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STEP-BY-STEP SYSTEMS NO. 1 TEST SET CIRCUIT FOR TESTING LOCAL, TOLL, AND COMBINATION LOCAL AND TOLL CONNECTORS

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The rating of this circuit is changed from AT&T Standard to Mfr. Disc.

D.2 "Replaced by SD-31637-02" is added to the replacement note.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3030-OCH-RLL-02

STEP-BY-STEP SYSTEMS
NO. 1
TEST SET CIRCUIT
FOR TESTING LOCAL, TOLL, AND
COMBINATION LOCAL AND TOLL CONNECTORS

CHANGES

B CHANGES IN APPARATUS

Superseded	Superseded By	Removed
479GR Key H option	552E Key ZA option	19MU Res. formerly ZA option

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The 19 MU resistance and associated wiring, formerly designated "ZA" option, were removed, and the alternate "H" option was made part of Fig. 1. The 479 GR key is replaced by a 552E, but is designated "ZA", and the 552E is designated "H" option to permit reuse of the 479GR key where it is provided. The alternate wiring is shown in added note 112.

D.2 In Notes 109 and 110 reference to H and ZA options were removed, and in the column headed "Keys operated" (1600) was removed wherever it appeared, and (1200) was added wherever (1600) or (1900) did not formerly appear, except for 750, 800 or 900 ohm range lines of note 109. This is done since the middle (undesignated) position of the key, formerly used for 1200 ohm trip value, is now used for 1600 ohms. This change is made so that when 1900 ohms is used for the trip relay test, 1600 ohms may be applied as a D relay test in case the D relay does not operate on 1900 ohms.

All other headings under Changes, no Change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is designed to test all standard connectors in step-by-step offices.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS

3.01 Arranged to test pulsing condition of connector.

3.02 Arranged to test talking condition of connector.

3.03 Arranged to test ringing condition of connector.

3.04 Arranged to test release condition of connector.

3.05 Arranged to test the permanent signal alarm feature of the connector.

3.06 Arranged to test the reverting call feature of 10-party terminal per station connector.

3.07 Provides a rapid operate key (ROT) for making a rapid operate test of local connectors and local side of combination connectors.

3.08 Provides a 40 type test set for remote control of test set.

3.09 Provides facilities for pulsing by either dial or pulsing test set.

3.10 Provides receiver for listening.

3.11 Provides for testing level hunting connectors.

3.12 Provides for testing non-reversing connectors.

3.13 Provides key (SUP/TST) in Figs. A and B for applying the test condition to the tripping relay of connectors having superimposed ringing.

3.14 Provides keys (SS) and (TST) in Fig. C for applying the test condition to the tripping relay of connectors in AC-DC or Sup. Ringing offices.

3.15 Provides key (SUP/ADJ) in Figs. A and B and (ADJ) key in Fig. C for applying the readjust condition to the tripping relay of connectors requiring adjustment on ringing current.

3.16 With Figs. A and B, provides for testing the ringing condition of 10-party terminal per line or terminal per station connectors by the operation of (10-P/TPL) or 10-P/TPS) key.

3.17 Provides key (10-P/TPS) with Fig. C to apply different sleeve resistance when testing 10-party T.P.S. connectors.

3.18 Provides for testing the "C" lead of toll connectors.

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3.19 Provides lamp signals to indicate progress of test, type of ringing received on tests of 8-party connectors, also failure to meet test condition.

3.20 Provides control of ringing test resistances in the test line, used for testing the (H) and (J) relays of 8-party semi-selective connectors.

3.21 Provides for testing connectors arranged for 1000 ohm, or 1400-1500 ohm loops in the same office.

3.22 Provides for remote control of complete testing of local and toll connectors, and 8-party T.P.S. connectors.

3.23 Arranged for monitoring on off-normal switches.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet, the connecting information thereon is to be followed.

4.01 Local Non-Hunting Connector - SD-30201-01*.

4.02 Local Rotary Hunting Connector - SD-30215-01.

4.03 Comb. Connector - SD-30228-01*.

4.04 Toll Non-Hunting Connector - SD-31171-01.

4.05 Toll Rotary Hunting Connector - SD-31114-01.

4.06 Local Level Hunting Connector - SD-31188-01*.

4.07 Toll Level Hunting Connector - SD-31527-01*.

4.08 Local 10-Party TPL Connector - SD-30956-01*.

4.09 Toll 10-Party TPL Connector - SD-31282-01.

4.10 Comb. 10-Party TPL Connector - SD-30973-01.

4.11 Local 10-Party TPS Connector - SD-31525-01.

4.12 Toll 10-Party TPS Connector - SD-31300-01.

4.13 Comb. 10-Party TPS Connector - SD-31811-01.

4.14 Local 8-Party TPS Connector - SD-31326-01.

4.15 Toll 8-Party TPS Connector - SD-31327-01.

4.16 Comb. 8-Party TPS Connector - SD-30862-01.

4.17 Connector Test Line - SD-31653-01.

4.18 Pulsing Test Set - SD-31481-01.

4.19 Switch Trouble Alarm Circuit for Connector Shelves - SD-32045-01*.

*Typical circuit.

DESCRIPTION OF OPERATION

5. GENERAL

When "F" option is used, operate the (1200) key when testing connectors arranged for use with sub. lines of 1000 ohms max. external circuit resistance. Leave this key unoperated when testing connectors using 45-50V. trip battery and arranged for use with sub. lines of 1400 or 1500 ohms max. external circuit resistance, and operate the (1900) key when testing similar connectors using 60-75 volt trip battery.

