BELL SYSTEM PRACTICES
Teletypewriter and Data Stations

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130-TYPE TELETYPEWRITER SUBSCRIBER SET WITH 43A1 CARRIER TELEGRAPH TERMINAL

CONTENTS **PAR. NO.**

1. GENERAL

1.01 This section covers the 130-type teletypewriter subscriber sets. These sets each consist of a metal framework which contains a small amount of equipment and a connector for a 43A1 channel terminal. The complete unit is arranged for mounting on a teletypewriter table or floor stand.

1.02 This section is reissued:

(a) to include the 130B2 and 130C1 teletypewriter subscriber sets

(b) to revise the description of the 130-type teletypewriter subscriber set

(c) to amplify the instructions for tests and adjustments

(d) to change the title of the section.

The changes in this issue are so extensive that the marginal arrows ordinarily used to indicate passages changed, have been omitted.

1.03 The 130B1 subscriber set may be operated on a 2-wire or hybrid basis. The 130B2 and 130C1 sets, which have identical circuits but different equipment arrangements, may be operated on a 2-wire, 4-wire, or hybrid basis. These sets were all designed primarily for use at the subscriber stations for private line or TWX service.

1.04 Power for the 130-type subscriber set and its associated 43A1 channel terminal is supplied by a separate rectifier associated with the equipment. The KS-5663,L6 rectifier is used with either the 130B1 or 130B2 subscriber set. The KS-5663,L8 rectifier is used with the 130C1 subscriber set.

1.05 In private line service (PLS), two subscribers, each equipped with a 130-type subscriber set and associated 43A1 channel terminal, may be connected together directly or through equipment in one or more central offices.

1.06 For TWX service, the 130-type terminal equipment on the subscriber's premises connects with another carrier terminal in the central office. Through various central office equipment, an operator can connect the calling station to any other station with TWX service.

1.07 For unattended TWX service a 120-type subscriber set is required in addition to the 130-type subscriber set. This set contains relays whose functions are to control the operation of the teletypewriter station. One relay, responding to the ringing signal, starts a chain of action through the other relays to start the teletypewriter motor and condition the station for reception.

2. DESCRIPTION OF THE 130-TYPE SUBSCRIBER SET

A. General

2.01 The principal units of equipment at a station equipped with a 130-type subscriber set are as follows:

(a) The impedance matching transformer between the balanced line circuit and the unbalanced circuits of the carrier terminal.

(b) Resistors and a rheostat for limiting the current to the value in the local circuit of the teletypewriter.

(c) Power supply for the 43A1 channel terminal and the local teletypewriter loop.

(d) For TWX service, a retardation coil and shunting capacitcr is supplied for use with the ringer. Fig. 1 is a block diagram showing the relation of the 130-type subscriber set to the other units of the station.

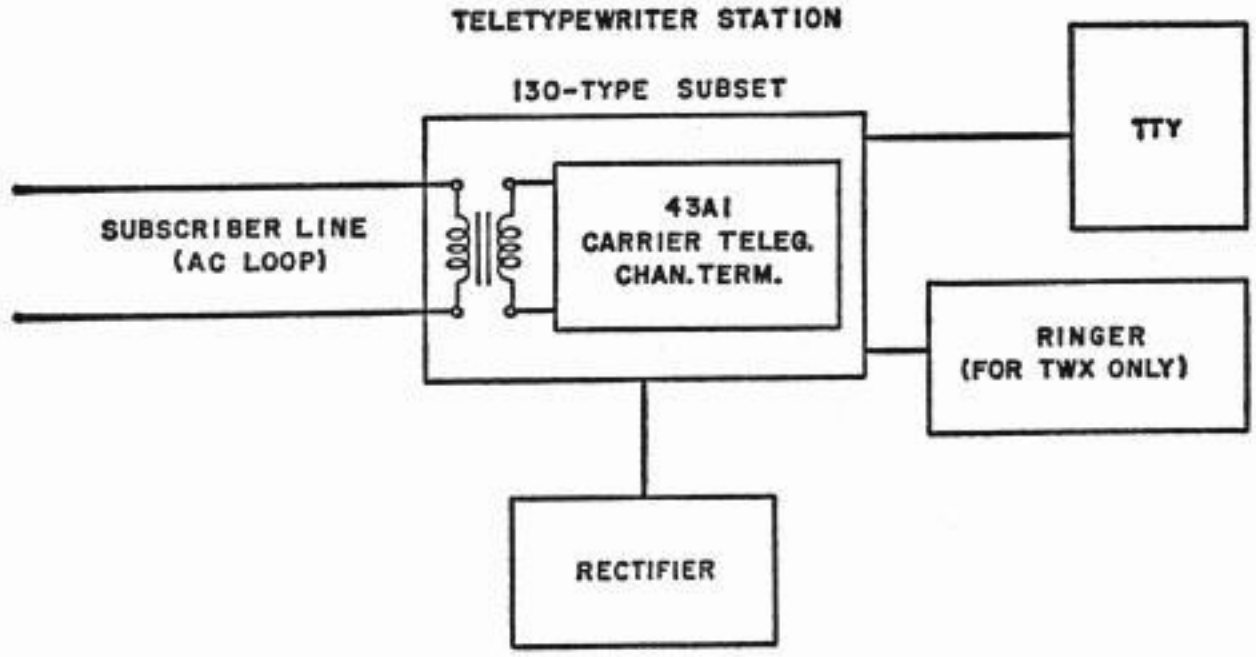

Fig. 1—Block Diagram of Teletypewriter Station Set Using 43A1 Carrier Channel Terminal Mounted in 130-type Teletypewriter Subscriber Set

2.02 **Power:**

(a) The 130-type subset supplies the connections for power to the 43A1 channel terminal and for current from the channel terminal to the local teletypewriter loop. The rectifier associated with the subscriber set furnishes:

(1) 130 volts dc for the tube plates and screens of the 43A1 channel terminal.

(2) 130 volts dc for the local teletypewriter circuit.

(3) 20 volts ac for the tube heaters in the carrier terminal.

2.03 **Relay Operation:** For 62.5 ma full duplex or 62.5 ma half duplex with relay operation, an additional rectifier is needed.

2.04 **Line Transformer:** Since the 43A1 channel terminal is required to work into lines having a wide range of impedances, the 130-type subscriber set has an adjustable impedance matching transformer. This transformer is capable of providing an approximate match between the 600-ohm channel filter and the line. The line transformer arrangement is used for all channels except where it is necessary to use adjacent sending and receiving channel frequencies. When adjacent sending and receiving frequencies are used, and the level of the sending frequency exceeds the level of the receiving frequency by approximately 15DB in either voice or above voice-frequency range, a hybrid transformer with an adjustable balancing network is required. The difference in level which may be tolerated is also dependent upon the noise level present in the system. The hybrid transformer augments the discrimination when adjacent frequencies are used for sending and receiving. The procedure for obtaining a hybrid balance is described in 5.08.

