

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

CHANGES

B. CHANGES IN APPARATUS

B.1	<u>Superseded</u>	<u>Superseded By</u>
	7F-42 Buzzer	7F-49 Buzzer

D. DESCRIPTION OF CHANGES

- D.1 The Mfr Disc. 7F-42 buzzer is superseded by the 7F-49 buzzer.
- D.2 Circuit Note 106 is revised to reflect this change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 6261 -- PJH-AFB

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 7F Buzzer 7F-42 Buzzer

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The Mfr. Disc. 7F buzzer is superseded
 by the 7F-42 buzzer.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5241-ADS-AFB-RI

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

CHANGES	TABLE OF CONTENTS	PAGE
	DESCRIPTION OF OPERATION	
B. CHANGES IN APPARATUS	1. PURPOSE OF CIRCUIT	2
B.1 Added	2. WORKING LIMITS	2
1 - 5P3B Cord, Fig. 10	3. FUNCTIONS	2
1 - 5P5A Cord, Fig. 11	4. CONNECTING CIRCUITS	2
2 - 238 Type Jacks, H Option	5. GENERAL	3
1 - 552H Key (LO-UP), H Option	5.1 Patching Test Set	3
1 - 552A Key (MI), H Option	5.2 Test of Local Connector or Local Side of Combination Connector	3
D. DESCRIPTION OF CIRCUIT CHANGES	5.201 Pulsing Test with Leak Condition	3
D.1 A new cord added in Fig. 10 provides access to lines in the upper or lower group of lines through a 200 point local or local side of a combination connector.	5.202 Busy Line Test	4
D.2 A new cord added in Fig. 11 provides access to lines in the upper or lower group of lines through the toll side of a combination 200 point connector.	5.203 Release from Busy Line	5
D.3 Jack RU and key LO-UP, part of H op- tion are added to provide a means of connecting to and directing the 200 point connector to the upper or lower group of lines.	5.204 Pulsing Test with Resistance Loop Condition and When Testing 200 Point Connectors Test for Machine Intercept	5
D.4 Jack (4-200), H option, is added for connecting the test set to the test line of the 200 point connectors.	5.205 Pretrip Test	5
D.5 The MI key, H option, is added for use with 200 point connectors.	5.206 Tripping Test	6
D.6 Option H shows wiring and apparatus for use in offices equipped with 100 and 200 point connectors. Option J shows wiring and apparatus for use in offices equipped only with 100 point connectors.	5.207 (D) Relay and Talking Circuit Test	6
D.7 Circuit Note 109, Feature or Option table, is added to show use of Op- tions H and J.	5.208 Reverse Battery Test	6
D.8 Reference to Options H and J and Figs. 10 and 11 is added to Note 106 and Options Used table.	5.209 Test of Supervisory 1 Permanent Signal Alarm	6
All other headings under Changes, no change.	5.210 Holding Connector by Called Party	6
	5.211 Permanent Signal Test	7
	5.212 Connector Release	7
	5.213 Nonreversing Connectors	7
	5.214 Level Hunting Connectors	7
	5.215 10-Party Terminal Per Line Connectors	7
	5.216 8-Party Terminal Per Station Connectors	8
	5.217 10-Party Terminal Per Station Connectors	8
	5.218 Reverting Call Test of 10-Party Terminal Per Station Connector	8
	5.3 Test of Toll Connector or Toll Side of Combination Connector	8
	5.301 Preliminary Test	8
	5.302 Pulsing Test With Leak Con- dition	8
	5.303 Busy Line Test	9
	5.304 Pulsing Test With Resistance Loop Condition	9

