	. 08	Check FL2 (par. 161). Check wiring to FL3.

158. AN TCC–11 Line Amplifier, Signal Substitution

The procedures for the AN/TCC–11 line amplifier signal substitutions are described below:

a. Set up the test circuit (par. 148 and fig. 41).

b. Turn on the power supply and adjust it to 200 volts (par. 145*b*).

c. Turn on Signal Generator SG–71/FCC and allow a 2-minute warmup period before using it.

d. Connect Electronic Multimeter ME–6/U to terminals 4 and 1 (ground) of TB1 of AN/TCC–11 line amplifier test jig.

e. Adjust the SG–71/FCC output for the proper voltage reading on the ME–6/U for each of the frequencies given in the chart below:

SG–71/FCC frequency settings (kc)	ME–6/U readings (volts)
68	0. 17
28	. 30
12	. 36

f. Use Electronic Multimeter ME–6/U to perform the signal tracing procedures outlined in the AN/TCC–11 line amplifier signal substitution chart below.

AN/TCC–11 Line Amplifier Signal Substitution Chart

ME–6/U connections				Typical ME–6/U reading (volts)			Corrective measures
Positive probe to—		Negative probe to—					
Component	Terminal	Component	Terminal	68 kc	28 kc	12 kc	
EQ1	1	Ground		0. 052	0. 095	0. 11	Check wiring from P1 to EQ1. Check EQ1 (par. 162).
EQ1	3	Ground		. 052	. 095	. 11	Check EQ1 (par. 162). Check EQ2 (par. 163).
EQ2	1	Ground		. 052	. 095	. 11	Check wiring between EQ1 and EQ2.
EQ2	3	Ground		. 033	. 033	. 033	Check EQ2 (par. 163). Check R20.
Stand off	E1	Ground		. 016	. 016	. 016	Check R21, R22, and R23. Check T1 (par. 153).
T1	4	Ground		. 016	. 016	. 016	Check wiring between E1 and T1. Check T1 (par. 153).

AN/TCC–11 Line Amplifier Signal Substitution Chart—Continued

ME–6/U connections				Typical ME–6/U reading (volts)			Corrective measures
Positive probe to—		Negative probe to—					
Component	Terminal	Component	Terminal	68 kc	28 kc	12 kc	
T1	6	Ground		.0035	.0035	.0035	Check T1; check S1. Check R1, R17, R18, and R19. Check C1 and C6. Check L2 (par. 153) check Z2 (par. 164).
V1	1	Ground		.0035	.0035	.0035	Check R2. Check wiring.
V1	5	Ground		.1	.084	.11	Check C2, C3, and C11. Check Z1 (par. 166). Check R3 and R4.
Z1	3	Ground		.1	.084	.11	Check Z1 (par. 166).
V2	1	Ground		.1	.084	.11	Check R7 and wiring.
V2	5	Ground		4.7	4.7	4.7	Check C8, C10, and C12. Check R8 and R10. Check T2 (par. 153).
T2	4	Ground		.77	.77	.77	Check T2 (par. 153).
Stand off	E9	Ground		.77	.77	.77	Check L1 (par. 153). Check R13, R14, and R15. Check C13 and C14.
T2	1			.26	.26	.26	Check T2 (par. 153).
Z2	1			.15	.15	.15	Check R16. Check C15.

159. Telephone Repeater AN/TCC–11, Parts Testing

The paragraphs which follow are intended as a guide in determining the quality of the major parts of Telephone Repeater AN/TCC–11. Instructions are given for testing high-pass, low-pass filters FL1, FL2, FL3, and FL4 (par. 161), delay equalizer EQ1 (par. 162), basic equalizer EQ2 (par. 163), regulator network Z2 (par. 163), looping filter FL5 (par. 165), interstage network Z1 (par. 166), and thermistors RT1 and RT2 (par. 167).

160. Telephone Repeater AN/TCC–11, Equipment Required for Parts Testing

The equipment required for testing the parts of Telephone Repeater AN/TCC–11 is listed in the chart below.

Item	Test equipment	Technical manual or instruction book	Amount required
1	Electronic Multimeter ME–6/U.	Manufacturer's instruction book.	1
2	Multimeter TS–352/U	TM 11–5527	1
3	Signal Generator SG–71/FCC.	Manufacturer's instruction book.	1
4	Repeating coil (GA–51116).		1
5	Clip leads		2
6	Resistor, 15,000 ohms ±5%; ½ w (RC20BF153J).		1
7	Resistor, 1,620 ohms ±1%; ½ w (GA50083A1621).		2
8	Resistor, 600 ohms ±1%; ½ w (GA50083A6000).		2
9	Resistor, 200 ohms ±1%; ½ w (GA500832000).		1
10	Resistor, 68.1 ohms ±1%; ½ w (GA50083A68R1).		2

161. Telephone Repeater AN/TCC–11, High-Pass, Low-Pass Filter Test

a. High-Pass Section Test Set-Up. Arrange the A test circuit shown in figure 59 as indicated below.

(1) Connect the BAL OUTPUT of Signal Generator SG–71/FCC to a protection pad consisting of a 15,000-ohm resistor in series and a 600-ohm resistor in shunt. Designate the junction point between these resistors as test point A. Designate the other end of the 600-ohm resistor as ground.

(2) Connect a 600-ohm resistor across the binding posts of Electronic Multimeter ME–6/U.

(3) Terminate terminals 3 and 4 of the high-pass, low-pass filter with a 1,620-ohm resistor.

b. High-Pass Sections Test. The procedures for testing the high-pass sections of filters FL1, FL2, FL3, and FL4 are outlined below:

(1) Adjust the frequency output of Signal Generator SG–71/FCC to 5KC.

(2) Disconnect terminals 1 and 2 of the high-pass, low-pass filter from test point A and ground and connect Electronic Multimeter ME–6/U test leads to these points.

(3) Adjust the amplitude controls of the SG–71/FCC to obtain a meter reading of 0.5 volt on the ME–6/U.

(4) Disconnect the ME–6/U from terminals A and ground and connect terminals 1 and 2 (ground) of the high-pass, low-pass filter to test point A and ground.

(5) Connect the test leads from the ME–6/U to terminals 5 and 6 (ground) of the filter.

(6) Note the reading on the ME–6/U. For correct 5-kc transmission, the meter reading should be less than 0.012 volt.

(7) Remove the ME–6/U connections from terminals 5 and 6 of the filter and connect the ME–6/U to test point A and ground. Remove the leads which connect terminals 1 and 2 of the filter to terminals A and ground.

(8) Adjust the SG–71/FCC frequency output to 20 kc.

(9) Repeat the procedures given in (3), (4), and (5) above.

(10) Note the reading on the ME–6/U. For correct 20-kc transmission, the reading should be greater than 0.48 volt.

c. Low-Pass Section Test Set-Up. Arrange the B test circuit shown in figure 59 as indicated below.

(1) Remove the 600-ohm resistor from the protection pad and replace it with a 1,620-ohm resistor.

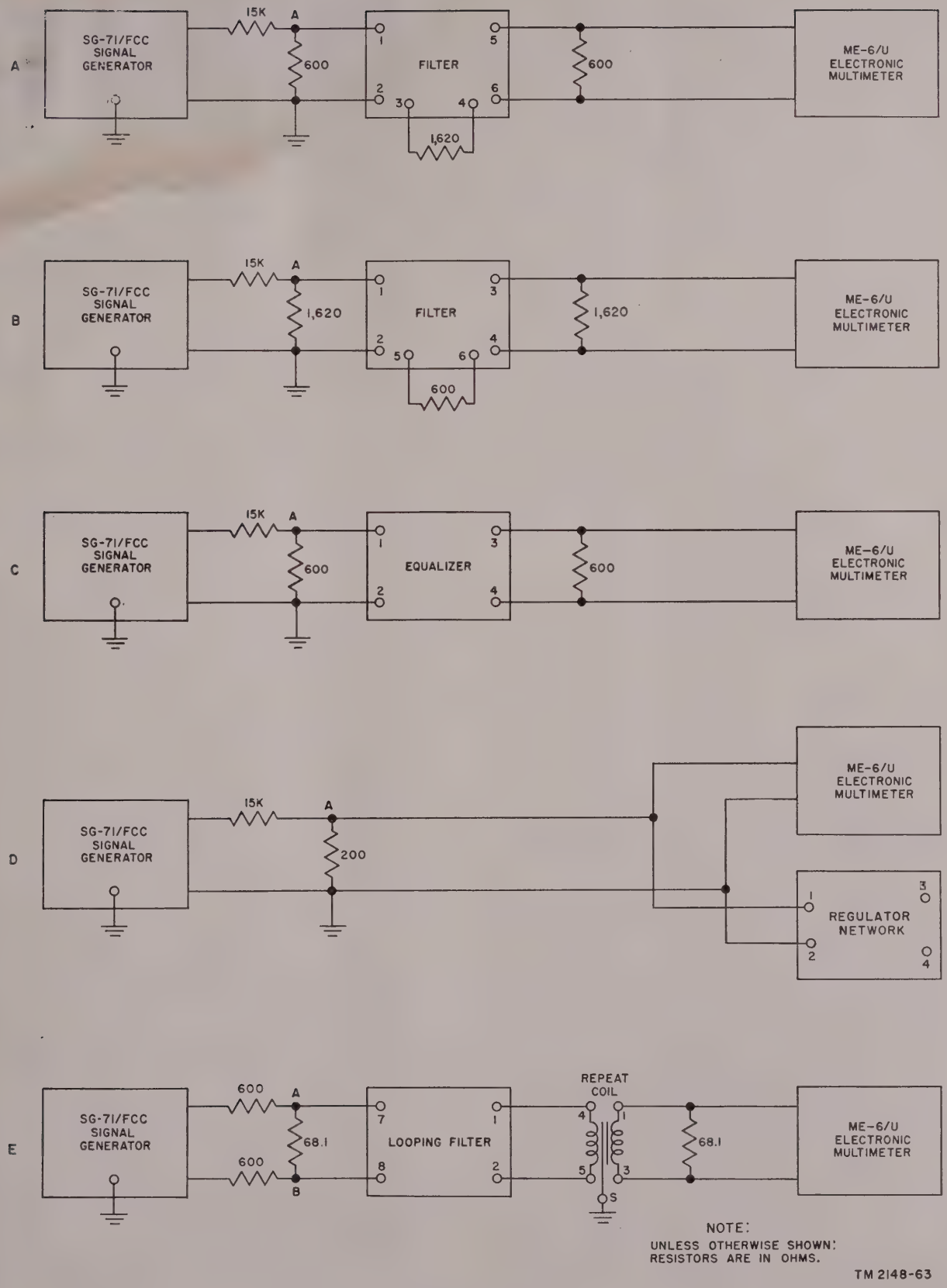


Figure 59. Telephone Repeater AN/TCC–11, test set-ups for testing equalizers, filters, and regulator networks.

(2) Remove the 1,620-ohm resistor from terminals 3 and 4 of the filter and terminate terminals 5 and 6 of the filter in 600 ohms.

(3) Remove the 600-ohm resistor from the ME–6/U binding posts and replace it with a 1,620-ohm resistor.

d. Low-Pass Section Test. The test procedures for testing the low-pass sections of filters FL1, FL2, FL3, and FL4 are outlined below:

(1) Adjust the SG–71/FCC frequency output to 2 kc.

(2) Repeat the steps given in *b*(2), (3), and (4) above.

(3) Connect the ME–6/U test leads to terminals 3 and 4 (ground) of the filter.

(4) Note the reading on the ME–6/U. For correct 2-kc transmission, this reading should be greater than 0.41 volt.

(5) Remove the ME–6/U test leads from terminals 3 and 4 of the filter and remove the leads which connect terminals A and ground to filter terminals 1 and 2.

(6) Connect the test leads from the ME–6/U to terminals A and ground.

(7) Adjust the SG–71/FCC frequency output to 12 kc.

(8) Repeat the procedures given in *b*(3) and (4) above.

(9) Repeat the procedure given in (3) above.

(10) Note the reading on the ME–6/U. For correct 12-kc transmission, this reading should be less than 0.002 volt.

162. Telephone Repeater AN/TCC–11, Delay Equalizer Test

a. Test Set-Up. Arrange the C test circuit shown in figure 59. Repeat the steps given in paragraph 161*a*(1), and (2).

b. Test. The procedures for testing the delay equalizer EQ1 of Telephone Repeater AN/TCC–11 are outlined below:

(1) Adjust Signal Generator SG–71/FCC frequency output to 20 kc.

(2) Connect the ME–6/U test leads to terminals A and ground.

(3) Adjust the SG–71/FCC amplitude controls to obtain a meter reading of 0.5 volt on the ME–6/U.

(4) Disconnect the ME–6/U leads from A and ground and connect terminals 1 and 2 (ground) of the delay equalizer to test point A and ground.

(5) Connect the ME–6/U to terminals 3 and 4 (ground) of the equalizer.

(6) Note the reading on the ME–6/U. For correct 20-kc transmission, this reading should be greater than 0.485 volt.

(7) Adjust the SG–71/FCC frequency output to 50 kc.

(8) Remove the ME–6/U leads from delay equalizer terminals 3 and 4 and remove the leads that connect terminals 1 and 2 of the delay equalizer to A and ground.

(9) Repeat the procedures given in (2) through (5) above.

(10) Note the reading on the ME–6/U for correct 50-kc transmission, this reading should be less than 0.495 volt.

163. Telephone Repeater AN/TCC–11, Basic Equalizer Test

a. Test Set-Up. The test set-up for the basic equalizer test is the same as for the delay equalizer test (C, fig. 59).

b. Test. The procedures for testing the basic equalizer EQ2 of Telephone Repeater AN/TCC–11 are outlined below:

(1) Adjust Signal Generator SG–71/FCC frequency output to 12 kc.

(2) Repeat the procedures given in paragraph 162*b*(2) through (5).

(3) Note the reading on the ME–6/U. For correct 12-kc transmission, this reading should be between 0.138 and 0.149 volt.

(4) Adjust the SG–71/FCC frequency output to 68 kc.

(5) Repeat the procedures given in paragraph 162*b*(8) and (9).

(6) Note the reading on the ME–6/U. For correct 68-kc transmission, this reading should be between 0.308 and 0.334 volt.

(7) Adjust the SG–71/FCC frequency output for 100 kc.

(8) Repeat the procedures given in paragraph 162*b*(8) and (9).

(9) Note the reading on the ME–6/U. For correct 100-kc transmission, this reading should be between 0.47 and 0.505 volt.

164. Telephone Repeater AN/TCC–11, Regulator Network Test

a. Test Set-Up. Set up the D test circuit shown in figure 59.

(1) Connect output No. 1 of Signal Generator SG–71/FCC to a protection pad consisting of a 15,000-ohm resistor in series and a 200-ohm resistor in shunt. Designate the junction of these two resistors as test point A.
(2) Designate the other end of the 200-ohm resistor as ground.

b. Test. The procedures for testing the regulator network of Telephone Repeater AN/TCC–11 are outlined below:
(1) Connect the ME–6/U across test point A and ground.
(2) Adjust the SG–71/FCC frequency output to 12 kc.
(3) Adjust the SG–71/FCC amplitude controls to obtain a meter reading of 0.5 volt on the ME–6/U.
(4) Connect terminal 1 of the regulator to A, and terminal 2 of the regulator to ground.
(5) Note the reading on the ME–6/U. For correct 12-kc regulator network operation this reading should be between 0.314 and 0.338 volt.
(6) Remove the regulator network connection point from A and ground.
(7) Adjust the SG–71/FCC frequency output to 24.5 kc.
(8) Repeat the procedures given in (3) and (4) above.
(9) Note the reading on the ME–6/U. For correct 24.5-kc operation of the regulator network, this reading should be between 0.334 and 0.359 volt.
(10) Repeat the procedure given in (6) above.
(11) Adjust the SG–71/FCC frequency output to 68 kc.
(12) Repeat the procedures given in (3) and (4) above.
(13) Note the reading on the ME–6/U. For correct 68-kc operation of the regulator network, this reading should be between 0.298 and 0.319 volt.

165. Telephone Repeater AN/TCC–11, Looping Filter Test

a. Test Set-Up. Set up the E test circuit shown in figure 59.
(1) Connect output No. 1 of the signal generator to a protection pad consisting of two 600-ohm resistors in series and a 68.1-ohm resistor in shunt. Designate the junctions of the 68.1-ohm resistor with the two 600-ohm resistors as test points A and B (fig. 59).
(2) Connect a 68.1-ohm resistor across the binding posts of Electronic Miltimeter ME–6/U.
(3) Connect terminals 1 and 3 (ground) of a repeating coil to the binding posts on the ME–6/U.
(4) Connect terminal S on the repeating coil to the ground terminal on the SG–71/FCC.
(5) Connect test leads to terminals 4 and 5 of the repeating coil.

b. Test. The procedures for testing looping filter FL5 of Telephone Repeater AN/TCC–11 are outlined below:
(1) Adjust the SG–71/FCC frequency output to 75 kc and the filter switch to the full clockwise position.
(2) Connect the test leads from the repeating coil to test points A and B.
(3) Adjust the SG–71/FCC amplitude controls for a ME–6/U meter reading of 0.5 volt.
(4) Remove the test leads from test points A and B and connect terminals 7 and 8 of filter FL5 to test points A and B.
(5) Connect the test leads from the ME–6/U to terminals 1 and 2 of filter FL5.
(6) Note the reading on the ME–6/U. For correct 68-kc looping filter transmission, this reading should be less than 0.005 volt.
(7) Remove the filter connections from test points A and B.
(8) Adjust the SG–71/FCC frequency output to 83 kc.
(9) Repeat the procedures given in (2) through (5) above.
(10) Note the reading on the ME–6/U. For correct 83-kc transmission, this reading should be between 0.035 and 0.09 volt.
(11) Adjust the SG–71/FCC frequency output to 91 kc and the filter switch to the middle position.
(12) Repeat the procedures given in (2) through (5) above.

(13) Note the reading on the ME–6/U. For correct 91-kc transmission, this reading should be between 0.395 and 0.11 volt.
(14) Adjust the SG–71/FCC frequency output to 99 kc and the filter switch to the full counterclockwise position.
(15) Repeat the procedures outlined in (2) through (5) above.
(16) Note the reading on the ME–6/U. For correct 99-kc transmission, this reading should be between 0.05 and 0.125 volt.

166. Telephone Repeater AN/TCC–11, Interstage Network Test

To test interstage network Z1 of Telephone Repeater AN/TCC–11, use Multimeter TS–352/U to make the resistance measurements listed in the chart below.

Measure between Z1 terminals	Resistance requirements (ohms)
1 and 2	11K ±K.
1 and 3	Greater than 5 megohms.
3 and 4	330K ±30K.

167. Telephone Repeater AN/TCC–11, Thermistor Test

The value of resistance of the thermistor depends on the temperature of the unit. When checking the thermistor, determine the ambient temperature at the location of the test. Use the values of resistance in the chart below which corresponds to the temperature at the location of test. Use Multimeter TS–352/U to make the resistance measurements.

Thermistor resistance chart

Measure between terminals	Resistance in ohms at—							
	40° F.	50° F.	60° F.	70° F.	80° F.	90° F.	100° F.	110° F.
1 and 2	22	18	14	11	9	7	6	5
3 and 4	830	625	485	315	285	230	190	155
3 and 4	852	643	599	326	294	237	196	160

Section VI. REPAIRS

168. Replacement of Parts

a. Most parts on Telephone Repeater AN/TCC–11 are readily accessible and are easily replaced if found to be faulty. Figures 43 through 55 show the location of the individual parts. If any switch requires replacement, mark carefully with tags or other devices the wires connected to the switch to avoid misconnection when the new switch is installed. Follow this practice whenever replacement requires the disconnection of numerous wires.

b. To replace the PWR LOOP-PWR THRU switch, loosen the setscrew in the switch knob. Remove the knob from the switch shaft. Remove the through nut that holds the switch on the panel. Move the switch back, away from the receiver panel, and lift the switch up to a position where all connections are accessible.

c. To remove either of the gain controls on the line amplifiers, first remove the flexible shaft after unscrewing the setscrew in the base of the coupling. When the flexible shaft has been removed proceed in the same manner as for any other switch.

169. Disassembly of Telephone Repeater AN/TCC–11

The disassembly instructions for Telephone Repeater AN/TCC–11 for field maintenance are listed below.

a. Stand the repeater on end with the J1 end on top.

b. Unscrew the three captive mounting screws (fig. 4) located on the rim of the J1 end cover assembly.

c. Pry loose the J1 end cover with a screwdriver or other tool (fig. 60). Slide the screwdriver blade into the prying notch located under the end cover assembly rim and work the blade around between the cover assembly and the repeater case. Remove the J1 end cover assembly.

d. Remove connectors J4 and J9 from their mounting brackets on the interior wall of the repeater case (fig. 63) and allow them to dangle over the edge of the repeater case so that the line amplifier may be removed.

e. Turn the line amplifier cover fastener (fig. 61) counterclockwise to release it.

f. Remove the line amplifier cover by grasping the four holes in the cover and pulling it vertically.

g. Unscrew the two line amplifier mounting screws (fig. 62). These screws are outlined with a black circle for identification.

h. Remove the line amplifier by pulling it vertically.

i. Turn the repeater end-for-end so that the J2 end is on top.

j. Unscrew the three captive mounting screws on the J2 end cover assembly.

k. Repeat *d* above for connectors J5 and J6.

l. Repeat *e, f, g,* and *h* above at the J2 end.

m. Depress the filter section catch release and push the filter section as far as it will go (fig. 63).

Caution: Make sure that the cables and connectors associated with the filter section do not get caught on the mounting rails.

n. Place the repeater on its side and remove the filter section from the case by pulling it along the mounting rail.

