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COMMON SYSTEMS
TRANSMISSION TEST LINE OR
TEST TRUNK CIRCUIT
CROSSBAR, MANUAL, PANEL,
STEP-BY-STEP, PBX, OR TOLL OFFICES

CHANGES

D. Description of Changes

D.1 Revised wiring to relays OSA of Fig. B, OSA of Fig. F, and T1 of FS71 to eliminate blowing of G fuse in Fig. 18 by momentary closure of battery to ground through EMB relay contacts.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 4631-ERW-EGS

COMMON SYSTEMS
TRANSMISSION TEST LINE OR
TEST TRUNK CIRCUIT
CROSSBAR, MANUAL, PANEL,
STEP-BY-STEP, PBX, OR TOLL OFFICE

CHANGES

A. Changed and Added Functions

A.1 Provides for timed on-hook supervision from FS79 for making milliwatt and loop-around tests as well as balance termination tests.

A.2 Provides (per option X0) for continuous off-hook supervision from FS79 for all tests in step-by-step PBXs with the transfer feature.

A.3 Provides (per option YU), in FS79, for connection to 60A control unit.

A.4 Provides, in Fig. 54 and FS79, for optional 600- or 900-ohm terminations.

B. Changes in Apparatus

B.1 To prevent the bothersome timed release of the reference trunk during a series of tests using Fig. 2:

(a) Relay LA is made optional Fig. J.

(b) Relays LA-1 and LA-2, an AK44 relay, and two 186A contact protection networks are made optional Fig. K.

(c) The combination of all apparatus in Fig. J and K is made optional Fig. L.

D. Description of Changes

D.1 In Table A, item 117 is added to provide an application that utilizes the new manual test frame (MTF), SD-98587-01 in the toll switching system.

D.2 Note 309 is revised.

D.3 In Table B and Note 104, options H, J, N, and P are rated Mfr Disc.

D.4 In Table B, reference is made to BSP 105-335-503.

D.5 In Notes 101, 102, 104, 207, 318, 319, 320 and Table A, item 301, corrections (applicable to drawing through Issue 19B) are made for clarity and accuracy.

D.6 In FS71, in option XN (2-dB pad), capacitor P is designated D, G option.

D.7 In App Fig. 71, revisions are made per D.6.

D.8 In App Fig. 71, the value of resistor P2 (option G) is corrected.

D.9 Note 102 is revised to add reference to AIC No. 1A System for use with FS71.

D.10 In Table A, reference to Note 324 is removed from items 308, 309, 310, and 336.

D.11 In Fig. 2, relay LA is removed and designated Fig. J, and Fig. K and L are added to provide, on an optional basis, for the elimination of undesirable timed release of an established connection after the disconnect of the other connection.

Note: For installations in manual PBXs, the addition of the new wiring option XP will accomplish the same purpose.

D.12 Notes 102 and 104 are revised per D.11.

D.13 Note 328 is added per D.11.

D.14 In Table A, for loop-around test applications (Fig. 2), references to Note 328 are added.

D.15 Revised CADs 10, 21, 24, 26, 28, 30, 32, 35, 40, 42, 43, 44, 45, 47, and 49.

D.16 In Fig. 54 and FS79, made voice-terminating resistors optional 600 or 900 ohms (Q or R options) to be consistent with the conversion of PBXs (except No. 101 ESS) from 900- to 600-ohm terminations.

D.17 In Table A, items 283, 289 through 292, and 357 made voice-terminating resistors optional 600 or 900 ohms.

D.18 In App Fig. 79, made voice-terminating resistors RL1 and RL3 optional 600 or 900 ohms.

D.19 Per agreement with WECo, the following changes are made on a no-record basis and are applicable to Issues 19B and 20A of the drawing. The changes were previously forwarded to WECo on LDI-20A and 20C.

D.20 In Fig. 45, connecting reference to Fig. 54 is removed from lead H1 and is added to lead H or H2.

D.21 In Fig. 48, superfluous wiring for option YM is removed.

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D.22 In FS71, 77, and 79, references to options H, J, N, and P are removed.

D.23 In FS79, designations of winding terminals of relays OSB and OSM are corrected.

D.24 In FS79, the circuit is redesigned to add features described in A.1, A.2, and A.3.

D.25 In App Fig. 71, 77, and 79, references to options H, J, N, and P are removed.

D.26 In App Fig. 79, contact coordinate designations for all relays are revised in accordance with D.24.

D.27 In App Fig. 79, optional designation of resistor RL4 is changed from L to M.

D.28 Notes 102 and 104 are revised.

D.29 Notes 325, 326, and 327 are added.

D.30 In Table A, items 308, 331, 336 through 344, and 357 are revised.

D.31 Sequence charts for FS77 and 79 are added.

