110C1 MULTIPLE SENDER FOR TELETYPEWRITER TEST SIGNALS DESCRIPTION

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1. GENERAL

1.01 This section gives the principles of operation and describes the circuits and equipment of the 110C1 Multiple Sender. This equipment provides test signals as follows for testing teletypewriter circuits and machines:

Type of Circuit	Type of Signals	For Use At
Neutral Loop	Open and Close	Testboard (TLT)
Type 1 Hub	—48-volt Mark 0-volt Space	No. 1 Service Board
Type 2 Hub	+60-volt Mark —30-volt Space	2 and 9B Service Boards

1.02 This section is reissued to add information on the electronic equipment required to convert the signals from the transmitter-distributor to Type 2 hub signals required by the hub circuits of the 2 and 9B service boards. These signals are referred to subsequently in this section as Type 2 hub signals, to distinguish them from the Type 1 hub signals which are also provided by the 110C1 Multiple Sender for the No. 1 service board hub circuits.

1.03 By proper choice of the transmitter-distributor, which is the primary source of signals, the signal output may be made to consist either of the standard test sentence or of reversals, at speeds of either 40, 60, 75 or 100 words per minute and in the 5-unit code. No provision is made for 6-unit code signals.

1.04 The 110C1 Sender is designed to produce practically undistorted signals. If calibrated amounts of distortion are desired in the signals, they may be produced by the supplementary use of a 119-type signal distorting set.

1.05 A source of polar test signals is provided for use in calibrating 118-type telegraph transmission measuring sets. This source is obtained directly from the distributor by means of a potentiometer circuit and does not involve repetition through a relay.

1.06 Any number of neutral or Type 1 hub signal sources may be obtained in multiples of four. The minimum number of sources is 4. A unit of 4 relays as supplied contains output circuits of only one type, i.e., either neutral or Type 1 hub. When only one source is needed the transmitter-distributor may be used alone. Not more than nine Type 2 hub output signal sources may be obtained from one polar-to-hub converter circuit, but four of such converter circuits may be associated with one distributor.

2. PRINCIPLES OF OPERATION

2.01 The test signals are generated by transmitter-distributors. Neutral and Type 1 hub signals are obtained from groups of 255A relays, which are coupled to the distributor by tubes. The contacts of the relays are wired to the I.D.F., from which they may be connected to test signal jacks at the testboard or to other places as needed. Type 2 hub signals are obtained from a polar-to-hub converter circuit which is driven by the distributor circuit.

3. DESCRIPTION OF CIRCUITS

(A) General

3.01 The complete circuit is shown on Drawing SD-70206-01. Fig. 1 is a schematic of the circuit when equipped with a test message transmitter-distributor. Fig. 2 is a schematic of the hub converter and output circuits.

(B) Source of Neutral or Type 1 Hub Signals - Fig. 1

3.02 The transmitter-distributor shown at the left connects positive voltage (130 volts) to the upper lead (a) for spacing signals and the same voltage to the lower lead (b) for marking signals. This connects spacing or marking voltages, respectively, to the grids of the (S) and (M) tubes via the potentiometer consisting of the 9375-ohm and 14,845-ohm resistances. When the positive voltage is applied to the grid of one tube, causing plate current to flow, negative voltage is applied to the grid of the other tube preventing the flow of plate current. Plate current in the (M) tube will operate the relays to marking and plate current in the (S) tube will operate the relays to spacing.

3.03 Each pair of tubes operates either one or two groups of 4 relays each. The relay windings of each group are connected in parallel and the two groups are connected in series. The plate current is normally .040 ampere, or .010 ampere operating current in each relay.

3.04 Practically all the current-limiting resistance appears in the cathode circuit of the tubes. With this arrangement a decrease in plate current, such as might be caused by a small increase in the plate resistance of the tube,

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IIOCI MULTIPLE SENDER
SCHEMATIC CIRCUIT