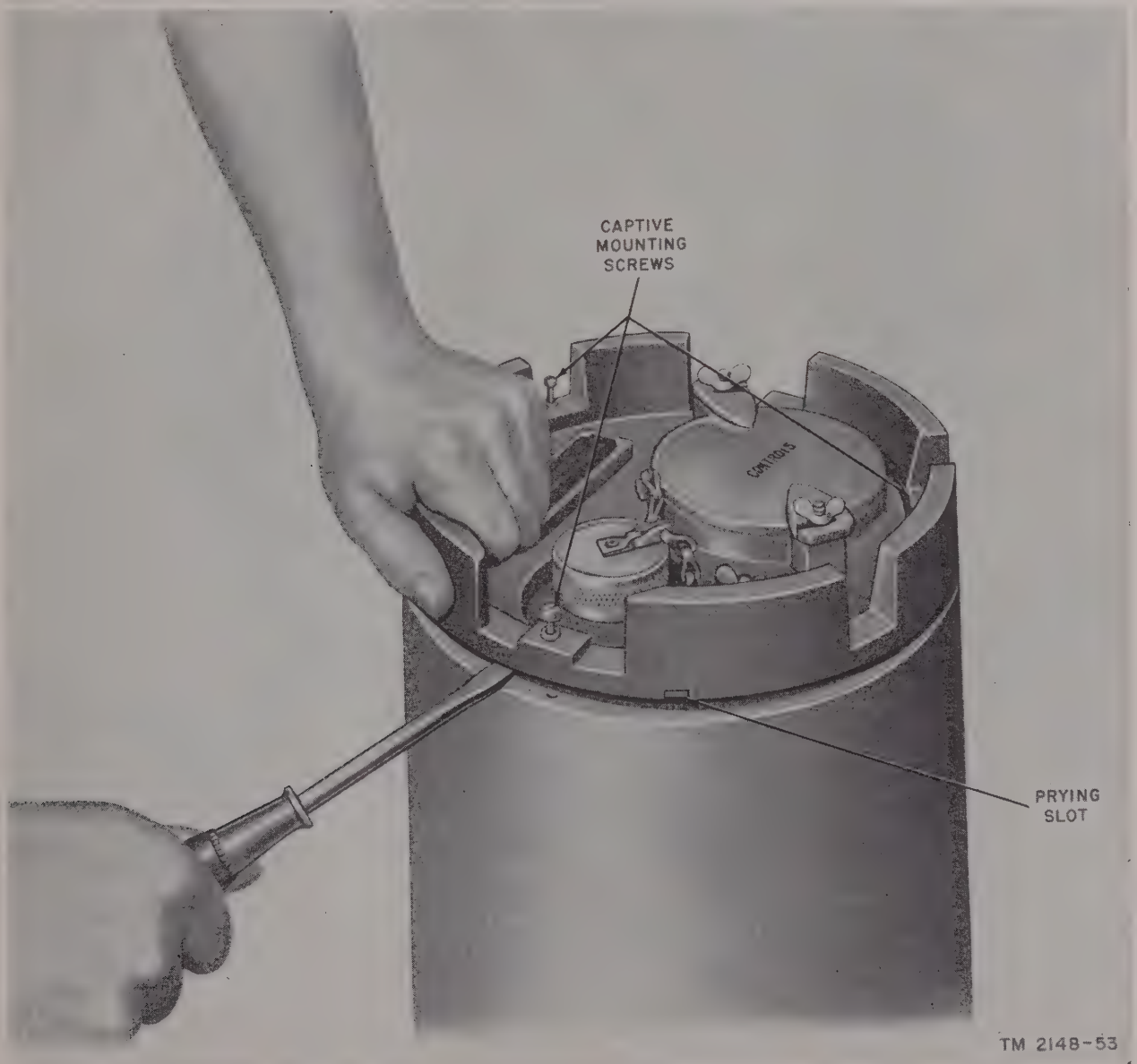


Figure 60. Telephone Repeater AN/TCC–11, disassembly, method of removing end cover assembly.

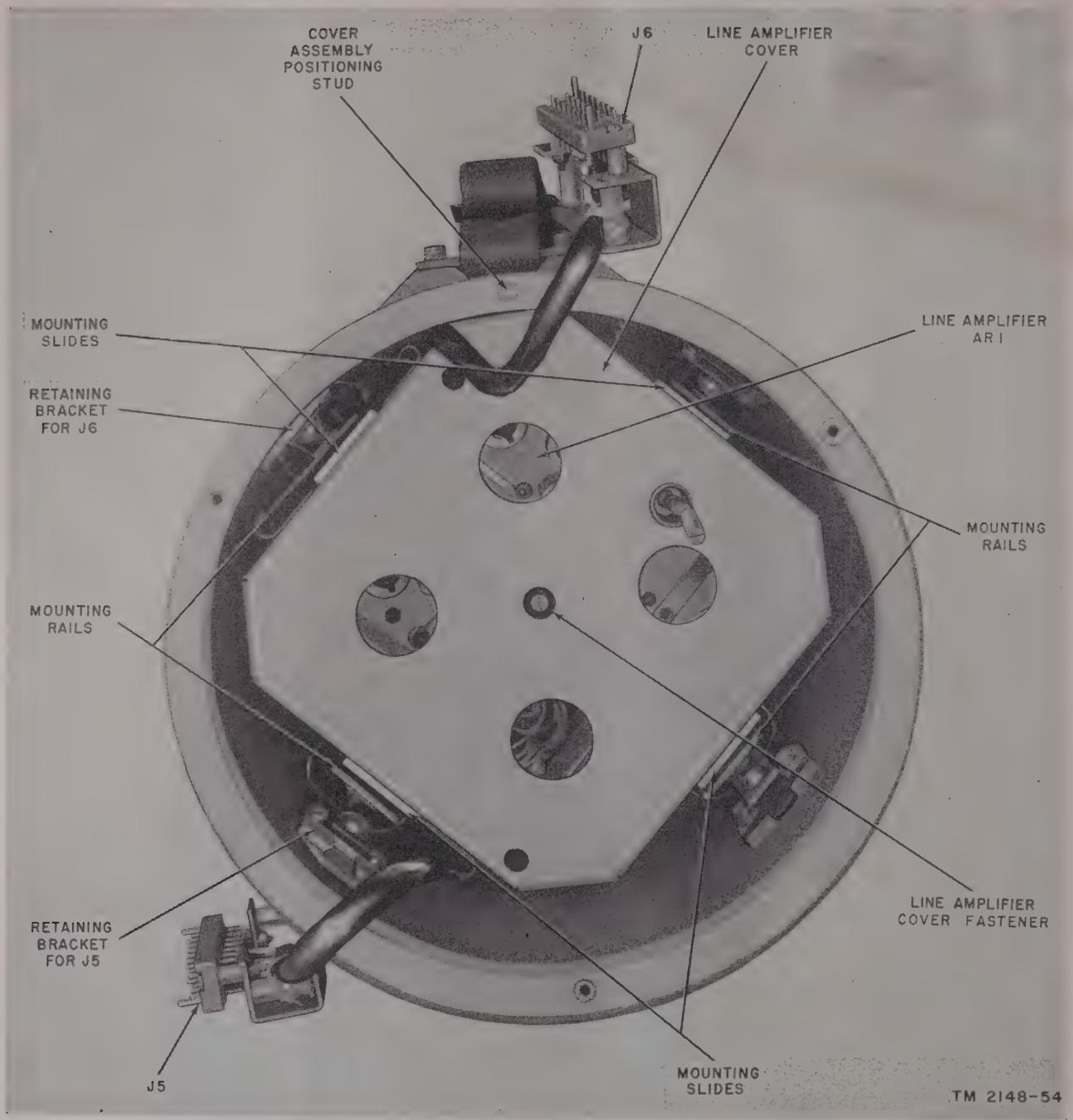


Figure 61. Telephone Repeater AN/TCC–11, disassembly, end cover assembly removed to show line amplifier cover.

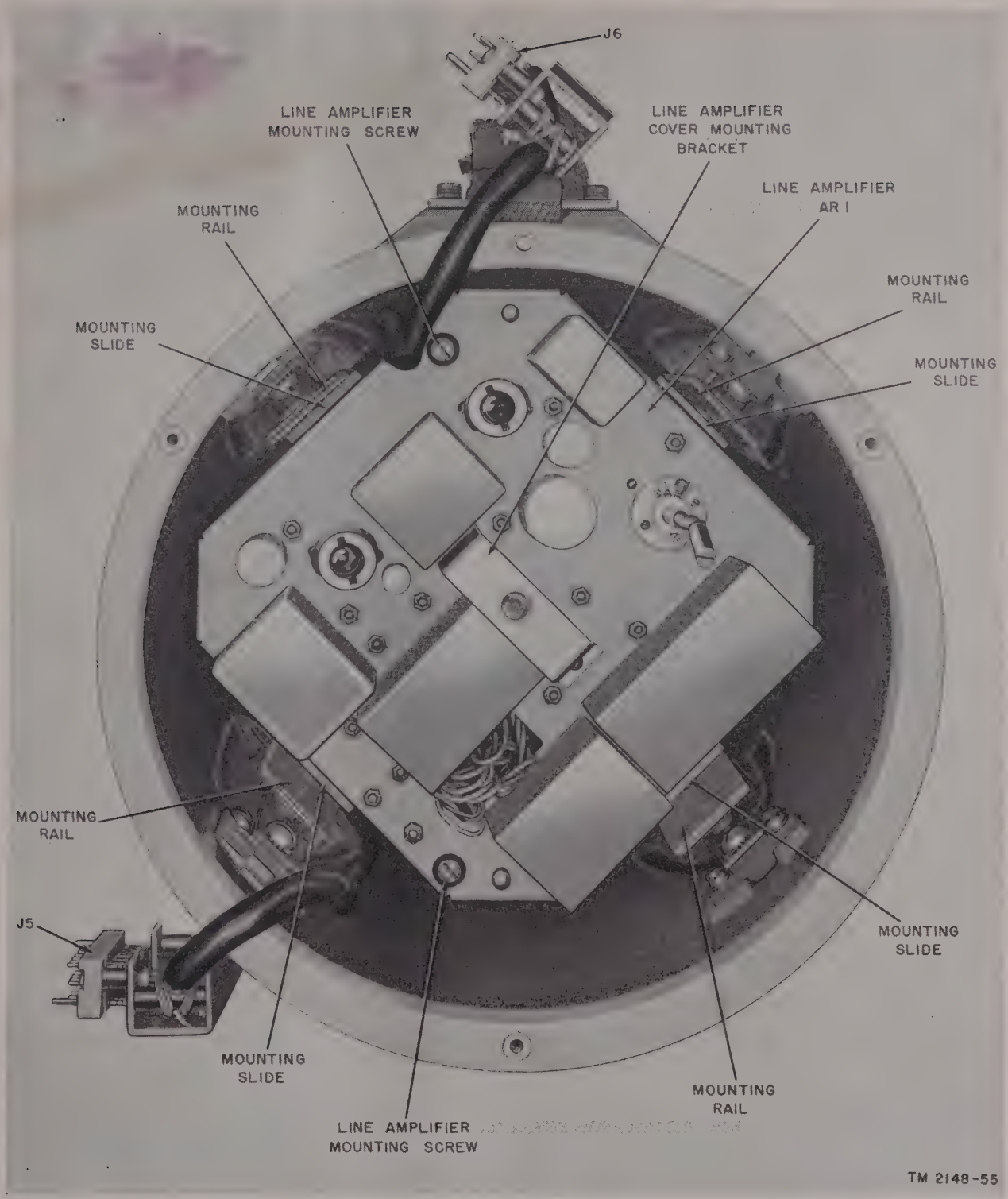


Figure 62. Telephone Repeater AN/TCC–11, disassembly, end cover assembly and line amplifier cover removed.

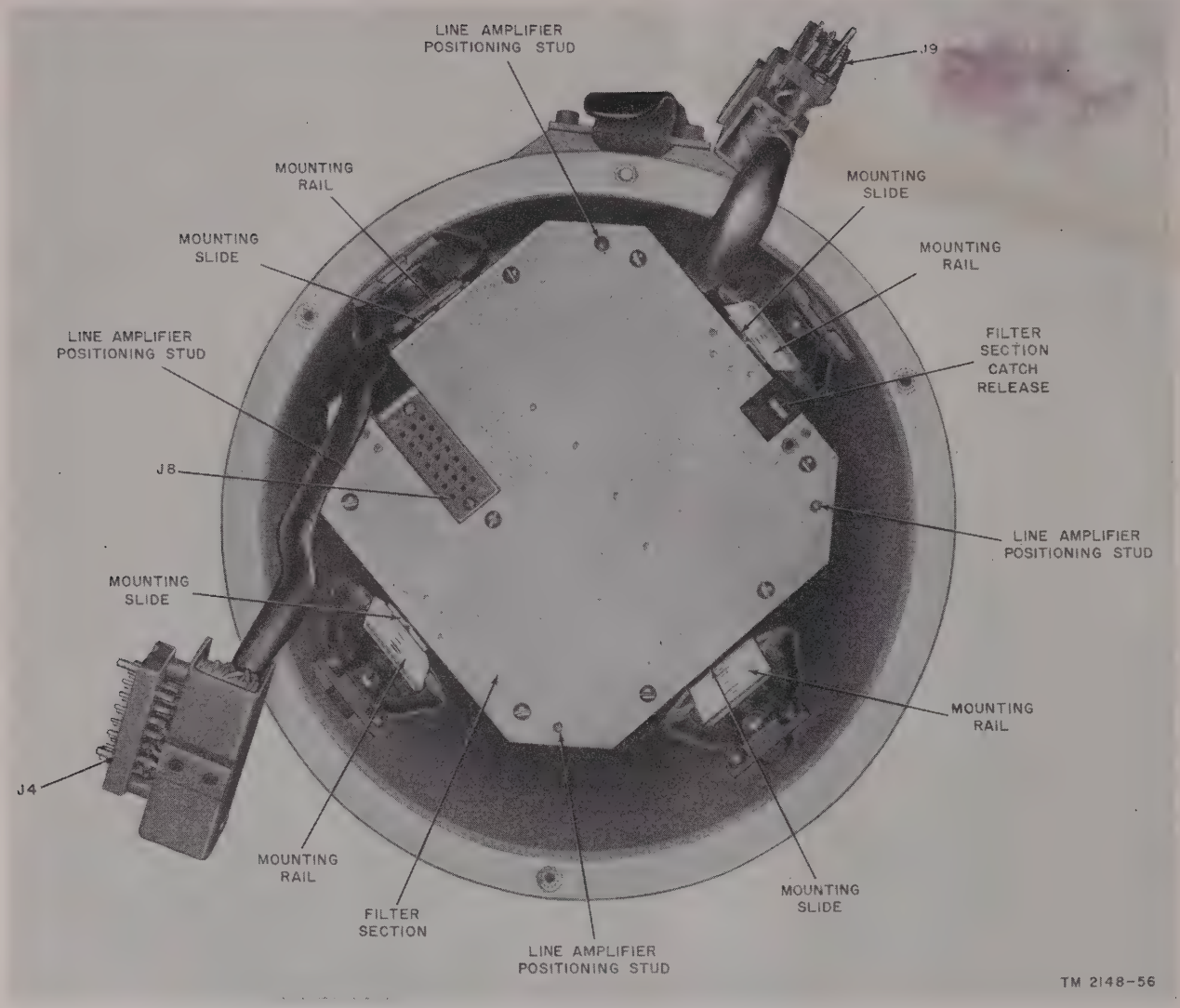


Figure 63. Telephone Repeater AN/TCC–11, disassembly, line amplifier removed to show filter section.

170. Assembly of Telephone Repeater AN/TCC–11

The assembly procedure for Telephone Repeater AN/TCC–11 for field maintenance is given below.

a. Set the repeater case on the end on the floor.

b. Orient the case so that the slotted guide rail faces the repairman. A red dot on the interior wall of the case aids in identifying the slotted guide rail.

c. Orient the filter section so that the red dot on the end of the filter section chassis is on the same end as the dot on the interior case wall. Aline the red dot on the filter section to correspond with the dot on the case, so that the filter section catch will be alined with the slotted guide rail.

d. Insert the filter section in the case and push it down until the filter section catch engages the slot in the mounting rail.

e. Place connectors J5 and J6 so that they dangle over the rim of the repeater case.

f. Orient a line amplifier so that plug P1 of the amplifier lines up with connector J8 of the filter section.

g. Insert the line amplifier in the repeater case and push it down until it rests on the filter section.

h. Tighten the two line amplifier mounting screws (fig. 62).

i. Place the cover on the line amplifier, making sure that the gain switch flexible shaft extension

passes through the proper hole (fig. 47) in the cover.

j. Fasten the line amplifier cover fastener (fig. 61) by turning clockwise.

k. Insert connectors J5 and J6 in the mounting brackets on the interior wall of the case, and place the cables in the clips on the sides of the line amplifier cover.

l. Orient the J2 end cover assembly so that the positioning stud enters the hole on the cover assembly, and the three mounting screws engage their respective holes in the cover assembly.

m. Place the cover assembly on the case and push it down as far as possible making sure that the line amplifier gain switch flexible shaft extension enters the guide tube on the end panel.

n. Tighten the three captive mounting screws on the cover assembly.

o. Turn the repeater end-for-end.

p. Place connectors J4 and J9 so that they dangle over the rim of the repeater case.

q. Orient a line amplifier so that plug P1 lines up with connector J7 on the filter section, and insert the line amplifier in the repeater case, pushing down until the line amplifier rests on the filter section.

r. Repeat the instructions in *h*, *i*, and *j* above.

s. Repeat the procedures given in *k* above for connectors J4 and J9.

t. Repeat the procedures given in *l*, *m*, and *n* above for the J2 end.

171. Refinishing

Instructions for refinishing badly marred panels on exterior cabinets are given in TM 9–2851. Rustproofing instructions for metal parts are given in TB SIG 23.

Section VII. FINAL TESTING, LINE AMPLIFIER

172. General

a. This section is intended as a guide to be used in determining the quality of a repaired line amplifier for Telephone Repeater AN/TCC–11. The minimum test requirements outlined in paragraphs 173 through 180 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

b. The final testing for the Telephone Repeater AN/TCC–11 line amplifier includes the continuity tests (par. 174), d-c voltage test (par. 175), gain test without feedback (par. 176), gain test with feedback (par. 177), regulation test (par. 178), over load test (par. 179), and phase margin test (par. 180). All tests use the same basic test setup (fig. 41) and are performed in the order in which they appear in this manual, so that the procedures of one test will follow immediately the procedures of the preceding test.

173. Test Equipment for Final Tests

The test equipment required for final tests of Telephone Repeater AN/TCC–11 line amplifier is listed in the table below.

Item	Test equipment	Technical manual or instruction book	Fig. No.	Amt. Req.
1	Electronic Multimeter ME–6/U	Manufacturer's instruction book		1
2	Multimeter TS–352/U	TM 11–5527		1
3	Power Supply PP–827/U			1
4	Signal Generator SG–71/FCC	Manufacturer's instruction book		1
5	Telephone Repeater AN/TCC–11 line amplifier test jig		35	1
6	Resistor, 130 K, ±5%, ½ w			

174. Continuity Tests

Make continuity tests on all wiring except where lack of continuity or incorrect association of apparatus will cause a failure on some other test. Sufficient continuity tests should be made in all cases to verify that the electrical association of apparatus and equipment is in accord with the equipment layout. Check that paired and shielded wire is used where specified and that the shielding is connected correctly to terminals, panel ground, or filament ground where specified.

Note. Conventional ohmmeters may be used for checking continuity in this equipment provided the short-circuit current between the test leads of the ohmmeter does not exceed 200 milliamperes, and the product of the open circuit voltage and the short-circuit current does not exceed 0.4 volt-ampere on any scale.

a. Check that ground is present for all terminals and all apparatus cases for which ground is specified.

b. Check the absence of ground for all wires inclosed in shielding, and all apparatus cases that are insulated from the panel.

c. Check the proper functioning of all controls through transmission tests and not by visual inspection alone.

175. D-c Voltage Test

a. Test Set-Up. Make the test set-up as shown in figure 41.

(1) Connect terminals 2 and 5 of the Telephone Repeater AN/TCC–11 line amplifier test jig to the output of the power supply.

(2) Connect connector J1 on the AN/TCC–11 line amplifier test jig to plug P1 of the amplifier to be checked.

(3) Connect the Signal Generator SG–71/FCC output number 1 to terminals 3 and 0 of the test jig through a 130 K resistor. Connect one terminal of Signal Generator SG–71/FCC directly to terminal 0 of the test jig and connect the other terminal to terminal 3 through a 130 K resistor.

b. Test. The d-c voltage test is performed in the manner described below.

(1) Turn on the power supply and adjust to 200 volts (par. 145*b*).

(2) The d-c voltage requirements for final testing of the line amplifier are given in the table below.

Measure		Voltage requirements	
From pin	To pin	Min	Max
Plug P1, pin 16	Ground	15. 5	17. 5
Plug P1, pin 2	Ground	A+1. 0	A+2. 5
Plug P1, pin 19	Ground	A+1. 0	A+2. 5

Note. A = Value of first reading falling between 15.5 and 17.5.

176. Gain Test Without Feedback

The gain test without feedback uses the same test setup (fig. 41) as the d-c voltage test (par. 175). The test procedures are listed below.

a. Turn on the power supply and adjust to 200 volts (par. 145*b*).

b. Turn on Signal Generator SG–71/FCC and allow a sufficient warm-up period before using.

c. Operate the gain switch S1 to the full clockwise position corresponding to the LOW position.

d. Use a jumper wire to short the wiper (No. 10) contact of switch S1 to panel ground, removing feedback.

e. Adjust the Signal Generator SG–71/FCC frequency output to the frequencies shown in the table below.

f. Connect Electronic Multimeter ME-6/U to terminals 4 and 1 of the test jig and adjust the Signal Generator SG-71/FCC output for a voltage reading of 0.003 volt on the ME–6/U. Repeat this step for each frequency setting indicated in the table below.

g. Connect the ME–6/U to terminals 14 and 17 on the line amplifier test jig.

h. The ME–6/U readings indicating correct gains are listed in the table below.

Frequency (kc)	ME–6/U reading (volts)
68	1. 5± 1. 0
28	1. 05± . 7
12	. 68± . 5

177. Gain Test With Feedback

a. Test Set-Up. The test set-up for the gain test with feedback is the same as for the gain test without feedback (fig. 41) with the following exceptions.

(1) Remove the jumper wire between the wiper contacts (No. 10) on gain switch S1.

(2) Remove the 130 K resistor between Signal Generator SG–71/FCC and terminal 3 of the line amplifier test jig.

(3) Connect Signal Generator SG–71/FCC directly to terminal 3 of the line amplifier test jig.

b. Test. The procedures for the line amplifier gain test with feedback are described below.

(1) Adjust the frequency output of Signal Generator SG–71/FCC to 68 kc.

(2) Connect Electronic Multimeter ME–6/U to terminals 4 and 1 of the line amplifier test jig and adjust the output of SG–71/FCC for a voltage reading of 0.051 volt on the ME–6/U.

(3) Connect the ME–6/U to terminals 14 and 17 of the line amplifier test jig.

(4) The reading for correct 68-kc gain is 0.25±0.04 volt. Note the ME–6/U reading on the db scale.

(5) Operate gain switch S1 to the full counterclockwise position corresponding to the LOW position.
(6) The reading on the ME–6/U should decrease 2.5 ±0.5 db with respect to the reading in (4) above.
(7) Operate gain switch S1 to its full clockwise position corresponding to the HIGH position.
(8) The ME–6/U reading should increase 2.5 ±0.5 db with respect to the reading in (4) above.
(9) Operate gain switch S1 to the middle position.

178. Regulation Test

a. Test Set-Up. The test set-up for the line amplifier regulation test (fig. 41) is the same as for the d-c voltage test (par. 175*a*).

b. Test. The procedures for the regulation test are described below.