F. Changes in CD Sections

F.1 In Section II, insert ahead of 5.02 the subheading:

FIG. J PROVIDED

F.2 In Section II, add after 5.05:

FIG. K PROVIDED

5.06 When this circuit is seized at its first code entry by the tandem selector, the short-circuit on the T and R leads from the connected circuit will operate relay A of the first Fig. D. Operation of relay A operates slow-release relay SR of the first Fig. 27. The operation of relay SR operates relay LA1 of Fig. K and connects ground to the S lead to hold the tandem connection, since the A relay may release during supervision changes. The operated LA1 relay returns off-hook supervision.

5.07 When the second code entry to this circuit is seized by a tandem selector, the A relay of the second Fig. D operates, in turn operating relay SR of the second Fig. 27. The operation of relay SR operates relay LA2 of Fig. K which returns off-hook supervision. Relays LA1 and LA2 operated:

(a) Remove the voice-frequency terminations from the T and R leads of both entries.

(b) Connect the T and R leads of both entries together through capacitors T1 and R1.

5.08 When testing is completed and either entry to the loop around is disconnected, the associated relay LA- is released, returning the voice-frequency terminations to the T and R leads of both entries. However, off-hook supervision continues to be returned on the connected entry, thereby eliminating troublesome timed release during a series of tests. The circuit is restored to normal when both entries are disconnected, releasing their respective A and SR relays.

FIG. L PROVIDED

5.09 When this circuit is seized at its first code entry by the tandem selector, the short-circuit on the T and R leads from the connected circuit will operate relay A of the first Fig. D. Operation of relay A operates slow-release relay SR of the first Fig. 27. The operation of relay SR operates relay LA1 of Fig. L and connects ground to the S lead to hold the tandem connection, since the A relay may release during supervision changes. The operated LA1 relay returns off-hook supervision.

5.10 When the second code entry to this circuit is seized by the tandem selector, the A relay of the second Fig. D operates, in turn operating relay SR of the second Fig. 27. The operation of relay SR operates relay LA2 of Fig. L which returns off-hook supervision. Operated relays LA1 and LA2 operate relay LA. Relay LA operated:

(a) Removes the voice-frequency terminations from the T and R leads of both entries.

(b) Connects the T and R leads of both entries together through capacitors T1 and R1.

5.11 See 5.04.

5.12 When testing is completed and either entry to the loop around is disconnected, the associated relay LA- and relay LA are released, returning the voice-frequency terminations to the T and R leads of both entries. However, off-hook supervision continues to be returned on the connected entry, thereby eliminating troublesome timed release during a series of tests. The circuit is restored to normal when both entries are disconnected, releasing their respective A and SR relays.

F.3 In Section II, replace 6.12, 6.13, and 6.14 with the following:

6.12 When the circuit is seized on a milliwatt call, ground over lead S operates the S relay of the associated Fig. 34. Relay S (first Fig. 34) operated:

(a) Connects terminals 2 and 4 of inductor A to trip ringing and to return off-hook supervision.

(b) Partially closes operating path of relay LA.

(c) Partially closes operating path of relay OSM.

(d) Operates relay ST.

Relay ST operated:

(a) Grounds lead ST to start the milliwatt supply where a start lead is required (option XJ).

(b) Provides off-normal grounds to FS79.

(c) Activates 175-ms TM1 timer which operates relay T1.

Relay T1 operated:

(a) Locks operated to relay T2 released.

(b) Deactivates TM1 timer.

(c) Operates relay OSM which locks operated to relay ST.

(d) Activates 5.5-second TM2 timer which operates relay T2.

Relay OSM operated:

(a) Removes the voice-frequency termination, resistor RL1, from leads T and R.

(b) Removes dummy load resistor RL2 from the milliwatt supply.

(c) Connects milliwatt supply to leads T and R.

Relay T2 operated:

(a) Deactivates TM1 timer.

(b) Releases relay T1 which deactivates TM2 timer.

(c) Operates relay T3.

Relay T3 operated:

(a) Releases relay T2.

Relay T2 released:

(a) Activates 5.5-second TM1 timer which operates relay T1.

Relay T1 operated:

(a) Activates 1-second TM2 timer which operates relay T2.

(b) Releases relay OSM.

(c) Returns on-hook supervision (unless option XO is provided).

Relay OSM released:

(a) Disconnects milliwatt supply from leads T and R.

(b) Connects resistor RL1 to leads T and R.

(c) Connects resistor RL2 to milliwatt supply.

Relay T2 operated:

(a) Operates relay T4.

Relay T4 operated:

(a) Releases relay T1.

Relay T1 released:

(a) Returns off-hook supervision.

(b) Releases relay T2.

Relay T2 released:

(a) Releases relay T3.

(b) Activates 30-second TM1 timer which operates relay T1 (option XD, provided).

Relay T3 released:

(a) Releases relay T4.

Relay T4 released:

(a) Activates 175-ms timer which operates relay T1 (option XD or XE, provided).

6.13 The cycle of operation is then repeated from the initial operation of relay T1. If a second test call is made to the second Fig. 34 for a loop-around test, the operation of relay LA is delayed until a certain point in the 11-second milliwatt cycle. Seizure of the second Fig. 34 operates its S relay.

Relay S (second Fig. 34) operated:

(a) Connects terminals 2 and 4 of inductor B to trip ringing and to return off-hook supervision.

