ON/RADIO — RADIO MULTIPLEX POINTS
CARRIER LINE-UP — 48-CHANNEL COMBINING UNITS
MEASUREMENT OF INDIVIDUAL CARRIERS AND TOTAL POWER

In the most usual applications, this unit combines, through low-pass - high-pass filters, two 20- or 24-channel groupings of ON1 or ON2 carrier for transmission from cable or ON terminals toward the radio transmitter input; and, in the receiving direction, separates, through similar filters, two 20- or 24-channel groupings received from the radio receiver output for transmission toward the cables or ON terminals. Pads and slope networks are provided, where needed, for adjusting levels and equalization. In applications where only one 20- or 24-channel grouping is involved and future growth to 48 channels is not expected, the high-pass - low-pass filters may be omitted. At radio repeater points where either 24-channel grouping is dropped and the other carried further on the radio, two 48-channel combining panels may be operated back-to-back between radios.

Pin jacks are provided on this panel for connecting instruments.

The purpose of the tests described here is to measure transmission, in terms of power of individual carriers and total power, by bridging measurements at the designated test points.

Measurements for system line-up should be made progressing from sending end toward receiving end so that it is certain that each preceding point has been tested satisfactorily before attempting to test at the point in question. For example, referring to Fig. 1, before measuring at HG TRSG and LG TRSG jacks, the output of the W-E repeaters should be within requirements, and before measuring at LG REC and HG REC jacks, the radio path and/or the path through the 96-channel multiplex equipment if used should have been properly aligned so that the measurements at L & H REC jacks on the equipment are satisfactory.

At the test points designated HG TRSG and LG TRSG, the individual carrier should, in most instances, be approximately −15 dbm each, and total power approximately −4 dbm. An exception to these levels occurs at radio repeater dropping points where either (or both) group L or H is not dropped, but carried through the multiplex from one radio to another without passing through pads or slope networks. In such cases, the levels are determined by the requirements of the radio system involved and will be within 0.5 db of the levels received from the radio.

At the test points designated LG REC and HG REC, the levels of the individual carriers should, in most instances, be −40 dbm each, and total power approximately −29 dbm. The exception described in the previous paragraph applies also to LG REC and HG REC jacks.

Referring to Figs. 1, 2, and 3, losses in transformers T1 through T4 and filters FL1 and FL2 are very small. Levels at the L & H TRSG pin jacks will be ***lower*** than those at HG TRSG and LG TRSG jacks only by the amount of loss, if any, in pads E and G. Individual carriers, as measured at pin jacks L & H REC, are ***higher*** than those at LG REC and HG REC only by the amount of loss, if any, in pads F and H. Information regarding the apparatus furnished for each installation should be obtained from office records.

This section is reissued to make it applicable to TL radio application.

APPARATUS:

1 — KS-15538, L3 Carrier Frequency Voltmeter

1 — 400D Hewlett-Packard Vacuum Tube Voltmeter

1 — W2DW Test Cord

1 — Terminating Plug Per Fig. 4

STEP	PROCEDURE
1	In the associated type N- or ON-on-radio repeaters, make certain that repeater connectors have been inserted in the switching jacks J2 and J3.
2	In the associated 96-channel multiplex equipment, if available, verify that ED-92309-30 connectors per Fig. 14 of the application schematic have been plugged into switching jacks J15 and J65.
3	Determine from office records which of the three arrangements of Fig. 1, 2, or 3 most nearly applies to the 48-channel combining circuit to be tested.
4	Referring to the circuit under test, using Fig. 1, 2, or 3 as a guide; if the branch which includes the HG TRSG test jacks is equipped and is supposed to be operating: (a) Connect the 400D VTVM to HG TRSG test jacks using the W2DW cord, to measure total power. ***Requirement:*** For arrangements similar to Fig. 1 or Fig. 2, -10.5 ± 1.5 db. For arrangements similar to Fig. 3, within 0.5 db of level received from radio or 96-channel multiplex by complementary 48-channel combining circuit. (b) Connect the KS-15538, L3 carrier frequency voltmeter to HG TRSG test jacks, using the W2DW cord, and turn the selector switch to "135 OHMS BAL BRG" for Fig. 1 or 2, or to "600 OHMS UNBAL BRG" for Fig. 3. Measure and record the individual carriers and level control tone LCO, if used, at the frequencies indicated in Table I. Compute the slope by the methods described in Section 362-400-510. ***Requirement:*** Slope $= 0 \pm 3$ db. ***Note:*** For Figs. 1 and 2, individual carriers should be approximately -15 dbm each. For Fig. 3, they should be within 0.5 db of levels of same carrier as received from the radio or 96-channel multiplex by complementary 48-channel combining circuit.
5	If the branch containing the LG TRSG test jacks is equipped and supposed to be operating: (a) Connect the 400D VTVM to LG TRSG test jacks using the W2DW cord, to measure total power. ***Requirement:*** For arrangements similar to Fig. 1 or Fig. 3, -10.5 ± 1.5 db. For arrangements similar to Fig. 2, within 0.5 db of level received from radio or 96-channel multiplex by complementary 48-channel combining circuit.