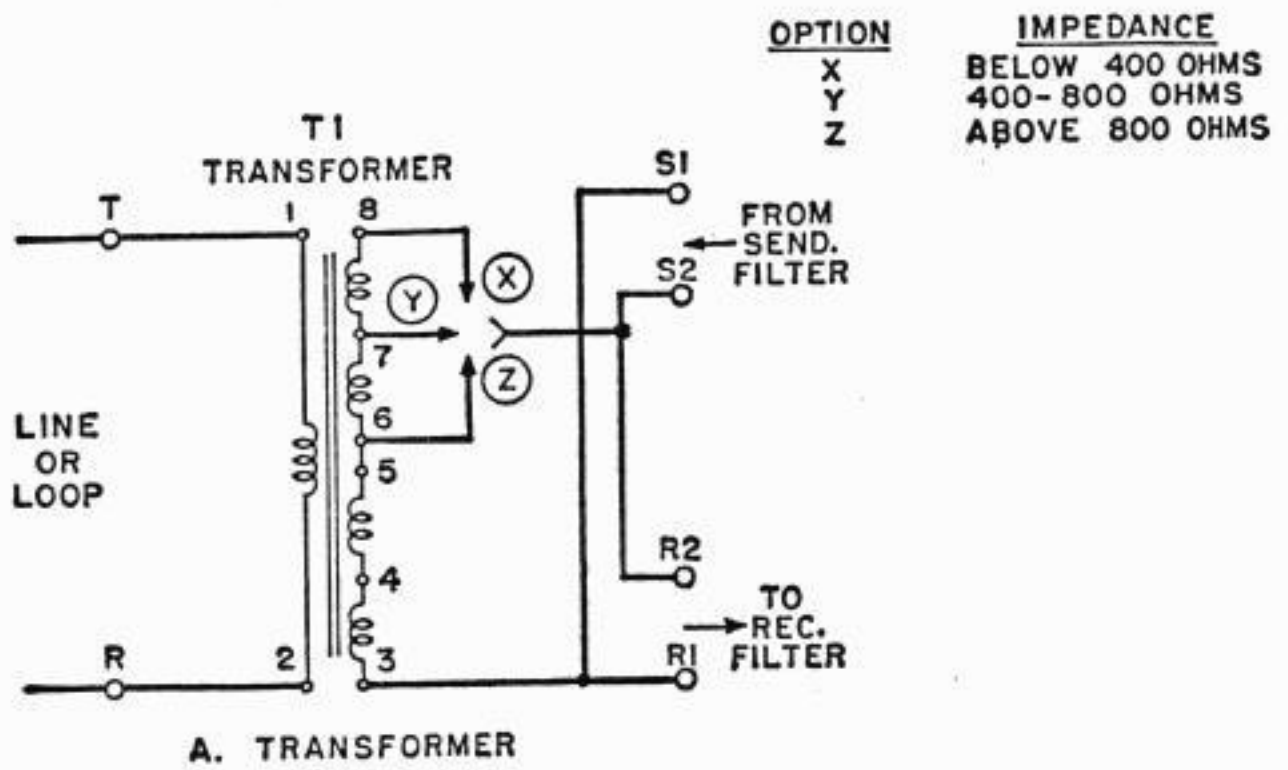

Fig. 2—Line Transformer Connections—130B1 Set

2.05 Figs. 2A and 2B show the 2-wire line and the hybrid transformer circuits, respectively, for the 130B1 subscriber set.

2.06 Figs. 3, 4, and 5 show the 2-wire line, 4-wire line, and hybrid transformer circuits, respectively, for the 130B2 and 130C1 subscriber sets. Each of these sets is provided with a plug-in unit for ease in converting the subscriber sets from one type of operation to another. A ground switch is provided on each of these plug-in units which, on the 2- and 4-wire units, grounds the center tap of the line transformer. In the hybrid

unit the switch is used to ground the center of the primary windings of the hybrid transformer when its two primary windings are connected in series. The grounding of the center tap of these transformers, may aid in reducing the effect of longitudinal currents when open wire line facilities are used.