(1) Remove resistor R4 (135 ohms) from terminals 9 and 6 of the terminal board.
(2) The reading on the ME–6/U should change −3.3 db ±1.0 db with respect to the reading in paragraph 177*b*(4).
(3) Connect a short circuit across terminals 9 and 6 of the terminal board.
(4) The ME–6/U reading should increase +5.5 db ±1.0 db with respect to the reading in paragraph 177*b*(4).
(5) Adjust the frequency output of SG–71/FCC to 28 kc.
(6) Connect the ME–6/U to terminals 4 and 1 of the test jig and adjust the SG–71 amplitude controls for a meter reading of 0.09 volt.
(7) Connect the ME–6/U to terminals 14 and 17 of the test jig, and connect a 135-ohm resistor to terminals 6 and 9 of TB1.
(8) Note the reading on the ME–6/U. This reading should not deviate more than ±0.8 db from the reading in paragraph 177*b*(4).
(9) Remove the 135-ohm resistor from terminals 9 and 6 of the test jig and short circuit terminal 9 to terminal 6.
(10) Note the ME–6/U reading. This reading should decrease +7.5 db ±1.0 db with respect to the reading in (9) above.
(11) Connect resistor R4 to pins 9 and 6 of terminal board.
(12) Adjust the SG–71/FCC frequency output to 12 kc.
(13) Connect the ME–6/U to terminals 4 and 1 of the line amplifier test jig and adjust the SG–71/FCC amplitude controls for an ME–6/U reading of 0.11 volt.
(14) Connect the ME–6/U to terminals 14 and 17 of the line amplifier test jig.
(15) Note the reading on the ME–6/U. This reading should not deviate more than ±0.8 db from the reading in paragraph 177*b*(4).
(16) Repeat (10) above.
(17) Note the reading on the ME–6/U. This reading should change 6.3 ±1.0 db with respect to the reading in (16) above.

179. Overload Test

a. Test Set-Up. The test set-up for the overload test (fig. 41) is the same as for the d-c voltage test (par. 175*a*).

b. Test. The test procedures for the overload test are described in detail below.

(1) Connect resistor R4 (135 ohms) to terminals 9 and 6 and short out resistor R14 (15 K) on the line amplifier test jig.
(2) Connect Electronic Multimeter ME–6/U across terminals 4 and 1 of the test jig and adjust the Signal Generator SG–71/FCC amplitude controls for a meter reading of 1.75 volts.
(3) Connect the ME–6/U across terminals 14 and 17 of the test jig.
(4) Note the ME–6/U reading. The reading should be 7.75 ±1.5 volts for correct 68-kc gain at high load.
(5) Remove the short circuit from resistor R14.

180. Phase Margin Test

a. Test Set-Up. The test set-up for the phase margin test is the same as for the d-c voltage measurements (fig. 41) with the following changes.

(1) Turn off Signal Generator SG–71/FCC.
(2) Remove resistor R4 (135 ohms) from test jig and leave terminals 6 and 9 unterminated.
(3) Connect the leads of Electronic Multimeter ME–6/U to pin 5 of V2 and panel ground and set on the 1.0-volt range.

b. Test. The procedures for performing the phase margin test are described below.

(1) Operate switch S1 to the full counterclockwise position.
(2) Turn on the power supply and observe the ME–6/U.
(3) For proper phase margin the multimeter needle will come to rest with a sustained reading not higher than 0.1 volt within 15 seconds after the application of power.

Section VIII. FINAL TESTING, TELEPHONE REPEATER AN/TCC–11

181. General

a. This section is intended as a guide to be used in determining the quality of a repaired Telephone Repeater AN/TCC–11. The minimum test requirements outlined in paragraphs 183 to 192 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipments meeting these requirements will furnish uniformly satisfactory operation.

b. The final testing for the Telephone Repeater AN/TCC–11 includes the continuity tests (par. 183), filter section d-c resistance test (par. 184), repeater d-c resistance test (par. 185), relay operation test (par. 186), repeater d-c voltage test (par. 187), transmission test, transmission circuit 1 (par. 188), transmission test, transmission circuit 2 (par. 189), looping filter transmission test (par. 190), crosstalk test, transmission circuit 1 (par. 191), crosstalk test, transmission circuit 2 (par. 192).

182. Test Equipment Required for Final Testing

The test equipment required for the final testing of Telephone Repeater AN/TCC–11 is listed in the table below.

Item	Test equipment	Technical manual or instruction book	Fig. No.	Amt. req.
1	Attenuator TS–402/U	TM 11–2044		1
2	Multimeter TS–352/U	TM 11–5527		1
3	Electronic Multimeter ME–6/U	Manufacturer's instruction book		1
4	Signal Generator SG–71/FCC			1
5	Audio Level Meter ME–71/FCC			1
	The following items are a part of Telephone Carrier Test Facilities Kit MK–155( )/TCC:			
6	Telephone Repeater AN/TCC–11, test jig		34	1
7	Telephone Repeater AN/TCC–11, repeater transmission test cable assembly.		30	2
8	Telephone Repeater AN/TCC–11, voltage-resistance test cable assembly.		31	1
9	Telephone Repeater AN/TCC–11, filter section test cable assembly.		64	2
10	Power Supply PP–827/U			1
11	Repeating coil (GA 51116)			1
12	Resistor: 20,000 ohms ±20%; 5 w			1
13	Resistor: 2,000 ohms ±20%; 25 w			1
14	Resistor: 6,800 ohms ±5%; ½ w			2
15	Resistor: 600 ohms ±1%; ½ w			1
16	Resistor: 135 ohms ±1%; ½ w			1

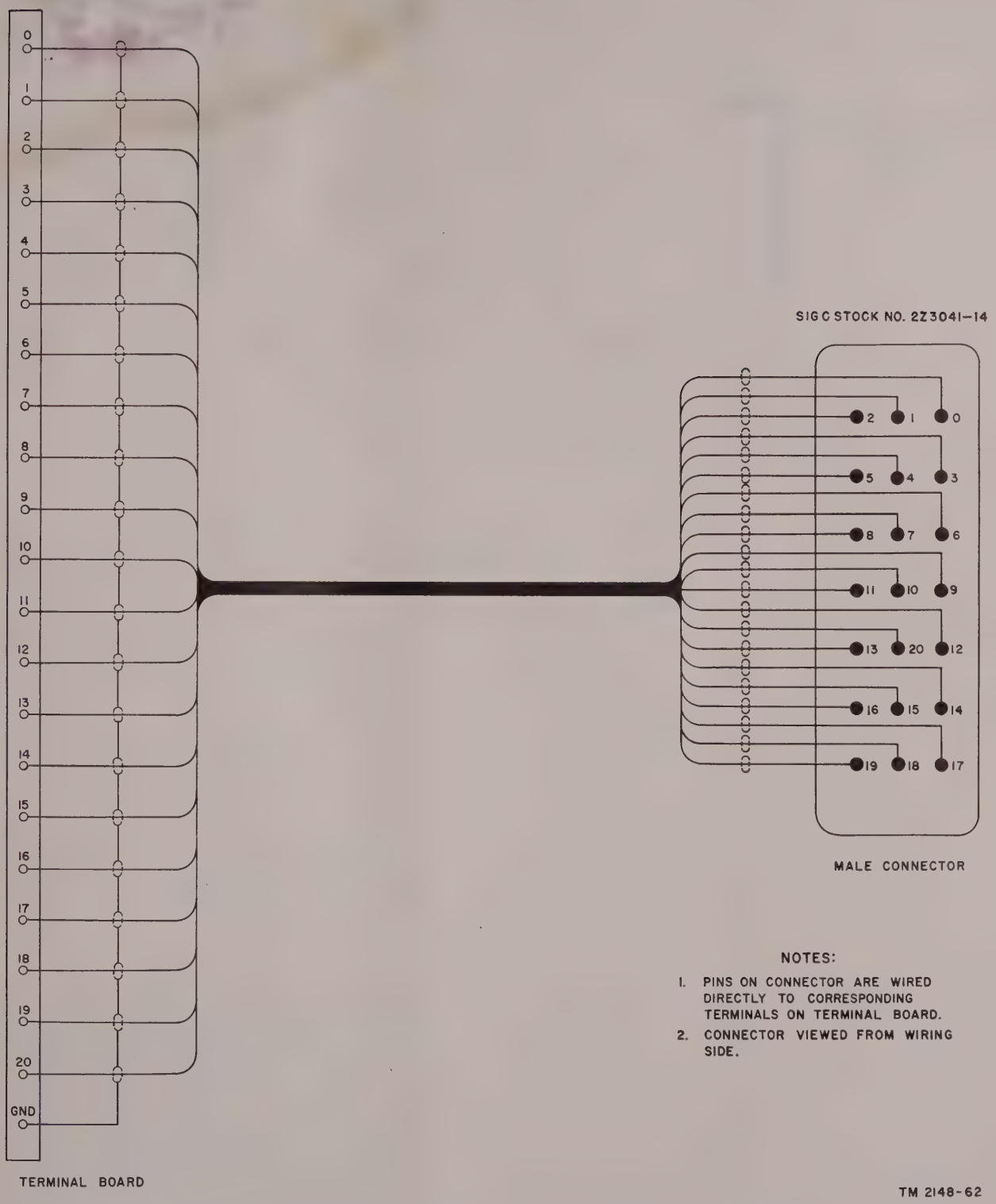
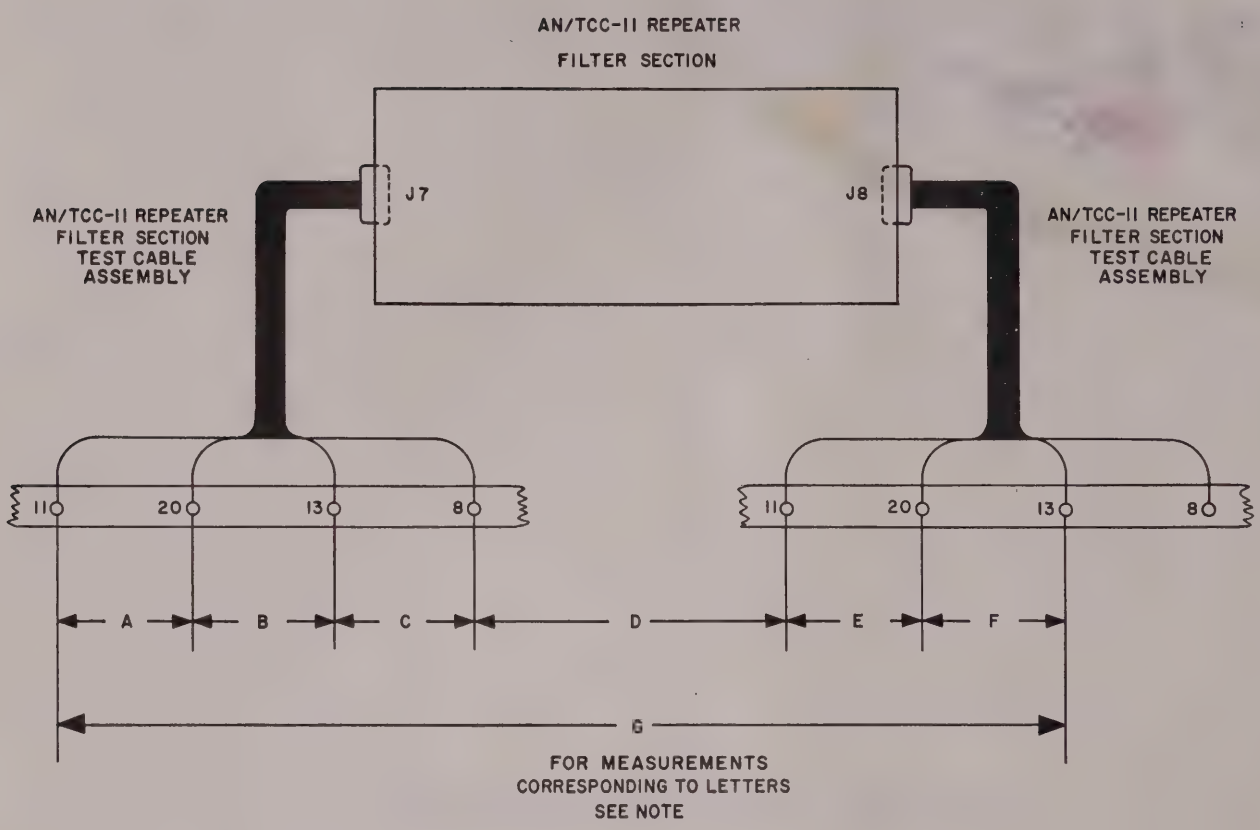


Figure 64. Telephone Repeater AN/TCC–11, filter section test cable assembly.



NOTE:

MEASUREMENTS CORRESPONDING TO LETTERS BETWEEN TERMINALS ON TEST CABLE ASSEMBLIES ARE LISTED IN TABLE BELOW:

MEASUREMENTS	READING IN OHMS		
	AVG	MIN	MAX
A	1200	1100	1300
B	1200	1100	1300
C	1100	1000	1200
D	5900	5300	6500
E	1200	1100	1300
F	1200	1100	1300
G	0	0	1

TM 2148-61

Figure 65. Telephone Repeater AN/TCC–11, filter section test set-up.

183. Continuity Tests

Make continuity tests on all wiring except where lack of continuity or incorrect association of apparatus will cause a failure on some other test. For detailed instructions on continuity tests refer to paragraph 174.

184. D-c Resistance Test, Filter Section

A d-c resistance test should be made on the filter section before the repeater is assembled to assure that the correct voltages will be supplied to the line amplifiers.

a. Test Set-Up. Connect the filter section test cable assemblies (fig. 64) to connectors J7 and J8 of the filter section (fig. 65).

b. Test. Use Multimeter TS–352/U to make the d-c resistance measurements described in the table below.

Measure between—				D-c resistance (ohms)		
Terminal	Test cable to connector	Terminal	Test cable to connector	Avg	Min	Max
8	J7	11	J8	5, 900	5, 300	6, 500
8	J7	13	J7	1, 100	1, 000	1, 200
13	J7	20	J7	1, 200	1, 100	1, 300
20	J7	11	J7	1, 200	1, 100	1, 300
11	J7	13	J8	0	0	1
13	J8	20	J8	1, 200	1, 100	1, 300
20	J8	11	J8	1, 200	1, 100	1, 300

185. Telephone Repeater AN/TCC–11, D-c Resistance Test

The d-c resistance test for Telephone Repeater AN/TCC–11 is made with Telephone Repeater AN/TCC–11 completely assembled.

a. Test Set-Up. Arrange the test set-up shown in figure 36.

(1) Connect a transmission test cable assembly to connector J1 of the repeater.

(2) Connect a transmission test cable assembly to connector J2 of the repeater.

(3) Connect a voltage-resistance test cable assembly to connector J3 of the repeater.

b. Test. The test procedures for the d-c resistances test of Telephone Repeater AN/TCC–11 are listed below.

(1) Remove the CONTROLS cover from the J2 end panel of the repeater and operate the PWR LOOP-PWR THRU switch to the PWR THRU position.

(2) The d-c resistance requirements for proper operation are given in the table below.

Item checked	Measure between—				D-c resistance (ohms)		
	Terminal	Test cable to connector	Terminal	Test cable to connector	Avg	Min	Max
Power circuit resistance	3	J1	1	J2	1, 200	1, 000	1, 400
Power circuit insulation resistance	3	J1	1	J1	100K	80K	120K
Power return circuit resistance	3	J2	1	J1	34	20	50
Panel ground to case ground resistance	M	J3	D	J3	----------	5 meg	----------

(3) Operate the PWR LOOP-PWR THRU switch S1 to the PWR LOOP position (fig. 37).

(4) The d-c resistance requirements for proper operation are given in the table below.

Item checked	Measure between—				D-c resistance (ohms)		
	Terminal	Test cable to jack	Terminal	Test cable to jack	Avg	Min	Max
Power circuit resistance	3	J1	1	J1	1, 200	1, 000	1, 400
Power circuit insulation resistance	3	J1	1	J2	----	5 meg	----
Power return circuit resistance	3	J2	1	J2	4. 5	3. 0	5. 5
Power ground to case ground resistance	M	J3	D	J3	----	5 meg	----

186. Relay Operation Test

The relay operation test for final testing purposes is the same as the relay test for field maintenance (par. 146 and fig. 40).

187. Telephone Repeater AN/TCC–11, D-c Voltage Tests

a. Test Set-Up. The test set-up is the same as for the transmission test (par. 141*a–c*) (fig. 38). Be sure that Signal Generator SG–71/FCC is turned off.

b. Test. Perform the Telephone Repeater AN/TCC–11 d-c voltage test in the manner described below.

(1) Operate the Telephone Repeater AN/TCC–11 controls to the positions shown in the table below.

Switch	Location	Position
GAIN AMP 1	J1 end panel	AVG.
GAIN AMP 2	J2 end panel	AVG.
PWR LOOP-PWR THRU.	J2 end panel	PWR LOOP.
REP	J2 end panel	1.

(2) Turn the power supply on and adjust to 200 volts (par. 145*b*).

(3) Using Multimeter TS–352/U on the 50-volt scale, measure the d-c voltages indicated in the table below.

Measure between—				D-c voltage requirement	
Pin	Jack	Pin	Jack	Min	Max
J	J3	M	J3	15. 5	17. 5
B	J3	M	J3	A+1. 0	A+2. 5
K	J3	M	J3	A+1. 0	A+2. 5
F	J3	M	J3	A+1. 0	A+2. 5
P	J3	M	J3	A+1. 0	A+2. 5

Note. A=Value of first reading between 15.5 and 17.5.

188. Telephone Repeater AN/TCC–11, Transmission Test, Transmission Circuit 1

a. Test Set-Up. The test set-up for the transmission test of transmission circuit 1 is the same as for the Telephone Repeater AN/TCC–11 d-c voltage test (par. 187*a*).

b. Test. Perform the transmission test of transmission circuit 1 in the manner described below.

(1) Adjust the amplitude controls of Signal Generator SG–71/FCC for minimum output.

(2) Turn on the SG–71/FCC and allow a sufficient warm-up period before using.

(3) Adjust the frequency output of SG–71/FCC to 68 kc.

(4) Adjust Attenuator TS–402/U to provide 22 db of attenuation.

(5) Connect Electronic Multimeter ME–6/U across the input of TS–402/U and adjust the input to the TS–402/U to 0.25 volt.

(6) Connect the probes of ME–6/U to terminal posts 3 and 4 of the repeater test jig.

(7) The voltage requirements for correct 68-kc transmission are given in the table

below. Note the equivalent reading on the db scale of the ME–6/U for the voltage reading taken.

Ambient temperature at time of test (degrees F.)	ME–6/U reading (volt)
50	0. 175 to 0. 28
60	. 18 to . 29
70	. 185 to . 30
80	. 19 to . 31
90	. 195 to . 32
100	. 20 to . 33
110	. 205 to . 34

(8) Operate the GAIN AMP 1 switch to the LOW position. The ME–6/U reading should decrease −2.5 ±0.5 db with reference to the meter reading with the gain switch in the AVG position.

(9) Operate the GAIN AMP 1 switch to the HIGH position. The meter reading should increase +2.5 ±0.5 db with reference to the meter reading with the gain switch in the AVG position.

(10) Operate the GAIN AMP 1 switch to the AVG position.

(11) Use the ME–6/U to measure the voltages listed in the table below on the test cable connected to connector J3 of Telephone Repeater AN/TCC–11.

(12) Adjust the frequency output SG–71/FCC to 28 kc.

(13) Adjust the controls of TS–402/U to provide 17 db of attenuation.

(14) Connect the ME–6/U across the input of Attenuator TS–402/U and adjust the amplitude controls on the SG–71 for a reading of 0.24 volt on the ME–6/U.

(15) Connect the ME–6/U to terminals 3 and 4 of the repeater test jig.

(16) Note the reading on the db scale of the ME–6/U. If the 28-kc transmission is correct, this reading should not deviate from the reading in (7) by more than ±1.2 db.

(17) Adjust the frequency output SG–71/FCC to 12 kc.

(18) Adjust the controls of TS–402/U to provide 15 db of attenuation.

(19) Connect the ME–6/U across the input of TS–402/U and adjust the amplitude controls on the SG–71/FCC for a reading of 0.235 volt on the ME–6/U.

(20) Connect the ME–6/U to terminals 3 and 4 of the repeater test jig.

(21) Note the ME–6/U reading on the db scale. This reading should not deviate from the reading obtained in (7) above by more than ±1.0 db.

(22) Adjust the frequency output of SG–71/FCC to 1 kc.

(23) Adjust the controls of TS–402/U to provide 10 db of attenuation.

(24) Connect the ME–6/U to the input of the TS–402/U and adjust the amplitude controls of the SG–71/FCC for a reading of 0.25 volt on the ME–6/U.

(25) Connect the ME–6/U to terminal points 3 and 4 of the repeater test jig.

(26) Note the reading on the ME–6/U. The voltage requirement for 1 kc transmission is 0.05 ±0.008 volt.

(27) Connect the ME–6/U to terminals L and M (ground) of the test cable connected to connector J3 of Telephone Repeater AN/TCC–11.

(28) Note the reading on the ME–6/U. The voltage requirement is 0.08 ±0.0025 volt.

Item checked	Positive probe on terminal	Negative probe on terminal	ME–6/U reading (volt)
Input to amplifier AR1.	A	M	0.017±0.007
Output from amplifier AR1.	C	M	. 33 ± . 12

189. Telephone Repeater AN/TCC–11, Transmission Test, Transmission Circuit 2

a. Test Set-up. The test set-up for the transmission test of transmission circuit 2 is the same as the test set-up for Telephone Repeater AN/TCC–11, d-c voltage test (par. 187).

b. Test. Perform the transmission test of transmission circuit 2 in the manner described below.

(1) Repeat the procedures given in paragraph 188*b*(3) through (5).

(2) Connect the probes of Electronic Multimeter ME–6/U to terminals 7 and 8 of the repeater test jig.

(3) Note the reading on the db scale of the ME–6/U. The voltage requirements for 68-kc transmission are given in the table in paragraph 188*b*(7).

(4) Operate the GAIN AMP 2 switch to the LOW position. The reading on the ME–6/U should decrease −2.5 ±0.5 db with reference to the reading in (3) above.

(5) Operate the GAIN AMP 2 switch to the HIGH position. The meter reading should increase +2.5 ±0.5 db with reference to the meter reading in (3) above.

(6) Operate the GAIN AMP 2 switch to the AVG position.

(7) Use the ME–6/U to measure the voltages on the test cable connected to J3 of Telephone Repeater AN/TCC–11. The correct voltages are given in the table below.

Item checked	Positive probe on terminal	Negative probe on terminal	ME–6/U reading (volt)
Input to amplifier AR2.	R	M	0.017±0.007
Output from amplifier AR2.	E	M	.33 ± .12

(8) Repeat the procedures given in paragraph 188*b*(12) through (14).

(9) Connect the ME–6/U to terminals 7 and 8 of the repeater test jig.

(10) Repeat the procedures given in paragraph 188*b*(16) through (19).

(11) Connect the ME–6/U to terminals 7 and 8 of the repeater test jig.

(12) Repeat the procedures given in paragraph 188*b*(21) through (24).

(13) Connect the ME–6/U to terminals 7 and 8 of the repeater test jig.

(14) Note the reading on the ME–6/U. The voltage requirement for 1-kc transmission is 0.05 ±0.008 volt.

(15) Connect the ME–6/U to terminals N and M (ground) of the test cable connected to connector J3 of Telephone Repeater AN/TCC–11. The voltage requirement is 0.08 ±0.025 volt.