STEP	PROCEDURE
5 (Contd)	(b) Connect the KS-15538, L3 carrier frequency voltmeter to LG TRSG test jacks, using the W2DW cord, and turn the selector switch to "135 OHMS BAL BRG" for Fig. 1 or 3 or to "600 OHMS UNBAL BRG" for Fig. 2. Measure and record the individual carrier and level control tone LCO, if used, at the frequencies indicated in Table I. Compute the slope by the methods described in Section 362-400-510. ***Requirement:*** Slope = 0 ± 3 db. ***Note:*** For Figs. 1 and 3, individual carrier should be approximately −15 dbm each. For Fig. 2, they should be within 0.5 db of levels of same carrier as received from radio or 96-channel multiplex by complementary 48-channel combining circuit.
6	Referring to the circuit under test, using Fig. 1, 2, or 3 as a guide; if the branch which includes the LG REC test jacks is equipped and is supposed to be operating: (a) Connect the 400D VTVM to LG REC test jacks using the W2DW cord, to measure total power. If, as determined from office records, the branch containing the LG REC jacks connects to the input of an LH repeater, the measurement of total power at the LG REC jacks may be incorrect due to presence of 304 kc leak from the repeater. In such cases where the system may be disabled, as in initial line-up tests, remove both repeater connectors from the switching jacks of the repeater, insert a terminating plug per Fig. 4 in one of the switching jacks and read the VTVM. When reading has been obtained, remove the Fig. 4 terminating plug and replace the repeater connectors in the repeater switching jacks. Where transmission may not be interrupted, the requirement is waived, but the requirement given in Step 6(b) must still be met. ***Requirement:*** For arrangements similar to Fig. 1 or Fig. 2, −35.5 ± 2 db. For arrangements similar to Fig. 3, requirement is determined by the radio system employed, and will be specified on circuit layout card. (b) Connect the KS-15538, L3 carrier frequency voltmeter to LG REC test jacks, using the W2DW cord, and turn the selector switch to "135 OHMS BAL BRG" for Fig. 1 or 2, or to "600 OHMS UNBAL BRG" for Fig. 3. Measure and record the individual carriers and level control tone LCO, if used, at the frequencies indicated in Table I. Compute the slope by the methods described in Section 362-400-510. ***Requirement:*** Slope = 0 ± 3 db. ***Note:*** For Figs. 1 and 2, individual carriers should be approximately −40 dbm each. For Fig. 3, the carrier levels are determined by the radio system employed and will be given on circuit layout card.
7	If the branch containing the HG REC jacks is equipped and supposed to be working: (a) Connect the 400D VTVM to HG REC test jacks using the W2DW cord, to measure total power. If, as determined from office records, the branch containing the HG REC jacks connects to the input of an LH repeater, the measurement of total power at the HG REC jacks may be incorrect due to presence of 304 kc leak from the repeater. In such cases, and where the system may be disabled, as in initial line-up, remove both repeater connectors from the switching jacks of the repeater, insert a terminating plug per Fig. 4 in one of the switching jacks and read the VTVM. When reading has been obtained, remove the Fig. 4 terminating plug and