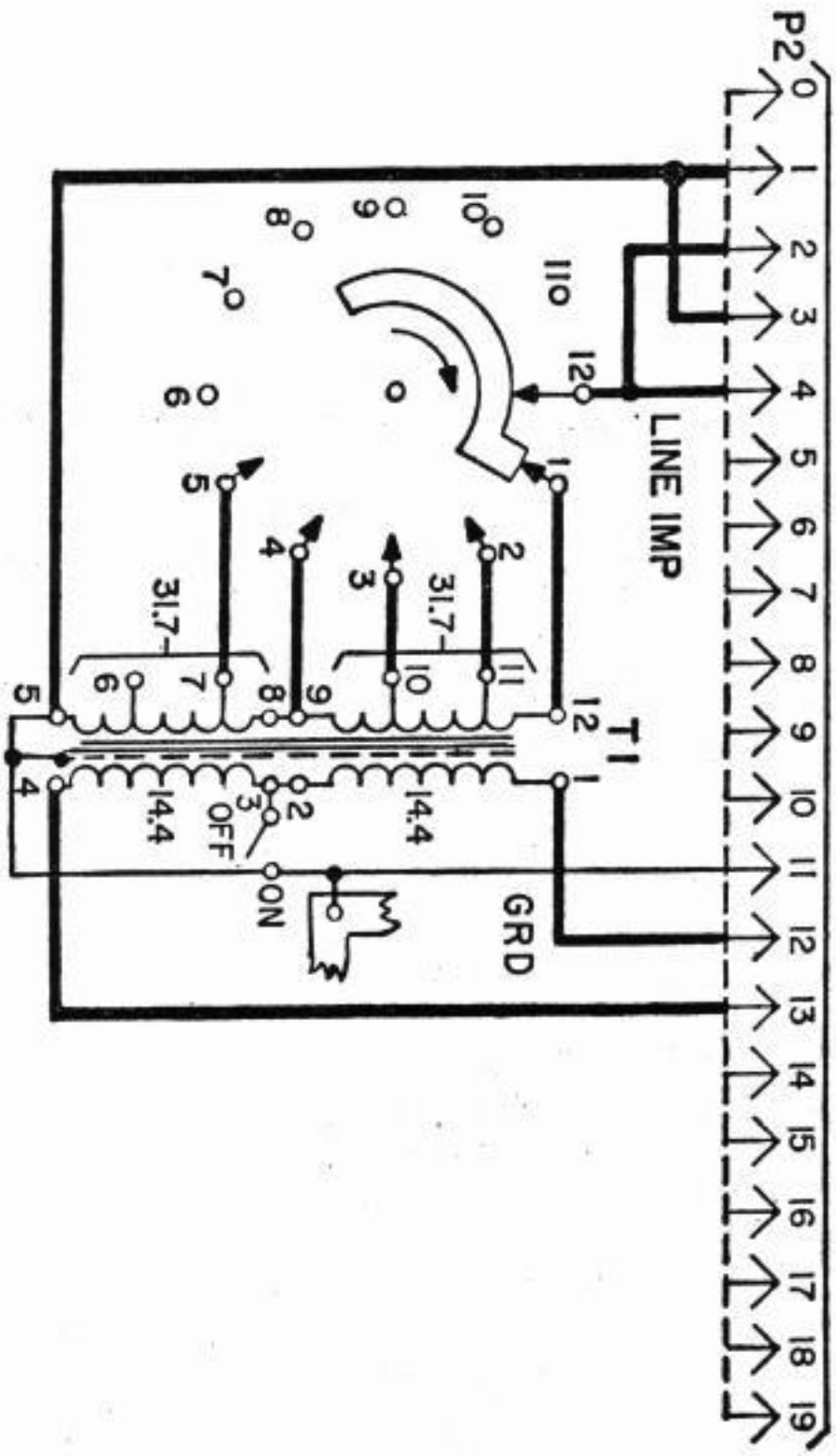

Fig. 3—Two-wire Transformer Unit without Hybrid Balance

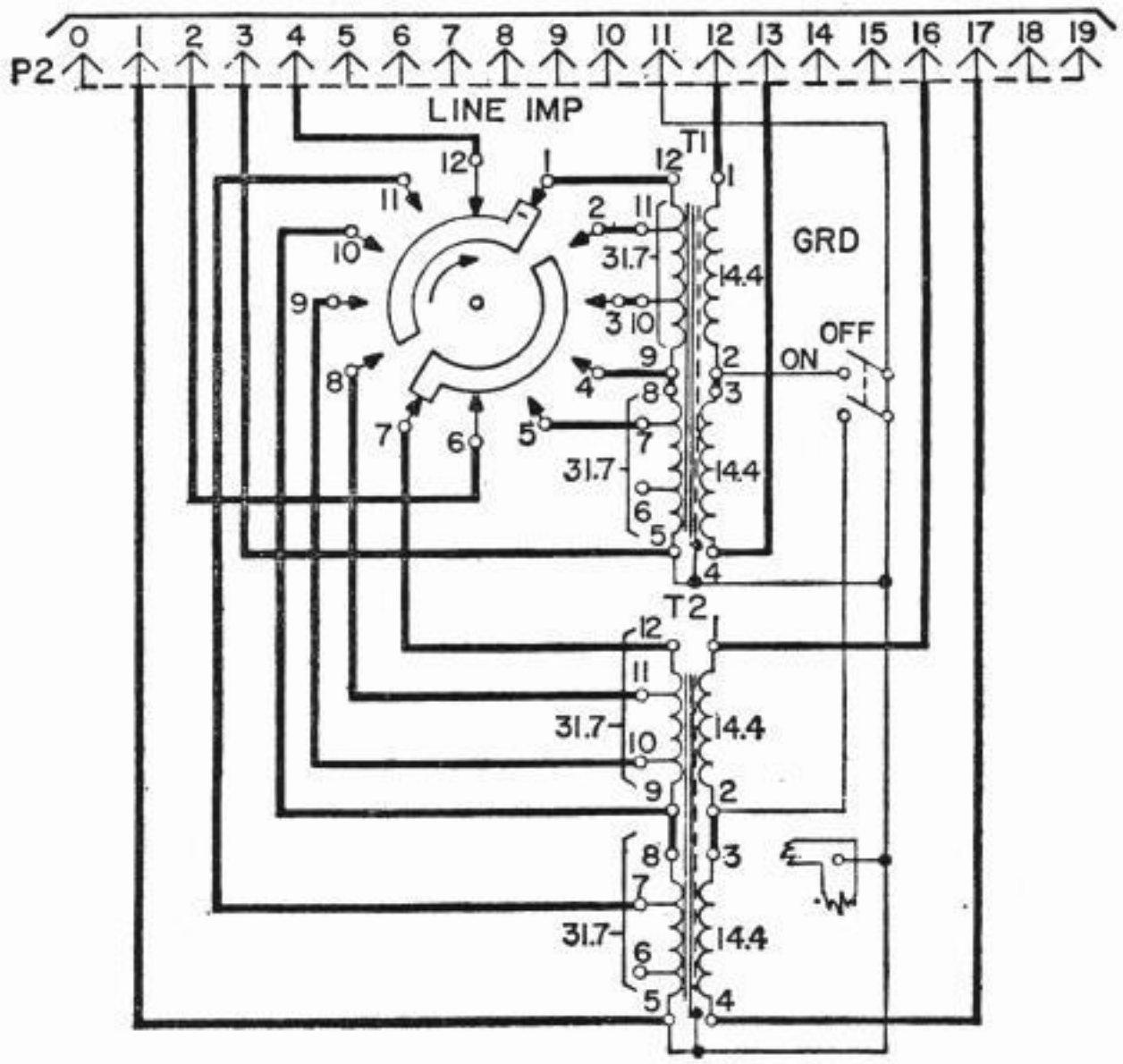

Fig. 4—Four-wire Transformer Unit

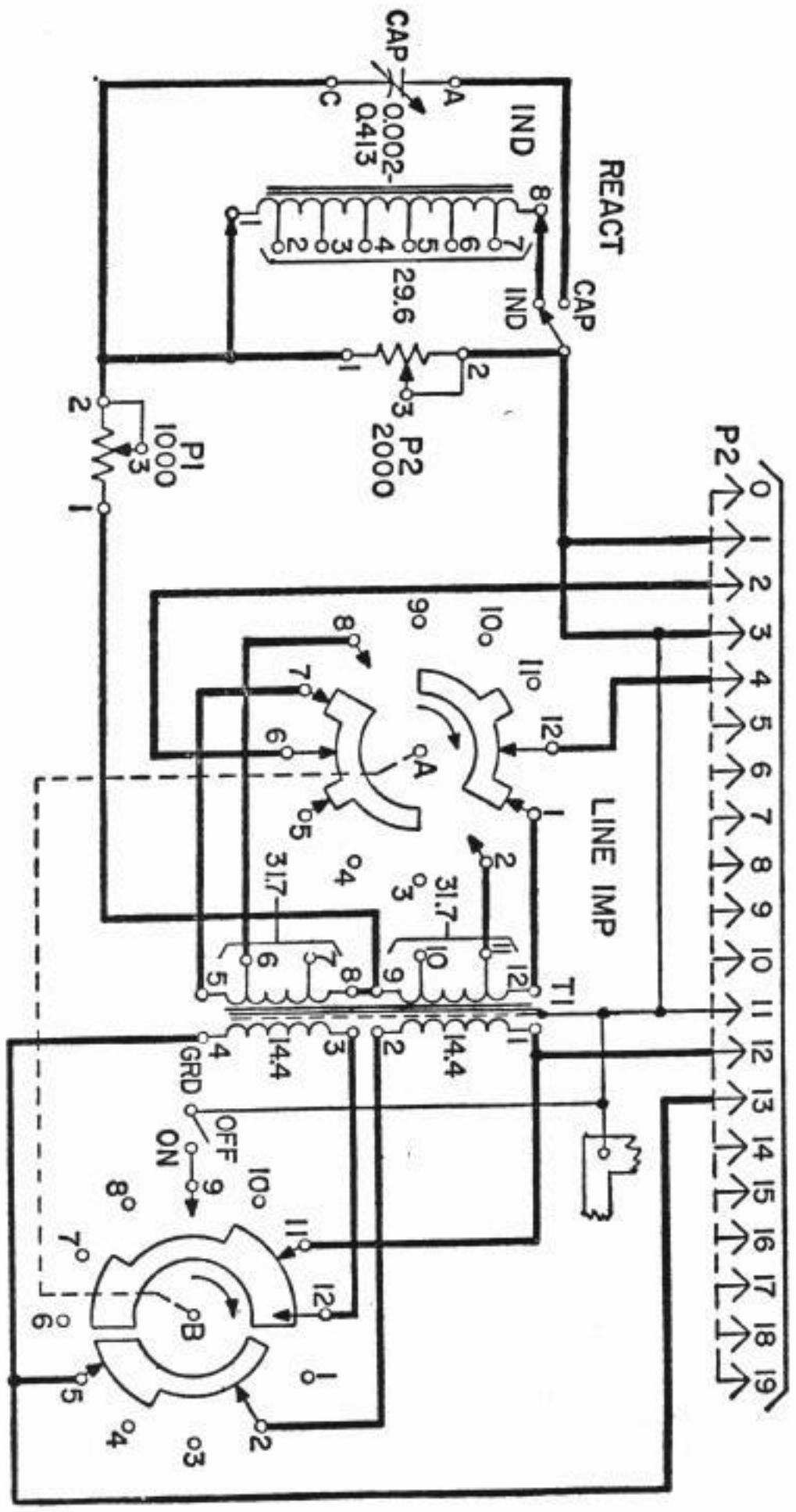

Fig. 5—Two-wire Transformer Unit with Hybrid Balance

B. Private Line Service (PLS)

2.07 Fig. 6 is a simplified schematic of the 130B1 subscriber set used for PLS half-duplex operation. Fig. 7 shows only the corresponding dc circuits for full-duplex operation. The 130-type subscriber set can be arranged to operate either half or full duplex by means of external strapping at the screw-type terminal strip.