5.1 Patching Test Set

The test set should be connected to all required connecting circuits before patching to the connector to be tested. Connect jacks (3) and (4) to the corresponding jacks of the connector test line and note that the test set is normal as indicated by all lamps out. Connect jack (P) to jack (PERM-T) on the connector frame using a cord of Fig. 9. If the Pulsing Test Set is to be used for pulsing the connectors it must be connected to the battery supply jack of the frame and its (A), (B) and (TL) jacks patched to jacks (LK), (LP) and (A), respectively, of the connector test set by means of cords of Fig. 9 and Fig. 8. The proper keys of the Pulsing Test Set must be operated to provide the desired resistance for loop and leak. For tests of 8-party connectors, when "ZD" option is provided, and the connector Test line is arranged to return visual Ringing Signals, patch jack (8-PTY) to the corresponding jack of the connector test line and operate the 498A key to the position required for the tests to be made. The connector patching cord, Fig. 6, is then connected to jack (T) for local connectors and local test of combination connectors; or The cord of Fig. 4, for toll, or of Fig. 5 for the toll test of combination connectors, is connected to jack (TT). The receiver, Fig. 3, is plugged into jack (TEL) to listen and the 40 Type test set, Fig. 2, is plugged into jacks (EXT) for remote control of the test set. When the 240 type plug of the test cord is inserted in the test jack of the connector to be tested the listening circuit is established for the purpose of monitoring on off-normal connectors.

5.2 Test of Local Connector or Local Side of Combination Connector

5.201 Pulsing Test With Leak Condition

As soon as patching is completed to a local connector a monitoring circuit is closed through the (L) condenser and the sleeve is connected to the (SC) relay. If the connector is busy, relay (SC) will operate lighting guard lamp (GD) and preventing the operation of relay (HC) to close the tip and ring loop. If the (GD) lamp does not light when patching is completed to the connector, the testman will immediately operate the stepping key to advance the rotary switch and make the connector busy. When the stepping switch reaches terminal 1, a circuit is closed from ground through a back contact of relay (SC) to operate relay (HC). Relay (HC) locks and closed the dialing loop of the test set to the tip and ring of the connector. This completes the circuit for the (A) relay of the connector which causes ground to be returned on the sleeve. Relay (SC) will operate from the connector sleeve ground and will operate relay (BR) from ground on arc 2 of the stepping switch leaving relay (SC) locked to the sleeve to check for a momentary opening of the (B) relay of the connector during dialing. The lighting of the guard lamp (GD) after the operation of the (STP) key will indicate that the connector has been made busy by the test set.

The stepping of the rotary switch to terminal 1 will also light the busy line lamp (BSY/L) indicating the first test to be made. The (SL) relay is operated in a local circuit to apply the busy condition to the sleeve of the test line. The (SL) relay also switches the start lead for the pulsing test set from the (LP) to the (LK) jack, provides a leak resistance and short circuits the loop resistance as a dialing condition for the hand operated dial. Consequently, the stepping of the connector for the busy line test is done with the leak condition and with zero resistance loop whether dialed manually or operated by pulses from the pulsing test set. If the pulsing test set is used the pulsing key (PLS) on the test set or the 40 type test set is operated momentarily. Relay (PL) operates to short circuit the listening circuit and closes the sleeve of jack (A) to the winding of relay (PL1). Relay (SL) being operated the ground from the (PLS) key will be closed through the tip of jack (LK) to start the pulsing test set. As soon as the pulsing test set is primed ground will be supplied on the sleeve of jack (A) to operate relay (PL1) and on the tip of jack (LK) to maintain relay (PL) operated after the (PLS) key is restored. By this operation nine pulses will be sent over the tip and ring of the (A) jack which being cut into the connector bridge by the operation of relay (PL1) will cause the connector to take nine vertical steps. If the (PLS) key has been released, the pulsing test set will stop and ground will be removed from the tip of jack (LK) which will cause relays (PL) and (PL1) to release. If the (PLS) key is held operated during the first nine pulses then after a proper time interval a second series of nine pulses will be sent which will complete the stepping of the connector to terminal 99. If the hand dial is used to step the connector, the number 9 is dialed twice in succession. The connector will step on the leak condition across the tip and ring and will connect to the test lines through terminal 99 or 90.

5.202 Busy Line Test

The connector test line associated with terminal 99 is connected to the test set through jacks (3) and (4) for non-hunting connectors, and to terminal 90 for rotary hunting connectors, but as terminal 99 is made busy, the connector will hunt from 99 to 90, and thus test the rotary hunting feature and connect to the test line. The busy condition, namely, ground through the primary winding of relay (SB) and a non-inductive resistance is connected by relay (SL) to the sleeve of the test line through the tip of jack (4). When the connector tests the sleeve of the test line, relay (SB) will operate on its primary winding and lock on its secondary winding and will operate relay (LS) which will light the busy lamp (BSY). The busy lamp indicates that the connector satisfactorily completed the pulsing test and made a test of a busy line. The operation of the busy relay of the connector may be checked by listening to the busy tone in the receiver of the test set.