TABLE OF CONTENTS	PAGE	
5.305 Delayed Ringing Test	9	3.13 Provides resistances and keys for applying Trip and Pretrip tests to tripping relays, and operate tests to connector supervisory relays in offices having station loop ranges of 1000, 1115, 1400, and 1500 ohms.
5.306 Pretrip Test	9	
5.307 Tripping Test	9	3.14 Provides resistances and keys for re-adjusting tripping relays requiring adjustment on ac, and for adjusting relays in 1400 and 1500 ohm offices which are within readjust current flow requirements but do not pass the trip or pretrip resistance test.
5.308 Test of Talking Circuit	10	
5.309 Connector Release	10	3.15 Provides key (10-P/TPS) to apply different sleeve resistance when testing 10-party T.P.S. connectors.
5.310 Test of Toll Connectors Arranged for Level Hunting	10	3.16 Provides for testing the "C" lead of toll connectors.
5.311 10-Party Terminal Per Line Toll Connectors	10	3.17 Provides lamp signals to indicate progress of test, type of ringing received on tests of 8-party connectors, also failure to meet test condition.
5.312 Toll Connectors for 8-Party Terminal Per Station Lines	10	3.18 Provides control of ringing test resistances in the test line, used for testing the ringing control relays of 8-party semiselective connectors.
5.313 Toll Connectors for 10-Party Terminal Per Station Lines	10	3.19 Provides for remote control of complete testing of local and toll connectors, and 8-party T.P.S. connectors.
5.4 Rapid Operate Test	11	3.20 Arranged for monitoring on off-normal switches.
5.5 Tripping Relay Adjustment	11	3.21 Arranged for testing the upper or lower group of lines associated with 200 point connectors.
5.6 The Varistor	11	3.22 Arranged to test connector F lead.
1. PURPOSE OF CIRCUIT		3.23 Arranged to test that connector calls in machine intercept trunk.
1.1 This circuit is designed to test connectors in step by step offices.		4. CONNECTING CIRCUITS
2. WORKING LIMITS		When this circuit is listed on a key-sheet, the connecting information thereon is to be followed.
2.1 None.		4.01 Local Nonhunting Connector - SD-30201-01*.
3. FUNCTIONS		4.02 Local Rotary Hunting Connector - SD-30215-01*.
3.01 Arranged to test pulsing condition of connector.		4.03 Comb. Connector - SD-30228-01*.
3.02 Arranged to test talking condition of connector.		4.04 Toll Nonhunting Connector - SD-31171-01*.
3.03 Arranged to test ringing condition of connector.		4.05 Toll Rotary Hunting Connector - SD-31114-01*.
3.04 Arranged to test release condition of connector.		4.06 Local Level Hunting Connector - SD-31188-01*.
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 the 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 nonreversing connectors.		

- 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*.
- 4.20 200 Point Connectors.
- 4.201 Local Connector, 10-Party - SD-33005-01.
- 4.202 Local Connector, 10-Party Rotary Hunting - SD-33006-01.
- 4.203 Local Connector, 8-Party - SD-33007-01.
- 4.204 Local Connector, 8-Party Rotary Hunting - SD-33008-01.
- 4.205 Combination Connector, 10-Party - SD-33009-01.
- 4.206 Combination Connector, 8-Party - SD-33010-01.
- 4.207 Switch Tbl. Alm. Ckt., Connector Shelf - SD-32045-01

*Typical circuit.

DESCRIPTION OF OPERATION

5. GENERAL

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 jack (3) and jack (4-100) for 100 point connectors in offices equipped with 100 point connectors only or jack (4-200), H option, for 100 and 200 point connectors in offices equipped with both types of connectors to the corresponding jacks of the connector test line (jack 4-100 corresponds to jack 4) and note that the test set is normal as indicated by all lamps out. Connect jack (P) to jack (PS) 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 the connector test line is arranged to return visual Ringing Signals, patch jack (8-PTY) to the (8P) jack of the connector test line and operate the (J-NO) key to the position required for the tests to be made. In offices equipped with 100 point connectors only, when testing connectors, 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). In offices equipped with both 100 point and 200 point connectors, when testing 200 point connectors, the red shell of connector patching cord Fig. 10 is connected to jack (T) and the black shell is connected to jack (RU), H option, for local connectors and local test of combination connectors. For the toll test of combination connectors, the 289B plug of Fig. 11 is connected to jack (TT) and the 310 plug is connected to jack (RU), H option. If it is desired to test upper set of banks of 200 point connector operate (LO-UP) key to "UP" position. 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) and (B) condenser and the U and V resistances, 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) which would 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 closes 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 resistances 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, 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