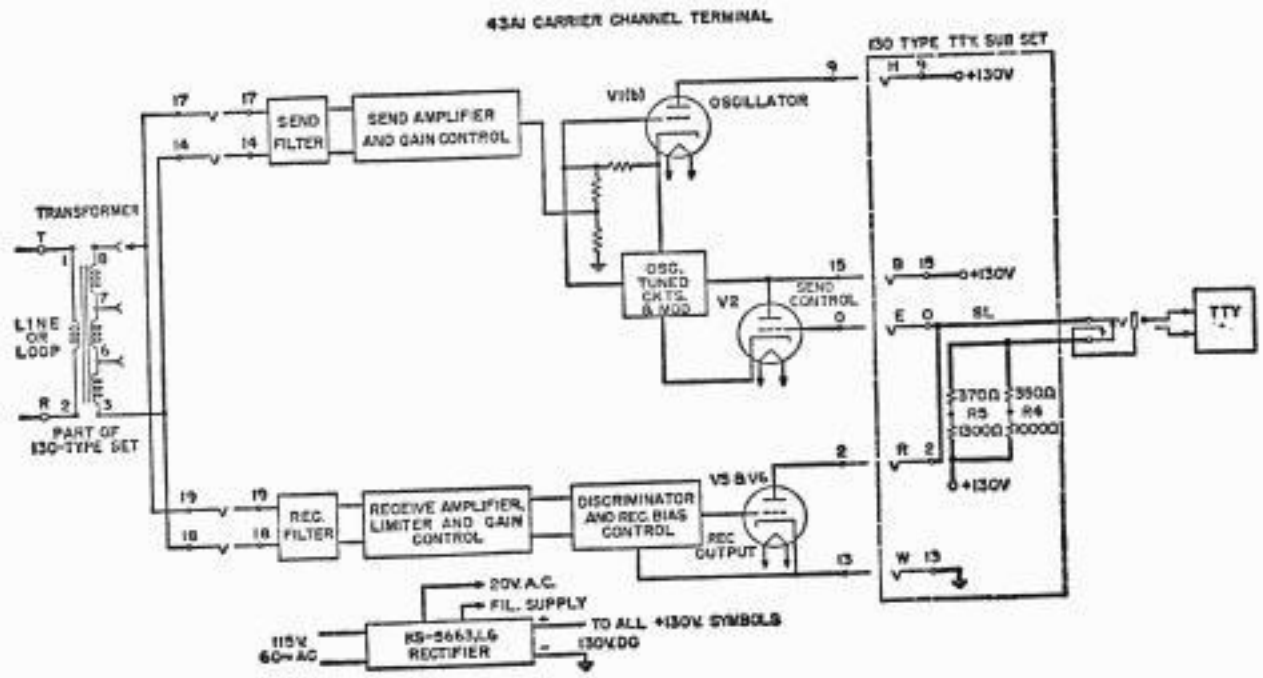

Fig. 6—TTY Station Set Using 43A1 Carrier Terminal—PLS—Half Duplex

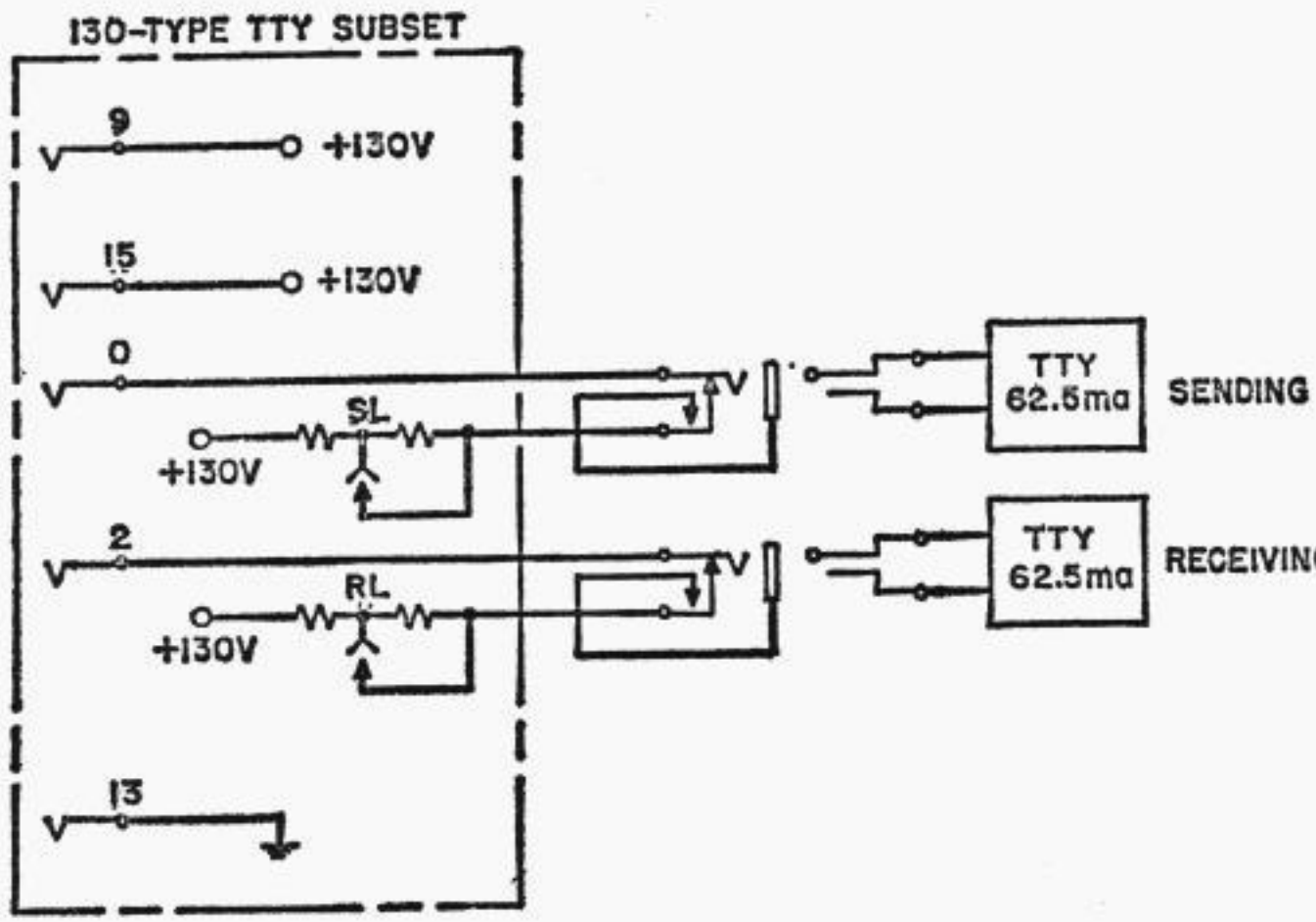

Fig. 7—TTY Station Set (130B1) Used for PLS—Full Duplex

2.08 For 62.5 ma operation, tubes V5 and V6 are operated in parallel. For 20 ma operation, only tube V5 is required and V6 is removed.