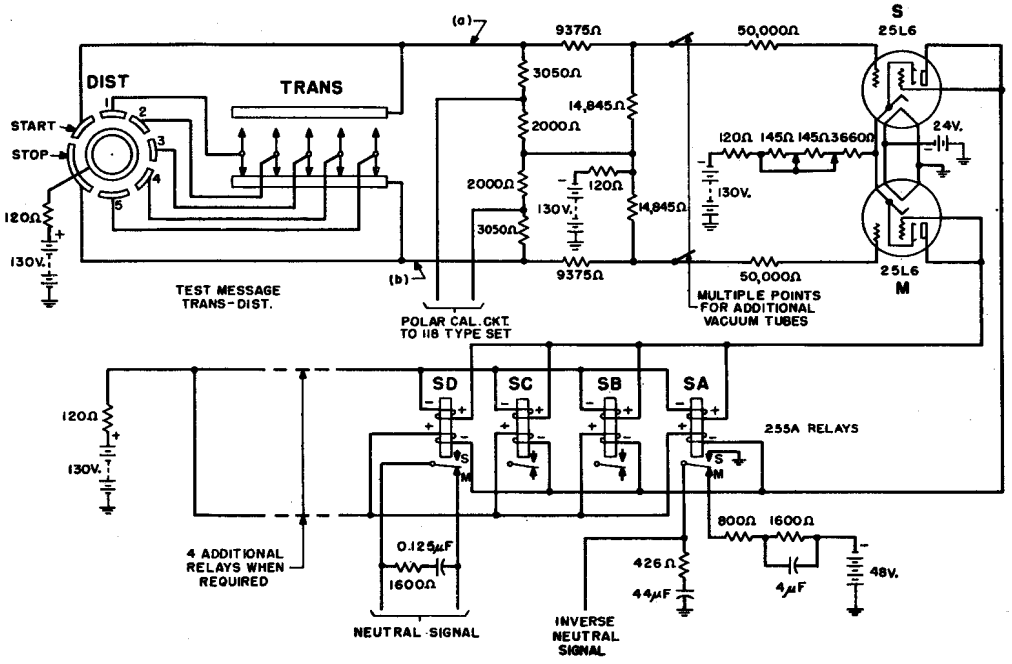


Fig. 1

decreases the current through this resistance. This makes the grid more positive, which in turn tends to increase the plate current. This negative feedback tends to make operation independent of the impedance in the plate circuit of the tubes. This effect also causes the plate current to rise very rapidly when positive voltage is applied to the grid in spite of the presence of inductance in the plate circuit.

3.05 A single relay may be removed temporarily from any group of four, for adjustment, without causing an appreciable change in the output signals of the other relays of the group. However, distortion will be produced by the

removal of two or more relays from a group.

3.06 The relay output circuits are arranged for optional connection to either neutral or Type 1 hub circuits. When used in a ±130-volt .0625-ampere or ±48-volt .020-ampere neutral circuit the arrangement shown below the (SD) relay is provided. This bridges the armature and marking contacts by a condenser-resistance wave shaper which not only reduces arcing at the contacts but serves to compensate for bias caused by the travel time of the relay. The relay armature should be adjusted to have a travel of .002 inch.

3.07 When used in a —48-volt Type 1 hub circuit the arrangement shown below the (SA) relay is provided. The wave shaper consists of a condenser-resistance combination bridged from armature to ground. The relay armature should be adjusted to have a travel of .004 inch.