When testing 100 point connectors, the connector test line associated with the test set through jacks (3) and (4-100) is connected to terminal 99 for nonhunting 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. When testing 200 point connectors, the connector test line associated with the test set through jacks (3) and (4-200) is connected to terminal 99 of the upper group of lines for either rotary hunting or nonhunting connectors and to terminal 99 of the lower group of lines for nonhunting connectors and to terminal 90 of the lower group of lines for rotary hunting connectors. The test of the rotary hunting feature is made on the lower group only for connectors arranged for rotary hunting. 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 (4-100) or with H option to the tip of jack (4-200) for the test line sleeve of the lower bank of the 200 point connector and to the sleeve of jack (4-200) for the sleeve of the upper bank. 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 and with H option, busy flash over the F lead causes the CT lamp to flash.

When a busy line test is being made on a 200 point connector with the (LO-UP) key normal and the (BSY) lamp fails to light at the completion of dialing the test line of the lower bank, the switch position should be observed. If the brushes are resting on the desired terminals, either the connector failed to ground the sleeve of the called line or the switch was directed to the upper bank. If the call is directed to intercept, the trouble may be in the sleeve lead. If the call is not directed to intercept, for nonhunting connectors the (LO-UP) key should be operated immediately to transfer the tip and ring to the tip and ring of the upper bank before the (B) relay in the connector releases. If the (BSY) lamp lights after this operation, the connector was directed to the wrong group of lines. If testing a rotary hunting connector and the call is not directed to intercept, the connectors should be released and the test line number dialed again. If the busy test is made with key (LO-UP) operated and the (BSY) lamp fails to light, release key (LO-UP) if the call is not directed to intercept.

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 (LS). 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 and When Testing 200 Point Connectors Test for Machine Intercept

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 with J option or 1325 ohms with H option 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 nand 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. If the call is directed to machine intercept during the idle line test, it is an indication that either the connector cut-thru relay failed to operate fast enough to prevent the connector switching relay which transfers the call to machine intercept from operating or the switching relay is operating too fast. 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. When testing 200 point connectors, if the (BSY) lamp fails to light, it may be due to the connector being directed to the wrong group of 100 lines or a trouble condition in the sleeve lead. 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 $\begin{pmatrix} R+ \\ RS \end{pmatrix}$. In synchronism with the flashing lamp, ringing induction will be heard in the receiver of the test set. If the (8 PTY) jack is patched to the test line for tests of 8-party connectors, the $\begin{pmatrix} R+ \\ RS \end{pmatrix}$ lamp should light during the ringing test with the (J-NO) key in its (J-O) position, and the $\begin{pmatrix} R- \\ TCO \end{pmatrix}$ lamp should light with this key in its (J-NO) or (H-O) position. When testing connectors arranged for use with relay type subsets, remove the cord from the (8 PTY) jack of the test line before making the Pretrip Test.

When testing 200 point connectors, to test that the connector calls in the machine intercept, operate the MI key when the rotary switch is advanced to position 2. With relay SL released and the MI key operated, the sleeve of the test line is open. When the test line number is dialed, the connector, finding an open sleeve, operates a relay to connect to the machine intercept trunk. When the connector is connected to the machine intercept equipment, the recorded message is heard in the receiver connected to the (TEL) jack.

