PANEL SYSTEMS
LOCAL TEST DESK NO. 12B
TESTING CIRCUIT
PRIMARY AND SECONDARY
ARRANGED FOR TESTING DISTANT OFFICES
FOR MODIFYING EXISTING EQUIPMENT
ARRANGED FOR DIALING

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 An (IN) key is added in the primary and secondary circuits to provide for testing over single jack type IN and OUT trunks to the MDF.

B. CHANGES IN APPARATUS

B.1 Added

AIYN key - Fig. 1 - "CZ" option
13E resistance lamp, (D))Fig. 3
18EC resistance, (DC))"DB" option
2-178AA relays, (NPI)&(NSI) - Fig. 1
"DB" option

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The AIYN key code containing (IN) and (3WO) key units for the primary and secondary circuits is added and designated "CZ" option.

D.2 Options "DB" and "DC" are added and "DA" option is designated. Prior to this issue "DA" option was undesignated and part of Fig. 1.

D.3 Note 142 is revised to add the line showing the options required for IN and OUT testing over single jack type MDF test trunks, and to add the references to "DA" option in the lines pertaining the condition when IN and OUT testing over single jack type MDF test trunks is not required.

D.4 In Note 101 the reference to Fig. 3 in the line for the +CC potential is added.

D.5 In Note 138 and the "Options Used" table the lines referring to "CZ," "DA," "DB," and "DC" options are added.

D.6 Note 153 is added.

All other headings under changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is used for testing in a panel, crossbar or manual office or to a distant panel crossbar, manual or step-by-step office.

2. WORKING LIMITS

2.01 The maximum range of the artificial trunk of a transmission test is about 30 miles.

2.02 Supervisory relays (PS) (SS) (Figs. 4 and 6) limits - 2060 ohms maximum external circuit loop with 10,000 ohms minimum line insulation resistance and with 60,000 ohms minimum trunk insulation resistance.

2.03 Supervisory relays (PS) (SS) (Figs. 5 and 7) limits - 900 ohms maximum external circuit loop with 10,000 ohms minimum line insulation resistance and 60,000 ohms minimum trunk insulation resistance.

2.04 Supervisory relays (PS) (SS) (Figs. 8 and 9) limits - 1500 ohms maximum external circuit loop combined subscriber and trunk loop with 10,000 ohms minimum insulation resistance combined subscriber and trunk loop.

2.05 Supervisory relays (PS) and (SS) (Figs. 14 and 15) limits - 2250 ohms maximum external circuit loop, minimum insulation resistance 10,000 ohms and earth potential ± 20V.

2.06 Sounder relay (SR) (Fig. 20) limits maximum external circuit loop 2250 ohms, minimum insulation resistance 10,000 ohms and earth potential ± 20V.

2.07 Sounder relay (BR) (L wiring) (Fig. 19) - 2220 ohms maximum external circuit loop with 10,000 ohms minimum line insulation resistance and 60,000 ohms minimum trunk insulation resistance.

2.08 Buzzer relay (BR) (M wiring) (Fig. 19) B222 relay - 2100 ohms maximum external circuit loop with 10,000 ohms minimum line insulation resistance and 60,000 ohms minimum trunk insulation resistance.

2.09 Sounder relay (BR) (N wiring) (Fig. 19) - 1500 ohms maximum external circuit loop combined subscriber and trunk loop with 10,000 ohms minimum line insulation resistance combined subscriber and trunk loop.

2.10 Buzzer relay (BR) (M wiring) (Fig. 19) F1722 - 750 ohms maximum external combined subscriber and trunk loop with 10,000 ohms minimum insulation resistance combined subscriber and trunk.

3. FUNCTIONS

3.01 This circuit will make tests as follows:

3.02 Tests may be made over either the primary or secondary test cords. The primary and secondary test cords may be used simultaneously if desired.

3.03 A panel or crossbar test switch train with an associated test trunk sender can be dialed from either the primary or secondary test cord.

3.04 The test features associated with either primary or secondary test cords may be used with the other cord.

3.05 The tip and ring of either or both test cords may be reversed.

3.06 Provision is made for talking over either primary or secondary cords by means of the position telephone circuit.

3.07 The circuit is arranged optionally to supply either 48-or 24-volt battery thru a repeating coil on either the primary or secondary test cord.

3.08 When battery is furnished, regular "A" cord supervision is provided, on both primary and secondary cords.

3.09 Provision is made for monitoring on both primary and secondary cords.

3.10 Transmission tests may be made over the primary cord.

3.11 Voltmeter and milliammeter tests may be applied to the primary cord, the meter being connected to tip or ring as required. Tests may be made for the following.

3.111 Grounds.

3.112 Short circuits.

3.113 Continuity.

3.114 Crosses with lines carrying current.

3.115 Crosses with other lines.

3.116 Ballistic capacity test.

3.12 The sleeve circuit of the test cord may be opened and the operation of subscribers line and cutoff relays checked and other tests made. This can be done with manual testing or thru the test switch train.

3.13 The howler may be applied over the secondary cord.

3.131 Should the receiver be replaced on the switchhook while the howler is being applied, the circuit is arranged to immediately cut off the howler from the cord, and given an indication by lamp that the receiver has been replaced.

3.14 Ringing current may be applied to either test cord for direct or party line ringing as desired, by means of the associated ringing circuit.

3.15 To assist in locating and checking cable conductors the secondary cord is arranged to connect a sounder to either tip or ring of the cord as desired, and at the same time superimpose trouble tone on the circuit.

3.151 To permit the use of the sounder and tone without tying up the secondary test cord, a separate sounder cord is provided.

3.16 Tests may also be made in connection with the following supplementary test circuits.

3.161 Wheatstone Bridge.

3.162 Line insulation breakdown test.

3.163 Coin control test.

3.164 Coin prepayment line relay test.

3.165 Subset relay test.

3.166 50-A dial test.

3.167 51-type dial test.

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3.17 When testing thru toll switchboards the proper sleeve resistance can be cut in the circuit by the operation of keys in this circuit.

3.18 Arranged to test subscriber lines using tube type subsets.

3.19 This circuit can be used for making the above tests in a crossbar office except that of paragraph 3.12. Tests may be made in crossbar offices for party and terminal hunting line conditions when the connecting trunk is arranged for such test.