STEP	PROCEDURE
7 (Contd)	replace repeater connectors in the switching jacks. Where transmission may not be interrupted, the requirement is waived, but the requirement given in Step 7(b) must still be met. ***Requirement:*** For arrangements similar to Fig. 1 or Fig. 3, −35.5 ± 2 db. For arrangements similar to Fig. 2, requirement is determined by the radio system employed, and will be specified on circuit layout card. (b) Connect the KS-15538, L3 carrier frequency voltmeter to HG REC jacks, using the W2DW cord, and turn the selector switch to "135 OHMS BAL BRG" for Fig. 1 or 3, or to "600 OHMS UNBAL BRG" for Fig. 2. Measure and record the individual carriers and level control tone LCO, if used, at the frequencies indicated in Table I. Compute the slope by the methods described in Section 362-400-510. ***Requirement:*** Slope = 0 ± 3 db. ***Note:*** For Figs. 1 and 3, individual carriers should be approximately −40 dbm each. For Fig. 2, the carrier levels are determined by the radio system employed and will be given on circuit layout card.
8	For future trouble location purposes, measure and record total power at L & H TRSG and L & H REC test jacks, using the 400D VTVM and W2DW cord.

TABLE I

ON1 AND ON2 CARRIER FREQUENCIES
IN
48-CHANNEL COMBINING CIRCUIT

ON1 FREQUENCIES		
	LOW GROUP	HIGH GROUP
GRP 5	44 KC 52	260 KC 252
GRP 4	64 72	244 232
LCO	76	228
GRP 3	84 92	224 212
GRP 2	104 112	204 192
GRP 1	124 132	184 172

ON2 FREQUENCIES		
	LOW GROUP	HIGH GROUP
GRP 6	40 KC 48	264 KC 256
GRP 5	56 64	248 240
GRP 4	72	232
LCO	76	228
GRP 4	80	224
GRP 3	88 96	216 208
GRP 2	104 112	200 192
GRP 1	120 128	184 176