190. Looping Filter Transmission Test

a. Test Set-Up. The test set-up for the looping filter transmission test is the same as for the field maintenance transmission test (fig. 38) with the following exceptions.

(1) Remove the voltage resistance test cable assembly from connector J3 of Telephone following exceptions.

(1) Remove the voltage resistance test cable assembly from connector J3 of Telephone Repeater AN/TCC–11, and leave connector J3 unterminated.

(2) Terminate terminals 5 and 6 of the Telephone Repeater AN/TCC–11 test jig with a 600-ohm resistor.

b. Test. Perform the looping filter transmission test according to the procedures given below.

(1) Turn the power supply on and adjust to 200 volts (par. 145*b*).

(2) Operate the signal generator frequency dial, the REP switch, and attenuator TS–402/U as indicated in the table below.

(3) Connect the ME–6/U across the input of TS–402/U and adjust the input to the TS–402/U to 0.25 volt. Repeat this step for each frequency setting listed in the table below.

(4) Connect the probes of the ME–6/U to terminals 7 and 8 of the repeater test jig. The meter readings for proper looping filter transmission are listed in the table below.

SG–71/FCC frequency setting (kc)	TS–402/U setting (db)	REP switch setting	ME–6/U readings (volts)
68	10	3	Less than 0.0012.
83	10	3	1.2 ±0.6.
83	10	2	Less than 0.012.
91	10	3	Less than 0.012.
91	10	2	1.75 ±0.9.
91	10	1	Less than 0.04.
99	10	2	Less than 0.04.
99	10	1	2.1 ±1.0.
110	10	1	Less than 0.04.

191. Telephone Repeater AN/TCC–11, Crosstalk Test, Transmission Circuit 1

a. Test Set-Up. The test set-up for the crosstalk test of transmission circuit 1 is the same as for the looping filter transmission test (par. 190).

b. Test. The procedures for performing the crosstalk test of transmission circuit 1 are given below.

(1) Operate the REP switch to the 3 position.

(2) Connect Audio Level Meter ME–71/FCC to terminals 7 and 8 of the Telephone Repeater AN/TCC–11 test jig.

(3) Turn the power supply on and adjust to 200 volts (par. 145*b*).

(4) Adjust the frequency output of Signal Generator SG–71/FCC and the attenuation of Attenuator RS–402/U as indicated in the table below.

(5) Connect Electronic Multimeter ME–6/U across terminals 3 and 4 of the Telephone Repeater AN/TCC–11 test jig and adjust the amplitude controls of the SG–71/FCC for a meter reading of 2.5 volts on the ME–6/U for each frequency setting shown in the table below.

(6) Note the readings on Audio Level Meter ME–71/FCC. The crosstalk requirements as indicated on the ME–71/FCC are shown in the table below.

SG–71/FCC frequency setting (kc)	TS–402/U setting (db)	ME–71/FCC indication (db)
68	0	Less than −56.
28	0	Less than −56.
12	0	Less than −56.

192. Telephone Repeater AN/TCC–11, Crosstalk Test, Transmission Circuit 2

a. Test Set-Up. The test set-up for crosstalk test of transmission circuit 2 is the same as for the crosstalk test of transmission circuit 1 with the following exceptions.

(1) Connect the 600-ohm resistor between terminals 1 and 2 of the repeater test jig.

(2) Connect the leads to Audio Level Meter ME–71/FCC to terminals 3 and 4 of the repeater test jig.

b. Test. The procedures for performing the crosstalk test of transmission circuit 2 are discussed below.

(1) Adjust the frequency output of Signal Generator SG–71/FCC and the attenuation of Attenuator TS–402/U as shown in the chart in paragraph 191*b*(6).

(2) Connect Electronic Multimeter ME–6/U across terminals 7 and 8 of the repeater test jig. Adjust the amplitude controls on the SG–71/FCC for a meter reading of 2.5 volts on the ME–6/U for each frequency setting in (1) above.

(3) Note the readings on the ME–71/FCC. The crosstalk requirements as indicated on the ME–71/FCC are shown in the table accompanying paragraph 191*b*(6).

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

193. Disassembly

The following instructions are recommended as a guide for preparing Telephone Repeater AN/TCC–11 for transportation and storage.

a. Disconnect the spiral-four cable connectors from receptacles J1 and J2.

b. Thread the receptacle covers back on connectors J1 and J2, and tighten the cover over TEST receptacle J3, using the wingbolt. Be sure the receptacle covers are clean before replacing them.

c. Wipe a small amount of silicone grease over the O-shaped rubber gaskets on the CONTROLS access port covers, replace the covers, and tighten both wingnuts.

194. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 22 and reverse the instructions given in that paragraph.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the cardboard cartons. Protect the crates with a waterproof tape barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected cartons in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

195. General

The demolition procedures outlined in paragraph 196 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

196. Methods of Destruction

a. Smash. Smash the controls, tubes, switches, capacitors, transformers, and filter network, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords and wiring, using axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend end and assembly panels, chassis.

e. Explode. If explosives are necessary, use firearms, grenades, or TNT.

f. Dispose. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. Destroy Everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, check SR 310–20–3, SR 310–20–4, SR 310–20–5, and SR 310–20–7. Check Department of the Army Supply Manual SIG I for Signal Corps supply manuals.

1. Army Regulations

AR 380–5 Safeguarding Security Information.
AR 750–5 Maintenance Responsibilities and Shop Operation.

2. Supply Bulletins

SB 11–6 Dry Battery Supply Data.
SB 11–100 Serviceability Standards for Signal Equipment in Hands of Troops.

3. Auxiliary Equipment and Test Equipment

TM 11–680 Teletypewriter Circuits and Equipment (Fundamentals).
TM 11–2044 Attenuators TS–402/U and TS–402A/U.
TM 11–2627 Tube Tester I–177 and I–177–A.
TM 11–5527 Multimeter TS–352/U.

4. Painting, Preserving, and Lubrication

TB SIG 13 Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 23 Rustproofing of Engines.
TB SIG 69 Lubrication of Ground Signal Equipment.
TM 9–2851 Painting Instructions for Field Use.

5. Camouflage, Decontamination, and Demolition

FM 5–20 Camouflage, Basic Principles.
FM 5–25 Explosives and Demolitions.
TM 3–220 Decontamination.

6. Other Publications

FM 24–5 Signal Communications.
FM 24–18 Field Radio Techniques.
FM 24–20 Field Wire Technique.
FM 72–20 Jungle Warfare.
SR 310–20–3 Index of Training Publications.
SR 310–20–4 Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
SR 310–20–5 Index of Administrative Publications.
SR 310–20–7 Index of Tables of Organization and Equipment, Reduction Tables, Tables of Organization, Tables of Equipment, Type Tables of Distribution, and Tables of Allowances.
SR 700–45–5 Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247(R1).
SR 725–405–5 Preparation and Submission of Requisitions for Signal Corps Supplies.
SR 745–45–5
NAVY SHIPPING GUIDE, ARTICLE 1850–4
AFR 71–4 — Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), S and A–70–6 (Navy), and AF–MC–U2 (Air Force)).
TB ORD 313 Spark Plugs.
TB SIG 4 Methods for Improving the Effectiveness of Jungle Radio Communication.
TB SIG 25 Preventive Maintenance of Power Cords.
TB SIG 66 Winter Maintenance of Signal Equipment.
TB SIG 72 Tropical Maintenance of Ground Signal Equipment.
TB SIG 75 Desert Maintenance of Ground Signal Equipment.
TB SIG 123 Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178 Preventive Maintenance Guide for Radio Communication Equipment.
TB SIG 219 Operation of Signal Equipment at Low Temperatures.
TB SIG 223 Field Expedients for Wire and Radio.
TM 9–2858 Cooling Systems; Vehicles and Powered Ground Equipment.
TM 11–310 Schematic Diagrams for Maintenance of Ground Radio Communication Sets.
TM 11–314 Antennas and Antenna Systems.

273209—53 —10

TM 11–369	Spiral-Four Cable.
TM 11–430	Batteries for Signal Communication, except those pertaining to Aircraft.
TM 11–462	Signal Corps Tactical Communication Reference Data.
TM 11–486	Electrical Communication Systems Engineering.
TM 11–661	Electrical Fundamentals (Direct Current).
TM 11–676	Grounding Procedure and Protective Devices.
TM 11–681	Electrical Fundamentals (Alternating Current).
TM 11–2150	Telephone Carrier Systems Using Telephone Terminal AN/TCC–7, Telephone Repeater AN/TCC–8 (AN/TCC–21), Telephone Repeater AN/TCC–11, and Telephone Test Set TS–712/TCC–11.
TM 11–2261	Telephone Outside Plant Engineering.
TM 11–2262	Open Wire Pole Line; Construction and Maintenance.
TM 11–4000	Troubleshooting and Repair of Radio Equipment.
TM 55–405	Preventive Maintenance of Electric Motors and Generators.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. This appendix lists the parts for Telephone Repeater AN/TCC–11 (Sig C stock No. 4B3185–11). The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O & E, T/A, SIG 7 & 8, list of allowances of expendable material, or another authorized supply basis. For an index of available supply manuals, see SIG 1.

1. Telephone Repeater AN/TCC–11

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	J1 END COVER ASSEMBLY: 10″ dia, 2 9/16″ d w/o mtd parts. (See par. 2 of this app. for parts.)	Cover assembly for J1 end of repeater.	4B3185–11–3.
	J2 END COVER ASSEMBLY: 10″ dia, 2 9/16″ d w/o mtd parts. (See par. 3 of this app. for parts.)	Cover assembly for J2 end of repeater.	4B3185–11–1.
	FILTER SECTION: 8 5/16″ lg x 7 13/16″ wd x 7 5/8″ h. (See par. 4 of this app. for parts.)	Holds filters and other circuits common to both line amplifiers.	4B3185–11–4.
AR1	LINE AMPLIFIER AR1: 7 9/16″ lg x 4 1/2″ h x 7 9/16″ wd. (See par. 5 of this app. for parts.)	Amplifies signals entering at connector J1 and leaving at connector J2.	4B3185–11–2.
AR2	LINE AMPLIFIER AR2: identical to line amplifier AR1. (See par. 5 of this app. for parts.)	Amplifies signals entering at connector J2 and leaving at connector J1.	4B3185–11–2.

2. J1 End Cover Assembly

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E1	ARRESTER, lightning: carbon block type; 800 v peak break-down voltage; 565 v rms line to gnd; 21/32″ lg x 23/32″ dia; single cont bayonet base.	Protect equipment from lightning and power surges.	3Z75–6.2.
E2, E5 through E7	ARRESTER, lightning: carbon block type; 500 v peak break-down voltage; 350 v rms line to gnd; 21/32″ lg x 23/32″ dia; single cont bayonet base.	Protect equipment from lightning and power surges.	3Z75–6.1.
C1, C2	CAPACITOR: paper; 1 sect; 470,000 μμf, ±20% 1000 vdcw.	Longitudinal drainage capacitors.	3DA470–40.
J1	CONNECTOR, receptacle: 4 cont, 2 male, 2 female, flat; pol; straight type; Jan No. U–121/G.	Provides connection to spiral-four cable.	2Z7250–121.
P1, P4	CONNECTOR, receptacle: 21 rd male cont; pol; straight type.	Provides electrical connection	2Z3082–107.
XE1, XE2, XE5 through XE7.	HOLDER, lightning arrester: plug type; bayonet base.	Hold protector blocks.	3Z3344–1.
RT1	THERMISTOR: terminals 1 and 2, with terminal 1 connected to terminal 3, 10 ohms ±5% at 77° F.; terminals 3 and 4, 305 ohms ±5% at 77° F.	Regulates amplifier gain to compensate for temperature changes.	3Z6925–6.15.

2. J1 End Cover Assembly—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
T1, T2	TRANSFORMER, AF; Line type; pri 135 ohms (1–2) (3–4), secd 600 ohms (5–6) (7–8); Pri tapped at 67.5 ohms; 1:2.124 ratio of turns, pri (1–2) (3–4) to secd (5–6) (7–8); ±5 db from 0.1 kc to 150 kc freq response.	Match impedance between line and repeater.	2Z9637.188.

3. J2 End Cover Assembly

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E4	ARRESTER, lightning: carbon block type; 800 v peak break-down voltage; 500 v rms line to gnd; 21/32'' lg x 23/32'' dia; single bayonet base.	Protects equipment from lightning and power surges.	3Z75–6.2.
E3, E8 through E10	ARRESTER, lightning: carbon block type; 500 v peak break-down voltage; 350 v RMS line to gnd; 21/32'' lg x 23/32'' dia; single bayonet base.	Protect equipment from lightning and power surges.	3Z75–6.1.
C3, C4	CAPACITOR: paper; 1 sect; 470,000 μμf ±20%; 1,000 vdcw.	Longitudinal drainage capacitor	3DA470–40.
J2	CONNECTOR: receptacle; 4 cont, 2 male, 2 female; flat type; pol; straight type; JAN No. U–121/G.	Provides connection to spiral-four cable.	3Z250–121.
J3	CONNECTOR, receptacle: 14 rd female cont; pol; straight type.	Provides electrical connection	2Z3075–26.
P2, P3	CONNECTOR, receptacle: 21 rd female cont; pol; straight type.	Provides electrical connection	2Z3082–107.
FL5	FILTER, band pass: 67.5 ohms input, 67.5 ohms output impedance; adjustable to pass 83 kc, 91 kc, or 99 kc: three sections, separately cased.	Loop filter to verify transmission condition of repeater and line.	3Z1892–1.80.
XE3, XE4, XE8 through XE10.	HOLDER, lightning arrester: plug type; bayonet base.	Hold protector blocks	3Z3344–1.
RT2	THERMISTOR: terminals 1 and 2, with terminal 1 connected to terminal 3, 10 ohms ±5% at 77° F.; terminals 3 and 4, 305 ohms ±5% at 77° F.	Regulates amplifier AR2 gain to compensate for temperature changes.	3Z6925–6.15.
S1	SWITCH, rotary: 2 sect. 2 switching positions; non-pile-up type, DPDT; 125 v a-c, 10 amps.	Loops power back to attended point or transmits through repeater.	3Z9825–45.11.
S2	SWITCH, rotary: 1 sect. 3 switching positions; non-pile-up type, 3 poles, 3 throws.	Selects repeater verification looping filter.	3Z9825–66.166.
E15, E16	TERMINAL, stud: solder connections; 27/32'' lg x 1/4'' wd across flats.	Provides electrical connection	3Z12101–9.1.
T3, T4	TRANSFORMER, AF: line type; pri 135 ohms (1–2) (3–4), sec 600 ohms (5–6) (7–8); pri tapped at 67.5 ohms; 1:2.124 ratio of turns, pri (1–2) (3–4) to sec (5–6) (7–8); ±5 db from 0.1 kc to 150 kc freq response.	Match impedance between line and repeater.	2Z9637.188.
R1	RESISTOR: comp; 12,000 ohms; ±%: JAN RC42BF123J.	Bridging resistor tube activity test.	3RC42BF123J.

4. Filter Section

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C5 through C13	CAPACITOR: paper; 1 sect; 1μf, ±20%; 300 vdcw.	C5 through C7: D-c power bypass capacitors. C8 through C13: Plate filter condensers.	3DB1–434.
C14, C15	CAPACITOR: paper; 1 section; 100,000 μμf, ±20%; 300 vdcw.	Heater bypass capacitors	3DA100–1163.
C16	CAPACITOR: paper; 1 sect; 470,000 μμf, ±20%; 300 vdcw.	Grid bias filter capacitor	3DA470–26.
C17	CAPACITOR: paper; 1 sect; 470,000 μμf; ±20% 300 vdcw.	Bypass capacitor for relay K1	3DA470–24.
J4 through J6, J9	CONNECTOR, plug: 21 rd male cont; pol; straight type.	Provide electrical connection	2Z3041–14.
J7, J8	CONNECTOR, receptacle: 21 rd female cont; pol; straight type.	Provide electrical connection	2Z3082–107.
FL1 through FL4	FILTER, high pass-low pass: assy c/o 2 filters; 1 filter, high pass type, 12 kc cut off freq, 600 ohms input impedance, 600 ohms output impedance; 1 filter, low-pass type, 1.7 kc cut-off freq, 1,500 ohms input, 1,500 ohms output.	FL1, FL3: Separate v-f and carrier channels. FL2, FL4: Combine v-f and carrier channels.	3Z1892–1.77.
K1	RELAY, armature: normally closed, single break cont; 1 inductive wnd, 30 ohms; up to 220 v, 40 ma oper cur; no time delay; continuous duty.	Cable continuity verification on power failure.	2Z7599A–470.
R2	RESISTOR: comp; 100,000 ohms ±5%; ½ w; JAN RC20BF104J.	Bridge resistor for cable continuity verification on power failure.	3RC20BF104J.
R3, R4	RESISTOR: comp; 100 ohms ±5%; ½ w; JAN RC20BF101J.	R3—Plate filter resistor for amplifier AR1. R4—Plate filter resistor for amplifier AR2.	3RC20BF101J.
R5	RESISTOR: WW; inductive wdg; 1,000 ohms ±5%; 10 w, JAN RW31G102.	Voltage-dropping resistor for tube heaters.	3RW24320.
R6	RESISTOR: film; 130,000 ohms ±1%; ½ w, 350 v rms or d-c.	Voltage divider for grid bias	3Z6713–18.
R7	RESISTOR: film; 16,000 ohms ±1%; ½ w, 350 v rms or d-c.	Voltage divider for grid bias	3Z6616–49.
R8 through R11	RESISTOR: WW; inductive wdg; 1,200 ohms ±5%; 10 w; JAN RW31G122.	Power stabilizing resistors for tube heater.	3RW24928.
E11 through E14, E17	TERMINAL, stud: solder connection; ⅝″ lg x ¼″ wd. x ¼″	Provide electrical connection	3Z12101–9.9.

5. Line Amplifier AR1 (and AR2)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C1	CAPACITOR: mica; 15 μμf, ±10%; 500 vdcw; JAN type CM20B150K.	Shape h-f transmission around around feedback loop.	3K2015021.
C2	CAPACITOR: mica; 2200 μμf, ±5%; 500 vdcw; JAN type CM30D222J.	Shapes h-f transmission around feedback loop.	3K3022242.
C3	CAPACITOR: paper; 1 sect; 1 μf, ±20%; 100 vdcw.	Shapes l-f transmission around feedback loop.	3DB1–432.

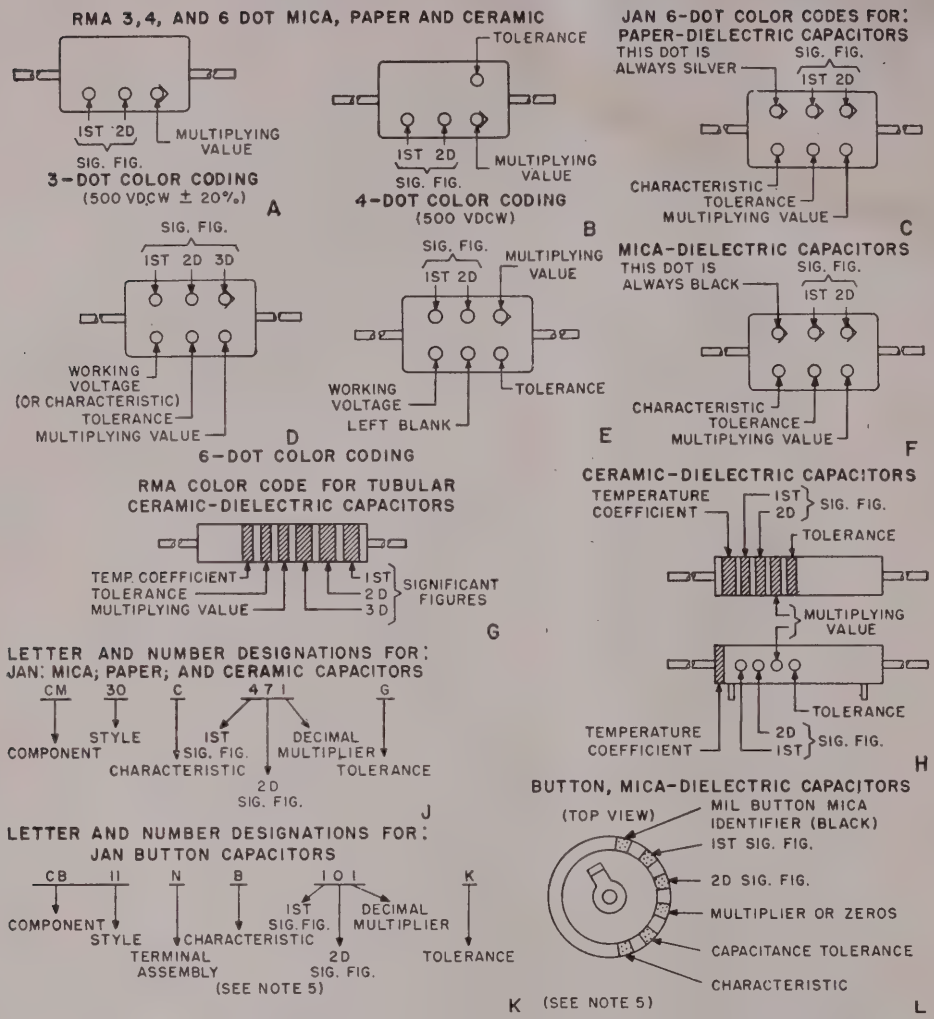
5. Line Amplifien AR1 (and AR2)—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C5, C6, C9	CAPACITOR: mica; 10,000 μμf, ±5%; 300 vdcw; JAN type CM35D103J.	C5, C9—Reduce crosstalk on bias meter connection. C6—Couples feedback circuit to input transformer T1.	3K3510342.
C7, C10	CAPACITOR: mica; 100 μμf, ±5%; 500 vdcw; JAN type CM20C101J.	Shape h-f transmission around feedback loop.	3K2010132.
C8	CAPACITOR: paper; 1 sect; 100,000 μμf, ±20%; 100 vdcw.	Shapes l-f transmission around feedback loop.	3DA100–1134.
C11	CAPACITOR: paper; 1 sect; 1 μf, ±20%; 400 vdcw.	Screen bypass for electron tube V1.	3DB1–449.
C12	CAPACITOR: paper; 1 sect; 470,000 μμf, ±20%; 400 vdcw.	Screen bypass for electron tube V2.	3DA470–17.
C13	CAPACITOR: mica; 1500 μμf, ±5%; 500 vdcw; JAN type CM30D152J.	Shape h-f transmission around feedback loop.	3K3015242.
C14	CAPACITOR: mica; 510 μμf, ±5%; 500 vdcw; JAN type CM30D511J.	Part of h-f stabilizing network	3K3051142.
C15	CAPACITOR: mica; 1000 μμf, ±5%; 500 vdcw; JAN type CM25D102J.	Shapes h-f transmission around feedback loop.	3K2510242.
L1	COIL, RF: 200 mh at 564 kc, 3.62 ohms d-c res; 1 wnd, untapped, unshielded.	Part of h-f stabilizing network	3C323–194G.
L2	COIL, RF: 50 mh at 1,126 kc, 1.92 ohms d-c res; 1 wnd, untapped, unshielded.	Shapes h-f transmission around feedback loop.	3C323–194H.
P1	CONNECTOR, plug: 21 rd male cont; pol; straight type.	Provide electrical connection	2Z3041–14.
EQ1	EQUALIZER, telephone line: bridged T-type; 12–68 kc freq range, 600 ohms impedance; 2–132″ lg x 1 7/16″ wd x 3 3/64″ h.	Equalizer phase characteristics of high-pass filters.	4C3623A–6.
EQ2	EQUALIZER, telephone line: bridged T-type; 12–68 kc freq range; 600 ohms impedance; 3½″ lg x 2 19/32″ wd x 1 7/16″ h.	Equalizes loss of incoming line	4C3623A–8.
Z1	NETWORK, impedance matching: 1 21/32″ lg x 1½″ wd x 3 13/32″ h.	Couple plate of electron tube V1 to grid of electron tube V2.	4B2145–1.
Z2	NETWORK, regulating: 4 term., solder lug type; 3 1/32″ lg x 1 7/16″ wd x 3 3/64″ h.	Regulates amplifier gain in conjunction with thermistor.	4B2148C.
R1, R9	RESISTOR: film; 31,600 ohms ±1%; ½ w, 350 v rms or d-c.	R1—Terminates high side of input transformer T1. R9—Meter current limiter for grid-cathode bias measurement.	3Z6631F6–1.
R2, R7	RESISTOR: comp; 33 ohms ±5%; ½ w; JAN RC20BF330J.	Vhf anti-sing resistors.	3RC20BF330J.
R3	RESISTOR: film; 180 ohms ±1%; ½ w, 350 v rms or d-c.	Shapes h-f transmission around feedback loop.	3Z6018–35.
R4	RESISTOR: film; 3160 ohms ±1%; ½ w, 350 v rms or d-c.	Provides d-c bias between cathode and grid of electron tube V1.	3Z6316–3.
R5	RESISTOR: film; 25,200 ohms ±1%; ½ w, 350 v rms or d-c.	Meter current limiter for grid-cathode bias measurement.	3Z6625B2.
R6	RESISTOR: film; 1 megohm ±1%; ½ w, 350 v rms or d-c.	D-c grid return for electron tube V1.	3Z6801–151.
R8	RESISTOR: film; 1,780 ohms ±1%; ½ w, 350 v rms or d-c.	Provides d-c bias between cathode and grid of electron tube V2.	3Z6178–1.
R10	RESISTOR: film; 10,000 ohms ±1%; ½ w, 350 v rms or d-c.	Shapes h-f transmission around feedback loop.	3Z6610–367.