3.20 The optional use of a (DO) key is provided. When this key is normal, the transmission test, line relay test, coin line relay test and coin magnet test are arranged for testing offices in the same building as the desk. When the key is operated these tests are modified to compensate for the trunk loop to another building.

3.21 When associated with a crossbar office, a feature is provided for dialing thru subscriber line circuits by the operation of the (DSL) key. For this feature the connection must be set up thru an MDF test trunk.

3.22 Extra numbers not in the regular subscriber number series in a crossbar office may be reached over the primary or secondary test cord over a test trunk associated either with a "B" board or dial pulse terminating sender.

3.23 Testing dial speeds using the volt-milliammeter of this circuit in connection with the secondary cord.

3.24 When Fig. 28 is provided.

3.241 Key (ELVM) operated, connects the meter to the Electronic Voltmeter Test Circuit for investigating high leak conditions disclosed by rapid line insulation testing.

3.242 Key (MET VM) operated provides non-grounded test battery for measuring insulation resistance of a pair from tip to ring excluding the resistance from either side to ground.

3.243 Key (SC) operated, short circuits the tip and ring for measuring the insulation resistance of the pair to ground excluding the resistance between tip and ring.

3.244 Key (AC) operated, connects the meter through a rectifier circuit for detecting the presence of alternating currents on the line under test.

3.245 Key (60 volt), provides a 60-volt, 50,000-ohm scale range on the meter.

3.246 Key (FEMF) operated, replaces the test battery with ground to test foreign DC potentials on the line under test.

3.25 When "CX" option is provided, an MF key pulsing circuit can be associated with either the primary or secondary test by operating the corresponding (KP) key in the connecting circuit.

3.26 When "CZ," "DB," and "DC" options are provided, the manipulation of the (IN) and (3WO) keys permit the IN or OUT sides of a line to be selected for test over a single jack type MDF test trunk.

4. CONNECTING CIRCUITS

4.01 Primary and Secondary Test Cord Circuit.

4.02 Cords, Plugs and Sleeve Relays on ES-11446-01.

4.03 Sender and Recording Keys, ES-239385.

4.04 Telephone and Dial Circuit, ES-20634-01.

4.05 Test Line and Test Trunk.

4.06 Outgoing for use with Test Trunks of No. 14 Desk Type, ES-20635-01.

4.07 To M.D.F. and I.D.F. for Interrupted Trouble, ES-20163-01, ES-239767.

4.08 From District or Office Multiple or Crossbar Office Secondary.

4.09 From Local Office, ES-20176-01, ES-13284-01.

4.10 Outgoing from Distant Office, ES-96187-01, ES-13284-01.

4.11 Test Selector Associated Test Trunk Sender, SD-21642-01.

4.12 Incoming Trunk Circuit from "B" Switchboard Crossbar Office, SD-25436-01.

4.13 Incoming Selector Dial Pulse Full Selector Crossbar Office, SD-25432-01.

4.14 To Outgoing Test Board, SD-21615-01.

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4.15 To M.D.F. Regular, (three jack type), ES-259944 and ES-96140-01.

4.16 To DSA and Toll Switchboard, ES-359335.

4.17 To Manual Switchboard, ES-239411.

4.18 To Toll Switchboard, ES-20249-01.

4.19 To Trouble Desk, ES-239410.

4.20 To MDF Regular, (single jack type), ES-20747-01.

4.21 Supplementary Test Features.

4.22 Wheatstone Bridge Circuit, ES-359363.

4.23 Line Insulation Breakdown Test, ES-359373.

4.24 Coin Control Test Circuit, ES-359373.

4.25 Coin Prepayment Line Relay Test Ckt., ES-359373.

4.26 Subset Relay Test Circuit, ES-359373.

4.27 50A Dial Test Circuit, ES-239691.

4.28 61-Type Dial Test Key Circuit, SD-20153-01.

4.29 Primary and Secondary Ringing Circuits ES-226027, ES-239441, ES-239442, ES-239446, ES-261166, ES-239651.

4.30 PBX Dial Circuit, Ohio Bell Dwg. 4C-1327.

4.31 Dial Testing Circuit, SD-96335-01.

4.32 Misc. Ckt. for Misc. Interrupter Frame, SD-21666-01, SD-21667-01.

4.33 Interrupter Frame Circuit, SD-25062-01.

4.34 Electronic Voltmeter Test Ckt., SD- 95596-01.

4.35 MF Keyset Circuit - SD-95570-01.

DESCRIPTION OF OPERATION

5. APPARATUS FUNCTIONS

5.1 For Primary Test Circuit

5.101 Primary (REV) key reverses the tip and ring of the primary test cord, affecting all primary features but the primary ringing circuit. This key also signals an incoming test trunk in a cross-bar office to connect to extra numbers not in the subscriber number series.

5.102 Primary (G) key connects ground to the tip of the primary cord.

5.103 Primary (M) key disconnects the tip and ring of the test cord from all ground and battery connections and connects the monitoring coil of the telephone circuit across the tip and ring of the primary test cord.

5.104 The primary (Dial) key associates the dial in the telephone circuit with the primary test cord.

5.105 Primary (T) key connects the telephone circuit to the primary test cord.

5.106 (RCCI) key connects talking battery thru a repeat coil to the primary test circuit. The milliammeter and rheostat which is normally shunted by the (RHE) key are connected in series with the battery to the ring of the cord.

5.107 (TMT) key when operated with the (RCCI) key connects the telephone circuit to the primary cord thru an artificial line for transmission test.

5.108 (3WO) key opens the sleeve of the primary cord and connects ground thru 100 ohms to the sleeve relay in the primary test cord circuit.

5.109 (3WT) key opens the sleeve circuit, connecting ground thru the 100 ohm resistance to the sleeve relay as does the (3WO) key, and in addition connecting the sleeve of the test cord to the voltmeter for test purposes.

5.110 (VM-REV) key reverses the connections to the voltmeter when making foreign potential tests.

5.111 (FEMF) disconnects the test battery and connects ground in its place to make tests for foreign potentials.

5.112 (20,000 ohms) key Fig. 27 disconnects the 100V test battery and connects in its place the 20V test battery. The connection to the 100,000 ohms winding of the meter is also changed to the 20,000 ohms winding.

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5.113 (1000 ohms) key Fig. 27 disconnects the 100V test battery and connects in its place the 20V test battery. The connection to the 100,000 ohms winding of the meter is also changed to the 100 ohms winding.