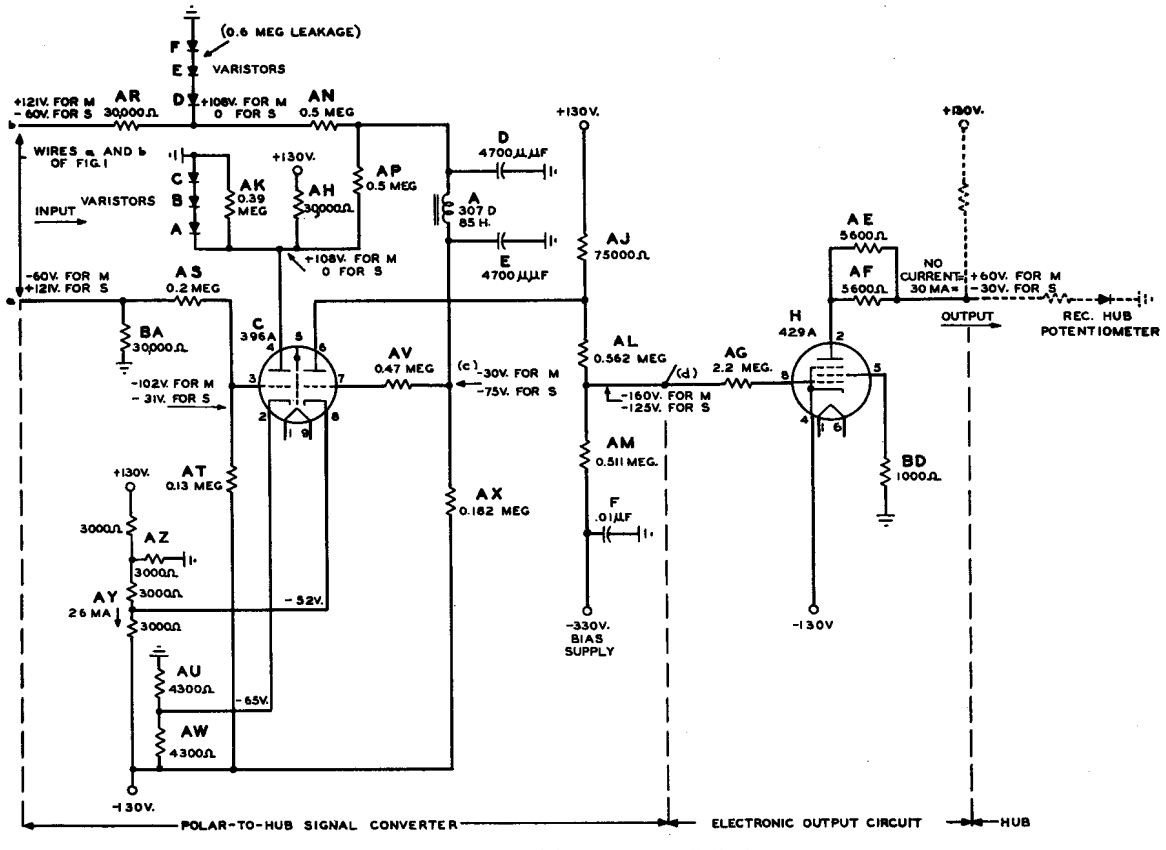
3.08 In order to simplify the drawing, both neutral and Type 1 hub output circuits are shown in the same group of 4 relays. In the actual equipment arrangement provided only one type of signal is obtained from a single group of 4 relays.

(C) Source of Type 2 Hub Signals — Fig. 2.

3.09 The signals for operating the Type 2 hub circuit used in the 2 or 9B service boards consist of +60 volts for marking and —30 volts for spacing. These signals are obtained from the 110C1 Multiple Sender circuit shown in Fig. 1 by adding the electronic circuit shown in Fig. 2 which converts polar signals to Type 2 hub signals. The wires (a) and (b) of Fig. 2 are bridged on the wires (a) and (b) of Fig. 1. For convenience in drawing Fig. 2, the wires are interchanged, (b) being now the upper wire.

3.10 When the distributor of Fig. 1 is sending a marking signal, +130 volts is connected to wire (b) through a battery-tap resistance of 120 ohms. This positive battery in connection with the negative battery connected at the center point of the 14,845-ohm resistances of Fig. 1 will cause about 7 ma to flow in the lead (b) which will reduce the actual voltage at this lead to about +121 volts.

3.11 This +121 volts acting in connection with the —130 volts of Fig. 2 through resistance AX, will impress about —30 volts on grid terminal 7 of tube C. As this is positive by an appreciable amount with respect to the cathode (at —52 volts) plate current flows from the +130 volt supply



POLAR-TO-HUB SIGNAL CONVERTER FOR HUB TEST SIGNALS

Fig. 2

through the AJ resistance. This in turn makes the grid terminal 8 of tube H more negative and no plate current flows in this tube. With no plate current the voltage at the output of the circuit is +60 for applying a marking signal to the hub.

3.12 At the same time that the voltage of wire (b) of Fig. 1 is +121 during a mark, the voltage of wire (a) is about —60. This is obtained from the —130 volt connection at the center point of the 14,845-ohm resistances. The —60 volts at lead (a) in connection with —130 volts at resistance AT will apply about —102 volts at grid terminal 3 of tube C and no current will flow in plate circuit 4.

3.13 When the distributor of Fig. 1 is sending a spacing signal, the conditions in this symmetrical circuit are interchanged and +121 volts appears on lead (a) while —60 volts appears on lead (b).