2.09 The ringer and its associated equipment are not provided at a PLS station.

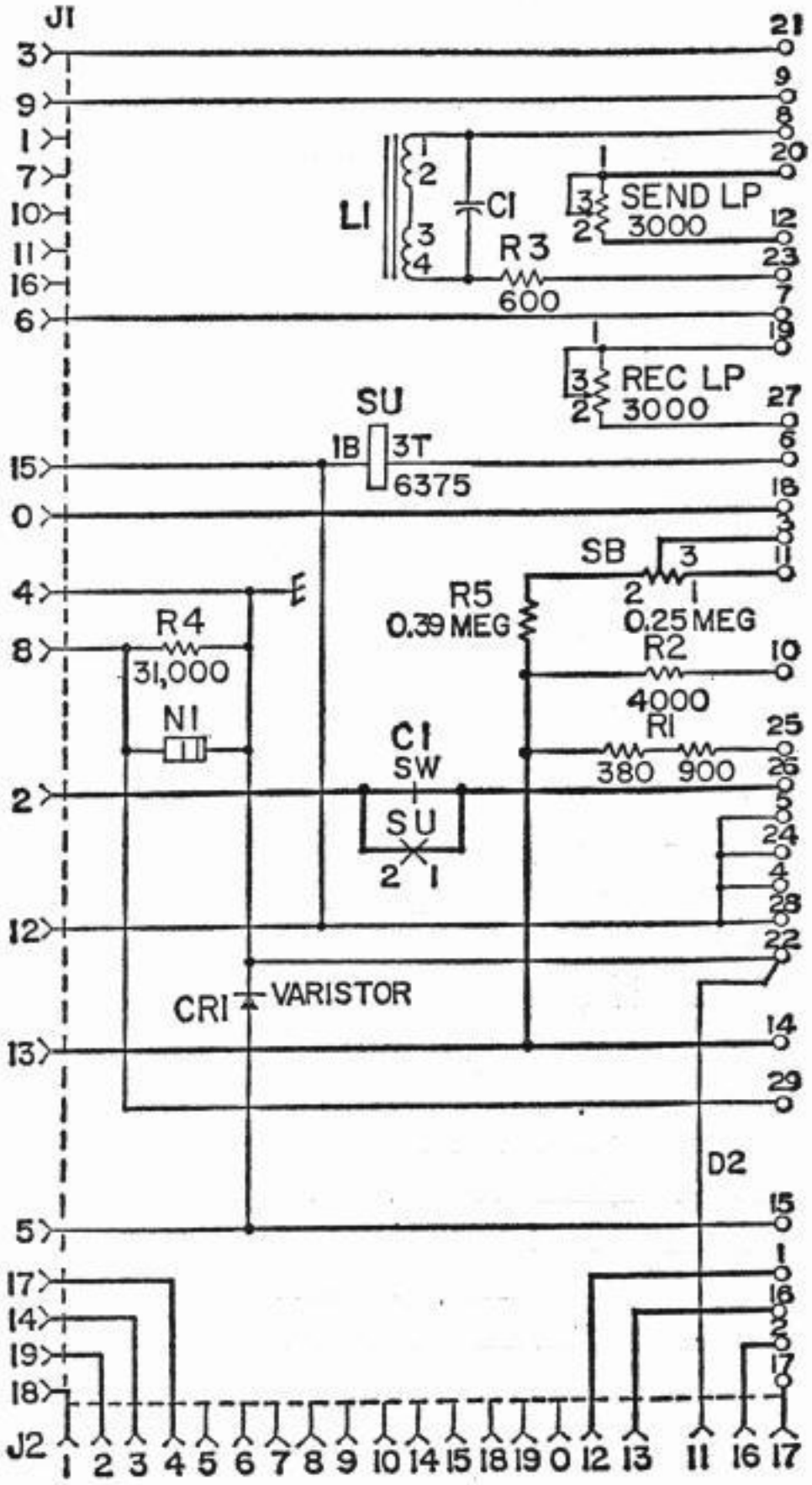

Fig. 8—130B2 or 130C1 Subscriber Set

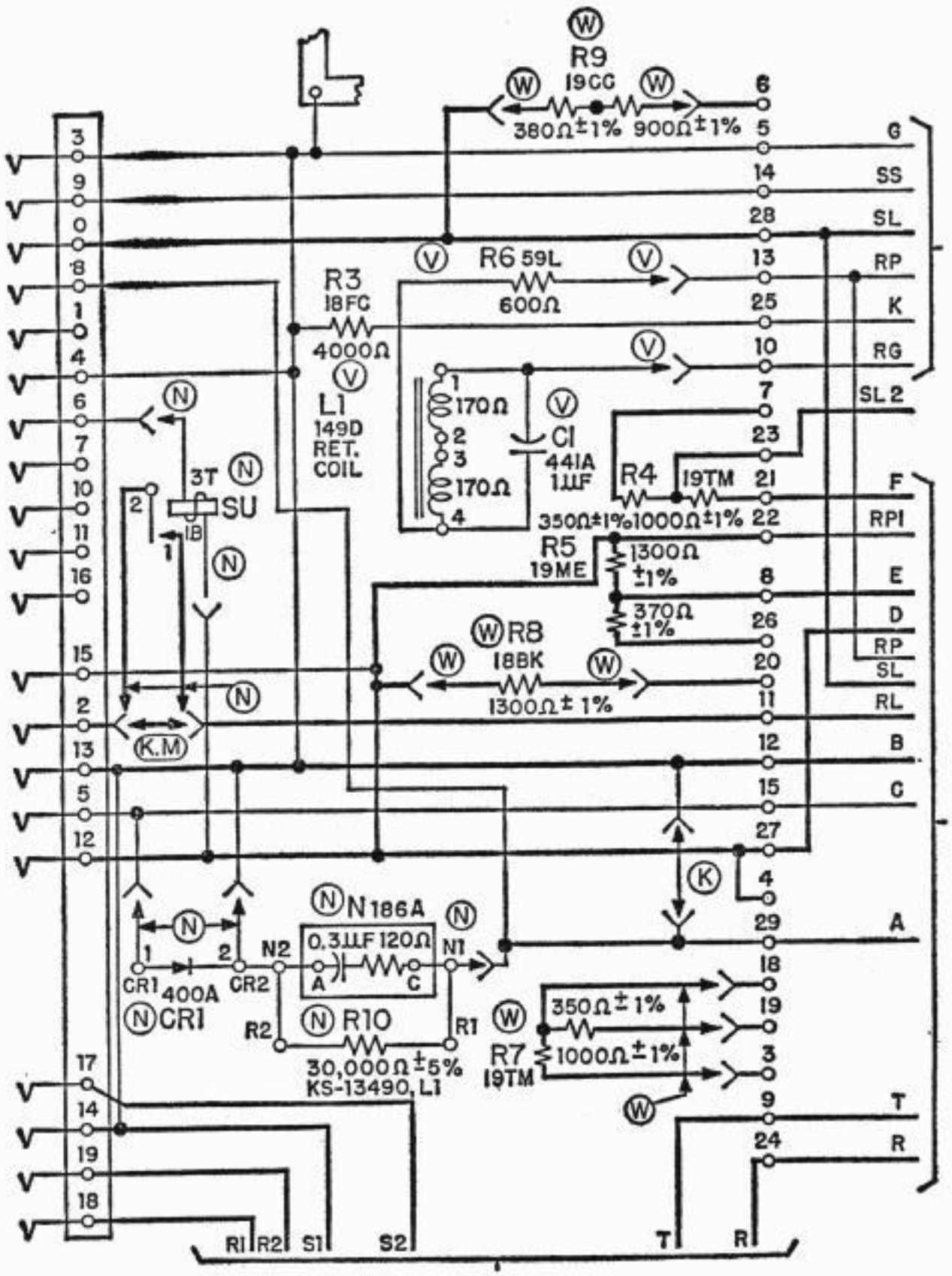

Fig. 9—130B1 Subscriber Set

C. TWX Service

2.10 The 130-type subsets used for TWX service require additional equipment for control of the teletypewriter and supervisory functions. These arrangements are described in detail in the sections describing the 120-type subscriber sets.

D. 130-type Subscriber Set Schematics

2.11 Fig. 8 is the schematic of a 130B2 or 130C1 subset. The 130B1 subset is now Manufacture Discontinued. The schematic of this subset is shown in Fig. 9.

3. TOOLS AND APPARATUS

3.01 The following tools, meters, and spare units will be found necessary or desirable, as indicated, for installation and maintenance work in the field.

(a) **Necessary**

Teletypewriter maintenance tools including a KS-14510,L1 volt-ohm-milliammeter or equivalent.

13A transmission measuring set, or equivalent, capable of measuring levels from +6 dbm to —20 dbm.

164C1 or 164C2 telegraph transmission measuring set or 161A1 telegraph station test set or equivalent.

(b) **Desirable**

Spare set of tubes.

Spare channel terminal.

Spare send and receive networks for the station frequencies.

High-impedance telephone receiver such as the Type 509.

Note: This will be useful to check for the presence or absence of the send or receive frequency.

4. INSTALLATION

4.01 This section lists the tests and adjustments required when a 43A1 terminal and 130-type subscriber set are installed on a subscriber's premises. It is assumed that the terminal has been tested and is known to be in good condition. The tests listed are needed to assure that the terminal will operate satisfactorily when put in service.

CAUTION: Make sure the power is off when plugging or unplugging the channel unit or making connections to the subscriber set.

4.02 The steps to be taken as part of the installation operation are as follows:

(a) Check that the send and receive filters are the correct frequency specified for the installation.

(b) Check that the filters and channel terminal are secure in their connectors.

(c) Strap the line transformer for the correct impedance ratio. (Par. 5.06)
(d) If hybrid operation is used, adjust the hybrid transformer balance. (Par. 5.08)
(e) Adjust the rectifier for 130 ± 2 volts. (Par. 5.03)
(f) Adjust the a-c filament voltage to 20 ± 0.5 volts. (Par. 5.04)
(g) Set the SEND and REC switches to their required positions. (Par. 5.05)
(h) Adjust the send level if it has not been previously set to the specified value. (Par. 5.07)
(i) Adjust the loop current to 62.5 ± 2.5 or 20 ± 1 ma, as required. (Par. 5.10)
(j) Adjust the REC GAIN potentiometer. (Par. 5.09 or 5.14)
(k) Adjust the receive bias. (Par. 5.11)
(l) Adjust the send bias. (Par. 5.12)
(m) Adjust for no-carrier indication if required. (Par. 5.14)
(n) Check the over-all operation with the testboard. (Par. 5.15)

5. TESTS AND ADJUSTMENTS

5.01 The amount and type of repair work to be done at the station depends on local practice and the amount of training received by, and the equipment available to, the repairman.

5.02 The tests and adjustments herein are primarily for the initial installation of a 130-type subscriber set supplied for field installation and alignment. They will also be useful as checks in connection with maintenance work. When a subset has been sent out as a part of assembled station by the Western Electric shops, it can be assumed that all adjustments have been made except the send and receive levels, the line impedance adjustment, and the hybrid balance, if required. It is a matter of local practice as to how many of the following adjustments need be repeated on an assembled station supplied by the distributing house.

5.03 **Adjustment of Rectifier Voltage:** With the line-test key of the teletypewriter set in the LINE position, and with the POWER switch to ON, so that an approximately normal load is supplied by the rectifier, connect a dc voltmeter across terminals 12 and 27 of the 130B1 or terminals 14 and 28 of the 130B2 and 130C1 subscriber sets. With the KS-5663,L6 type rectifier adjust the voltage to obtain a dc output of 130 ± 2 volts. The KS-5663,L8 rectifier is only to be adjusted if the dc

voltage is over 135 volts or below 125 volts under load conditions. When the output voltage is below 125 volts, use tap "B" in the rectifier. Use tap "A" when the output voltage is above 135 volts.

5.04 **Adjustment of Filament Voltage:** Connect an ac voltmeter across terminals 15 and 29 of the 130-type subscriber set, and with the 20-V A.C. potentiometer in the KS-5663,L6 rectifier, adjust the voltage for 20 ± 0.5 volts. The KS-5663,L8 rectifier has no filament voltage adjustment.