5. Line Amplifier AR1 (and AR2)—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R11	RESISTOR: comp; 6800 ohms ±5%; ½ w; JAN Type RC20BF682J.	Plate and screen filtering resistor for electron tube V1.	3RC20BF682J.
R12	RESISTOR: comp; 470 ohms ±5%; ½ w; JAN Type RC20BF471J.	Plate and screen filtering resistor for electron tube V2.	3RC20BF471J.
R13	RESISTOR: film; 470 ohms ±1%; ½ w; 350 v rms or d-c.	Part of h-f stabilizing network	3Z6047–37.
R14	RESISTOR: film; 147 ohms ±1%; ½ w, 350 v rms or d-c.	Determines output impedance of amplifier.	3Z6014G7–7.
R15	RESISTOR: comp; 220 ohms ±5%; ½ w; JAN Type RC20BF221J.	Part of h-f stabilizing network	3RC20BF221J.
R16	RESISTOR: film; 82.5 ohms ±1%; ½ w, 350 v rms or d-c.	Fills out impedance of feedback loop for regulator.	3Z6008B2–24.
R17	RESISTOR: film; 178 ohms ±1%; ½ w, 350 v rms or d-c.	Part of separate gain step providing potentiometer.	3Z6017H8–2.
R18	RESISTOR: film; 121 ohms ±1%; ½ w, 350 v rms or d-c.	Part of separate gain step providing potentiometer.	3Z6012A1–3.
R19	RESISTOR: film; 383 ohms ±1%; ½ w, 350 v rms or d-c.	Part of separate gain step providing potentiometer.	3Z6038C3–1.
R20	RESISTOR: film; 2150 ohms ±1%; ½ w, 350 v rms or d-c.	Part of impedance-matching pad	3Z6215–2.
R21	RESISTOR: film; 422 ohms ±1%; ½ w, 350 v rms or d-c.	Part of impedance-matching pad	3Z6042B2–3.
R22	RESISTOR: film; 4,640 ohms ±1%; ½ w, 350 v rms or d-c.	Part of impedance-matching pad	3Z6464–1.
R23	RESISTOR: WW; nonind wdg; 59.3 ohms ±1.5% at 86° F.; ¼ w.	Temperature loss compensator for repeater components.	3Z6005J9–2.
R24	RESISTOR: comp; 100,000 ohms ±5%; ½ w; JAN Type RC20BF104J.	GAW limiting resistor	3RC20BF104J.
	SHIELD, electron tube; cylindrical shape; 1⅜″ lg x 0.810″ wd x 0.941″ d; JAN Type TS102U01.	Electrical shield for electron tube.	2Z8304.57.
XV1, XV2	SOCKET, electron tube: 7 cont; miniature size; oval shape; JAN No. TS102 Pol.	XV1—Holds electron tube V1 XV2—Holds electron tube V2	2Z8677.94.
S1	SWITCH, rotary: 1 sect.; 3 switching positions; non-pile-up type, 1 pole, 3 throws.	Amplifier selector switch	3Z9825–66.165.
E1 through E12	TERMINAL, stud: solder connections; 2⅞₂″ lg x ¼″ w across flats.	Provide electrical connection	3Z12101–9.1.
T1	TRANSFORMER, AF: input type; pri 600 ohms, sec 31,600 ohms; 1 to 7.25 ratio of turns pri to secd; ±1.25 db from 0.3 kc to 100 kc freq response.	Steps up incoming signal voltage to grid of electron tube V1.	2Z9631.495.
T2	TRANSFORMER, AF: pl coupling type; pri 16000 ohms, secd 600 +200 ohms; pri rated 25 ma d-c; 4.448 to 1 ratio of turns pri to secd; ±1.5 db from 1 kc to 300 kc freq response.	Couples output of electron tube V2 to output circuit and feedback circuit.	2Z9632.775.
V1, V2	TUBE, electron: pentode; r-f amplr; JAN Type 6028.	V1—First amplifier stage V2—Second amplifier stage	2J6028.

CAPACITOR COLOR AND LETTER CODES



- STANDARDS -					JAN MICA-CM		JAN PAPER-CN		JAN CERAMIC-CC					
										CAP. TOL. FOR MORE THAN 10 UUF		CAP. TOL. FOR 10 UUF OR LESS		
COLOR	SIG. FIG.	DECIMAL MULTIPLIER	% TOL.	VDCW	LETTER TOL.	CHARAC-TERISTIC	LETTER TOL.	CHARAC-TERISTIC	DEC. MULT.	%	LETTER DESIG-NATION	UUF	LETTER DESIG-NATION	CHARAC-TERISTIC
BLACK	0	1	±20	500	M	A	M	.A	1	±20	M	±2.0	G	C
BROWN	1	10	± 1	100	-	B	-	*E	10	± 1	F	-	-	H
RED	2	100	± 2	200	G	C	-	H	100	± 2	G	-	-	L
ORANGE	3	1,000	± 3	300	-	D	N*	J	1,000	-	-	-	-	P
YELLOW	4	10,000	± 4	400	-	E	-	P	-	-	-	-	-	R
GREEN	5	100,000	± 5	500	-	F	-	R	-	± 5	J	±0.5	D	S
BLUE	6	1,000,000	± 6	600	-	G	-	S	-	-	-	-	-	T
VIOLET	7	10,000,000	± 7	700	-	-	-	T	-	-	-	-	-	U
GRAY	8	100,000,000	± 8	800	-	-	-	-	0.01	-	-	±0.25	C	B
WHITE	9	1,000,000,000	± 9	900	-	-	-	-	0.1	± 10	K	±1.0	F	SL
GOLD	-	0.1	± 5	1,000	J	-	-	-	-	-	-	-	-	A
SILVER	-	0.01	±10	2,000	K	-	K	-	-	-	-	-	-	-
NO COLOR	-	-	±20	500	-	-	-	-	-	-	-	-	-	-
* THE TOLERANCE OF THIS CAPACITOR IS ±30%, NOT ±3%														

NOTES

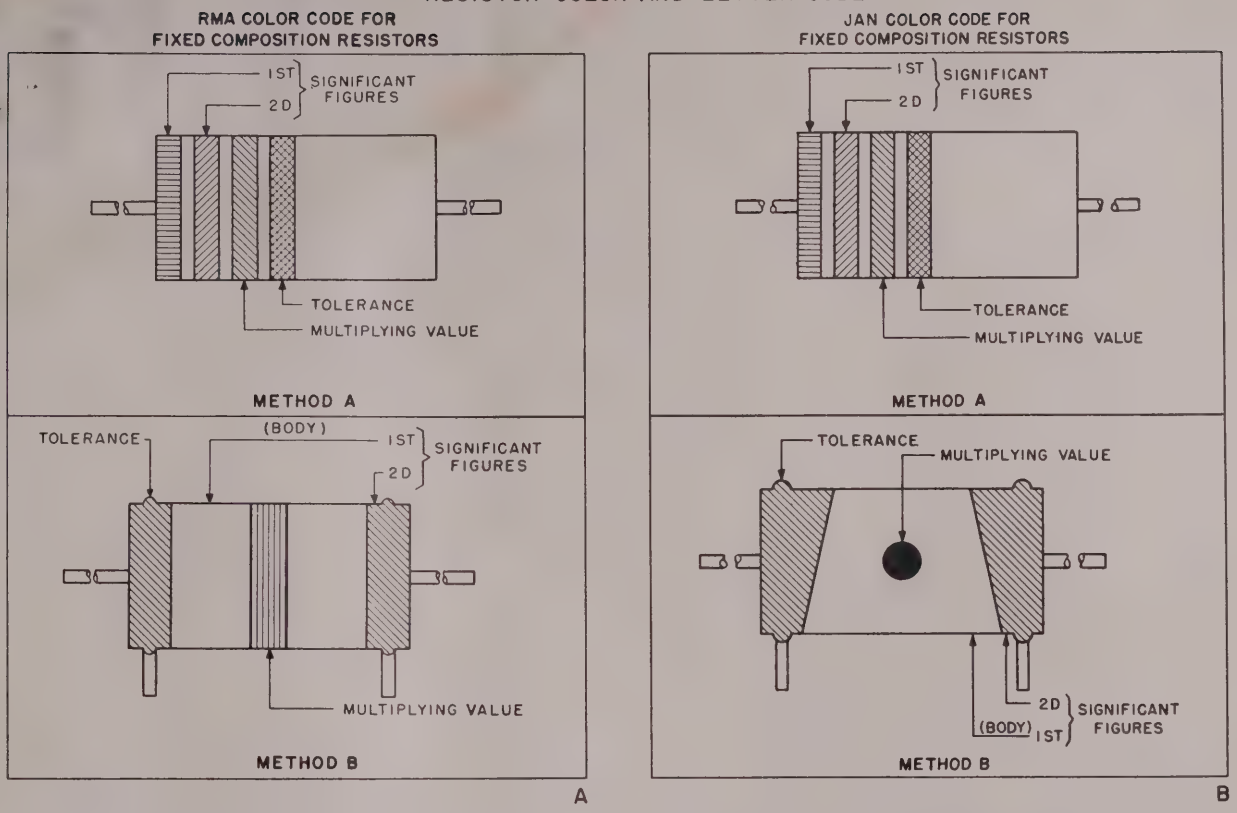
JAN: JOINT ARMY-NAVY
RMA: RADIO MANUFACTURERS ASSOCIATION

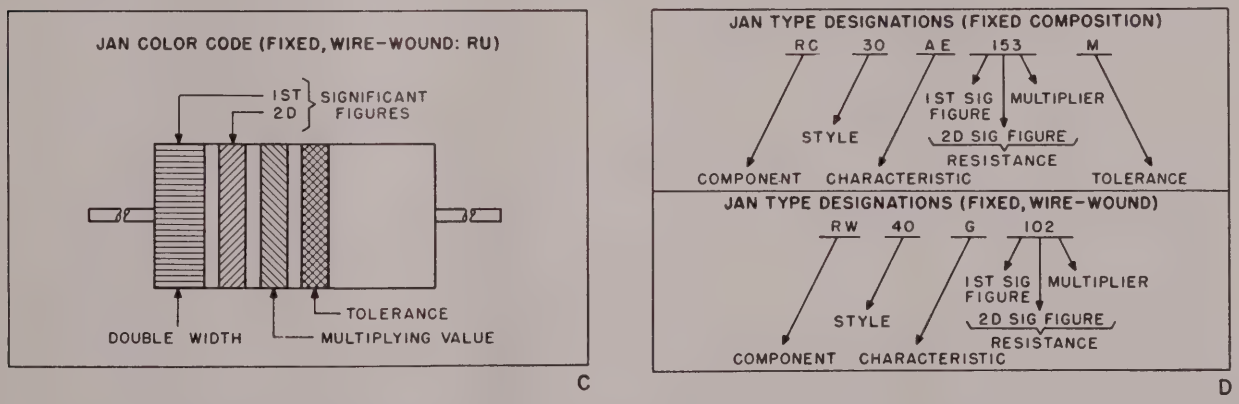
1. THESE COLOR AND LETTER CODES GIVE CAPACITANCES IN MICROMICROFARADS
2. THIS TABLE IS ADAPTED FOR JAN AND RMA COLOR AND JAN LETTER TYPE DESIGNATIONS
3. CERAMIC AND MICA CAPACITORS, BOTH JAN AND RMA, ARE GENERALLY 500 VDCW
4. BUTTON CAPACITORS ARE GENERALLY 300 VDCW
5. READ BUTTON CAPACITOR TOLERANCE UNDER CERAMICS OF MORE THAN 10 UUF
6. CHARACTERISTICS ARE AVAILABLE IN JAN CAPACITOR SPECIFICATION MANUALS
7. THE COMPONENTS USED ABOVE FOR JAN LETTER TYPE DESIGNATIONS ARE:
   CB MICA BUTTON: *CC* CERAMIC; *CM* MICA MOULDED: *CN* PAPER MOULDED

TM CC

Figure 66. Resistor color code.

RESISTOR COLOR AND LETTER CODE





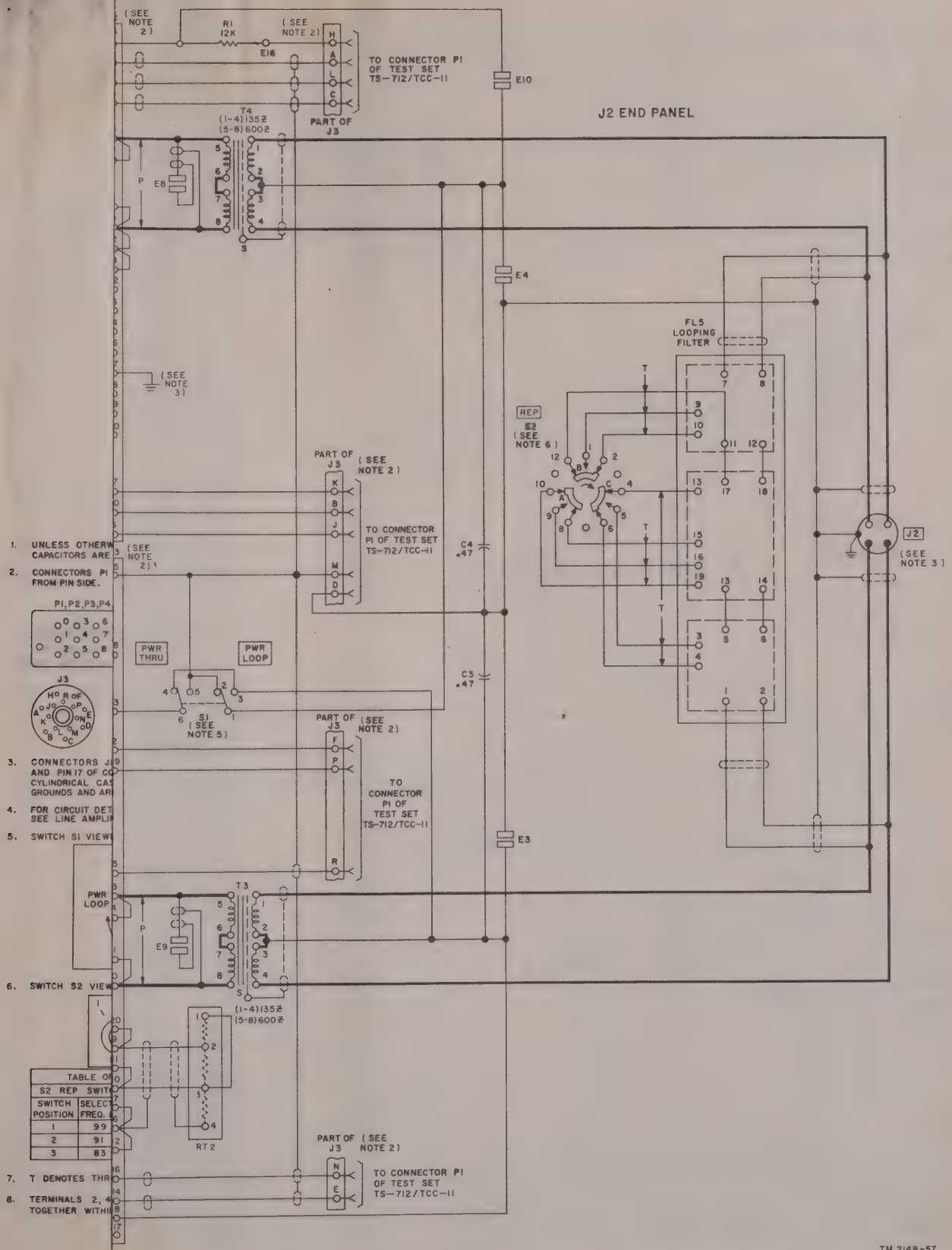
STANDARDS				
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)	JAN LETTER TOLERANCE
BLACK	0	1	—	—
BROWN	1	10	± 1	F
RED	2	100	± 2	G
ORANGE	3	1,000	± 3	—
YELLOW	4	10,000	± 4	—
GREEN	5	100,000	± 5	—
BLUE	6	1,000,000	± 6	—
VIOLET	7	10,000,000	± 7	—
GRAY	8	100,000,000	± 8	—
WHITE	9	1,000,000,000	± 9	—
GOLD	—	0.1	± 5	J
SILVER	—	0.01	±10	K
NO COLOR	—	—	±20	M

NOTES:

1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION.
3. JAN: JOINT ARMY - NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS.

TM RC

Figure 67. Capacitor color code.


J2 END PANEL
R1 12K
E16
E10
E4
E3
E8
E9
T4 (1-4)135Ω (5-8)600Ω
T3 (1-4)135Ω (5-8)600Ω
TO CONNECTOR P1 OF TEST SET TS-712/TCC-11
PART OF J3
FL5 LOOPING FILTER
REP
S2 (SEE NOTE 6)
J2
C4 .47
C3 .47
PWR THRU
PWR LOOP
S1 (SEE NOTE 5)
RT2
P1,P2,P3,P4
J3
1. UNLESS OTHERW CAPACITORS ARE
2. CONNECTORS P1 FROM PIN SIDE.
3. CONNECTORS J AND PIN 17 OF C CYLINDRICAL CA GROUNDS AND AR
4. FOR CIRCUIT DE SEE LINE AMPLI
5. SWITCH S1 VIEW
6. SWITCH S2 VIEW
7. T DENOTES THR
8. TERMINALS 2, 4 TOGETHER WITH
TABLE OF S2 REP SWITCH
SWITCH POSITION
SELECT FREQ.
1 99
2 91
3 83

TM 2148-57

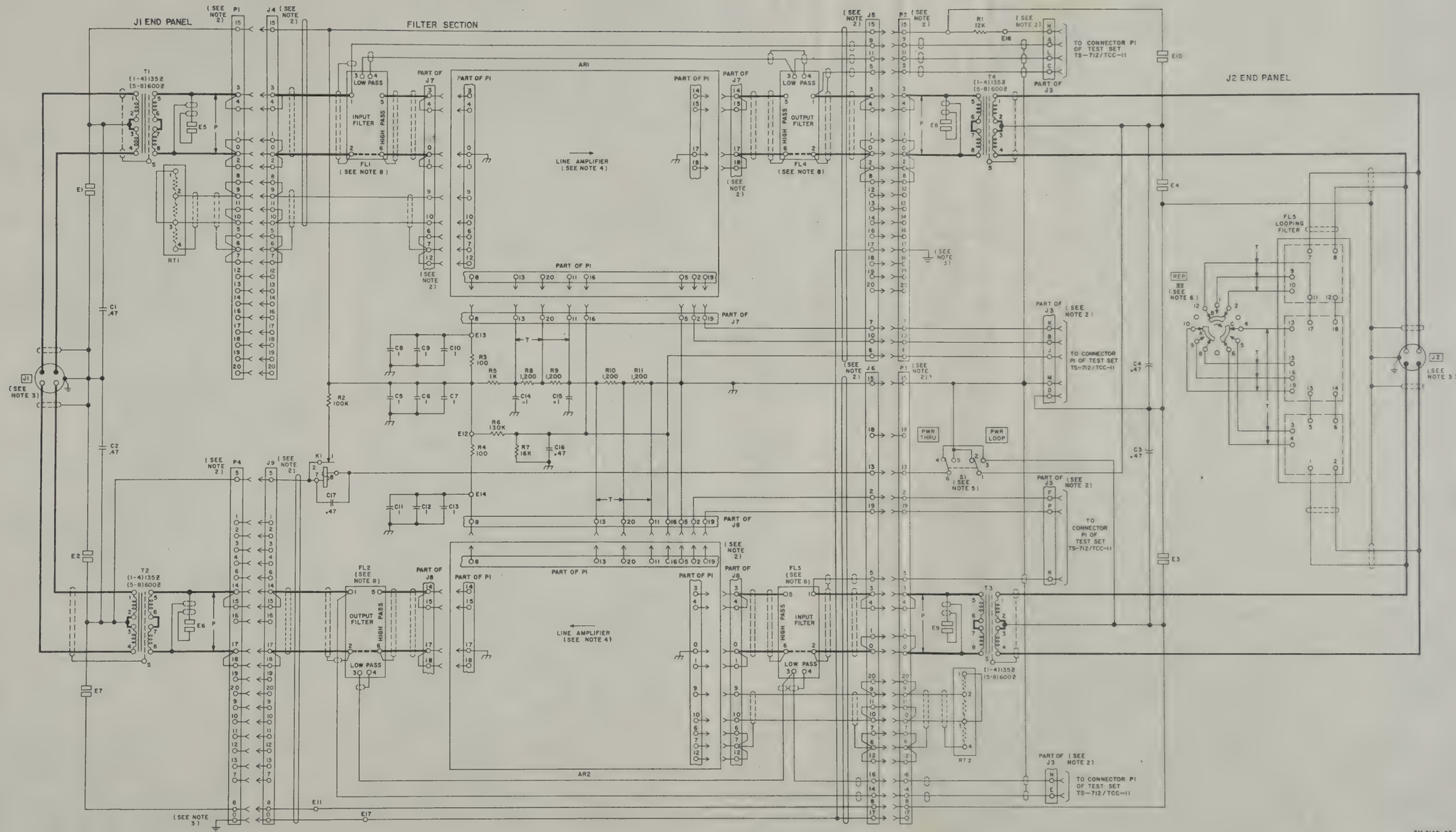
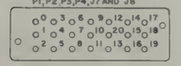


Figure 68.—Telephone Repeater AN/TCC-11, schematic diagram.