3.14 The +121 volts at (a) will make grid 3 of tube C positive with respect to its cathode and plate current will flow at 4. This will reduce the voltage at the plate to practically zero (with respect to ground) and will react through the filter coil A to make grid 7 more negative. This will, in turn, reduce the plate current at 6, and raise the grid voltage of tube H making it slightly positive with respect to the cathode. Plate current of 30 ma will flow in tube H to bring the voltage of the output circuit to the desired —30 volts. The varistors A, B and C offer a low impedance from ground to plate terminal 4 in the direction to insure that this terminal can never be at an appreciable negative potential with respect to ground.

3.15 The process is also aided by the fact that lead (b) changes from +121 volts to —60 volts as the distributor moves from mark to space. Varistors D, E and F also insure that the point where they are connected to the circuit can never be at an appreciable negative potential with respect to ground.

3.16 The circuit of Fig. 2 has been designed to produce telegraph signal voltages of +60 for mark and —30 for space which are as free from bias as possible even with some variation of the 130-volt battery and of the condition of the distributor brushes. The part of the circuit which would be particularly susceptible to voltage and corresponding current changes which might affect bias, is at point (C) near grid terminal 7 of tube C. This is due to the sloping wave at this point caused by the filter. The voltage at the cathode terminal 8 is —52, obtained from a potentiometer connected between +130 and —130 volts. The voltage at the grid circuit is also obtained from the +130 volts at the distributor of Fig. 1 and the —130 volts (through resistance AX) of Fig. 2 and its average value is about —52 volts. Any change in these battery potentials therefore has little effect on the average potential difference between the grid and cathode of tube C.

3.17 Resistance AK is used to hold the positive voltage at plate terminal 4 of tube C to approximately the same value as the voltage at the point of connection of the D, E and F varistors above.

3.18 The filter consisting of coil A and condensers D and E is for eliminating any step in the signal wave which might be caused by a worn brush on the distributor. It also smoothes any irregularity which might be caused by a brush bounce. The sloping wave caused by the filter is made steep again by the small interval between the conducting and cutoff condition in plate circuit 6 of tube C.

3.19 There may be as many as nine output circuits containing tube H multipled to the polar-hub converter circuit at point (d).

(D) Calibration Circuit

3.20 This provides polar test signals for use with 118-type telegraph transmission measuring sets. These signals are obtained from the potentiometers shown in Fig. 1 just to the right of the transmitter-distributor. When a marking signal is transmitted a positive voltage is applied to point (b) and current flows in one direction through the leads to the 118-type set. For the spacing condition this voltage is removed and is applied to the point (a). This causes current of the same magnitude to flow through these leads in the opposite direction.

(E) Motor Control Circuit

3.21 A power relay is provided which may be operated by the application of ground either from a key at the equipment or from a start lead which is multipled at the various appearances of the test signals. When this relay is operated, it applies power to the distributor motor and also supplies positive 130-volt telegraph battery to the common ring of the distributor. When the key is operated, a guard lamp lights to give a warning that the distributor is under local control. A switch is provided for removing the power from both relay and distributor when testing. This switch should be closed when the multiple sender is to be used. A fusetron serves to protect the motor circuit from abnormally heavy currents. The details of this circuit are shown on SD-70206-01.