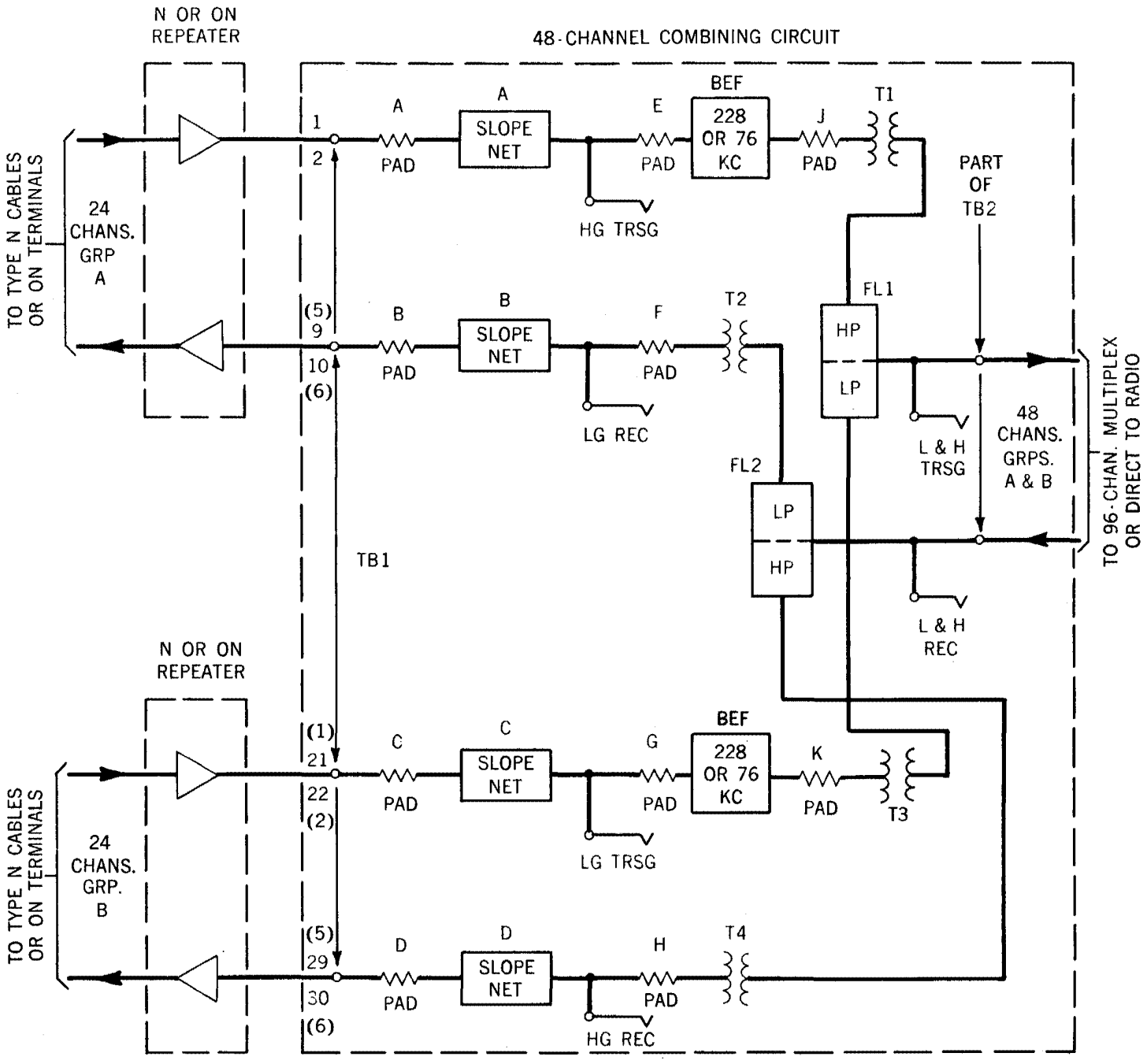

Fig. 1 – Block Diagram of Typical Arrangement of 48-Channel Combining Circuit at Radio Terminal

NOTE:

EITHER 24 CHANNEL GROUP A OR B MIGHT NOT BE EQUIPPED.