5.203 Release From Busy Line

The release key (RLS) on the test set or the 40 type test set is operated momentarily to release the connector from the busy line. The operation of the (RLS) key operates the (RL) relay which locks operated to a contact of relay (SL). Relay (RL) operated opens the battery for relay (HC) which releases and opens the tip and ring bridge on the calling side of the connector. This causes the connector to release in turn releasing relay (SC). Relay (SC) releasing

unlocks relay (SB) which releases relay (LS) which extinguishes the (BSY) lamp. Relay (LS) released unlocks relay (RL) which releases provided the (RLS) key has been released. The (GD) lamp will momentarily go out. The release of relays (SC) and (RL) closes the circuit for the reoperation of relay (HC) which again closes the loop. This seizes the connector which operates the (SC) and (BR) relays and lights the (GD) lamp as previously described.

5.204 Pulsing Test With Resistance Loop Condition

The stepping key (STP) is again operated to advance the rotary switch to terminal 2. The progress lamp (BSY/L) is extinguished and the idle line test lamp (IDLE/L) is lighted. Relay (SC) maintains the guard lamp (GD) lighted.

Relay (SL) releases which transfers the sleeve of the test line from the (SB) relay to the (S) relay which supplies a non-busy sleeve condition of 1425 ohms to battery. The pulsing test set may be used as previously described to supply pulses to operate the connector. The (SL) relay released connects the ground from the (PLS) key through the (LP) jack to start the pulsing. This provides the desired loop resistance condition determined by the setting of the resistance keys on the pulsing test set. If the hand dial is used, a 1000 ohm resistance is provided in the dialing loop but the leak resistance is opened. The two sets of nine pulses should again operate the connector to terminal 99 and connect to the test line. Relay (S) will be operated from the sleeve in turn operating relay (LS) which lights the busy lamp (BSY) indicating that the connector has made busy the sleeve of the test line. The connector then applies ringing ground and ringing current to the tip and ring, respectively, of the test line. This ringing current will cause relay (RS) to operate during the interval that ringing current is on and release during the silent interval thus intermittently flashing the ringing signal lamp (RS). In synchronism with the flashing lamp, ringing induction will be heard in the receiver of the test set. If the 8 party Jack is patched to the test line for tests of 8 party connectors, [illegible] should light the ringing test with the 498A key in its (J-OP) position, and the (R-) (TCO) Lamp should light with this key in its (J-NO) or (H-OP) position. Remove the cord from the (8 pty) jack of the test line before making the Pre-Trip Test.

5.205 Non-Trip Test

NOTE 1: When Fig. A is used if superimposed ringing current is used the superimposed test key (SUP/TST) must be operated during the test. All non-trip tests should be made during the ringing interval only. When Fig. B is used the tables of Note 108 or 113 should be referred to for the conditions for non-trip test for the particular ringing voltage and loop conditions required. Refer to Note 108 when ZJ option is used in Fig. B, and to Note 113 when ZK option is used. When Fig. C is used the table of Note 109 should be referred to. When Fig. D is used the table of Note 110 should be referred to.

The testman should listen for the beginning of a ringing interval and immediately operate the stepping key (STP) to advance the rotary switch. When testing local connectors position 3 is automatically passed by so the rotary switch will advance to terminal 4. The (IDLE/L) lamp goes out and the (PRE/TRIP) lamp lights. Relay (PT) will operate cutting off the (RS) relay and applying a series of non-inductive resistances across the tip and ring of the test line to provide a non-trip test to the connector. The stepping key (STP) should be reoperated immediately to advance the rotary switch to terminal 5 before the silent interval. The (PRE/TRIP) lamp will go out and the (RING) lamp will light. Relay (RS) operates on the remainder of the ringing interval and subsequent ringing intervals lighting the (RS) lamp indicating that the connector tripping relay met the non-operate condition imposed by the non-trip test. Ringing induction will be continued in the receiver.

NOTE: When testing connectors with the trip relay in the ground return lead, "Z1" option provides a lower pre-trip value, as resistance (AG) shunts the trip relay. When the trip relay is in the ringing lead resistance (AG) is shunted by direct ground in the connector. When testing TPL connectors,

the (RT) key connects resistance (AG) to the ring side of the pre-trip resistance network when ringing is received over the tip, to keep the (AG) resistance on the same side of the line as the trip relay of the connector.

5.206 Tripping Test

NOTE: With Fig. A or D, when testing connectors having AC-DC ringing and 10-party connectors the trip test shall be made during the silent interval only. With Fig. A, when testing connectors having superimposed ringing, except 10-party connectors, the trip test shall be made during the ringing interval only. When Fig. B is used the tables of Note 108 or 113 should be referred to for the conditions for trip test which apply to the particular ringing voltage and loop conditions. When Fig. C is used the table of Note 109 should be referred to. When Fig. D is used the table of Note 110 should be referred to.

The testman will operate the stepping key (STP) at the proper interval to advance the rotary switch to terminal 6 to make the tripping test. The ringing lamp (RING) goes out, also lamp (RS) ceases flashing and the tone trip lamp (T/TRIP) lights.

Relay (TR) operates in position 6 and remains operated through position 7 when "W" option is used, and also through position 8. Relay (TR) opens the circuit of the (RS) relay and applies a series of non-inductive resistances across the tip and ring to provide a circuit for operating the tripping relay of the connector. The operation of the tripping relay removes ringing current and substitutes a battery and ground feed through the (D) relay of the connector.