5.114 (RHE) key opens the shunt around the rheostat.

5.115 The (PRI) (TOLL) (1&2) and (PRI) (TOLL) (3) keys are used for testing thru toll switchboards.

5.116 (X) key reverses the primary and secondary test cords with regard to the tests associated with each so that the primary tests may be made over the secondary cord and vice versa.

5.117 (H) key connects the howler to the secondary test cord.

5.118 (ELVM) key Fig. 28 connects the meter to the Electronic Voltmeter Test Circuit for measuring high resistance leaks.

5.119 (MET) (VM) key Fig. 28 provides for testing with non-grounded test battery.

5.120 (SC) key Fig. 28 short circuits the tip and ring of the test circuit.

5.121 (AC) key Fig. 28 connects the meter through a rectifier for measuring AC potentials (10DV) scale.

5.122 (60V) key Fig. 28 provides a 20,000-ohm, 24-volt meter range with 20-volt test battery or with key (AC) operated, provides for measuring AC potentials up to 60 volts at full scale deflection.

5.123 (24V) key Fig. 28 provides a 20,000-ohm, 24-volt meter range with 20-volt test battery or, with key (AC) operated, provides for measuring AC potentials up to 24 volts at full scale deflection.

5.124 (24MA) key Fig. 28 provides a 1000-ohm, 24-volt meter range with 20-volt test battery and provides full scale deflection at 24 milliamperes.

5.125 The primary (IN) key disconnects the sleeve of the primary cord from the sleeve relay and substitutes positive coin control battery.

5.2 For Secondary Test Circuit

5.201 Secondary (REV) key reverses the tip and ring of the secondary test cord, affecting all secondary test features except the secondary ringing and howler circuits. This key also signals an incoming test trunk in a crossbar office to connect to extra numbers not in the subscriber number series.

5.202 The secondary (DIAL) key associates the dial in the telephone circuit with the secondary test cord.

5.203 (Dial Test) key connects the 50-A dial test circuit when specified, to the secondary test cord.

5.204 Secondary (G) key connects ground to the tip of the secondary test cord.

5.205 Secondary (M) key disconnects the tip and ring of the secondary cord from ground and battery thru the repeating coil and connects the monitoring coil of the telephone circuit instead. Where "AS" wiring is used the sleeve circuit is opened and ground thru 100 ohms connected to the sleeve relay in secondary test cord circuit.

5.206 Secondary (T) key connects the tip and ring of the secondary test cord to the telephone circuit.

5.207 (S) key disconnects battery and ground thru the repeating coil from the tip and ring of the secondary test cord and connects instead, direct ground to the tip and battery with tone superimposed to the ring, thru a relay, which when operated causes the sounder or buzzer to operate.

5.208 The (SEC) (TOLL) (1&2) and (SEC) (TOLL) (3) keys are used for testing thru toll switchboards.

5.209 (PRI) and (SEC) lamps are lighted when the sleeve relays of the primary and secondary cord, respectively, operate, indicating that the tip and ring has been connected thru from the cord to the test circuit. The operation of either supervisory relay extinguishes its corresponding lamp giving regular "A" cord supervision.

5.210 The volt-milliammeter Fig. 27 is provided with four windings, one of 100,000-ohms reading to 120 volts, one of 20,000-ohms reading to 24 volts and one of 1000-ohms reading to 24 volts and a low resistance winding reading to 480 milliamperes.

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5.211 The volt-milliammeter Fig. 28 is provided with four windings, one of 100,000-ohms reading to 120 volts, one of 20,000-ohms reading to 24 volts, one 800 ohms with a galvanometer scale and a low resistance winding reading to 480 milliamperes.

5.212 The interrupter (H) is used to step the 200-type selector (H).

5.213 The 200-type selector (H) is used to cut in sections of the 49A repeat coil for the howler.

5.214 The sounder is used to give an audible indication of intermittent trouble, such as ground or crosses.

5.215 The sounder cord is used for connecting the sounder or buzzer to a line without tying up the secondary test cord.

5.216 (RCCO) key disconnects the repeating coil and secondary test supervisory relay equipment from the secondary test circuit.

5.217 The (-STA) or (+STA) key connects negative or positive battery thru the meter to a line under test that is equipped with tube type subsets.

5.218 The (3WO) key of the secondary test circuit opens the sleeve of the cord.

5.219 The (DO) key is used to compensate certain tests for the trunk loop when testing distant offices.

5.220 The (DSL) key is used when it is desired to dial on a subscriber's line.

5.221 The (Set 18 - Set 10) & (Dial test) keys are used in connection with volt-milliammeter dial speed testing.

5.222 The secondary (IN) key disconnects the sleeve of the secondary cord from the sleeve relay and substitutes positive coin control battery.

6. TALKING - PRIMARY AND SECONDARY TEST CORDS

The telephone set is normally disconnected from the testing circuit. The operation of the (T) key connects the telephone circuit to the test circuit. To talk to a subscriber, operate the primary (T) key and the repeating coil cut-in key (RCCI) the operation of which connects talking battery to the subscriber's telephone set. To talk over a subscriber's line connected to the secondary testing circuit the secondary (T) key should be operated. In both cases, regular "A" cord supervision is obtained.

When used with "B" board trunks in a crossbar office and connection is required to extra numbers, not in the regular subscriber number series in the office, the (REV) key should be operated reversing the battery and ground connections to the tip and ring of the test cord. The plug of the test cord is then inserted in the jack of an idle test trunk. In a crossbar office incoming trunk circuit, if (REV) key is operated, a polarized relay will operate to signal the marker that the called number is in the extra number series. A talking connection is then established on a straightforward trunking basis and the number is ordered up. After the number is ordered up the (REV) key, if operated, may be restored. During selection, continuous dial tone is audible to the test man. This tone changes to interrupted tone in case an overflow condition is encountered. When selections are completed tone is disconnected indicating that the connection to the subscriber's line is completed.