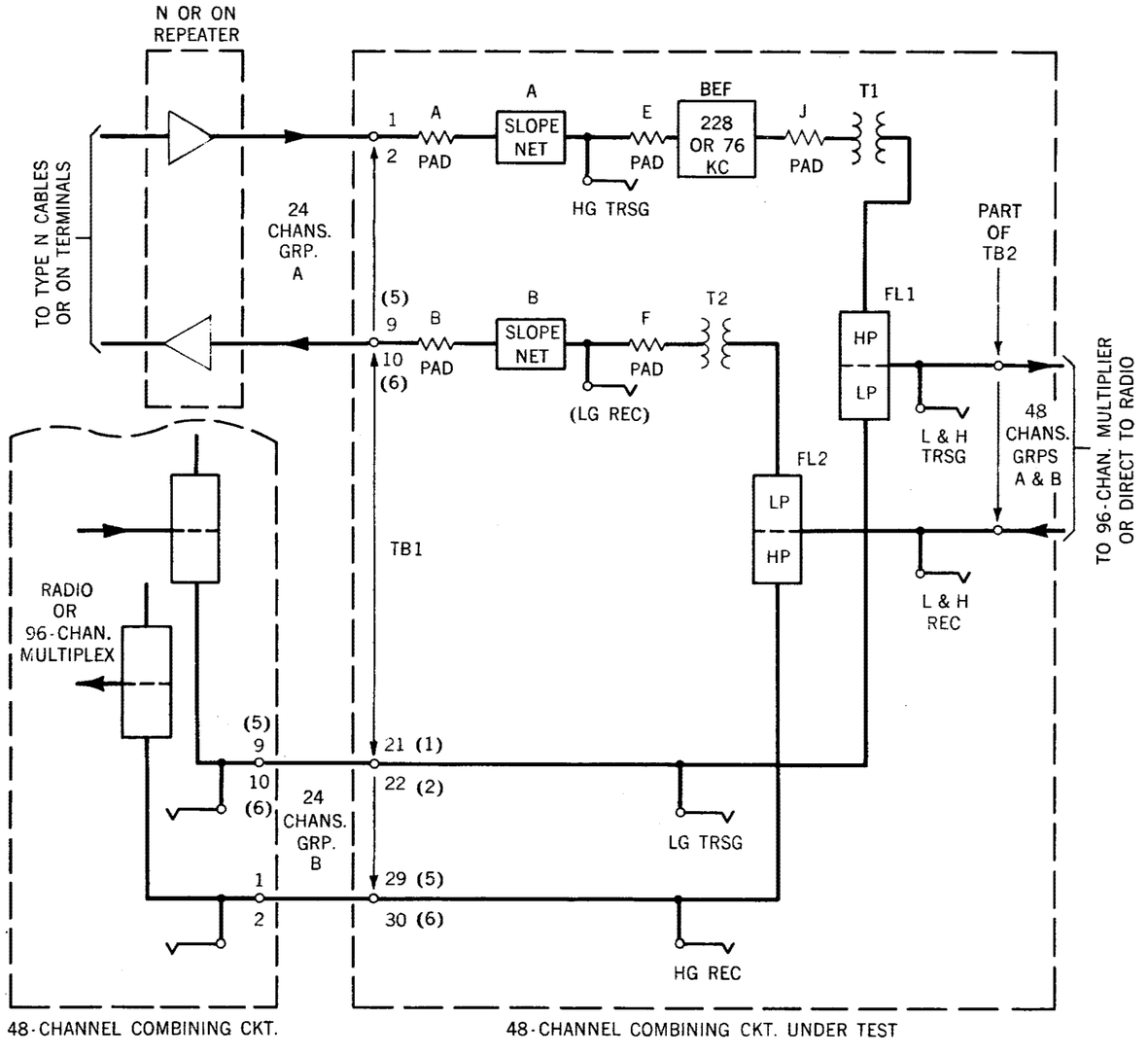

Fig. 2 – Block Diagram Showing One Arrangement of 48-Channel Combining Circuits Back-to-Back At Radio Repeater Dropping Point