5.207 Test of Talking Circuit

Following tripping, the (D) relay of the connector operates through the tripping resistances and reverses the battery feed to the calling side of the connector, except that when the key of "F" option is set at "1900" the (D) relay may not operate. In this case the (P) lamp will light, but this is not necessarily an indication that the (D) relay did not operate See Note of 5.211. Included in the loop circuit on the calling side of the connector is reversing relay (RE) in series with a retardation coil. Relay (RE) immediately recognizes the reversed current and operates. Relay (RE) operated in turn operates relay (TS), which locks under control of relay (HC) and switches the test line from the tripping resistance to a circuit through polarized relay (RT) and a winding of the induction coil. A local circuit is closed to start the buzzer operating. The buzzer induces a tone which trhough the induction coil is applied to the test line. If relay D did not operate , on the Trip Test, no tone will be heard. If the 1900 ohm trip test was used, momentarily restore the 1900 key to its non-operated position. Relay D should operate on the 1600 ohm trip resistance. This tone can be heard in the receiver of the test set through the talking circuit of the connector. A material reduction in the tone indicates an open talking condenser in the connector or other transmission fault.

NOTE: It is important that the trip relay test be made only in the ringing or silent interval specified in the Note of 5.206. Satisfactory operation of the trip relay is indicated as follows.

a) Tripping in silent interval - 552E Key in normal or 1200 position - Transmission tone should be heard as soon as the T-TRIP lamp lights.

b) Tripping in silent interval - 552E Key in 1900 position - as above if D relay of connector operates - otherwise, ringing induction should stop when T-TRIP lamp lights, and should not be heard again.

c) Tripping in Ringing interval - Ringing induction should stop and transmission tone should be heard as soon as the (T-TRIP) lights.

In superimposed offices under trip conditions where 900ω test is applied, the trip resistance is too low to adequately test the (D) relay of the connector to insure its operation on maximum loop. Where this condition exists an occasional test should be made with a trip value of 1100ω in order to apply a more severe test for operating the (D) relay so as to insure its operation on maximum loop. This test should be made when the silent interval battery is near its maximum in order to insure tripping. Under the above conditions the 1100ω trip condition is applied in Fig. A or B by restoring the (Supt. Test) key to normal, and in Fig. C by operating the (TST) key.

5.208 Reverse Battery Test

Should the battery and ground feed from the (D) relay of the connector be reversed due to reversed wiper cord or similar reversal in wiring the (RW) relay in the test set will operate and light the reverse lamp (REV/C) indicating the trouble.

5.209 Noisy Cord Test or Supv. 1 Test

5.2091 Noise Test ("W" Option)

The testman will operate the stepping key (STP) to advance the rotary switch to position 7 where a test for noisy talking circuit can be made. The (T/TRIP) lamp goes out and the (T/CO) lamp lights. The buzzer circuit is opened removing the tone from the line but otherwise preserving the talking circuit through the connector. The testman can shake the wiper cords of the connector and if the cords are defective it will be indicated by noise in the receiver.

5.2092 Test of Supervisory 1 Permanent Signal Alarm ("T" Option Used)

The testman will operate the stepping key to advance the rotary switch to position 7 to test the permanent signal alarm used with calling party control The (T/TRIP)) lamp is extinguished, the (T/CO) lamp lights, the buzzer circuit is opened and the (TR) relay releases, releasing the (D) relay of the connector. The green (P) lamp should light. (See NOTE under 5.211.)

5.210 Holding Connector by Called Party

The testman operates the stepping key (STP) to advance the rotary switch to position 8. The (T/CO) lamp goes out and the (CLD/HLD) lamp lights. A circuit is closed by the switch to shunt relay (HC) which releases and opens the loop on the calling side of the connedtor. The relay (TS) releases restoring the tripping resistance bridge across the test line which maintains the (D) relay of the connector operated, if the connector is arranged to hold until both parties disconnect. Opening the loop on the calling side of the connector will open the circuit for the (A) relay of the connector which releases the (B) relay and momentarily removes ground from the sleeve. Relays (SC) and (BR) will release and the (GD) lamp will go out momentarily. However, if the (D) relay remains operated ground will be maintained on the sleeve of the test line keeping the (BSY lamp lighted and will supply a ground to the calling sleeve reoperating relay (SC) and again lighting the guard lamp (GD). Relay (BR) will not reoperate.

If the connector is arranged to release under control of the calling party, the connector will release as soon as position 8 is reached by the rotary switch. Lamps (BSY) and (GD) will be extinguished.

5.211 Permanent Signal Test

When the (A) and (B) relays of the connector release with the (D) relay held by the called side, the permanent signal alarm circuit on the connector frame is closed. The (P) lamp should light and remain lighted until the test set is released.

NOTE: Since the (P) lamp is patched to a common alarm circuit it should be noted that it may flash occasionally due to normal operation of other connectors on the frame or may be lighted steadily if a trouble permanent signal occurs on the connector frame.

5.212 Connector Release

When testing connectors arranged to hold until both parties release the release key (RLS) on the test set or the 40 type test set is operated momentarily to test the release of the connector. Relay (RL) operates and locks to a contact of relay (LS). The operation of relay (RL) opens the tip and ring bridge on the called side of the connector causing the connector to release. Relay (RL) operated also steps the rotary switch from positon 8 and it returns to normal automatically. Lamps (CLD/HLD) and (P) go out, also lamps (BSY) and (GD) go out when the connector has released. The removal of ground from the sleeve will release relay (SC). Relays (SB) and (LS) will release which will release relay (RL), provided the (RLS) key is released and both the connector and test set are normal. When testing connectors arranged to release under control of the calling party, the connector is released in position 8 of the rotary switch and the operation of the (RLS) key will restore the test set to normal and extinguish all lamps. If tests are to be repeated on the same connector, the stepping key (STP) should be operated as soon as possible to advance the rotary switch to position 1 in order to make the connector busy and prevent its seizure for regular traffic. If repeat tests are not made, the test cord should be shifted to the next connector to be tested before the (STP) key is operated in order to make the preliminary

busy test of the connector as previously described. When testing the local side of combination connectors provision is made when releasing after hold test to open the sleeve so as to provide service conditions for the release of the (K) relay of the connector.