4. DESCRIPTION OF EQUIPMENT

TELEGRAPH SYSTEMS
110C1 MULTIPLE SENDER EQUIPMENT
TYPICAL BAY EQUIPMENT

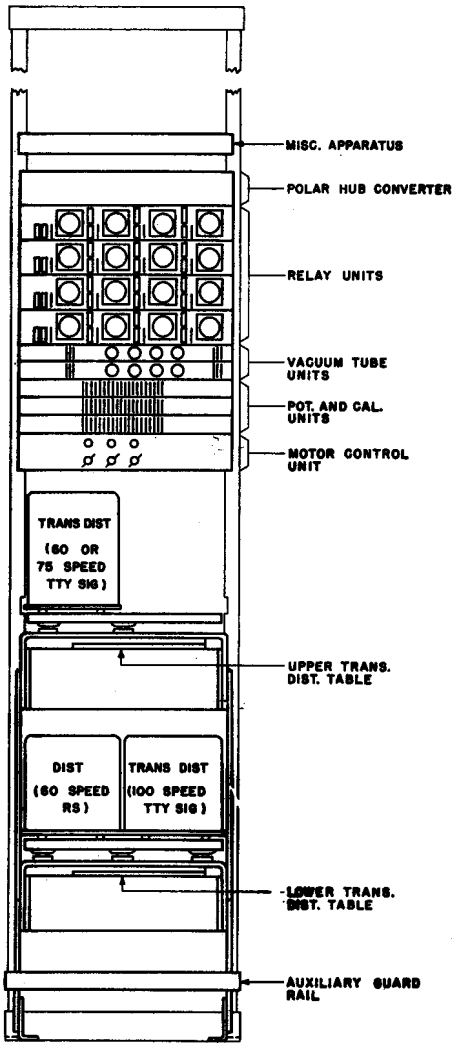


Fig. 3

4.01 The bay layout of a typical installation is shown in Fig. 3.

4.02 The equipment for 1 to 4 (3 illustrated in Fig. 3) multiple senders is mounted in one relay-rack bay. The transmitter-distributors are located on a table in the lower portion of the bay with one or two decks as needed to accommodate from one to four distributors. The table stands directly on the floor in order to isolate machine vibrations from the rack. The table tops are further insulated by rubber mountings.

4.03 Power relays and power switches for supplying power to the transmitter-distributors are mounted in a box on each table (not shown in Fig. 3). The keys for starting the machines from the multiple sender bay are located on a fibre-faced wood panel (motor control unit) just above the topmost distributor. This panel also mounts lamps which indicate that a sender has been turned on locally.

4.04 Higher in the bay, the resistances comprising the potentiometer and calibration circuits are mounted on plates just above the motor control unit. Above these are the tube units and again above these are the relay units. Above the relays is a panel containing the polar-hub converter. A typical equipment layout is shown on ED-70343-01.

Distributors

4.05 The same test-message transmitter-distributors used with the 110A1 and 110B1 multiple senders are used with this equipment. These distributors differ from those which employ a perforated tape in that the contact levers which set up the code combinations are operated from cams, which are arranged to send the repeated test sentence. Gears are available so that 40-, 60-, 75- and 100-speed operation may be obtained.

4.06 Following is a list of the coded test-message transmitter-distributors.

Code No.	Type of Motor	Speed
14F	Synchronous	60
14G	Synchronous	40
14P	Synchronous	75
14M	A-C Series	40 and 60
14AT	A-C Series	60 or 75
14AW	Synchronous	100

4.07 The test-message transmitter-distributor sends the following teletypewriter characters in the 5-unit code:

THE (sp) QUICK (sp) BROWN (sp) FOX (sp) JUMPED (sp) OVER (sp) A (sp) LAZY (sp) DOG (FIGS) (LTRS) S (sp) BACK (sp) (FIGS) 1234567890 (LTRS) (sp) (sp*) (sp*) (sp*) (sp) SENDING (CAR RET) (CAR RET) (LINE FEED) (LTRS).

* Identifying letter or letters of the repeater office to be inserted here.

4.08 An 8-segment distributor similar to the distributor of a 14-type transmitter-distributor is used to provide reversals. Three such distributors have been coded as listed below.

Code No.	Type of Motor	Speed
14T	Synchronous	60
14U	Synchronous	75
14AY	Synchronous	100

Tube and Relay Units

4.09 The tubes and associated resistances for the relay circuits are mounted on 1-3/4-inch plates. This equipment is wired as a unit with all external connections made to a terminal strip. Each unit mounts 2 complete tube circuits (4 tubes). This unit is shown on ED-70345-01. The polar-hub converter panel is shown on ED-71018-01. This panel contains one tube for the polar-to-hub signal converter and as many as 9 tubes for the separate output circuits.

4.10 The sending relays with associated resistances and condensers are mounted on 3-1/2-inch plates, with 4 relays on each plate which is wired as a unit. Each unit of 4 relays is completely equipped and wired for either neutral or inverse neutral operation. The assembly of this unit is shown on ED-70346-01.

5. LIST OF DRAWINGS (Not attached)

SD-70206-01 - Schematic
ED-70343-01 - Typical Bay Equipment
ED-70344-01 - Potentiometer and Calibration Unit
ED-70345-01 - Tube Unit
ED-70346-01 - Relay Unit
ED-70341-01 - Distributor Table
ED-71018-01 - Polar-Hub Converter