7. TESTS FOR GROUND - PRIMARY TEST CIRCUIT

To test for a ground on the ring side with the voltmeter scale of the voltmilliammeter, no keys need be operated since a 100-volt testing battery is connected to the ring side in series with the 100,000-ohm winding of the voltmilliammeter. The volt-milliammeter should show no deflection or at most a very small one if the line is clear except in the case of a grounded line or party line where the receiver was left off the hook. If a ground is indicated the resistance to ground may be determined as explained under "Test of Short-Circuit." If the deflection is in excess of 100 volts it indicates that the ring side of the line is crossed with the central office battery. To test on the tip side, operate the primary (REV) key. To measure a high resistance ground a 100-volt testing battery is used. On account of the high resistance of the 100-volt winding of the volt-milliammeter the needle will be deflected a greater distance than would be the case if the 20-volt testing battery were used, thereby giving a larger deflection and a more accurate reading. For measuring small resistances, the 20-volt battery should be used. To test with the milliammeter scale of the voltmilliammeter operate the (RCCI) key. If the line is clear no deflection will occur. To test on the tip side, operate the primary (REV) key in addition to the (RCCI) key.

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8. TESTS FOR GROUND - SECONDARY TEST CIRCUIT

When it is desired to use the sounder for making a test, all keys are in their normal position except the (S) key. The (S) key operated, will connect the (BR) relay of Fig. 19 or the (SR) relay of Fig. 20 to the ring side of the line and with superimposed tone and it will be operated if there is a ground on that side, or a short-circuit on the line. The operation of the relay in turn operates the sounder. If M wiring in Fig. 19 or if Fig. 20 is used, the operation of the (BR) or (SR) relay operates a buzzer if (BG) key is normal. With the (BG) key operated, the buzzer is again sounded, upon the release of the (BR) or (SR) relay.

9. TEST FOR SHORT-CIRCUITS

Tests for crossed lines are made by operating the ground key (G). If the line is crossed the voltmeter needle shows a deflection which is unchanged when the (REV) key is operated. The smaller the resistance of the short-circuit in the line, the greater is the deflection. In all cases, the external resistance of any given reading may be determined by calculating the resistance that would give a drop in potential equal to the testing voltage minus the reading obtained. For measuring lower resistance the lower scale and lower voltages are used. To test with the milliammeter, operate the (RCCI) and primary (G) keys. The deflection of the milliammeter results if the line is crossed. The milmiammeter needle returns to zero when the primary (G) key is restored to normal.

10. CONTINUITY TEST - PRIMARY TEST CIRCUIT

Continuity tests are made in the same manner as "Tests for short-circuits." On lines equipped with standard common battery substation sets which have a condenser in series with the ringer, no deflection occurs unless the receiver is removed from the switchhook at the substation, or the line is crossed. If it is not convenient to have the receiver removed a fairly satisfactory test of continuity can be made by operating the (REV) key several times. This results in momentary deflections of the voltmeter needle, due to the discharge of the station condenser, if the line is continuous. A test for continuity should always be preceded by a "Test for Grounds."

11. TEST FOR CROSSES WITH LINES CARRYING CURRENT - PRIMARY TEST CIRCUIT

To test a line for foreign battery, the battery cut-off key (FEMF) is operated. This connects the voltmeter to the ring side of the test circuit in series with ground. If the external potential causes a negative reading of the voltmeter, the (VM-REV) key is then operated thereby reversing the voltmeter, connection with respect to the line. To test the tip side of the line, the primary (REV) key is operated.

12. TEST FOR CROSSES WITH OTHER LINES - PRIMARY AND SECONDARY TEST CIRCUITS IN CONJUNCTION WITH EACH OTHER

To test for a cross between two lines, one of them is connected to the primary testing circuit and the other to the secondary testing circuit. The tip of the secondary testing circuit is connected to ground by the operation of the secondary (G) key. The ring may be connected to ground by the operation of the secondary (REV) key. The line connected to the primary testing circuit is tested for ground as described under "Test for Grounds".

13. BALLISTIC CAPACITY TESTS - PRIMARY TEST CIRCUIT

These tests are made to determine approximately the value of the capacity of the line locating an open or the capacity of the attached condensers. The circuit is arranged for a grounded capacity test only, unless the Wheatstone bridge circuit is equipped, in which case, tests for mutual capacity are made by operating the Wheatstone bridge key, which disconnects ground from the testing battery. To test a line for grounded capacity, the (G) key is operated; then, after the needle comes to rest, the (REV) key is operated and released several times. This causes a deflection proportional to the capacity on the ring, when the reversing key returns to normal and proportional to the capacity on the tip when the (REV) key is operated. If an extension bell is connected in series with a separate condenser and bridged across the line, the deflection will be increased. If the extension bell is connected in series with the ringer of the subscriber's main set, a slight reduction in the deflection of the needle results. Grounded lines or grounded bells give about 1/2 the deflection of bridged bell on a metallic line.

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14. TRANSMISSION TEST - PRIMARY TEST CIRCUIT

These tests are made for testing the degree of transmission on the line. The operation of transmission test key (TMT) and the (RCCI) key connects the line to the telephone circuit through an artificial line. The rheostat key is then operated and current through the transmitter varied by adjusting the rheostat. If Fig. 17 and the (DO) key is furnished, its operation reduces the size of the transmission pad in the test circuit.

15. APPLICATION OF HOWLER-SECONDARY TEST CIRCUIT

If there is a receiver off the switchhook on a line to which the secondary test circuit is connected, the (SS) and (H) relays will be operated, preventing the secondary supervisory lamp from lighting. The (H1) relay is operated through the "D" brush (SR) arc of the (H) selector, and is locked through its front contact under control of the (H) key. The (H1) relay operated, also connects the howler and hightone terminals to the primary winding of the 49A repeat coil inducing howler tone through the winding of the 49A repeat coil and connecting this to the secondary test circuit repeating coil. The stepping magnet STEP (H) is moved from its normal position to terminal 1 by an interrupted ground from the H interrupter under control of the (SR2) relay. The selector steps through its first revolution in the same manner as it was stepped to terminal 1. As the selector steps from terminal 1 to terminal 10, the number of turns connected to the secondary winding of the 49A repeat coil is increased with each step causing a graduated tone from a minimum to a maximum to be sent out. This graduated tone is again repeated from terminals 12 to 21. When terminal 21 of the (SR) arc is reached on its first revolution, ground from the D brush (SR) arc operates the (SR) relay and when the selector steps to terminal 22 the (SR1) relay is operated. The selector proceeds through its second cycle of operation in the same manner as the first until it reaches terminal 21 for the second time, when the (SR2) relay is operated. The (SR2) relay operated, opens the interrupter ground and prevents the selector from proceeding with the third revolution. Should the subscriber replace the receiver on the switchhook while the howler tone is being applied the (H) relay will release causing the supervisory lamp to light. The release of the (H) relay operates the (H2) relay, which removed the tone from the primary of the repeating coil, thereby preventing the howler tone from being applied to the line should the subscriber remove the receiver before the selector has completed its second cycle of operation. If Fig. 13 is used, relay (H1) grounds the howler machine start lead.