NOTE: THIS READING WILL BE ABOUT 28 VOLTS FROM THE KS-5663,L8 RECTIFIER DUE TO THE TYPE OF A-C WAVE PUT OUT BY THE RECTIFIER.

5.05 **Send and Receive Switches on the Carrier Terminal:** Set the SEND and REC switches of the carrier terminal to the positions indicated in the following table:

	Switch Setting	
	SEND	**REC**
Voice-Frequency Range		
All Channels	HM	H+
High-Frequency Range		
Bottom three frequencies sending	LM	H+
Top three frequencies sending	HM	L+

5.06 **Line Transformer Connections**

(a) To set the line transformer for optimum impedance in the 130B1 subscriber set, proceed as follows:

(1) Using the following table, position the REC switch at the receiving station in accordance with the setting of the SEND switch at the sending station:

SENDING STATION SEND SWITCH	RECEIVING STATION RECEIVE SWITCH
HM	L+
LM	H+

(2) Have the sending station transmit a steady mark signal at the specified sending level.

(3) Operate the OSC switch to the OFF position.

(4) Measure the loop current by connecting the KS-14510,L1 or equivalent meter in series with the lead removed from terminal 11 and terminal 11 of the subscriber set. Adjust the LP CUR potentiometer to obtain

62.5 mils if the station is to operate at that value. If the station is to operate at 20 mils, rotate the LP CUR potentiometer to its extreme clockwise position.

(5) Remove the lead from terminal 25 of the subscriber set and connect a test lead from this terminal to pin jack A2 of the channel terminal. This connects a 4000 ohm resistor across the input of the V4 tube in the terminal and reduces the incoming level to permit the following measurements.

(6) Provide X option for the transformer tap.

(7) Adjust the REC GAIN potentiometer until the receiving loop current is approximately 25 mils for either a 20- or 62.5-mil loop. (Rotating the REC GAIN potentiometer in a clockwise direction will decrease the current.) Carefully observe the meter reading.

(8) Provide Y option for the transformer and, without changing the REC GAIN potentiometer, observe the reading of the meter.

(9) Provide Z option for the transformer and observe the reading of the meter.

(10) That option which gives the **minimum** loop current in (6), (8), or (9), provides the optimum impedance match between the line and the carrier terminal.

(11) Wire the correct option to the transformer and restore all wiring and switches to their proper positions. Readjust the loop current in accordance with 5.10.

(b) To set the line transformer for optimum impedance in the 130B2 and 130C1 subscriber sets equipped with rotary switches for impedance matching, proceed as follows:

(1) Set up the station as in (a)(1), (a)(2), (a)(3), and (a)(4).

(2) Remove the lead from terminal 10 of the subscriber set and connect a test lead from this terminal to pin jack A2 of the channel terminal.

(3) Turn the LINE IMP switch to position A.

(4) Proceed as in (a)(7), of 130B1 adjustment.

(5) Check all the positions of the LINE IMP switch and note the reading of the meter for each position.

(6) The position of the switch that gives the **minimum** loop current in Step 5, provides the optimum impedance match between line and terminal.

(7) Set the LINE IMP switch on its proper tap and restore all other wiring and switches to their proper positions. Readjust the loop current in accordance with 5.10.

5.07 **Adjustment of Send Level:** The carrier level to be transmitted over the circuit is adjusted by means of the SEND LEV potentiometer. The required value may be specified in terms of the level sent by the subscriber terminal, or it may be specified in terms of the receiving level at the opposite end of the channel. One or the other of these values, or both, must have been worked out as a part of the engineering of the channel and should be available at the time of installation. Three methods for setting the send level are listed below, the one to be used depending on the conditions and testing apparatus available. The methods, listed in order of preference, are as follows:

(a) Adjust the send level as directed from the receiving point to meet the specified receive level value.

(b) Measure the send level locally with a 13A transmission measuring set or its equivalent. This is done by removing the line connections from terminals 9 and 24 of the 130B1 or 1 and 16 of the 130B2 and 130C1 subscriber sets, and substituting the measuring set for the line.

(c) Adjust the send level at a central test point before the subscriber set is taken to the customer's premises. (Extreme care must be taken not to move the SEND LEV potentiometer in transit.)

5.08 **Hybrid Transformer Balance:**

To obtain the optimum hybrid transformer balance for the 130B1 subscriber set, proceed as follows:

(a) Have the distant station operate its OSC switch to the OFF position.

(b) Note the normal position of the SEND switch on the local channel terminal. If the mid-band frequency of the sending filter is in the lower frequency range, operate the SEND switch to the HM position. If the mid-band frequency is in the higher frequency range, operate the SEND switch to the LM position.

(c) Measure the receiving loop current with a dc milliammeter by removing the lead from terminal 11 of the subscriber set and connecting the meter between this lead and terminal 11.

(d) Turn the REC GAIN control to the extreme counterclockwise position.

(e) The SEND LEV potentiometer should be set for its normal operating value in accordance with 5.07.

Note 1: With the REC GAIN control at minimum gain there is no amplification of the spill-over carrier from the sending side. Thus the grid of the output tube is at cathode potential, which causes current to flow in the loop. This

is the "Mark Hold" condition. For 62.5 ma loop applications, this current will be about 56 ma, and for 20 ma applications, about 18 ma.

Note 2: As the receiving gain is increased by turning the REC GAIN control clockwise, the incoming interference tends to change the loop condition from marking to spacing, reducing the loop current from its "Mark Hold" value to a smaller value, near zero if the interference is great enough. The smaller the effect of interference, the less will be the reduction below the "Mark Hold" value. The optimum is obtained when the loop current is as near as possible to the "Mark Hold" value when the REC GAIN control is set up to maximum gain.

(f) Adjust the potentiometers P1 and P2 (Fig. 9) to find a setting such that the gain may be increased as far as possible without causing the loop current to drop below its "Mark Hold" value. The REC GAIN control and the potentiometers P1 and P2 should be adjusted alternately, first increasing the gain until the loop current drops slightly and then adjusting the potentiometers to bring the loop current back to its "Mark Hold" value.

(g) These adjustments should be continued until no drop in loop current is obtained with the REC GAIN control in its maximum clockwise position, or until adjustment of P1 and P2 in either direction causes the loop current to drop.

(h) Restore the SEND switch to its normal position and set the REC GAIN control for maximum gain.

To determine the optimum hybrid transformer balance for the 130B2 or 130C1 subscriber set when this type of operation is required, proceed as follows:

(a) Have the distant terminal transmit a steady marking signal at the specified sending level.

(b) Measure the receiving loop current with a KS-14510,L1 or equivalent meter by connecting the meter in series with the lead removed from terminal 11 and terminal 11 of the subscriber set.

(c) Operate the OSC switch of the subscriber set to the ON position.

(d) Adjust the REC GAIN potentiometer to the maximum clockwise position.

(e) Using the following table, position the REC switch of the subscriber set in accordance with the setting of the SEND switch at the distant terminal:

DISTANT TERM. SEND SW.	130 SUBSET REC. SW
HM	H+
LM	L+

(f) Adjust the LP CUR potentiometer to obtain a current of 62.5 mils for a station that is to work at that value. For a station that is to operate at 20 mils, rotate the LP CUR potentiometer to its extreme clockwise position.

(g) Have the distant station operate its OSC switch to the OFF position.

(h) If the channel terminal in the subscriber set is to be operated with the sending frequency higher than the receiving frequency, position the SEND and REC switches as follows:

SEND SW	REC SW
HM	L+

If the channel terminal sending frequency is lower than the receiving frequency, position these switches as follows:

SEND SW	REC SW
LM	H+

(i) Adjust the SEND LEV potentiometer of the channel terminal to obtain approximately 5 mils of loop current.

(j) Position the REACT switch to the CAP position. Obtain the maximum loop current by moving the P1 and P2 potentiometers for each strapping of the CAP terminals. Terminal C is one of the line terminals and one side of all of the condensers is tied to it. Terminal A is the other line terminal and various combinations of capacitance can be arranged by strapping from it to the condenser terminals numbered from 1-10.