NOTES:

1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
2. CONNECTORS P1 THROUGH P4, J3 THROUGH J9 VIEWED FROM PIN SIDE.

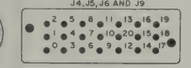
P1, P2, P3, P4, J7 AND J8



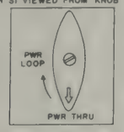
J3



J4, J5, J6 AND J9



3. CONNECTORS J1 AND J2, PIN 0 OF CONNECTOR P4, PIN D OF CONNECTOR J3, AND PIN 17 OF CONNECTOR P3, ARE CONNECTED TO CYLINDRICAL CASE GROUND. ALL GROUNDS INDICATED ⏚ ARE PANEL GROUNDS AND ARE INSULATED FROM CYLINDRICAL CASE.
4. FOR CIRCUIT DETAILS OF LINE AMPLIFIERS AR1 AND AR2 SEE LINE AMPLIFIER SCHEMATIC DIAGRAM.
5. SWITCH S1 VIEWED FROM KNOB SIDE.

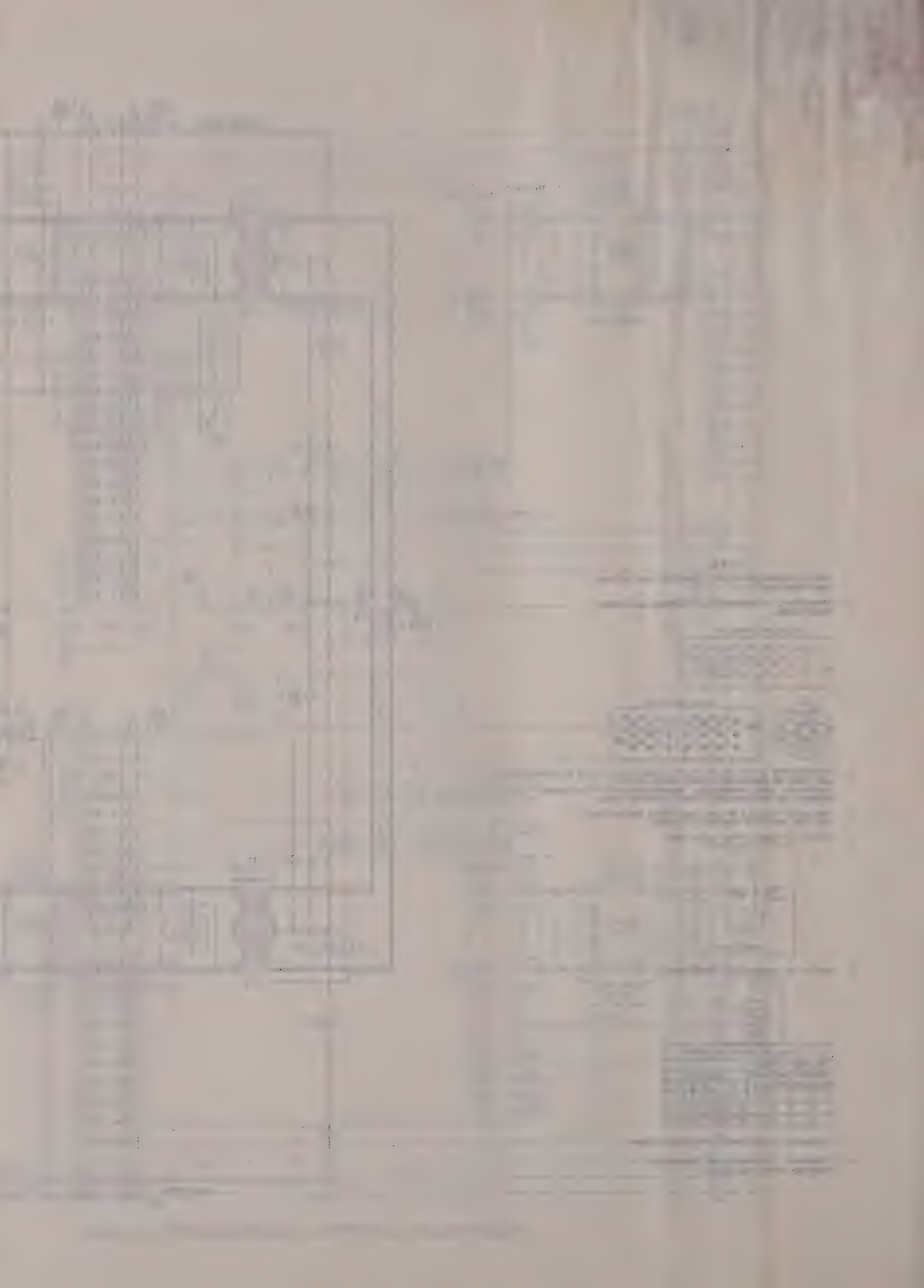


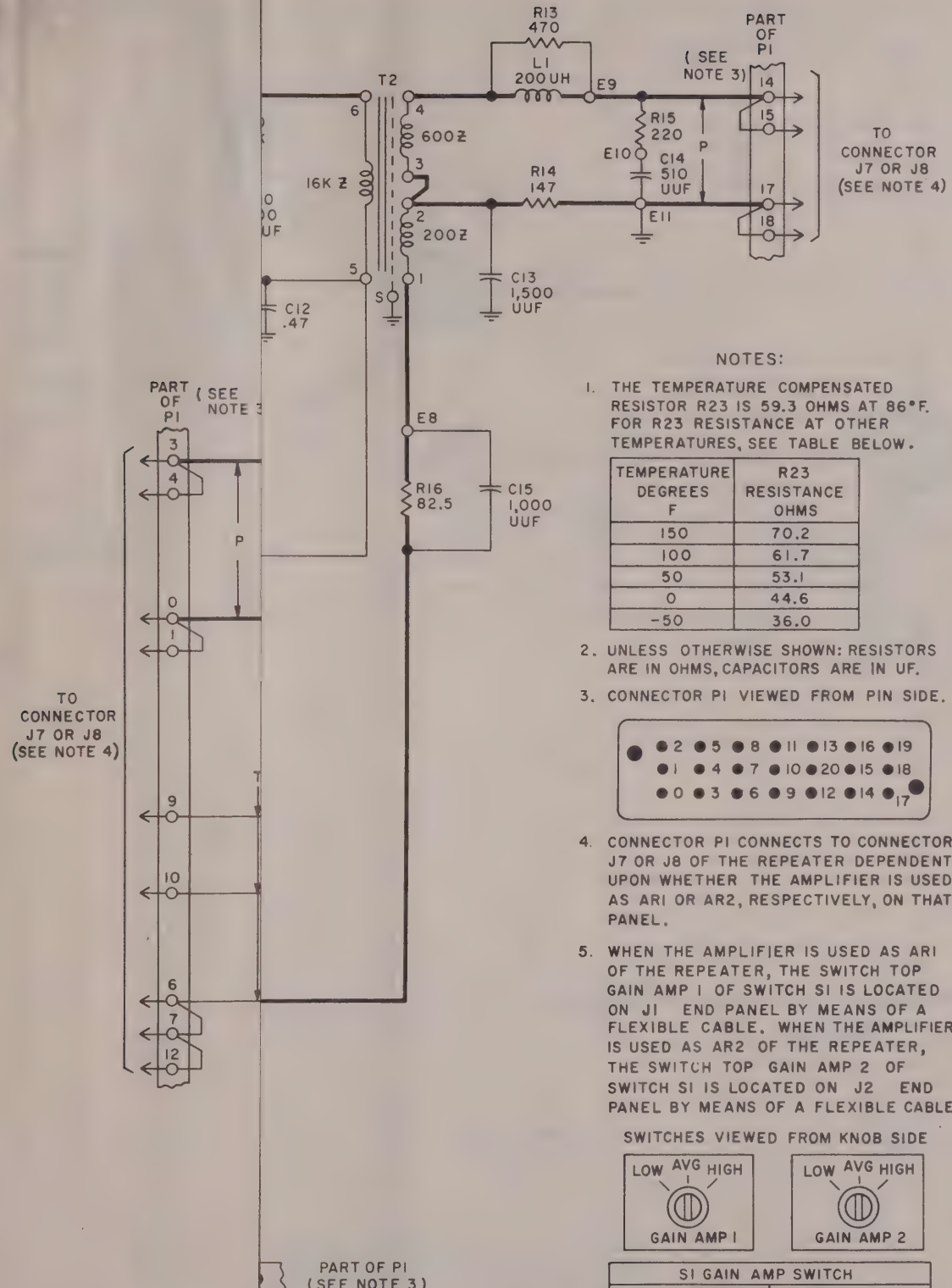
6. SWITCH S2 VIEWED FROM KNOB SIDE.



TABLE OF CONTACTS MADE				
S2 REP SWITCH				
SWITCH POSITION	SELECTIVE FREQ. KC	SECTION A	SECTION B	SECTION C
1	99	—	—	—
2	91	8—9	12—1	4—5
3	83	8—10	12—2	4—6

7. T DENOTES THREE WIRES TWISTED TOGETHER.
8. TERMINALS 2, 4, AND 6 ARE CONNECTED TOGETHER WITHIN THE FILTER.





NOTES:

1. THE TEMPERATURE COMPENSATED RESISTOR R23 IS 59.3 OHMS AT 86°F. FOR R23 RESISTANCE AT OTHER TEMPERATURES, SEE TABLE BELOW.

TEMPERATURE DEGREES F	R23 RESISTANCE OHMS
150	70.2
100	61.7
50	53.1
0	44.6
-50	36.0

2. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.

3. CONNECTOR P1 VIEWED FROM PIN SIDE.

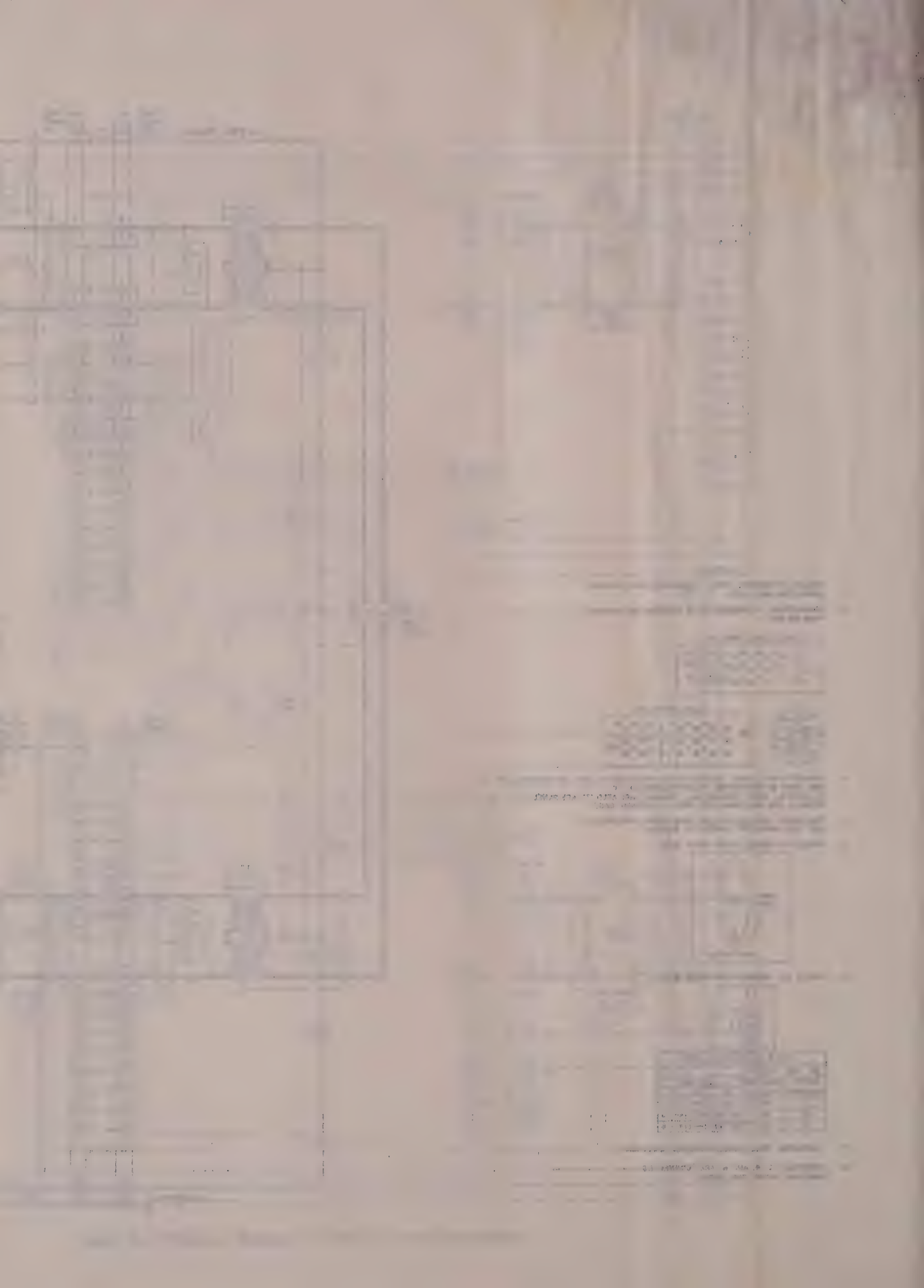
4. CONNECTOR P1 CONNECTS TO CONNECTOR J7 OR J8 OF THE REPEATER DEPENDENT UPON WHETHER THE AMPLIFIER IS USED AS AR1 OR AR2, RESPECTIVELY, ON THAT PANEL.

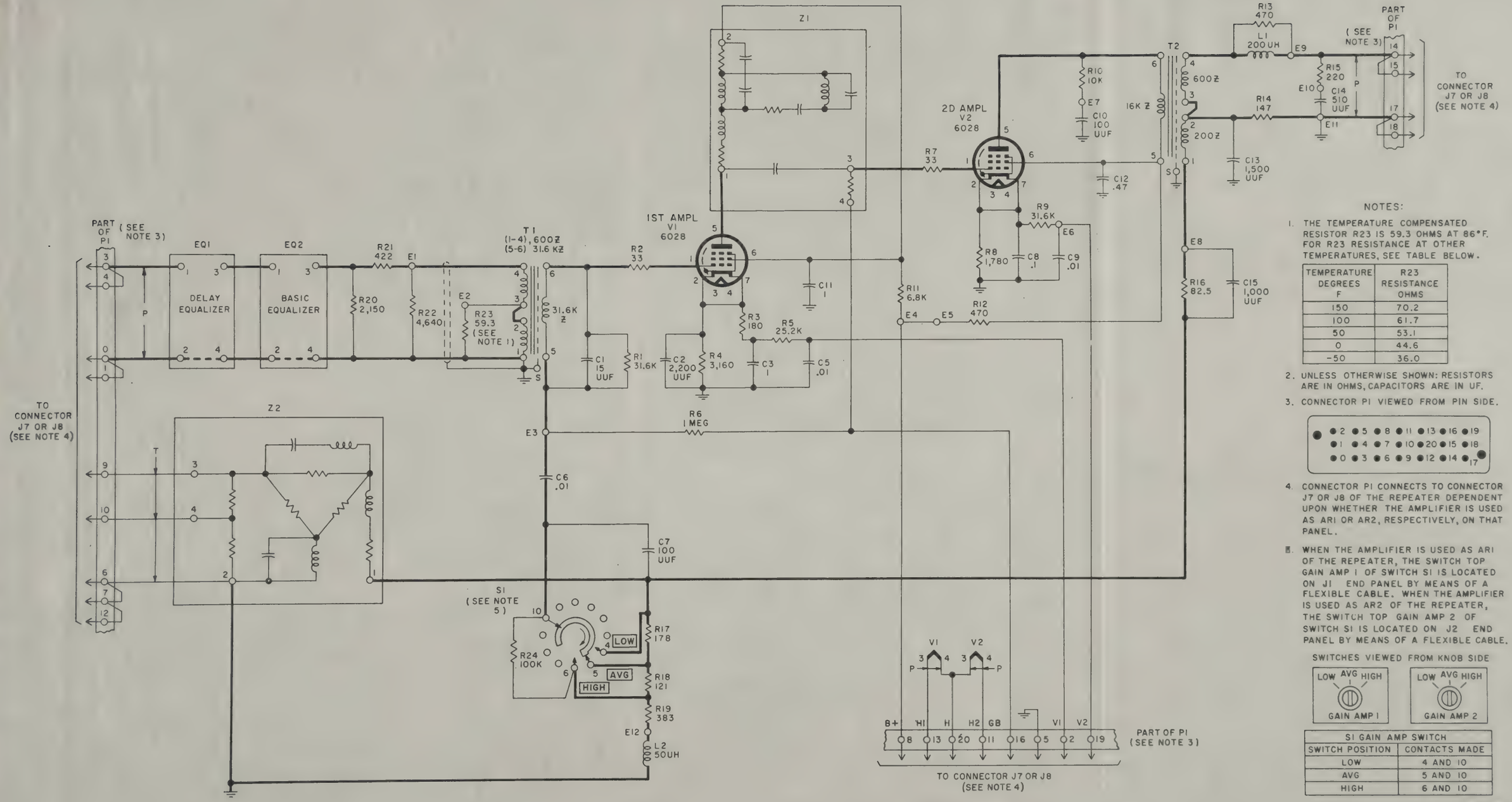
5. WHEN THE AMPLIFIER IS USED AS AR1 OF THE REPEATER, THE SWITCH TOP GAIN AMP 1 OF SWITCH S1 IS LOCATED ON J1 END PANEL BY MEANS OF A FLEXIBLE CABLE. WHEN THE AMPLIFIER IS USED AS AR2 OF THE REPEATER, THE SWITCH TOP GAIN AMP 2 OF SWITCH S1 IS LOCATED ON J2 END PANEL BY MEANS OF A FLEXIBLE CABLE.

SWITCHES VIEWED FROM KNOB SIDE

S1 GAIN AMP SWITCH	
SWITCH POSITION	CONTACTS MADE
LOW	4 AND 10
AVG	5 AND 10
HIGH	6 AND 10

TM 2148-58





NOTES:

1. THE TEMPERATURE COMPENSATED RESISTOR R23 IS 59.3 OHMS AT 86°F. FOR R23 RESISTANCE AT OTHER TEMPERATURES, SEE TABLE BELOW.

TEMPERATURE DEGREES F	R23 RESISTANCE OHMS
150	70.2
100	61.7
50	53.1
0	44.6
-50	36.0

2. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
3. CONNECTOR P1 VIEWED FROM PIN SIDE.

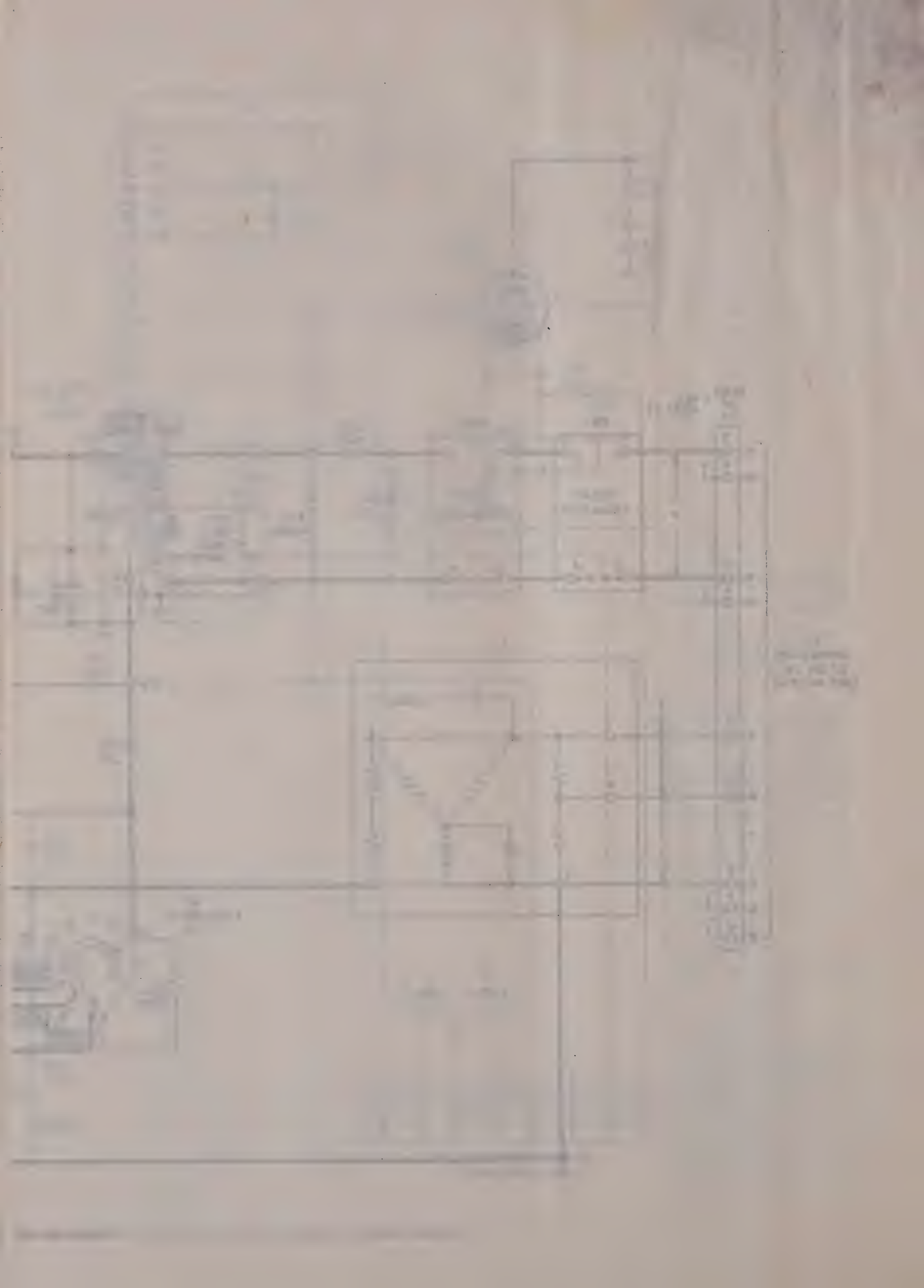
4. CONNECTOR P1 CONNECTS TO CONNECTOR J7 OR J8 OF THE REPEATER DEPENDENT UPON WHETHER THE AMPLIFIER IS USED AS AR1 OR AR2, RESPECTIVELY, ON THAT PANEL.
5. WHEN THE AMPLIFIER IS USED AS AR1 OF THE REPEATER, THE SWITCH TOP GAIN AMP 1 OF SWITCH S1 IS LOCATED ON J1 END PANEL BY MEANS OF A FLEXIBLE CABLE. WHEN THE AMPLIFIER IS USED AS AR2 OF THE REPEATER, THE SWITCH TOP GAIN AMP 2 OF SWITCH S1 IS LOCATED ON J2 END PANEL BY MEANS OF A FLEXIBLE CABLE.