16. TEST OF THIRD WIRE - OPERATION OF CUT-OFF RELAYS (MAN. LINES)

When this circuit is used to test manual lines, the (3-WT) and the (3-WO) keys and associated wiring are used. The operation of the (3-WT) key connects the sleeve wire to the ring side of the test circuit at such a point that the talking and monitoring key may be connected across the tip and ring side of the test circuit while the testing combination is connected in series with the third wire. The usual test for "shorts", "crosses", etc., can be made as described above. To test the operation of the cut-off relay, operate the (RCCI) key, the primary (T) key, the (3-WT) key and the rheostat shunt key. The rheostat is then adjusted till the volt-milliammeter indicates that the cut-off relay receives its minimum operating current. The (3-WO) key is then operated. This allows the cut-off relay to release. If the A operator answers, she can be told to pay no attention to the signal. Next, the third wire open key is restored. A click should be heard in the receiver if the cut-off relay is properly adjusted. If no click is heard, the relay needs adjustment. See paragraph 32 for party and terminal hunting indications, when using primary (3WO) key. If the (3WT) key is furnished and Fig. 21 is used the operation of the (3WT) key operates relay (WT).

When "AT" option is furnished, the sleeve wire of secondary circuit is opened by the operation of the secondary (3WO) key and ground thru 100 ohms is connected to the sleeve relay. The secondary (3WO) key is provided when associated with a crossbar incoming trunk circuit arranged to indicate party and terminal hunting line conditions.

17. TEST OF SUBSCRIBER'S LINE CIRCUIT (USING #14 TYPE TEST TRUNK) - PRIMARY TEST CIRCUIT

When a connection has been set up thru a Panel test switch train, to a subscriber's line, the line cut-off relay can be released. This is accomplished by the operation of the (3WO) key which opens the sleeve toward the test selector causing the test switch train to function to release the line sleeve relay. The (T) key is operated before the (3WO) key and bridges a retard coil across the tip and ring of the line if Fig. 16 is furnished or a retard coil and resistance pads if Fig. 21 is furnished.

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Therefore, when the line cut-off relay releases, this bridge will operate the line relay and dial tone should be heard at the test desk. The release of the (T) key should cause the central office line finder or line switch to release. The release of the (3WO) key allows the line cut-off relay to reoperate. If a (DO) key is used part of the line relay test is short circuited when the (DO) key is operated.

Similar tests may be made on manual connections when a connection is set up through a test trunk of the type used with the #14 test desk. However, for manual connections, the operation of the line relay is noted through the action of the manual operator instead of by dial tone.

18. COIN LINE RELAY TEST - (FIG. 21)

This test is made as described in paragraph #17 except that the (LRP) key is operated. This key operated, connects a ground through resistances (AL) and (AM), or part thereof, through the (LRI) retard coil and through resistances (AP) and (AR), with "BM" wiring or the (DO) key normal, or through resistances (AN) and (AO) with "BL" wiring and the (DO) key operated, to the tip side of the line. The ground also passes through either resistances (AS) and (AT) or (AU) and (AV) to the ring side of the line. This ground simulates the deposit of a coin at a pay station and tests the operation on a relay in the central office equipment.

The "AU" and "AV" leads shall be connected as required so that at minimum office voltage and maximum opposing earth potential, the current through any line relay tested will not be less than its operate test value and will approximate the test value of the line relay with the most adverse circuit conditions.

19. TESTING DIALS - SECONDARY TEST CIRCUIT

19.1 When used with 51 type Dial Tester, "W" option & Fig. 23, the secondary test cord is connected to a dial tester key circuit. When the keys in this key circuit are properly operated, the test circuit is connected to the 51 type dial tester. This dial test circuit is arranged for testing either 10 pulse or 20 pulse dials.

19.2 When used with 50 type Dial Tester, "V" option & Fig. 23, the (DIAL TEST) key is operated to connect the secondary test cord to the 50 type dial tester. This dial tester is arranged for testing 10 pulse dials only.

19.3 Testing Dials - Using Figs. 24 & 25 & CI option and Dial Testing Circuit (Voltmilliammeter Dial Testing)

Key (SET 10) is operated when it is desired to test a low speed (10 PULSE) dial or key (SET 18) when it is desired to test high speed (20 PULSE) dials. The (RHE) key is also operated. The (SET 10) or (SET 18) key (a) operates the (SW) relay, (b) connects ground to lead G of the dial testing circuit. The (SET 18) key also connects lead A of the dial testing circuit through the (Y) resistance to the E terminal of the meter for a purpose to be described later.

Ground on lead G closes the biasing winding of the pulsing relay in the dial testing circuit and also acts as an operate ground for that circuit. The (SW) relay operated, transfers the tip and ring of the secondary cord to the dial testing circuit, operates relay (DT), and connects ground through a resistance over the M lead to the E terminal of the meter. The (DT) relay operated (a) causes the (DT) lamp at the home position to flash and the (DT) lamps at the other three positions in the group to light steadily as busy signals, (b) connects battery through a resistance over lead B through the rheostat to the E terminal of the meter, (c) opens the connection from +100 volts to the A terminal of the meter and (d) connects ground under control of the (DIAL TEST) key to lead C of the dial testing circuit which now functions to close ground through a resistance over lead S through resistances (W) or (X) to the B terminal of the meter. This provides the necessary potential for adjusting the voltmilliammeter. The rheostat should be adjusted to give a reading of 10 for (10 PULSE) dials or 18 for (20 PULSE) dials on the 0-24 scale of the meter.

The (DIAL TEST) key should then be operated. This causes dial tone to be sent to the calling station as a signal to start dialing, sets the dial testing circuit to receive pulses and connects the output of the dial testing circuit across terminals C and E of the meter.

During dialing direct ground is connected to lead A. When the (SET 18) key is used this ground through the (Y) resistance is connected to the E terminal of the meter which aids the dial testing circuit to maintain the same potential at the E terminal of the meter as was used during the setting of the meter. When dialing takes place, the meter needle assumes a new position about which it vibrates momentarily and then falls off to a zero position. The position just prior to falling off, should

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be observed since it corresponds to the dial speed in pulses per second as read on the 0-24 scale.