5.205 Pretrip Test

Note: Refer to Note 301 for operation of keys to establish trip and pretrip resistance values

The testman should listen for the beginning of a ringing or silent interval as specified in Note 301 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 is extinguished and the (PRE/TRIP) lamp lights. Relay (PT) will operate cutting off the (RS) relay and applying a series of noninductive resistances across the tip and ring of the test line to provide a pretrip test to the connector. The stepping key (STP) should be reoperated immediately to advance the rotary switch to terminal 5 before the end of the ringing or silent interval. The (PRE/TRIP) lamp will be extinguished and the (RING) lamp will light. Relay (RS) operates and subsequent ringing intervals lighting the $\begin{pmatrix} R+ \\ RS \end{pmatrix}$ lamp indicating that the connector tripping relay met the nonoperate condition imposed by the pretrip test. Ringing induction will be continued in the receiver.

Note: When testing connectors with the trip relay in the ground return lead, the circuit provides a lower pretrip current, 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 pretrip 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

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) is extinguished, also lamp $\begin{matrix} (R+) \\ (RS) \end{matrix}$ ceases flashing and the tone trip lamp (T/TRIP) lights.

Relay (TR) operates in position 6, and also in position 8. Relay (TR) opens the circuit of the (RS) relay and applies a series of noninductive 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 (D) Relay and Talking Circuit Test

When the tripping relay in the connector operates it connects the (D) relay to the tripping resistance. When the tripping resistance is 1600 ohms or less the (D) relay should operate immediately, reversing the battery feeds to the calling side of the connector. (If the (D) relay does not operate, the (P) lamp will light, but this is not necessarily an indication that (D) did not operate. See note of Par. 5.211.) Battery reversal by (D) operates relay (RE) which operates (TS). (TS) locks under control of (HC), and switches the test line from the tripping resistance to a circuit through polar relay (RW) and an induction coil winding. (TS) also starts the buzzer. The buzzer and induction coil put tone on the test line. If the (D) relay does not operate no tone will be heard.

When the trip resistance is 1900 ohms, (D) may or may not operate. If it does not, momentarily reduce the resistance to 1600 ohms by operating the (PLS) key of Fig. 1 or 2, (this operates relay CT which reduces the resistance to 1600 ohms and lights lamp CT).

The tone caused by operation of (D) as heard in the receiver tests the talking circuit of the connector. A material reduction of the tone indicates an open talking condenser or other transmission fault in the connector.

Note: It is important that the trip relay test be made only in the ringing or silent interval specified in the Note 301. Satisfactory operation of the trip relay is indicated as follows.

- (a) Tripping in silent interval - trip resistance 1600 ohms or less - Transmission tone should be heard as soon as the T-TRIP lamp lights.
- (b) Tripping in silent interval - 1900 ohm trip - 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.

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 Test of Supervisory 1 Permanent Signal Alarm

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 (Connectors Arranged for Joint Control Only)

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 connector. 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 is extinguished 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 re-operate.

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 position 8 and it returns to normal automatically. Lamps (CLD/HLD) and (P) are extinguished, also lamps (BSY) and (GD) are extinguished 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 Nonreversing Connectors

All tests on nonreversing connectors are to be made with the (NON REV) key operated. Tests are made as described above, except at the completion of the trip test.

After the trip test is made, with the (T/TRIP) lamp lighted, a click will be heard in the receiver if tripping occurs in the silent interval, or ringing induction will cease if tripped during the ringing interval. The testman should then listen for the absence of tone, indicating that battery is not reversed. When testing 200 point nonreversing connectors, the nonreversal feature is provided only on the upper bank of lines on the ninth level. He should then momentarily operate the (PLS) key in the 40 type test set in order to proceed with the test of the talking circuit.

Operation of the (PLS) key at this time operates the (CT) relay. (CT) operates (TS), and incidentally lights the (CT) lamp. (TS) sets up the tone transmission test as described in Paragraph 5.207.

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 test 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.