The capacitance of the units, by terminal number, are as follows:

TERM. NO.	CAP. MF.	TERM. NO.	CAP. MF.
1	.002	6	.020
2	.002	7	.034
3	.004	8	.058
4	.007	9	.100
5	.012	10	.174

Increase the SEND LEV as necessary to maintain the loop current at approximately 5 mils as the balance improves. (Rotating the SEND LEV potentiometer in a clockwise direction will decrease the loop current.) Record the readings for each combination of strapping and potentiometers. The optimum balance is the setting of the P1 and P2 potentiometers and CAP strapping, which gives maximum loop current. Mark the position of the P1 and P2 potentiometers, and terminate the strapping permanently at its optimum setting. Position the REACT switch to IND and obtain the maximum loop current by again moving the P1 and P2 potentiometers for each tap of the IND winding. The following table shows the various values of inductance that can be obtained by connecting to the taps indicated.

TAPS	IND. HENRYS	TAPS	IND. HENRYS
4-5	.011	1-3	.078
1-2	.017	2-4	.083
3-4	.022	1-4	.1
3-5	.033	1-5	.111
3-6	.044	1-6	.122
3-7	.055	1-7	.133
2-3	.061	1-8	.145

Record the readings for the various taps and terminate the inductor for the combination that gives the maximum current. When the maximum reading has been determined for both the inductive and capacitive reactance, use the type of reactance that gives the largest current.

(k) Restore all wiring and switches to their proper positions and readjust the loop current in accordance with 5.10.

5.09 The REC GAIN potentiometer should thereafter be kept at maximum gain (extreme clockwise position) unless no-carrier indication is used as covered in Par. 5.14. If the no-carrier option is not used, the CI switch on the subscriber set should be set in the OFF position.

5.10 **Loop Resistance Adjustments**

(a) **130B1 Subscriber Set**

(1) The loop resistance for half duplex operation is adjusted by changing the strapping of the subset resistances. Table A gives the strapping to be used after the external resistance of the loop has been measured. Adjust the LP CUR potentiometer until a milliammeter in series with the loop and terminal 11 reads 62.5 ma or 20 ma

depending on the number of tubes in the output of the subscriber set. A voltmeter placed across pin jacks LP and C will show 80 ± 2 volts. Check the rectifier voltage as these adjustments are made as it may change as the load is changed.

(2) For full duplex sending loops, measure the resistance of the external loop and strap the subscriber set resistances as shown in Table A. The loop resistance of a full duplex receive loop is set in the same manner as for half duplex operation. The milliammeter is now put in series with the lead removed from terminal 11 and terminal 11 of the subscriber set, and the current is adjusted to the proper value.

TABLE A

LOOP RESISTANCE FOR HALF DUPLEX OPERATION

External loop Resistance-ohms	62.5 ma Operation		20 ma Operation	
	Strap	Connect SL1 to	Strap	Connect SL1 to
50 to 125	(8 to 22) (23 to 26)	7	8 to 21	23
125.1 to 175	(7 to 8) (22 to 23)	26	8 to 21	23
175.1 to 225	(8 to 21 to 22)(23 to 26)	7	8 to 21	23
225.1 to 285	(8 to 21) (22 to 23)	8	8 to 21	23
285.1 to 360	(7 to 26) (22 to 23)	8	8 to 21	23
360.1 to 405	(8 to 21 to 22)(7 to 26)	23	8 to 21	23
405.1 to 465	(8 to 22)	26	8 to 21	23
465.1 to 515	(7 to 22) (8 to 21)	23	23 to 26	7
515.1 to 575	(8 to 21 to 22)(23 to 26)	26	23 to 26	7
575.1 to 630	(7 to 8 to 22)(23 to 26)	26	(8 to 21) (23 to 26)	7
630.1 to 815	-	22	(8 to 22) (21 to 26)	7
815.1 to 1022	Loop resistance too high for 60 ma		(7 to 8)	23
1022.1 to 1350			-	8
1350.1 to 1642			(22 to 23)	21
1642.1 to 1682			(8 to 21) (22 to 23)	7
1682.1 to 1817			(8 to 22) (23 to 26)	7
1817.1 to 1887			(7 to 8) (22 to 23)	26
1887.1 to 1915			(8 to 21 to 22)(23 to 26)	7
1915.1 to 1985			(8 to 21) (22 to 23)	8
1985.1 to 2060			(7 to 26) (22 to 23)	8
2060.1 to 2106			(8 to 21 to 22)(7 to 26)	23
2106.1 to 2163			(8 to 22)	26
2163.1 to 2213			(7 to 22) (8 to 21)	23
2213.1 to 2275			(8 to 21 to 22)(23 to 26)	26
2275.1 to 2410			(7 to 8 to 22)(23 to 26)	26
2410.1 to 2550				22

TABLE A (continued)

LOOP RESISTANCE FOR FULL DUPLEX OPERATION

External loop Resistance-ohms	Send loop 20 ma		Receive loop 20 ma	
	Strap (25 to 28) &	Connect SL1 to	Strap	Connect RL1 to
50 to 125	(8 to 21)	23	(3 to 20)	18
125.1 to 175	(8 to 21)	23	(3 to 20)	18
175.1 to 225	(8 to 21)	23	(3 to 20)	18
225.1 to 285	(8 to 21)	23	(3 to 20)	18
285.1 to 360	(8 to 21)	23	(3 to 20)	18
360.1 to 405	(8 to 21)	23	(3 to 20)	18
405.1 to 465	(8 to 21)	23	(3 to 20)	18
465.1 to 515	(23 to 26)	7	(3 to 30)	18
515.1 to 575	(23 to 26)	7	(19 to 20)	18
575.1 to 630	(8 to 21) (23 to 26)	7	(19 to 20)	18
630.1 to 815	(8 to 22) (21 to 26)	7	(19 to 20)	18
815.1 to 1022	(7 to 8)	23	(19 to 20)	18
1022.1 to 1350	-	8	-	20
1350.1 to 1642	(22 to 23)	21	(3 to 4)	18
1642.1 to 1682	(8 to 21) (22 to 23)	7	(3 to 4) (18 to 20)	19
1682.1 to 1817	(8 to 23) (22 to 26)	7	(3 to 4) (18 to 20)	19
1817.1 to 1887	(7 to 8) (22 to 23)	26	(3 to 4) (18 to 20)	18
1887.1 to 1915	(8 to 21 to 22)(23 to 26)	7	(3 to 4) (18 to 20)	18
1915.1 to 1985	(8 to 21) (22 to 23)	8	(3 to 4) (18 to 20)	18
1985.1 to 2060	(7 to 26) (22 to 23)	8	(4 to 19)	18
2060.1 to 2106	(8 to 21 to 22)(7 to 26)	23	(4 to 19)	18
2106.1 to 2163	(8 to 22)	26	(4 to 19)	18
2163.1 to 2213	(7 to 22) (8 to 21)	23	(3 to 20) (4 to 19)	18
2213.1 to 2275	(8 to 21 to 22)(23 to 26)	26	(3 to 4 to 19)	18
2275.1 to 2410	(7 to 8 to 22)(23 to 26)	26	(3 to 4 to 19)	18
2410.1 to 2550	-	22	(4 to 18)	18

(b) **130B2 and 130C1 Subscriber Sets**

(1) The loop resistance value for these subscriber sets is obtained by means of variable potentiometers. For half duplex operation, turn off the power to the station and connect an ohmmeter across the LP and C pin jacks. Adjust the SEND LP potentiometer of the channel terminal until a resistance of 2500 ohms for a 20 ma loop or 800 ohms for a 62.5 ma loop is indicated by the meter. Connect an ammeter in series with the teletypewriter loop and adjust the LP CUR potentiometer to read 62.5 ma or 20 ma as required.

(2) For full duplex loops, the current in the receive loop is adjusted by removing the lead on terminal 19, and inserting an ohmmeter in series with this terminal and the lead. Adjust the REC LP potentiometer until a reading of 2500 ohms for a 20 ma or 800 ohms for a 62.5 ma loop is indicated. Remove the ohmmeter and put an ammeter in series with the loop and adjust the LP CUR potentiometer for a reading of 62.5 ma or 20 ma as required. The current in a full duplex sending loop is adjusted by removing the lead on terminal 20 of the subscriber set and connecting an ammeter in series with this lead and terminal 20. Adjust the SEND LP potentiometer to give a reading of 62.5 ma.

5.11 **The bias of the received signals** is adjusted by means of the REC BIAS control on the channel terminal. Three methods are given for measuring the bias, the first method being preferred. The choice will depend upon the availability of test equipment and signal sources.

(a) With a standard test sentence being sent from the distant end, adjust the REC BIAS control, using the 164C1 or 164C2 transmission measuring set, or equivalent, to obtain 0 bias as nearly as possible.