A repeat test can be made by momentarily restoring the dial test key and repeating the above procedure. The dial testing circuit is restored to normal by restoring the (SET 10) or (SET 18), and (DIAL TEST) keys to normal.

20. TEST OF COIN BOXES

When a coin control test circuit is specified, two keys are provided, coin collect key (CC) and coin return key (OR). The (CC) key operated sends out a positive current for collecting the coins; the (CR) key operated sends out a negative current for returning the coins. (These keys are not shown on this circuit.) If the (DO) key is furnished, it will, when operated, connect a series booster battery to compensate for trunk loop and earth potential.

21. BREAKDOWN TEST - PRIMARY TEST CORD

This test consists in connecting a 200-volt source of potential to the line through the volt-milliammeter by operating the breakdown test key. This breakdown test is applied by means of a spring actuated revolving mechanism adapted to make and break circuits in a predetermined sequence or by a 200 type selector. The 200-volt potential is connected to the line at the start through a high resistance to prevent bell tapping. This then cuts out of the circuit and finally when the 200-volt potential is disconnected, the line is connected to ground through a high resistance so that the discharge in the line will not tap the subscriber's bell.

During the test, the milliammeter reading should not exceed .020 amp. the current flow obtained on a 10,000 ohms leak. The spring key is arranged to apply the test to the tip of the line. To make the breakdown test on the ring side of the line, the (REV) key is operated together with the insulation breakdown test key. When the 200 type selector arrangement is used, the test is applied to both tip and ring. By the operation of the proper key, the test may be repeated on either tip or ring. (The breakdown test equipment is not shown on this circuit.)

22. TESTING OPERATION OF RELAY - FOUR-PARTY SUBSTATION SET

In order to test four-party substation sets of the relay type, the (SSRT) key (not shown on this circuit) is operated, which sends ringing current out on the lines by induction through a repeating coil, at the same time that the volt-milliammeter is connected to the line circuit so that from its deflection can be observed whether or not the ring-up relay in the substation set is properly operated. When making this test, it is preferable to have the 1000-ohm scale change key also operated.

23. ESTABLISHING A CONNECTION THRU A TEST SWITCH TRAIN WHICH OPERATES WITH A "B" SWITCHBOARD

When establishing a call to a subscriber's line in a panel or crossbar office where connections are made using the "B" switchboard, the (T) key associated with the (PRI) or (SEC) test cord is operated and if the primary circuit is used the (RCCI) key is also operated. When connection is required to extra numbers not in the regular subscriber number series in a crossbar office the (REV) key should be operated, reversing the battery and ground connections to the tip and ring of test cord. The plug of the (PRI) or (SEC) test cord is then inserted in the jack of an idle test trunk.

In a crossbar office incoming trunk circuit, if (REV) key is operated, a polarized relay will operate to signal the marker that the called number is in the extra number series. A talking connection is then established on a straightforward trunk basis and the number is ordered up. After the number is ordered up, the reverse key, if operated, may be restored. During selection continuous dial tone is audible to the test man. This tone changes to interrupted tone in case an overflow condition is encountered. When selections are completed tone is disconnected indicating that the connection to the subscriber's line is completed.

Talking battery is supplied by this circuit and regular "A" cord supervision is given by the (PS) relay and (PRI) lamp or by the (S) or (S1), (SS) relay and (SEC) lamp, the lamp being lighted and the relay normal if the line is clear and the lamp being extinguished and the relay operated if the receiver is off the hook or if the line is crossed or if the ring side of the line is grounded.

If the test trunk is arranged for "no test" operation, the (M) key should be operated soon after the number is passed, in order to monitor on the line before testing.

24. ESTABLISHING A CONNECTION THRU A TEST SWITCH TRAIN USING A DIAL PULSE TERMINATING SENDER (FIG. 2)

When establishing a call to a subscriber's line in a panel or crossbar office thru a test train having an associated dial pulse terminating sender, the (Dial) key of either the primary or secondary test circuit is operated. The dial key operated, (a) causes lamps (PRI) or (SEC) to light (b) operates the (PD) or (SD)

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relay. The (PD) or (SD) relay operating closes a circuit for the operation of the (NP) or (NS) relay and connects positive battery to the sleeve of the test cord circuit. The (NP) or (NS) relay operated, opens the circuit to the sleeve relay of the cord for purposes to be described below, and operates the (PD1) or (SD1) relays. The (PD1) or (SD1) relay operated (a) grounds the "F" lead to the telephone and dial circuit causing it to cut thru to this circuit and (b) cuts thru the tip and ring from the test cord to the dial impulse contacts.

When connection is required to extra numbers, not in the regular subscriber number series in a crossbar office, the (REV) key should be operated, this connects ground through operated contact of (PD1) or (SD1) relay, through (DL) 1000-ohm resistance, over "X" lead through the telephone circuit to the ring of the test cord.

The plug of the test cord is then inserted in the jack associated with a test trunk and the condition of the test cord (positive battery on the sleeve and a bridge across tip and ring) causes the test trunk and the selector in the panel or crossbar office to cut thru for dialing. In a crossbar office incoming trunk circuit, if (REV) key is operated, the 1000-ohm resistance ground, connected to the ring of the test cord, causes a relay to operate to signal the marker that the called number is in the extra number series. When a sender becomes connected to the test channel in use, a relay operates in the telephone circuit which connects battery to the "B" lead of this circuit, and extinguishes the cord (PRI) or (SEC) lamp as an indication that the circuit is ready to receive dial pulses. If the (REV) key is operated, it may be released at this point.

Upon the completion of dialing and when selections have been completed the (PRI) or (SEC) lamp will light and remain lighted as long as the dial key is left operated. During the progress of completing a call, a progress tone is received and therefore should the call fail to progress satisfactorily, a continuous tone will be received, as an indication of trouble. This tone is received after the dial key has been released. Also in the event an overflow or a busy line condition on calls that are not "no test" is encountered, an interrupted tone will be received as an indication, upon the release of the dial key. Assuming the call progressed satisfactorily, upon the release of the dial key, a talking connection is established, and regular "A" cord supervision is given by the (PRI) relay and (PRI) lamp or by the (SS) relay and (SEC) lamp, the lamp being lighted and the relay normal if the line is clear and the lamp being extinguished and the relay operated if the receiver is off the hook or if the line is crossed or if the ring side of the line is grounded.