5.213 Non-Reversing Connectors

The test of a non-reversing connector is identical with that described for reversing connectors except for the additional requirement of operating the non-reversing key (NON/REV) at a certain stage of the test. After the trip test is made with the (T/TRIP) lamp lighted, a click will be heard in the receiver if tripping occurs during the silent interval or ringing induction will cease if tripped during the ringing interval. After a short interval the testman should momentarily operate the non-locking key (NON/REV) in order to proceed with the test of the talking circuit. The operation of the (NON/REV) key operates the (TS) relay which is operated automatically by the operation of relay (RE) when testing reversing connectors. The slight pause before operating the (NON/REV) key is to listen for the tone indicating a reversal of battery which would be a trouble condition for a non-reversing connector.

5.214 Level Hunting Connectors

The test line for level hunting connectors is usually 91 but may be the first terminal in any level as assigned. Where the entire bank is assigned as a single trunk group the test number will be 11. To reach these test lines the connector should be stepped by means of the dial in the test set or the 40 type test set using the proper test digit for each switch as determined by the cross-connection. The level hunting key (LH) is operated before dialing, opening the sleeve of the test line so it will test busy to other connectors. When making a busy line test the 240A plug, Fig. 7, should be inserted in the sleeve cut-off jack of the connector. Turning either dial off normal operates relay (ED) which in turn operates relay (LH). Relay (PL) also will operate relay (LH) if the pulsing test set is used. Relay (LH) locks under control of relay (RL) and closes the sleeve of the test line to relay (S). The busy indication for this test will be the busy back tone in the receiver as the (BSY) lamp will be lighted by a local circuit. On other tests the 240A plug is removed and the idle line tests made as previously described. If the pulsing test set is used, the (PLS) key is operated in the usual way and the recording switch is observed for ability to reach the ninth terminal. This test cannot be made on connectors arranged to hunt over a group of 100 trunks since in this case the recording switch does not follow pulsing.

5.215 10-Party Terminal Per Line Connectors

When making tests of 10-party terminal per line connectors it is necessary to use the dial to set up the various ringing codes. The pulsing test set can be used if desired when ringing code "9" is required.

The (RT) or (RR) key is operated when the ringing code dialed corresponds to ringing on the tip or ring side of the line respectively. These keys connect the (RS) relay to ground on the proper side of the line to check the ringing during the ringing test.

With Fig. C or D, or Fig. B with ZK option the keys of the test set given in Table in Note 109, 110, or 113 respectively should be operated at the beginning of tests on this class of connectors to provide proper resistance values for the non-trip and trip tests. With Figs. A and B with ZJ option (10-P/TPL) key should be operated and if superimposed ringing is used the (SUP/TST) key should also be operated.

5.216 8-Party Terminal Per Station Connectors

These connectors with Fig. C, D, or B with ZK option are tested the same as other connectors with proper keys operated as given in Note 109, 110 or 113. With figures A and B with ZT option the (SUP/TST) key should be operated since these connectors use superimposed ringing.

With "ZC" option, the various ringing conditions are tested by connecting to the subset associated with the connector test line as described for that circuit. This test is made after dialing the connector to the test line and while the (IDLE/L) lamp is lighted.

When option "ZD" is provided, the 498A key controls a two step relay in the connector test line circuit, which in turn connects the proper resistances for tests of the connector (H) and (J) relays. Positive ringing will cause the connector test line circuit to connect ground to the tip of the (8 PTY) jack and light the (R+) lamp while negative ringing current will cause ground to be

applied to sleeve of the (8 PTY) jack and light the (R-) lamp.

NOTE: In some connectors, the relays which control ringing may have designations other than (H) or (J). By relay (H) is meant the relay which responds to the ringing code, while relay (J) designates the marginal relay.

5.217 10-Party Terminal Per Station Connectors

When testing these connectors in the usual manner the 10-party key (10-P/TPS) is operated during the tests to provide proper resistance value for the sleeve circuit. With Fig. C, D or B with ZK option keys to be operated are shown in Notes 109, 110 or 113. With Figs. A and B with ZJ option the (10-P/TPS) key also sets up the proper resistance combination for the non-trip and tripping conditions and if superimposed ringing is used on this class of connector both the (10-P/TPS) and the (SUP/TST) keys must be operated.

5.218 Reverting Call Test of 10-Party Terminal Per Station Connector

After connection is made to the connector and the sleeve ground operates the (SC) relay lighting the (GD) lamp, the (SLB) key is operated momentarily. This operates the (RC) relay which locks to the sleeve and connects the outgoing and incoming sleeve circuits together. The (BSY) lamp lights. The rotary switch should be advanced by the stepping key (STP) until the (RING) progress lamp is lighted. The code of the test line is dialed as described for other connectors. Busy tone should be heard in the receiver. The (OLP) key is then operated to release the calling end of the connector by opening the loop and should be left operated. The connector will remove ground momentarily from the calling sleeve which releases the (RC) and (SC) relays. The guard lamp (GD) goes out and the ringing signal lamp (RS) should flash intermittently. The (RT) key is operated transferring one side of the ringing relay from the ring side of the test line to ground. A short flash of the (RS) lamp should occur at regular intervals. The rotary switch is then advanced to the tripping position to trip the ringing and the connector is then restored to normal in the usual manner. The (OLP) key must be restored before starting next test.