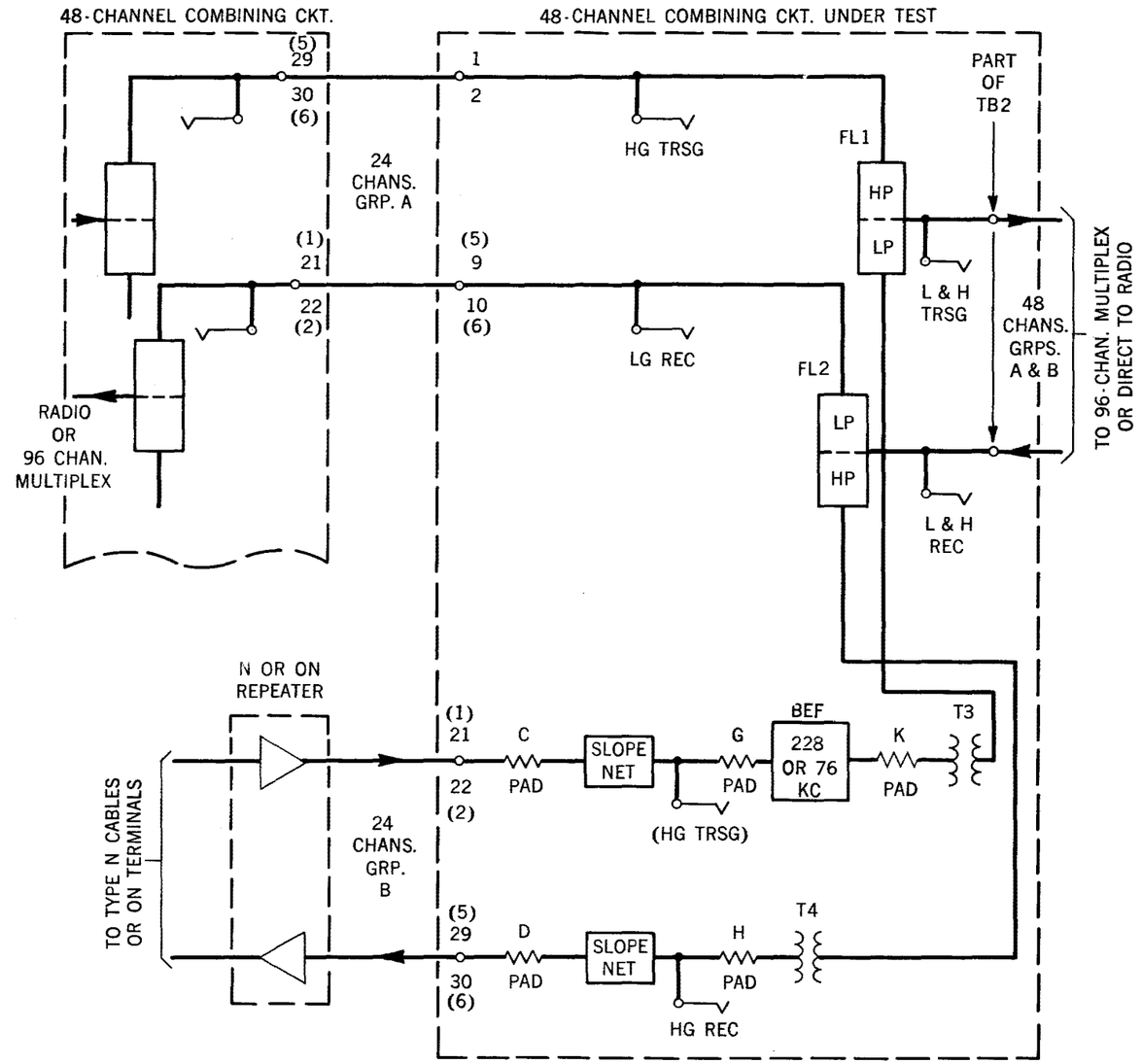

Fig. 3 – Block Diagram Showing Another Arrangement of 48-Channel Combining Circuits Back-to-Back At Radio Repeater Dropping Point

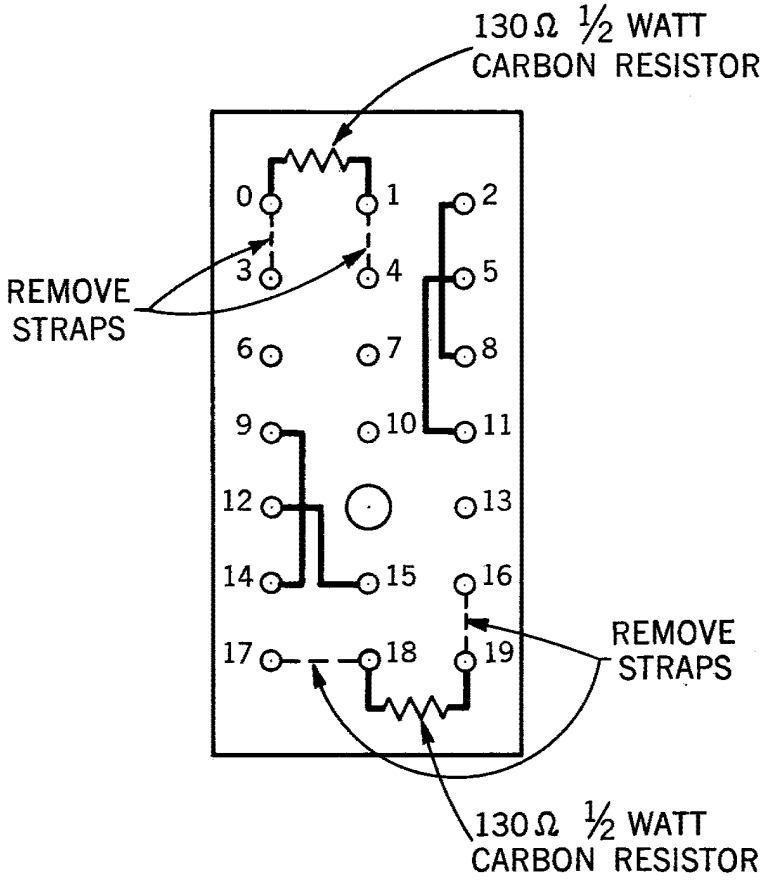

Fig. 4 – Terminating Plug Made by Modifying ED-92309-01, G1 (Repeater Connector per Fig. 6 SD-95124-01)