If it is desired to monitor on the particular line before attempting to make any tests or talking connection the (M) key is operated before restoring the (DIAL) key. The operation of this key in either the primary or secondary test circuit connects a high impedance monitoring circuit across the tip and ring. The monitoring circuit will not be closed however until the dial key is restored. If "AS" option is provided, the (M) key should be operated after the (DIAL) key is restored.

When the dial key is released the lamp circuit is closed to its normal path and relay (PD) or (SD) is released. Relay (PD) or (SD) released removes the positive battery from the sleeve and opens the circuit to the (NP) or (NS) relay. The (NP) or (NS) relay is slow to release and therefore holds the (PD1) or (SD1) relay operated for an interval thereby maintaining a bridge across tip and ring. This interval is required to permit certain sleeve relays in the test channel to release to prevent a premature disconnect.

25. ESTABLISHING A CONNECTION TO A CROSSBAR OFFICE USING MF KEY PULSING

When establishing a call to a subscriber's line in a crossbar office thru a test trunk associated with multifrequency key pulsing terminating equipment, "CX" and "CY" options and the connections to the MF Keyset circuit are provided. The MF Keyset circuit can be connected with either the primary or secondary test cords by the manipulation of the corresponding (KP) key in that circuit.

In No. 1 Crossbar Offices connection may be made to a subscriber line in either the "regular" or "extra number" series. Connection to a No. 1 Crossbar subscriber line in the extra number series requires the operation of key (REV) of the primary or secondary test circuit. For other types of calls the (REV) key must be normal. Key (REV), operated, provides ground over lead "X" to operate at relay in the MF Keyset circuit to indicate to the terminating equipment that the call is to a line in the extra number series.

With Key (REV) normal or operated, as required, the plug of the primary or secondary test cord is inserted in an idle test trunk and the proper key (KP) in the MF Keyset circuit is operated.

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Key (KP) operates a relay in the MF Keyset circuit which transfers the tip and ring of the test cord to the MF Keyset circuit and transfers the sleeve of the test cord to positive battery to operate a polarized relay in the Test Trunk terminating equipment.

The MF Keyset circuit functions, in conjunction with the Test Trunk terminating equipment in a Crossbar Office, to summon and attach a sender or register and MF receiver. Lamp (S) of the MF Keyset is lighted when the terminating equipment is prepared to receive numerical pulses.

By the operation of numerical keys, corresponding to the number of the called subscriber line (including an office digit when required), numerical pulses are transmitted to the MF receiver which operates relays in the sender or register to control the selection of the called number.

After numerical pulsing is completed, key (KP) is released. This disconnects the MF Keyset circuit from the "T", "R", and "S" leads of the primary or secondary test circuit and a connection is established to the called subscriber line.

26. TESTING THROUGH TOLL SWITCHBOARDS

When testing through a toll board the (PRI TOLL 1 & 2) key, the (PRI TOLL 3) key, the (SEC TOLL 1 & 2) key or the (SEC TOLL 3) key is operated depending on whether the primary or the secondary test cord is used, and whether the toll board is number 1, 2 or 3. The key operated puts the proper resistance relay on the sleeve, which when operated, operates a relay in the test cord circuit to cut the leads through for testing.

27. RINGING KEYS

This circuit is arranged to be used with a separate ringing circuit for connecting ringing current to the line under test.

28. INTERCHANGING TEST CORDS

The key marked (X) is used to interchange the primary and secondary test cords with respect to the primary and secondary testing circuits. When the key is in the normal position, the primary test cord is connected to the primary testing circuit and the secondary cord is connected to the secondary test circuit. The operation of the key makes it possible to apply all primary and secondary tests except the third wire test over the secondary cord, and all secondary tests except the howler test, over the primary cord.

29. SOUNDER

A separate cord for the sounder is provided in those cases where its use would tie up the secondary test circuit. The sounder is provided as an aid in locating and checking cable conductors both inside and outside the offices. To help in locating a particular wire, the trouble tone is superimposed upon the circuit. A buzzer and an additional key for testing between shorts or grounds may be obtained in place of the sounder.

30. MONITORING TESTS

In order to listen in on the circuit, the primary (M) key is operated, the operation of which frees the tip and ring of the test circuit from all ground and battery connections, and connects the telephone set in series with monitoring coil across the test circuit. To monitor for the secondary cord circuit, the secondary (M) key is operated as described above for the primary (M) key. When "AS" wiring is furnished, the sleeve is opened by the (M) key and ground thru 100 ohms is supplied to hold the test cord sleeve relay.

31. CONTINUITY TEST OF SUBSCRIBER LINES EQUIPPED WITH COLD CATHODE TUBE SUBSCRIBER SETS

Continuity tests of subscriber lines equipped with cold cathode tubes are made by the operation of (-STA) or (+STA) key. The operation of these keys causes negative or positive battery to be connected through the 100,000 ohm-voltmeter shunted by the (ST) 8,000 ohm resistance to the ring, of the line. With (-STA) key operated, the negative potential on the ring of the line will cause the control gaps of the tubes connected to the ring to break down and the voltmeter needle to deflect slightly. If there is a negative station on the ring there will be a flow of current through the ringer and consequently the deflection of the voltmeter needle will be greater than would be the case with no negative station connected to the ring. Similar conditions apply if the (+STA) key is operated in checking for positive stations. Connections on the tip of the line are checked by operating (REV) key as well as (-STA) or (+STA) key. The (-STA) key operates (STA) relay and the combined contacts of the key and relay perform the switching functions described above as well as opening a number of circuit paths to safeguard the circuit operation.

Where (-STA) and (+STA) key is provided the voltage of the negative and positive station test batteries may be

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checked by the operation of (-STA) or (+STA) key and then the (VM-REV) key.

32. TEST TO INDICATE CROSSBAR OFFICE PARTY AND TERMINAL HUNTING LINE CONDITIONS - PRIMARY TEST CIRCUIT

When a connection is established to a subscriber line circuit thru a crossbar office incoming trunk circuit tests to indicate the party and terminal hunting line conditions may be made as follows.