5.3 Test of Toll Connector or Toll Side of Combination Connector

5.301 Preliminary Test

When a toll connector is patched to the test set, the toll class key (TOLL) should be operated and left operated while testing toll connectors. A preliminary busy test is automatically made on the sleeve for ground. If the toll connector should be busy, the sleeve is grounded and the (SC) relay will operate lighting the guard lamp (GD) which prevents the operation of relay (HC) to close the tip and ring loop thereby preventing interference with the busy connection. If the (GD) lamp does not light, it indicates an idle connector and the stepping key (STP) should be operated momentarily as soon as possible in order to make the connector busy to regular incoming calls. The rotary switch steps to position 1 which closes ground from a back contact of relay (SC) to operate and lock relay (HC). This relay closes the loop to the toll connector, also closes ground to the sleeve to make it busy. This ground on the sleeve operates relay (SC) which lights the guard lamp (GD) but relay (BR) does not operate. The connector returns ground on the "C" lead which operates and locks relay (DR) which in turn lights the (C) lamp. The connector is now in condition to be dialed and the (BSY/L) lamp lighted indicates the busy line test will be made first.

5.302 Pulsing Test With Leak Condition

Relay (SL) operates in position 1 and applies the busy condition to the test line. Pulsing is done by the pulsing test set connected and operated as described for local connectors. The setting of keys on the pulsing test set will provide the desired leak condition for pulsing toll connectors. Either hand dial may be used to step the connector if desired. If the connector steps properly, it will stop on terminal 99 after the second series of pulses. This terminal is wired to the connector test line which is connected to the test set through jacks (3) and (4).

5.303 Busy Line Test

The toll connector in making the busy test will operate relay (SB) which locks and operates relay (LS) which lights the busy lamp (BSY) and closes a circuit but does not operate relay (CC). Relay (LS) opens the energizing circuit for relay (DR) but the latter remains locked to the "C" lead through a back contact of relay (CC). When the connector completes the busy test it removes ground from the "C" lead releasing relay (DR). Lamp (C) goes out, lamps (GD), (BSY), and (BSY/L) remain lighted and a circuit is closed to operate relay (CC). The operation of relay (CC) opens the dialing loop, connects battery feed relay (CT) to the tip and ring of the connector and

bridges the receiver circuit in series with a condenser across the tip and ring. Ground is applied to the "C" lead through a back contact of relay (DR). The connector will return interrupted ground over the ring which will cause relay (CT) to intermittently flash the (CT) lamp as a busy indication. The connector is released by operating the release key (RLS) momentarily. Relay (RL) operates and locks to ground through a back contact of relay (LS) and make contact of relay (CC) and opens the circuit for relay (HC). Relay (HC) releasing removes ground from the sleeve releasing the connector. Relay (SC) also releases and the (GD) lamp goes out. Relays (SB) and (LS) release extinguishing the (BSY) lamp and releasing relay (CC). Relay (CC) releasing unlocks relay (RL) which releases provided the (RLS) key is restored. Relay (RL) releasing closes the circuit for the reoperation of relay (HC) which again closes ground to the sleeve to make the connector busy to regular service and lights the (GD) lamp. The (C) lamp will light and the connector is again in condition for pulsing.

5.304 Pulsing Test With Resistance Loop Condition

The stepping key (STP) is operated to advance the rotary switch to terminal 2. The (BSY/L) lamp goes out and the (IDLE/L) lamp lights. Lamp (C) will remain lighted due to relay (DR) being locked to the "C" lead. The connector is again stepped to the test line by means of the pulsing test set through the operation of key (PLS). The required loop resistance should be obtained by operating the necessary resistance keys on the pulsing test set. Either hand dial may be used for stepping the connector if desired, in which case a 300 ohm resistance is provided in the loop. Relay (SL) released, applied a non-busy condition to the sleeve of the test line. When the connector connects to the test line relay (S) operates in turn operating relay (LS) which lights the (BSY) lamp. Removal of ground from the "C" lead will release relay (DR) which closes a circuit to operate relay (CC) which connects relay (CT) to the tip and ring of the connector. Ground is connected to the "C" lead through a back contact of relay (DR) to prevent immediate ringing. Lamp (C) goes out.

5.305 Delayed Ringing Test

The connector is associated with the test line but ringing is delayed because of the ground connected to the "C" lead. The testman should observe that the (RS) lamp does not flash or that the ringing signal is not heard in the receiver. To start ringing the stepping key (STP) is operated to advance the rotary switch to position 3. Lamp (IDLE/L) goes out and lamp (DEL/R) is lighted. Relay (DR) operates but relay (CC) locks operated through contacts of relay (LS). Ground is removed from the "C" lead which releases the (B) relay in the connector and starts ringing. Relay (DR) remains operated while the switch is in position 3 but lamp (C) is not lighted. The ringing on the test line will be indicated by the intermittent flashing of lamp (RS) and ringing tone will be heard in the receiver in synchronism with the flashing lamp.