5.216 8-Party Terminal Per Station Connectors

When the test line circuit is not arranged for visual indication of ringing signals, 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 the test line circuit is arranged for visual ringing signals, connect the (8 PTY) jack to the (8P) jack of the test line circuit. The (J-NO) 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 $\begin{pmatrix} R+ \\ RS \end{pmatrix}$ lamp while negative ringing current will cause ground to be applied to sleeve of the (8 PTY) jack and light the $\begin{pmatrix} R- \\ TCO \end{pmatrix}$ 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.

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) is extinguished, 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 is extinguished 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 nonbusy 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) is extinguished.

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) is extinguished 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 ring-trip 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 Pretrip Test

Note: Refer to Note 301 for operation of keys to establish trip and pretrip resistance values.

The testman should listen for the beginning of a ringing or silent interval as specified in Note 301 and immediately operate the stepping key (STP) to advance the rotary switch one step. The (DEL/R) lamp is extinguished 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 pretrip test of the connector. The stepping key (STP) should be reoperated immediately to advance the rotary switch to the next position before the end of the ringing or silent interval. The (PRE/TRIP) lamp is extinguished and the (RING) lamp lights. Relay (RS) operates on subsequent ringing intervals flashing the (RS) lamp which indicates that the connector meets the pretrip test satisfactorily.

5.307 Tripping Test

The testman will operate the stepping key (STP) to advance the rotary switch to position 6 to make the tripping test. The (RING) lamp is extinguished, the (RS) lamp ceases flashing and the (T/TRIP) lamp lights. Relay (TR) operates in position 6 and remains operated through position 7 and 8 of the rotary switch. Relay (TR) opens the circuit of the (RS) relay and connects a series of noninductive 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 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 (R-/TCO), (BSY) and (CT) lamps are extinguished. Relay (SC) releases and lamp (GD) is extinguished. 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.

5.310 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.

5.311 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.

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.

5.312 Toll Connectors for 8-Party Terminal Per Station Lines

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 $\begin{matrix} \{R+ \\ \{RS \end{matrix}$ or $\begin{matrix} \{R- \\ \{TCO \end{matrix}$ lamps 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.

5.313 Toll Connectors for 10-Party Terminal Per Station Lines

These connectors are tested in the usual manner for toll connectors. The 10-party key (10-P/TPS) is operated during the test.

5.4 Rapid Operate Test

Note: Refer to Note 301 for operation of keys to establish trip and pretrip resistance values.

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 (and for level hunting connectors the (LH) key also). This removes ground from the armature spring of the (PS) relay to prevent the rotary switch being stepped off normal. It also prepares a path for operation of 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. For 10-party TPL connectors arranged for reverting calls, the ringing digit must be dialed by the test set dial. For 10-party TPL connectors not arranged for reverting calls only two digits are required since the rapid operate test of these connectors does not check the trip relay. 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 relays (SC) and lighting the guard lamp (GD). When the test line is seized the (S) relay operates operating relay (LS) and in turn (TR) 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 momentarily operate the (PLS) key of the test set or remote control unit to reduce the resistance to 1600 ohms. When testing nonreversing connectors the (NON REV) key should be operated throughout the test. Momentary operation of the (PLS) key will then start the tone test. 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 extinguish and the circuit is normal. The test cord may then be connected to another connector, and the test repeated. When testing 200 point connectors, the test line in the lower group may be tested with key (LO-UP) nonoperated or the test line in the upper group may be tested with key (LO-UP) operated to the "UP" position.

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 is extinguished 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 are extinguished.

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 nontrip and trip conditions.

The test values or readjust values are applied with keys operated as stated in Note 301.

5.52 In offices arranged for 1400 and 1500 ohm subscriber loops there is some possibility that a tripping relay may be within its readjust current flow requirements and fail to meet the trip or pretrip resistance test provided by this circuit. For such cases, operation of the (ADJ) key provides readjust resistance values (as shown in Note 301) for trip and pretrip.

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.

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DEPT. 2315-MKD-RCD-BD