Operate the primary test circuit (3WO) key, this opens the sleeve lead of the trunk circuit, causing the crossbar office incoming trunk circuit to switch the tip and ring of the trunk from the line to the following signaling conditions which are dependent upon the party and terminal hunting line conditions:

(1) Individual line, ring party or last line of a terminal hunting group, the ring lead will be connected to 48 volt battery thru 300 ohms.

(2) First or intermediate line of a terminal hunting group, the ring lead will be connected to ground.

(3) Tip party, the tip lead will be connected to 48 volt battery thru 300 ohms.

In addition, if a connection has been completed thru the "no-test" train, high tone is connected to the side of the trunk which is not connected to battery or ground.

These conditions can be identified by means of voltmeter readings, operating the (REV) key when necessary to test the tip. To check for the "no-test" tone indication (M) or (T) key should be operated.

33. DIALING ON CROSSBAR SUBSCRIBER LINE (FIGS. 18 & 21) - PRIMARY TEST CIRCUIT

In a crossbar office, since the cut-off relay release feature is not provided, the line relay tests can be made only by establishing a connection thru a main frame test trunk and primary test cord. After the connection has been set up the test man may dial on this line after operating the (T) key, (3WO) key and (DSL) key. The operation of the (DSL) key opens the tip and ring to the telephone circuit and connects them thru to the dial. The operation of the (DSL) key also operates first the (DL) relay and then the (DL1) relay. The (DL) relay closes a bridge across the talking trunks and grounds lead 9 which grounds the "S" lead of the talking trunks, to hold any talking connections that may be up at the time. The (DL1) relay connects the bridge formed by the line relay test resistances thru the contacts of the dial and provides a path for short circuiting the (TW) retard coil when the dial is moved off normal. The line relay test resistance is in the dialing circuit.

If a tip party message rate condition is to be simulated, the (LRP) key of Fig. 1 is operated in advance of the other keys.

When three jack type MDF test trunks are used, the test cord plug should be inserted in the (LIST) jack if it is desired to leave the line conductors connected, or in the (SWBD) jack if it is desired to disconnect the line conductors. When single jack type MDF test trunks are used the line conductors will remain connected while the (3WO) key is operated. When the (3WO) key is released, the line conductors will be disconnected. (See paragraph 35)

34. TEST BATTERY AND VOLT-MILLIAMMETER FIGS. 28, A, B, & C

The testing facilities consist of a 100-volt dry battery poled opposite to that of the central office battery and having a 60-volt tap and a KS-13724 meter. Key 60 volts connects 30,000 ohms in series with terminal "B" of meter to provide the 50,000 ohm meter feature. In this case the scale reading (0-120) is divided in half since a 60 volt scale is provided. The KS-13724 meter scale is as follows:

Scale	Full Scale Current	Approximate Meter Resistance
0-120V	1.2 MA	100,000 ohms
0-24V	1.2 MA	20,000 ohms
Galv	1.2 MA	800 ohms
0-480MA	480 MA	4 ohms

The high testing voltage makes it unnecessary in the course of routine testing for the test man to be much concerned about earth potential when making measurements for insulation resistance, as the error introduced in reading of the volt-milliammeter is comparatively small. Resistance measurements when made by a voltmeter are most accurate when external resistance is equal to the resistance of the voltmeter. Under these conditions measurements accurate to within one or two per cent may be made. The milliammeter is best adapted for measuring resistance under 500 ohms, with this volt-milliammeter resistance from a few ohms to approximately 500,000 ohms can be measured with a fair degree of accuracy. The milliammeter scale is useful for detecting receivers off hook, lines plugged up at a PBX and wet subscriber's set cords. The 1000 ohm scale may be used for detecting short circuited condensers and sticky relays in subscriber's sets. The 20,000-ohm scale may be used for checking the resistance of relays at the incoming end of interoffice trunks and the

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10,000-ohm scale for testing insulation resistance on all lines whether subscriber's trunk or toll.

35. CONTROL OF SINGLE JACK TYPE IN AND OUT TEST TRUNKS

When single jack type IN and OUT MDF test trunks are used, "CZ," "DB," and "DC" options are furnished in the test cord circuit.

When a test cord is plugged into the jack of this type of trunk, the battery through the sleeve relay of the test cord circuit causes the nonpolarized relay in the sleeve circuit of the test trunk at the desk end to operate but will not operate a second relay in the sleeve circuit which is polarized to operate on positive battery. This combination will cause a sleeve condition to be transmitted to the test trunk at the MDF end which will cause that circuit to connect the tip and ring conductors of the test trunk to the line patched up for test and to open up the line toward the central office equipment.

If it is desired to test the side of the line toward the central office, the (IN) key associated with the test cord being used is operated. The operation of this key will replace the negative battery normally on the test cord sleeve with positive battery. This will cause both the polarized and nonpolarized relays in the test trunk at the desk end to operate. This combination will cause the proper sleeve condition to be transmitted to the test trunk at the MDF to cause that circuit to connect the tip and ring conductors of the test trunk to the line under test and to open up the side of the line toward the subscriber.

To obtain a bridging connection to the line under test, the (IN) key should be restored to normal and the (3WO) key operated. This will open the sleeve toward the test trunk and none of the sleeve relays in that circuit will operate. This open sleeve condition will be extended to the test trunk at the MDF causing that circuit to connect the test trunk tip and ring conductors to the line to establish the bridge connection.

The operation of the (IN) key in either cord will also operate the (NP1) or (NS1) relay which in turn will open the sleeve lead behind the (IN) key and connect resistance ground to the sleeve relay of the test cord circuit to keep it operated. Keeping the sleeve relay operated while the (IN) key is operated will maintain cord lamp supervision in the associated test cord When the (IN) key is restored to normal the (NP1) or (NS1) relay releases thereby reclosing the link in the sleeve lead. However, the (NP1) or (NS1) relay has a slow-release characteristic and the sleeve lead toward the test trunk will be open for the releasing time of this relay immediately after the (IN) key has been restored to normal. This open interval is necessary to insure the release of the marginal relay in the test trunk at the MDF end when changing from the IN to the OUT testing condition.

Besides opening the sleeve lead as described above, the operation of the (3WO) key in the primary test circuit will also connect resistance ground to the primary test circuit sleeve relay to keep it operated and maintain cord lamp supervision while the key is operated. It is to be noted that cord lamp supervision is not maintained when the (3WO) key in the secondary test circuit is operated.

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