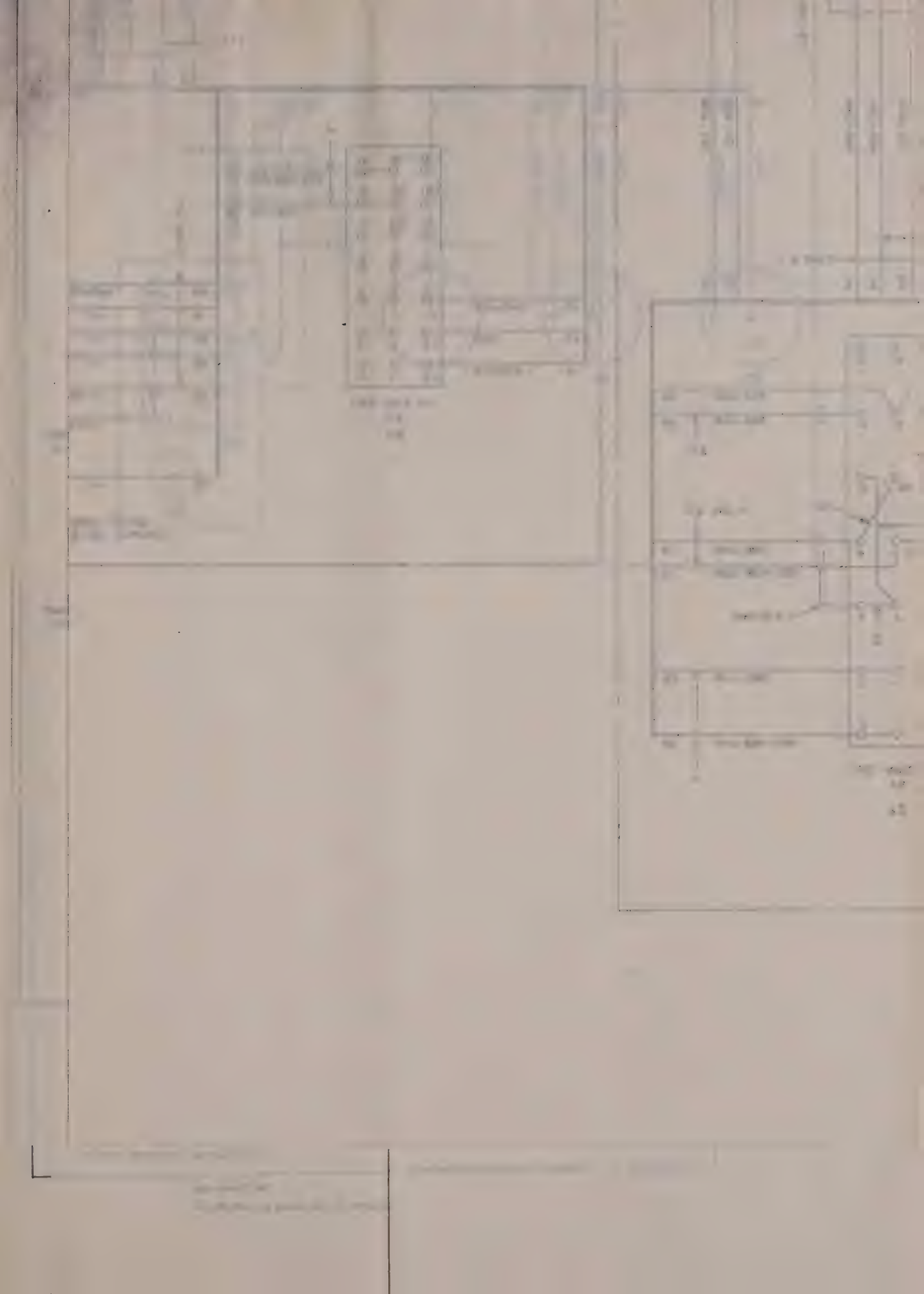
SWITCHES VIEWED FROM KNOB SIDE

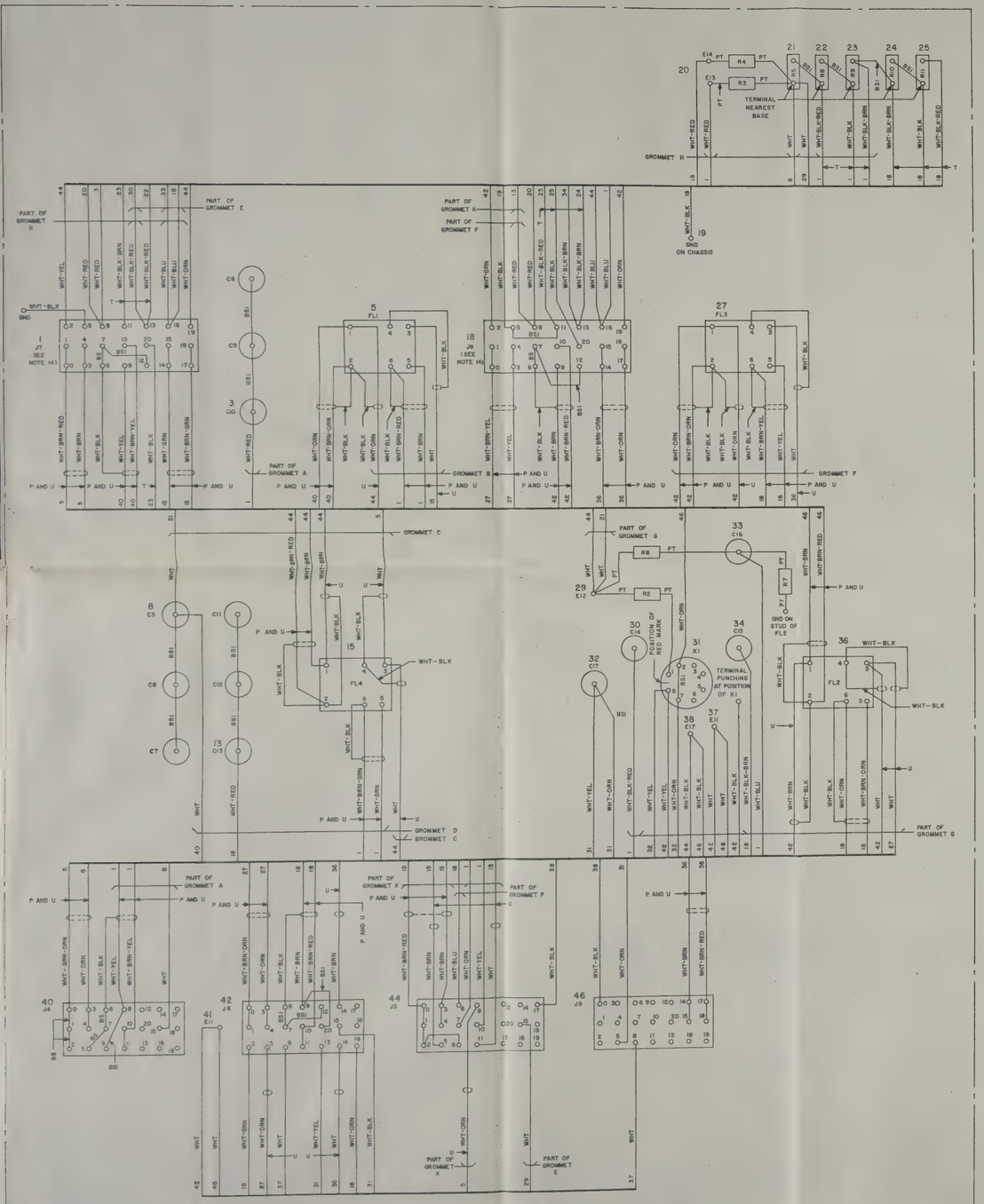
S1 GAIN AMP SWITCH	
SWITCH POSITION	CONTACTS MADE
LOW	4 AND 10
AVG	5 AND 10
HIGH	6 AND 10

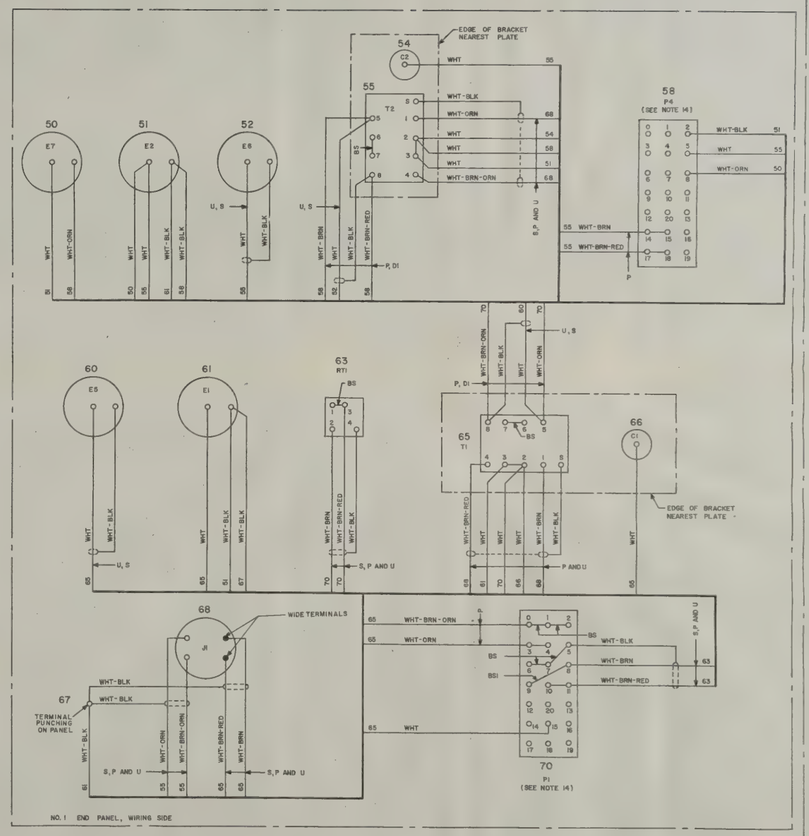
TM 2148-58

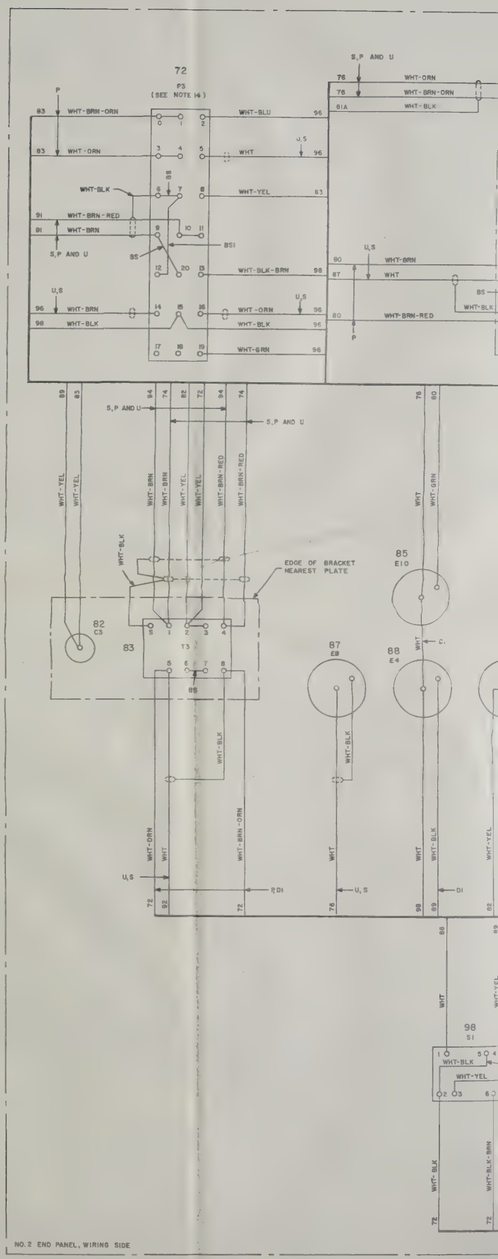
Figure 69.—Telephone Repeater AN/TCC-11, line amplifier, schematic diagram.







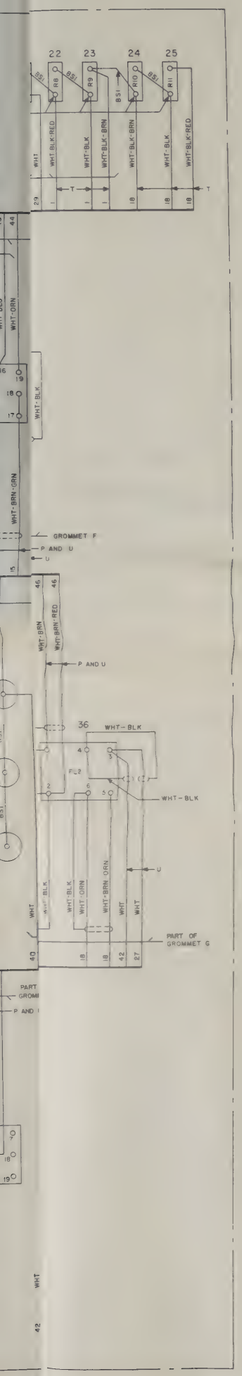


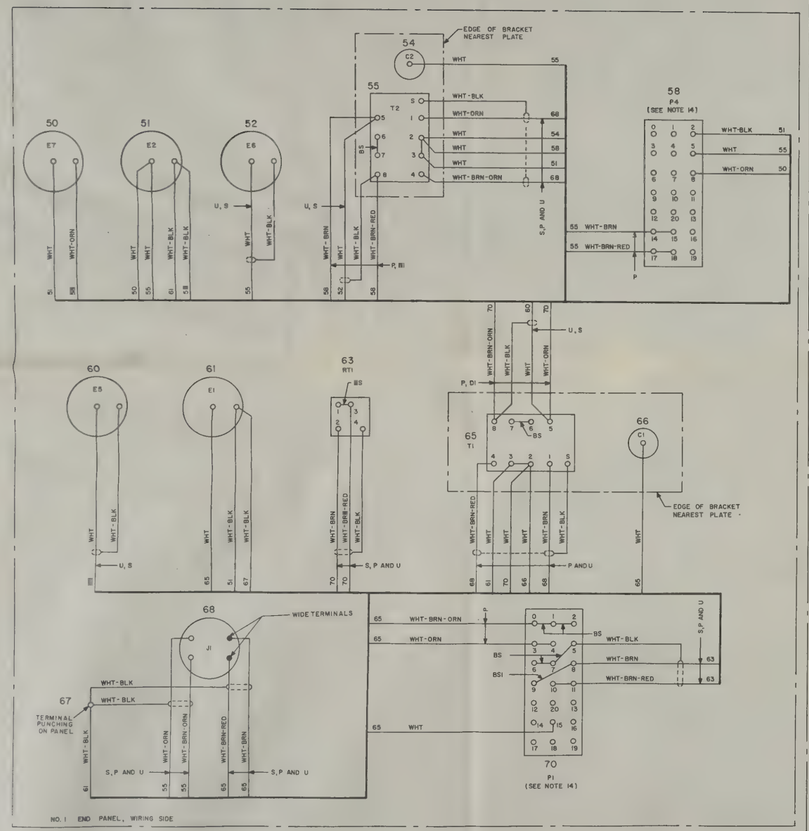


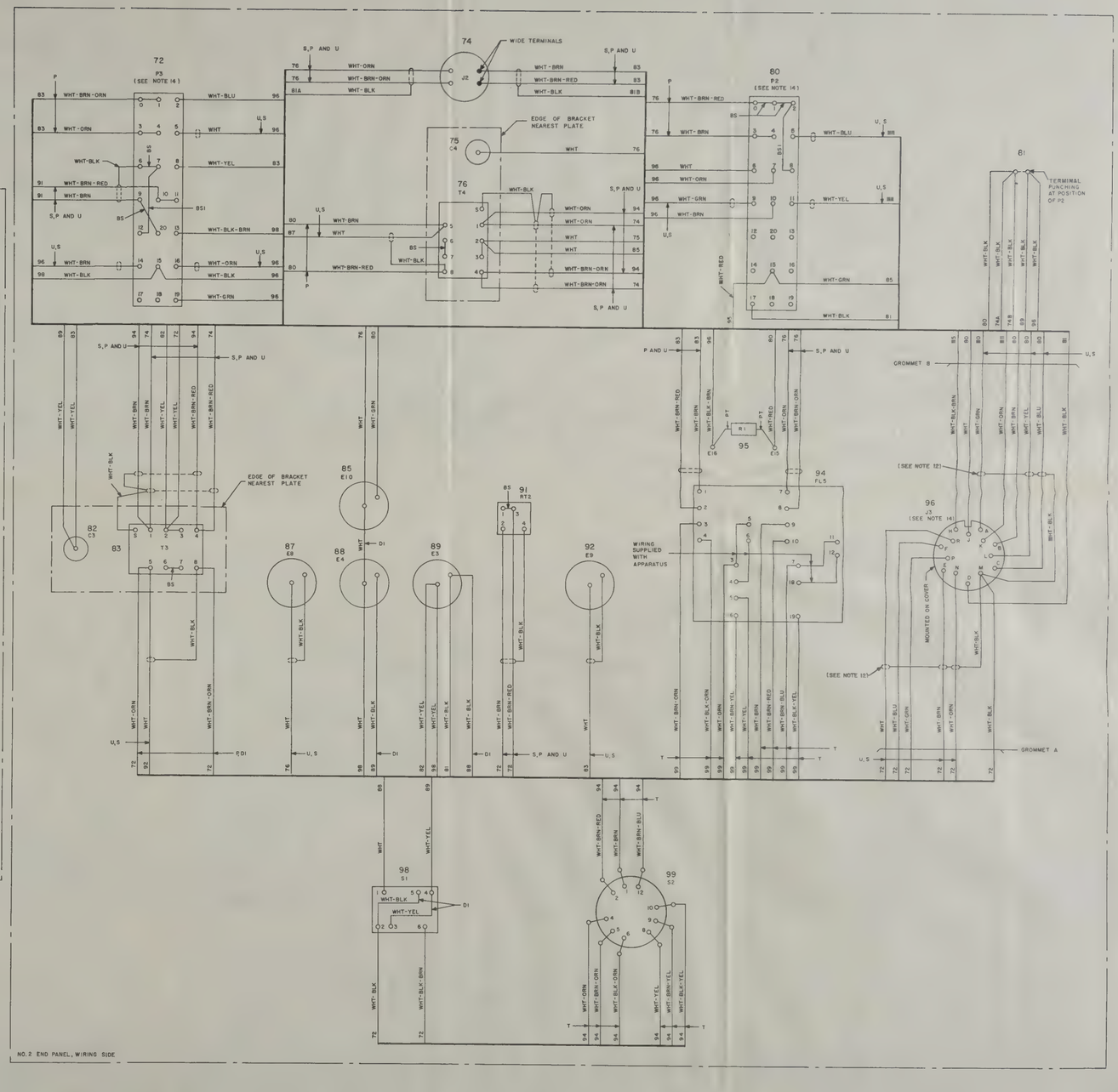
NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS. WHEN THERE ARE TWO OR MORE WIRES OF THE SAME COLOR BETWEEN TWO STATIONS, A LETTER SUFFIX IS ADDED TO THE SMALL NUMBER TO DIFFERENTIATE BETWEEN THE WIRES.
2. WIRES NOT OTHERWISE SPECIFIED ARE 22 GAUGE WITH NYLON JACKET.
3. DI WIRING IS CONNECTED DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER.
4. BS DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING.
5. BSI DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING COVERED WITH SILICON IMPREGNATED FIBRE-GLASS SLEEVING.
6. PT DENOTES LEADS PART OF APPARATUS.
7. P DENOTES PAIR.
8. T DENOTES TRIPLE.
9. U DENOTES SHIELDED 22 GAUGE WIRE WITH EXTRUDED NYLON JACKET.
10. P AND U DENOTES SHIELDED PAIR 22 GAUGE WIRE WITH EXTRUDED NYLON JACKET.
11. C)—— DENOTES SHIELDED CONNECTION.
12. SHIELDS EXTEND TO WITHIN 1/2 INCH OF TERMINAL.
13. WIRING NOT OTHERWISE SPECIFIED IS DRESSED BACK TO THE PANEL AND RUN AT RIGHT ANGLES IN THE MOST CONVENIENT MANNER.
14. LEADS TO CONNECTORS P1, P2, P3, P4, J3, J7 AND J8 HAVE SUFFICIENT SLACK SO THAT THESE CONNECTORS MAY BE UNFASTENED AND ACCESS OBTAINED TO THE WIRING SIDE WITHOUT UNSOLDERING CONNECTIONS.
15. S DENOTES SHIELDED WIRES WHICH HAVE AN ADDITIONAL COVERING OF POLYVINYL INSULATION TUBING.

Figure 70.—Telephone Repeater AN/TCC-11, wiring diagram.