(b) If the 164C1 is not available, measure the bias of reversals received from the distant end with a 161A1 telegraph station test set, and adjust the REC BIAS control for a bias of 0 ± 2 per cent.

(c) If reversals can be obtained but no transmission measuring set is available, connect a dc voltmeter across the receive loop of the 130 type subscriber set. Note the voltage while a steady marking signal is received. Have reversals sent, and adjust the REC BIAS control until the voltmeter reads half the steady mark value.

5.12 **The send bias adjustment** is normally made by setting the SB potentiometer at its extreme clockwise position. However, private line service loops with long lengths of cable between the subscriber set and the teletypewriter cause objectionable marking bias when sending. In such cases, adjust the SB potentiometer for minimum sending bias.

5.13 After the channel has been completely adjusted, determine the orientation range of the teletypewriter in accordance with the practices.

5.14 When **no-carrier indication** is provided, it will usually be necessary to reduce the gain of the receiving terminal to prevent false indication due to line noise. Two methods of adjustment are given, with the preferred method first.

(a) Arrange the distant channel terminal to send a steady mark.

(b) Connect a **vacuum tube voltmeter,** or equivalent, across pin jacks A2 and G in the receiving channel terminal.

(c) Adjust the REC GAIN potentiometer of the local terminal so that a level of +18 dbm is indicated by the meter.

(d) Have the oscillator in the sending channel terminal turned off.

(e) Note the reading of the voltmeter. This reading should not exceed —5 dbm over a period of ten minutes. If the noise peaks go above —5 dbm, the noise level of the circuit is too high, and it should not be used where no-carrier indication is required.

If a vacuum tube voltmeter is not available, the following method is to be used to adjust the no-carrier indication. For this method a KS-14510,L1 or equivalent meter **must** be used.

(a) With the REC GAIN control on maximum, arrange for the distant terminal to turn off its oscillator. Set the CI switch to the ON position.

(b) If relay SU is released, proceed to (d); if the relay is operated, proceed to (c).

(c) Adjust the REC GAIN control (counterclockwise) until SU releases. Refine this adjustment by determining the highest clockwise position of the REC GAIN control that does not operate the relay, as observed for at least 10 minutes.

(d) Have the distant oscillator turned on.

(e) Make over all signal bias tests and adjust the REC BIAS control for 0 ± 2 per cent bias in the received signals.

(f) Have the distant terminal transmit a steady marking signal.

(g) Connect a KS-14510,L1 meter, to pin jacks A2 and G, and note the ac voltage.

(h) Apply the voltage indication of (g) to the left-hand scale of Table B and then find the reduced gain voltage on the righ-hand scale of Table B. Adjust the REC GAIN control for this new voltage.

TABLE B

Receiving Gain Adjustment, A2-G Voltage Values for 6 db Reduction in Gain (Margin)

AC Voltage A2-G	
With max gain for nonoperate of relay "SU"	For 6db gain reduction
10.0	5.0
10.5	5.2
11.0	5.5
11.5	5.8
12.0	6.0
12.5	6.3
13.0	6.6
13.5	6.9
14	7.2
14.5	7.6
15	7.9
15.5	8.2
16	8.6
16.5	9.1
17	9.6
17.5	10.1
18	10.7
18.5	11.2
19	11.8
19.5	12.4
20	13.0
20.3	13.5
20.7	14
21.0	14.4
21.3	14.7
21.7	15.4
22.0	15.8
22.3	16.3
22.7	16.9
23.0	17.4
23.3	17.9
23.7	18.5
24.0	19
24.3	19.5
24.7	20.1
25.0	20.6
25.2	21.0
25.4	21.4
25.6	21.7
25.8	22.0
26.0	22.3
26.2	22.6
26.4	22.9
26.6	23.2
26.8	23.5
27.0	23.8
27.2	24.1
27.4	24.5
27.6	24.8
27.8	25.1
28.0	25.4
28.2	25.7
28.4	26.0
28.6	26.3
28.8	26.6
29.0	26.9
29.2	27.2
29.4	27.5
29.6	27.8
29.8	28.1
30.0	28.3

5.15 Make over all tests of station as prescribed by the Bell System Practices and local practices for installing a new station.

6. TROUBLE TESTING

(a) The tests mentioned here are checks of the major circuits of the subset and channel terminal. No attempt is made to locate trouble in specific components other than tubes and plug-in units. If the suggested adjustments and changing of components does not clear the trouble, replace the subset or channel terminal as needed. At locations where readings have been recorded at the time of installation, the values found at the time of the check should be compared to the installation values to see if a change has occurred. If components are changed, reset the controls to maintain the original values or enter the new readings on the record. A KS-14510,L1 meter or equivalent is necessary for these checks. A high-impedance receiver with test prods will be useful for checking tone.

Check the rectifier voltages before making these tests

(b) Receiving Tests:

(1) **LP to C** should read:

(a) **80 ± 2 volts dc** when receiving marking signal. If the reading is above or below 80 ± 2 volts, readjust per 5.10 of this practice.

(b) **130 volts dc** when receiving spacing signal. If no reading is indicated, the dc loop is open towards the teletypewriter. This loop consists of V5 and V6 tubes, strapping, and resistors in the subscriber set and channel terminal, as well as the external loop and machine.

(2) **D to C** should read when:

(a) Receiving **marking** signal, D should be positive to C, by approximately 35 volts dc.

(b) Receiving **spacing** signal, D should be negative to C, by approximately 47 volts dc. If this condition is not met, adjust the receive bias potentiometer per 5.11 of this practice. If there is no reading from D to C, check pin jacks A1 to G, and A2 to G.

(3) **A1 to G** should read no lower than one volt ac on the 12-volt scale.

(4) **A2 to G** should read no lower than ten volts ac on the 60-volt scale. When checking A1 to G, it should first be determined that the sending station is sending at the proper level. The reading of A2 to G is affected by the

REC GAIN potentiometer and the level of the incoming signal. If the readings are low, change tube V3. If the readings are correct, change V4 and recheck D to C. If no reading registers on A1 to G, turn off the OSC switch and listen for tone across the line terminals of the subscriber set. No tone here indicates line trouble or sending station trouble. If tone is present at the terminals, change the receive filter and recheck A1 to G. When test is completed restore the OSC switch to the ON position.

(c) **Sending Tests:**

(1) **SA to G** should show ac voltage, the value of which will depend on the setting of the SEND LEV potentiometer. If no voltage is present, listen for tone on the same pin jacks. If tone is present, check the setting of the SEND LEV potentiometer and change the V1 tube if necessary. If the voltage reads correct, disconnect the line from the subset terminals and listen across the terminals for tone. If there is no tone, replace the send filter. If there is tone, the trouble is not in the subscriber set.

(2) **Signal Shift** (mark to space): Listen across SA to G with a receiver. As the teletypewriter loop is opened and closed, the signal in the receiver should shift accordingly. If the tone does not shift, replace the V2 tube.

(d) If tube troubles are suspected in a channel terminal, it is best to replace the questionable tubes with new ones. There is, however, a quick test that can be used for tubes V5 and V6. This test applies only to a 62.5 ma loop where both V5 and V6 are used.

(1) Measure the loop current with a steady mark being received. It should read about 62.5 ma.

(2) Remove tube V5. The current should drop to 37 ± 7 ma.

(3) If these limits are met, both tubes are satisfactory and V5 may be replaced.

(4) If the current with V5 removed is less than 30 ma, substitute a new tube for V6. If the current with V5 removed is greater than 44 ma, substitute a new tube for V5.

(5) Readjust the loop current, if necessary, after new tubes are installed.

7. ASSOCIATED BELL SYSTEM PRACTICES

Subject	Section
Teletypewriter Station Installation Drawings	P10.329
Teletypewriter Tools and Maintenance Supplies	P30.301
Transmission Measuring Set, 164C1—Adjustments, Use and Maintenance	P31.405
43A1 Carrier Telegraph Terminal	AA281.517
130B1 and 130B2 Teletypewriter Subscriber Sets	AA286.039
130C1 Teletypewriter Subscriber Set	AA286.043

8. ASSOCIATED 28 ASR STATION DRAWINGS (NOT IN BSP)

Subject	Drawing No.
Private Line Stations	
Full-duplex Operation, With 130C1 Subset	SD-70891-01
Half-duplex Operation, With 130C1 Subset, With or Without Electrical Motor Control	SD-70890-01
TWX Stations (Attended or Unattended)	
130C1 Subset With 120C4 Subset	SD-70895-01