5.306 Non-Trip Test

NOTE: When Fig. A is used, if superimposed ringing current is used, the superimposed test key (SUP/TST) must be operated during the test. All non-trip tests should be made during the ringing interval only. When Fig. B with ZJ option is used the tables of Note 108 should be referred to for the conditions for non-trip test for the particular ringing voltage and loop conditions required. When Fig. C or D or Fig. B with ZK option is used Note 109, 110 or 113 respectively should be referred to.

The testman should listen for the beginning of a ringing interval and immediately operate the stepping key (STP) to advance the rotary switch one step. The (DEL/R) lamp goes out and the (PRE/TRIP) lamp lights. Relay (PT) will operate cutting off the (RS) relay and applying a series of non-inductive resistances across the tip and ring of the test line to provide a non-trip test of the connector. The stepping key (STP) should be reoperated immediately to advance the rotary switch to the next position before the silent interval. The (PRE/TRIP) lamp goes out and the (RING) lamp lights. Relay (RS) operates on the remainder of the ringing interval and on subsequent ringing intervals flashing the (RS) lamp which indicates that the connector meets the non-trip test satisfactorily.

5.307 Tripping Test

NOTE: With Fig. A, when testing connectors having AC-DC ringing and 10-party connectors, the trip test shall be made during the silent interval only. With Fig. A, when testing connectors having superimposed ringing, except 10-party connectors, the trip

test shall be made during the ringing interval only. When Fig. B with ZJ option is used the tables of Note 108 should be referred to for the conditions for trip test which apply to the particular ringing voltage and loop conditions. When Fig. C, D or B with ZK option is used, Note 109, 110 or 113 respectively shall be referred to.

The testman will operate the stepping key (STP) to advance the rotary switch to position 6 to make the tripping test. The (RING) lamp goes out, the (RS) lamp ceases flashing and the (T/TRIP) lamp lights. Relay (TR) operates in position 6 and remains operated through positions 7 and 8 of the rotary switch. Relay (TR) opens the circuit of the (RS) relay and connects a series of non-inductive resistances across the tip and ring to provide a circuit for operating the tripping relay of the connector. The operation of the tripping relay removes ringing current and cuts through the tip and ring of the calling side directly to the tip and ring of the called side.

5.308 Test of Talking Circuit

Following tripping of the ringing the toll connector is cut straight through on tip and ring. The battery feed relay (CT) with the condenser and receiver is bridged across the calling tip and ring. The test line is bridged by the tripping resistances. Relay (CT) should operate in this circuit and light the cut-through lamp (CT). Ground through the make contact of relay (CT) closes a circuit to operate relay (TS) which locks operated. Relay (TS) operated substitutes relay (RW) and a winding of the tone induction coil for the tripping resistances across the test line. Relay (CT) remains operated and relay (RW) operates lighting lamp (REV/C). Relay (TS) closes a circuit to operate the buzzer which induces a tone on the test line tip and ring. This tone should be plainly heard in the receiver indicating a clear talking circuit through the connector. The lighting of lamp (REV/C) when testing toll connectors indicates continuity of the tip and ring through the connector. Relay (RW) operates because the battery feed from relay (CT) in the test set is reversed from that of the (D) relay in local connectors. Failure of the lamp to light indicates an open or reversal.

5.309 Noise Test ("W" Option Only)

The testman will operate the stepping kev (STP) to advance the rotary switch to position 7 when the test for noisy talking circuit is made. The (T/TRIP) lamp goes out and the (T/CO) lamp lights. The busser circuit is opened removing tone from the test line. The talking circuit is maintained through the connector and shaking the wiper cords will indicate faults by noise in the receiver. The (CT) lamp remains steadily lighted.

5.310 Connector Release

As no hold test is made of toll connectors, the release key (RLS) on the 40 type test set or on the test set is operated momentarily in order to release the connector and restore the test set to normal. Relay (RL) operates and locks to make contact of relay (CC) and opens the "C" lead. Relay (HC) releases and removes ground from the sleeve of the connector causing it to release. The (T/CO), (BSY) and (CT) lamps go out. Relay (SC) releases and lamp (GD) goes out. Relay (RL) grounds the rotary switch magnet through an arc and its interrupter contact stepping the rotary switch through positions 7 and 8 and it returns to normal automatically. Relays (S), (LS) and (CC) release in order and relay (RL) releases if the (RLS) key is restored. If the stepping key should be operated in position 7, the switch will return to normal where the release key should be operated to release the connector as described above.

5.311 Test of Toll Connectors Arranged for Level Hunting

Level hunting toll connectors may be tested in a manner similar to the test for level hunting local connectors. The toll key (TOLL) and the level hunting key (LH) should be operated. The test line is usually 91 but may be the first terminal in any level as assigned. Where the entire bank is assigned as a single trunk group the test number will be 11. When making a busy line test the 240A plug, Fig. 7, should be inserted in the sleeve cut-off jack of the connector. To reach the test line the code is dialed by either dial or the pulsing test set may be used. Turning the dial off normal operates relay (ED) or the operation of the (PLS) key operates relay (PL) which in turn operates relay (LH). Relay (LH) locks under control of relay (RL) and closes a local circuit to operate relay (SB). On the busy line test the

sleeve is opened by the (LH) key to prevent interference with other hunting connectors. After dialing is complete, the connector will level hunt and go to the tenth terminal in the last level of the test line group. The (BSY) lamp lights in a local circuit from the operation of relay (LS). Relay (CC) will operate and close through the busy back interruptions to relay (CT) which will provide a busy flash on lamp (CT). On the idle line test the 240A plug is removed from the cut-off jack and the test line number is again dialed. The connector connects to the test line and the test procedure is the same as for a regular toll connector. If it is desired to apply a pulsing test to the level hunting connector, the (PLS) key is operated in the usual way and the recording switch is observed for ability to reach the ninth terminal. This test cannot be made on connector groups of 100 trunks.