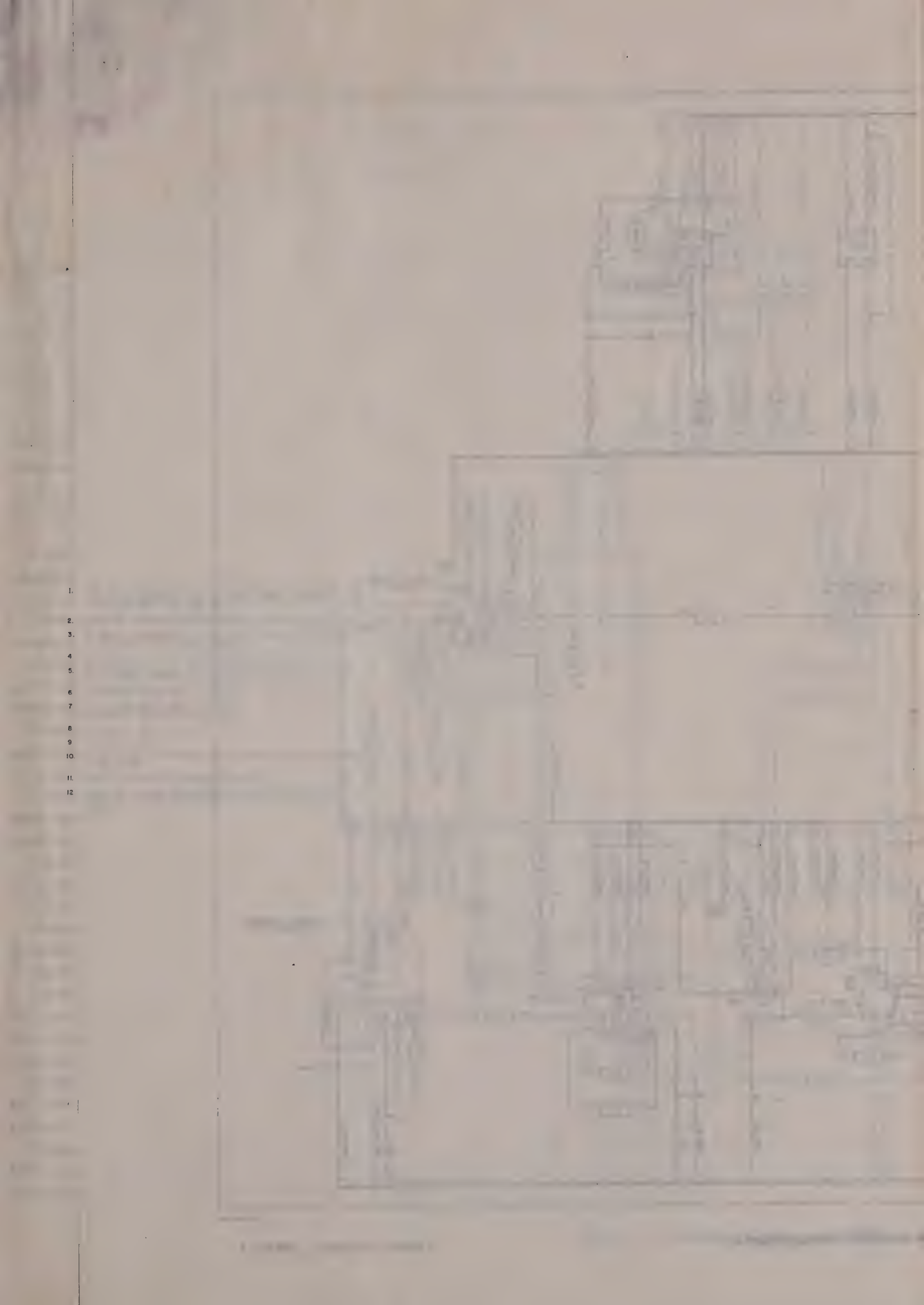


NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS. WHEN THERE ARE TWO OR MORE WIRES OF THE SAME COLOR BETWEEN TWO STATIONS, A LETTER SUFFIX IS ADDED TO THE SMALL NUMBER TO DIFFERENTIATE BETWEEN THE WIRES.
2. WIRES NOT OTHERWISE SPECIFIED ARE 22 GAUGE WITH NYLON JACKET.
3. DI WIRING IS CONNECTED DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER.
4. BS DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING.
5. BSI DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING COVERED WITH SILICON IMPREGNATED FIBRE-GLASS SLEEVING.
6. PT DENOTES LEADS PART OF APPARATUS.
7. P DENOTES PAIR.
8. T DENOTES TRIPLE.
9. U DENOTES SHIELDED 22 GAUGE WIRE WITH EXTRUDED NYLON JACKET.
10. P AND U DENOTES SHIELDED PAIR 22 GAUGE WIRE WITH EXTRUDED NYLON JACKET.
11. ⊂⊃ DENOTES SHIELDED CONNECTION.
12. SHIELDS EXTEND TO WITHIN 1/2 INCH OF TERMINAL.
13. WIRING NOT OTHERWISE SPECIFIED IS DRESSED BACK TO THE PANEL AND RUN AT RIGHT ANGLES IN THE MOST CONVENIENT MANNER.
14. LEADS TO CONNECTORS P1, P2, P3, P4, J3, J7 AND J8 HAVE SUFFICIENT SLACK SO THAT THESE CONNECTORS MAY BE UNFASTENED AND ACCESS OBTAINED TO THE WIRING SIDE WITHOUT UNSOLDERING CONNECTIONS.
15. S DENOTES SHIELDED WIRES WHICH HAVE AN ADDITIONAL COVERING OF POLYVINYL INSULATION TUBING.

Figure 70.—Telephone Repeater AN/TCC-11, wiring diagram.

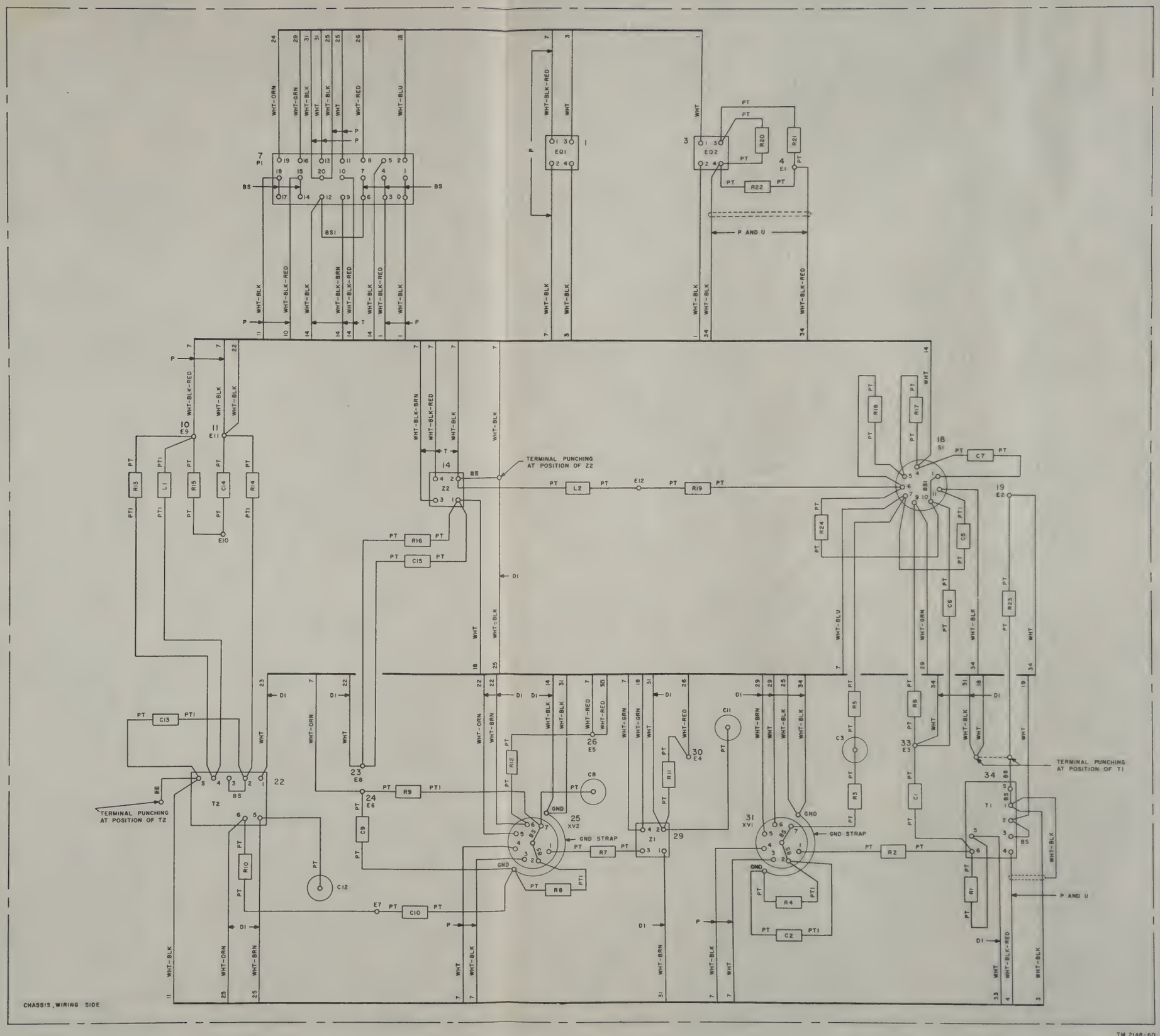
NO. 2 PIL PANEL, W-RING SIDE





NOTES:

1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.
2. WIRES NOT OTHERWISE SPECIFIED ARE 22 GAUGE WITH NYLON JACKET.
3. DI WIRING IS CONNECTED DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER.
4. BS DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING.
5. BSI DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING COVERED WITH SILICON IMPREGNATED FIBRE-GLASS SLEEVING.
6. PT DENOTES LEADS PART OF APPARATUS.
7. PTI DENOTES LEADS PART OF APPARATUS COVERED WITH SILICON IMPREGNATED FIBRE-GLASS SLEEVING.
8. P DENOTES PAIR.
9. T DENOTES TRIPLE.
10. P AND U DENOTES SHIELDED PAIR 22 GAUGE WIRE WITH EXTRUDED NYLON JACKET.
11. ⊂⊃——— DENOTES SHIELDED CONNECTION.
12. WIRING NOT OTHERWISE SPECIFIED IS DRESSED BACK TO THE PANEL AND RUN AT RIGHT ANGLES IN THE MOST CONVENIENT MANNER



TM 2148-60

Figure 71.—Telephone Repeater AN/TCC–11, line amplifier, wiring diagram.



GLOSSARY

DEFINITIONS

A-b direction of transmission—Transmission in the direction from the A terminal to the B terminal. Indicated on drawings from left to right.

Ambient temperature—Temperature of the air in the immediate vicinity of equipment or parts.

Antising element—A circuit or part used to suppress undesired oscillations.

Attenuation characteristic (loss characteristic)—A curve showing the manner in which attenuation through a circuit, cable, or network varies with frequency.

B a direction of transmission—Transmission in the direction from the B terminal to the A terminal. Indicated on drawings from right to left.

Bulge—The portion of the cable attenuation characteristic which is greatest at a frequency in the center of the transmitted frequency band.

Cable attenuation—Decrease in signal amplitude produced by the effects of the cable characteristics.

Cable building-out—The addition of loss with the same attenuation characteristic as lengths of cable, obtained with adjustable networks.

Cable system—A carrier communication system which uses only spiral-four cable for interconnection of the terminals and repeater equipment.

Cable and radio system—A system which uses both spiral-four cable and radio sets for interconnecting the terminal and repeater equipment.

Carrier—A frequency with which a band of frequencies is modulated or demodulated.

CHAN—Abbreviation for channel.

Channel output frequencies or channel input frequencies—Frequencies in the range from 4 kc to 20 kc, including four message channels.

Circuit noise—Electrical disturbance brought to the receiver from a telephone system, excluding disturbance picked up acoustically by the handset transmitter.

Control point—The terminal end of the 12-channel carrier system which directs the actions of the system.

Crosstalk—The interference caused by energy from one circuit being introduced into another circuit by electrostatic or electromagnetic coupling.

Energizing circuit—The circuit and series of contacts through which the winding of a relay is energized and the relay operated.

Equalization—Compensation for variations in attenuation with frequency in order to make the resultant transmission substantially constant for all frequencies.

Flat—Having the same loss at all frequencies. The part of the cable attenuation characteristic which is constant with frequency.

Group input frequencies or group output frequencies—Frequencies in the range from 12 kc to 60 kc, which include twelve message channels adjacent to each other.

Junction point—An unattended repeater location where the power circuits from the attended points are turned back (or looped back) to their sources.

Locking path—circuit and series of contacts through which a relay is held operating after initial actuation.

Message channel—One of the 12 v-f transmission bands of 300 to 3,500 cycles bandwidth.

Modem—Contraction for "modulator-demodulator."

Order wire—A 300 to 1,700 cycle v-f maintenance circuit.

Pilot frequency—A 68-kc frequency used for purposes of regulating the gain of the attended amplifiers to keep their outputs constant and independent of normal cable attenuation changes in temperature.

Power loop—The path of the power circuit over the spiral-four cable from a power source at an attended station to unattended repeaters and back to the source.

Repeater—A combination of one or more amplifiers and associated circuits spaced along the spiral-four cable to compensate for cable attenuation.

Repeating coil—A low-ratio transformer which is introduced into a circuit to separate balanced from unbalanced circuits, or to isolate repeater or terminal circuits from the line.

Radio system—A system which has one or more radio sets in tandem.

Reference voltage—A constant voltage source used as a standard for comparison with a fluctuating voltage, used for control purposes.

Regulation—Automatic gain control used to compensate for changes in the temperature of the cable from the mean temperature 45° F.

Sidetone—Transmission and reproduction of sounds through a local path from the transmitter to the receiver of the same handset.

Sideband—One of the frequency bands on either side of the carrier which is produced when a carrier is modulated or demodulated with a band of frequencies.

Slope—The portion of the cable attenuation characteristic which is proportional to frequency.

Special service—Special equipment such as facsimile, telephoto, or similar equipment requiring more bandwidth than the message channel.

Spiral-four cable—Field Carrier Cable WF–8/G. Consists of four equally spaced stranded copper conductors separately insulated with polyethylene and spiraled around a polyethylene core. The cable conductors are covered by an inner jacket of polyethylene, a carbon-cloth leakage stabilizing tape, an open-mesh stainless steel armor braid, and a thermoplastic outer jacket.

SYNC—Abbreviation for synchronizing.

System—The complete array of equipment and interconnecting cable, or radio with an AN/TCC–7 terminal at each end, providing 12 two-way v-f message channels or special service channels between the terminals.

Talk-up—Unwanted response of v-f ringer circuits to speech frequencies.

Thermistor—A type of resistor whose resistance decreases when its temperature increases. The name is a contraction of *thermal resistor*.

Unattended repeater—A repeater, the operation of which does not require the presence of an operator.

Varistor—A type of semiconductor whose resistance varies with the amplitude of the applied voltage.

INDEX

	Paragraph	Page
A-B direction of transmission	4*b*	9
Assembly of Telephone Repeater AN/TCC–11:		
For field maintenance	169	120
For organizational maintenance	90	57
Auxiliary equipment	73	44
B-A direction of transmission	4*b*	9
Block diagram:		
System application, Telephone Repeater AN/TCC–11	4*a*	8
Telephone Repeater AN/TCC–11	93	58
Circuits, Telephone Repeater AN/TCC–11	94	58
Components, table of	7	9
Connections:		
Telephone Repeater AN/TCC–11 system	27	21
Test Set, Telephone TS–712/TCC–11	28	24
Controls, Telephone Repeater AN/TCC–11:		
General	44	31
Use	45	31
Demolition:		
Authority for	195	136
Methods	196	136
Description:		
Case	8*b*	9
Filter section	14*c*	15
J1 end cover assembly	10	11
J1 end panel	12	13
J2 end cover assembly	11	13
J2 end panel	13	13
Line amplifier	14*b*	15
Plug-in assemblies	14	15
Shock mounting	15	15
Straps	8*c*	11
Telephone Repeater AN/TCC–11	8	9
Disassembly of Telephone Repeater AN/TCC–11:		
Field maintenance	169	120
For shipment or limited storage	193	136
Organizational maintenance	89	56
Equalizing circuit	106	61
Equipment performance checklist:		
Auxiliary equipment required	73	44
Checklist	74	44
Troubleshooting, by using	72	43
Fault-locating circuit:		
Circuit	123	68
Frequencies, necessity	122	68
Procedures	121	68
Final tests:		
Line amplifier:	Paragraph	Page
Continuity test	174	125
D-c voltage test	175	126
Gain test with feedback	177	126
Gain test without feedback	176	126
Overload test	179	127
Phase margin test	180	127
Regulation test	178	126
Telephone Repeater AN/TCC–11:		
Continuity test	183	131
Crosstalk test J1 to J2	191	134
Crosstalk test J2 to J1	192	135
D-c resistance test	185	131
Filter section d-c resistance test	184	131
Looping filter transmission test	190	134
Transmission test J1 to J2	188	132
Transmission test J2 to J1	189	133
First amplifier stage	107	63
Forms:		
DA Form 468	2*b*	7
DA AGO Form 11–238	2*c*, 61	7, 39
DA AGO Form 11–239	2*d*, 61	7, 39
DD Form 6	2*a*	7
Fungiproofing	63*e*	42
Gain switch	111, 113	64, 66
Glossary, definitions		147
Ground Installation, Telephone Repeater AN/TCC–11	20	16
Grounding Telephone Repeater AN/TCC/11	26	21
Identification:		
Line amplifiers	79	48
Repeater ends	9	11
Table of parts	App. II	139
Input circuit, transmission circuit 1	96	59
Installation, Telephone Repeater AN/TCC–11:		
Ground	20	16
Telephone pole	22	16
Interstage network	108	63
J-hook PF–81, use	25*a*	21
Lightning protection	131	72
Line amplifier:		
Circuits	97	59
Power distribution	128	69
Theory	105	61
Lubrication	62	42
Maintenance:		
Field	132	75
Organizational	65	42

Maintenance—Continued	Paragraph	Page
Preventive:		
Definition	58	39
Techniques	60	39
Tools, materials, and test equipment required	59	39
Moistureproofing	63*e*	42
Open circuit warning relay K1	130	72
Operation, unusual:		
Arctic climates	55	37
Desert climates	57	37
Tropical climates	56	37
Operation, usual:		
Carrier frequency	48*a*	35
Order wire	48*b*	35
Order wire:		
Circuit	116	67
Operation:		
Local	48*b*(2)	35
Remote location	120	67
Through transmission	48*b*(1)	35
Unattended repeater location	119	67
Test	144	89
Output circuit	110, 114	63, 66
Packing and packaging data	6	9
Plug-in assemblies:		
Filter section	14*c*	15
General	14*a*	15
Line amplifiers	14*b*	15
Pole mounting	19	16
Power circuit test	84	50
Power distributing circuit	125	69
Power distribution, line amplifier	128	69
Power loop, definition	125	69
Power requirements, Telephone Repeater AN/TCC–11	124	69
Preinstallation procedures	24	19
Preliminary starting procedures	46	34
Procedures:		
Preinstallation	24	19
Preliminary starting	46	34
Starting	47	35
Stopping	50	36
Stopping, emergency	53	36
Stopping, for replacing	52	36
Stopping, system shut down	51	36
Purpose, Telephone Repeater AN/TCC–11	3*a*	7
PWR LOOP–PWR THRU switch S1	127	69
References	App. I	137
Regulating circuit	111, 112	64
REP switch	123	68
Repacking for shipment of limited storage	194	136
Repeater spacing	4*c*	9
Replacement of parts	168	120
Replacing:		
Lightning arresters	77	47
Repeater AN/TCC–11	76	47
Switches	168	120
Resistance measurements, special instructions	82	49
Ringing from Telephone Repeater AN/TCC–11	49	35
Running spares	16	15
Rustproofing and painting	64*b*	42
Service upon receipt of used or reconditioned equipment	23	19
Signal substitution:		
Line amplifier	158	114
1 kc	157	113
Telephone Repeater AN/TCC–11	156	112
Siting:		
General	17	16
Normal conditions	18	16
Precautions	21	16
Starting procedures	47	35
Stopping procedure:		
Emergency	53	36
Replacing AN/TCC–11	52	36
System shut-down	51	36
Submersion, Telephone Repeater AN/TCC–11	21*a*	16
Tagging:		
Cable connectors	21*b*	16
Defective repeater	71	43
Talking from Telephone Repeater AN/TCC–11	49	35
Technical characteristics	5	9
Telephone Set EE–8 ( ):		
Connections for order wire use	28	24
Use of Telephone Set EE–8 ( )	28	24
Telephone Test Set TS–712/TCC–11, connections to Repeater AN/TCC–11	28	24
Test jig:		
Line amplifier	136	81
Telephone Repeater AN/TCC–11	135	81
Test, 1 kc	80	49
Test, vacuum tube activity	78	48
Testing parts:		
Equipment required	160	116
Basic equalizer test	163	118
Delay equalizer	162	118
High-pass, low-pass filter test	161	116
Interstage network test	166	120
Looping filter test	165	119
Regulator network test	164	118
Thermistor test	167	120
Tests, operational:		
Line amplifier	150	93
Telephone Repeater AN/TCC–11	139	84
Gain switch test	143	88
Looping filter test	145	89
Measuring circuit test	142	88
Order wire test	144	89
Power circuit test	140	84
Relay test	146	89
Transmission test	141	87
Tests, preinstallation:		
At AN/TCC–7 point	30	25
Adjustments of:		
AN/TCC–7	32	26
AN/TCC–11	31	25

Tests, Preinstallation—Continued	Paragraph	Page
Carrier frequency measurements	34	27
Completion of test	36	28
Fault-locating filter check	35	28
Order wire circuit test	33	26
At AN/TCC–8 point	37	28
Adjustments of:		
AN/TCC–8	39	28
AN/TCC–11	38	28
Carrier frequency measurements	41	29
Completion of test	43	31
Fault-locating filter check	42	30
Order wire circuit test	40	29
Transmission circuit 1	94, 103	58, 61
Transmission circuit 2	99, 115	60, 66
Transmission circuit tests	85	50
Using Telephone Terminal AN/TCC–7.	86	51
Using Repeater AN/TCC–8	87	52
Transmission direction, definition	4*b*	9
Troubleshooting:		
Additional information	152	109
D-c resistances of transformers and coils.	153	109
D-c voltage and resistance measurements of line amplifier as part of repeater.	155	109
Voltage measurements of Telephone Repeater AN/TCC–11.	154	109
Chart:		
Field maintenance	150	93
Troubleshooting—Continued		
Chart—Continued	Paragraph	Page
Organizational maintenance:		
Attended point	88	52
Unattended point	75	46
Data	133	76
General:		
Attended point	81	49
Unattended point	68	43
Precautions, general	137	83
Procedures:		
General	132	75
Line amplifier	147	92
Telephone Repeater AN/TCC–11	138	84
Test equipment required:		
Field maintenance	134	76
Organizational maintenance:		
Attended point	83	50
Unattended point	69	43
Using equipment performance checklist.	72	43
Types of operation, Telephone Repeater AN/TCC–11.	48	35
Uncrating, unpacking, and checking:		
New equipment	22	16
Used or reconditioned equipment	23	19
Use, Telephone Repeater AN/TCC–11	3*b*	7
Vacuum tube activity test	78	48
Visual inspection	66	42
Warning and protection circuits	129	72
Weatherproofing	63	42

[AG 413.42 (31 Aug 53)]

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

M. B. RIDGWAY,
General, United States Army,
Chief of Staff.

OFFICIAL:
WM. E. BERGIN,
Major General, United States Army,
The Adjutant General.

N. F. TWINING,
Chief of Staff, United States Air Force.

OFFICIAL:
K. E. THIEBAUD
Colonel, United States Air Force,
Air Adjutant General

DISTRIBUTION:

Active Army:

Tech Svc (1); Tech Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); AA Comd (2); OS Maj Comd (5); Base Comd (5); MDW (2); Log Comd (5); A (5); CHQ (2); FT (2); Sch (5) except 11 (25); Gen Dep (2); Dep 11 (20) except Sig Sec, Gen Dep (10); Tng Div (2); POE (10), OSD (2); Lab 11 (5); Mil Dist (3); Field Maint Shops 11 (3); Two (2) copies to each of the following T/O & E's: 11–107; 11–127A; 11–128; 11–500A, CA, CB, CC, CD; 11–587; 11–592; 11–597.

NG: Same as Active Army except one copy to each unit.

Army Reserve: Same as Active Army except one copy to each unit.

For explanation of distribution formula, see SR 310–90–1.

U. S. GOVERNMENT PRINTING OFFICE: 1953