5.312 10-Party Terminal Per Line Toll Connectors

When making tests of 10-party terminal per line toll connectors the dial is used to set up the desired ringing code. The pulsing test set can be used if desired when the ringing code "9" is required.

With Fig. C, D, or B with ZK option the toll key and proper keys given in Notes 109, 110 and 113 should first be operated. With Figs. A and B, with ZJ option the (10-P/PTL) key should be operated in addition to the (TOLL) key at the beginning of the test to provide the proper resistance values for the non-trip and trip tests. If superimposed ringing is used, the (SUP/TST) key should be operated also.

The (RT) or (RR) key is operated when the ringing code dialed corresponds to ringing on the tip or ring side of the line respectively. These keys connect the (RS) relay to ground on the proper side of the line to check the ringing during the ringing test.

5.313 Toll Connectors for 8-Party Terminal Per Station Lines

These connectors with Fig. C, D, or B with ZK option are tested the same as other connectors with proper keys operated as given in Notes 109, 110 or 113. With Figs. A and B, with ZJ option the (SUP/TST) key should be operated, since these connectors use superimposed ringing.

These connectors are tested the same as other toll connectors except for the ringing condition. The various ringing conditions are tested by connecting to the subsets associated with the test line as described for that circuit or by lighting the (R+) or (R-) lamp as in tests of local 8-party connector. This test is made after dialing the connector to the test line and while the (DEL/R) lamp is lighted.

5.314 Toll Connectors for 10-Party Terminal Per Station Lines

These connectors with Fig. C, D, or B with ZK option are tested in the usual manner for toll connectors with proper keys operated as given in Notes 109, 110 or 112.

With Figs. A, B and D, the 10-party key (10-P/TPS) is operated during the test and if superimposed ringing is used to (SUP/TST) key is also operated to provide the proper tripping resistance.

5.4 Rapid Operate Test

5.41 Provision is made for making what is called a rapid operate test of local connectors or the local side of combination connectors. The patching of the test set is the same as for a regular test. With the test set normal the (ROT) key is operated. This removes ground from the armature spring of the (PS) relay to prevent the rotary switch being stepped off normal. It also connects ground to operate relay (TR), supplies a ground to operate the buzzer and shorts the loop dialing resistance. In addition the (ROT) key closes ground from relay (SC) to contacts of relays (ED) and (PL). The code of the test line is dialed in the usual way either by the pulsing test set or hand dial. When relay (PL) or (ED) operates as a result of the operation of the (PLS) key or of turning the dial off normal a circuit is closed to operate relay (HC) which in turn closes a bridge across tip and ring to operate the (A) and (B) relays of the connector. Ground will be returned on the sleeve operating relay (SC) and lighting the guard lamp (GD). When the test line is seized the (S) relay operates operating relay (LS) and lighting the (BSY) lamp. The (TR) relay being operated the tripping resistance is across the tip and ring of the test line so that ringing is immediately tripped and reversed battery operates relay (RE) which then operates relay (TS) connecting the induction coil and relay (RW) across the line. Tone should be heard over the talking circuit of the connector. Where a 1900 ohm resistance is used, if transmission is not heard at this stage of the test

restore the 1900 key to its non-operated position. On non-reversing connectors the (NON/REV) key is operated to operate relay (TS) and send back the tone. The (RLS) key on the test set or the 40A test set is operated to release the connector and test set. Relay (RL) operates opening the test line and releasing relay (HC) which opens the dialing loop and releases the connector following which relays (SC) and (RL) release. The (BSY) and (GD) lamps go out and the circuit is normal. The test cord may then be connected to another connector, and the test repeated.

5.42 If it is desired to test the called-hold feature of local connectors during the rapid operate test this may be accomplished by removing the patching cord to the test jack on the calling side of the connector before operating the release key (RLS). The (GD) lamp will go out but the (BSY) lamp should remain lighted. If the (P) jack is patched, the (P) lamp will light. The (RLS) key is then operated to release the connector and restore the test set to normal. The (BSY) and (P) lamps go out.

5.5 Tripping Relay Adjustment

5.51 In offices using superimposed ringing current where the tripping relay is adjusted on ringing current, provision is made for applying test and readjust values to the tripping relay for both non-trip and trip conditions.

With Fig. C or B with ZK option the test values or readjust values are applied with keys operated as stated in notes 109 and 113, respectively.

With Figs. A and B with ZJ option the test values are applied by the operation of the (SUP/TST) key and if the readjust value is required the (SUP/ADJ) key is operated. This adjustment does not apply to 10-party connectors using superimposed current.

5.6 The Varistor

5.61 The resistance of the varistor becomes less as the voltage across its terminals is increased. This characteristic of the varistor when placed in multiple with the receiver reduces the volume of tone to the receiver to a greater extent when the volume is loud than when the volume is normal. In this way the intensity of clicks and loud volume are reduced without appreciably affecting the volume of normal transmission.

5.7 Punchings

5.71 The ring-trip relay test network of Fig. C is connected to 4 punchings and by use of straps A or straps B the test set may readily be changed to work in either 900 or 1000 ohm range offices respectively. "F" option provides added resistance and a 479 type key for use in 1400 or 1500 ohm range offices.

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