(b) Operates relay LA when milliwatt cycle closes remainder of operating path.

(c) Provides locking path for relay T4 which revises operations of timers TM1 and TM2 to conform with option XD or XE, as provided.

(With option XD provided, every 30 seconds there is a 1-second release of relay LA, during which time a balance termination is connected to each appearance and, if option XO is not provided, on-hook supervision is returned.)

6.14 Disconnect from either appearance will, within about 30 seconds, release relay LA and initiate the appropriate test on the remaining connection. Therefore, it is suggested that when making a series of loop-around tests, the reference trunk be connected to the milliwatt appearance. Thus, between tests, the milliwatt tone may serve as a signal to start dialing the balance termination access code over the next trunk to be tested.

F.4 In Section II, 14.02, after relay T3 has operated, replace from Relay T1 operated:

Relay T1 operated:

(a) Locks operated to relay T4 released.

(b) Activates 1-second TM2 timer which operates relay T2.

(c) Returns on-hook supervision (unless option XO is provided).

Relay T2 operated:

(a) Deactivates TM1 timer after relay T1 releases

(b) Operates relay T4.

Relay T4 operated:

(a) Locks operated to off-normal ground.

(b) Holds operated relay T3 until relay T2 releases.

(c) Deactivates TM1 timer after relay T2 releases (if option XE is provided).

(d) Releases relay T1.

Relay T1 released:

(a) Returns off-hook supervision.

(b) Deactivates TM2 timer which releases relay T2.

Relay T2 released:

(a) Releases relay T3.

(b) Activates 30-second TM1 timer which operates relay T1 (if option XD is provided).

(With option XD provided and option XO not provided, every 30 seconds there is a 1-second return of on-hook supervision.)

F.5 In Section III, 2.01, replace:

LA Loop-around

with

LA, LA1, LA2 Loop-Around

F.6 In Section III, replace 3.02 (e) as follows:

(e) Provides (with Fig. J or L) connections for a feature, option YU, for disabling the loop-around circuit to prevent unauthorized usage.

F.7 In Section III, replace 3.11 as follows:

3.11 Provides test terminations per FS79 for making 1000-Hz, balance termination, or loop-around tests.

(a) Systems applications are shown in Table A of the schematic drawing.

(b) Provides 600- or 900-ohm terminations to match the nominal office impedance.

(c) Provides for tripping machine ringing.

(d) Provides off-hook supervision.

(e) Provides for milliwatt tests, 175-ms after seizure, 1000-Hz tone interrupted every 11 seconds by a 1-second balance termination and, if option XO is not provided, on-hook supervision.

(f) Provides, for balance (or quiet) termination tests, 175-ms after seizure, a 5.5-second burst of 1000-Hz tone and a 5.5-second balance termination followed by 1 second of on-hook supervision unless option XO is provided. Then (per option XE and/or XO) quiet termination until disconnect, or (per option XD without XO) quiet termination interrupted every 30 seconds by 1 second of on-hook.

(g) Provides for loop-around test when both connections are established. Then (per option XD) out of each subsequent 30-second interval, there is a 1-second interval during which each appearance is connected to a balance termination and (per option XD, without XO) on-hook supervision is returned. With option XE provided, the loop-around connection remains until disconnect; however, if the loop-around connection is established very early in the timing cycle, there may be a 1-second interval during which balance terminations are connected and, without option XO, on-hook supervision returned.

(h) Provides connections for a feature, option YU, for disabling the loop-around circuit to prevent unauthorized usage.

F.8 In Section III, 4.01, TOLL SWITCHING SYSTEM NO. 4, 4A or 4M, change (c) to read:

(c) Test Line Circuit - SD-68577-01.

F.9 In Section III, 4.01, TOLL SWITCHING SYSTEM NO. 4, 4A, or 4M, add:

(e) Manual Test Frame (MTF) - SD-68587-01.

F.10 In Section III, 4.01, TEST SETS, replace (a) and (b) with:

(a) 22A Milliwatt Reference Meter.

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CHANGES

B. Changes in Apparatus

B.1 Removed	Replaced By
Adjustable Pad, Fig. 60	Fixed Pad, Fig. 26, option G
BT Relay AJ5, Fig. 54	BT Relay AJ83, Fig. 54

D. Description of Changes

D.1 Adjustable pad Fig. 60 is removed from the circuit (Table A, item 301) and replaced by the fixed pad Fig. 26, option G. This is done to avoid interacting adjustments on the milliwatt.

D.2 The combination loop around milliwatt and balance termination test line (Fig. 54) is modified to provide proper operation with ringing trip XBR No. 1 or No. 5 with delayed closure (Fig. 45) by changing the designation of lead H1 (Fig. 54) to H. In addition, relay BT (Fig. 54) is changed from an AJ5 to AJ83 to provide a pair of EMB contacts, which are used to maintain a termination on the balance port with BT either operated or non-operated.

D.3 Combined open and short-circuit termination for XBR No. 5 intertoll and tandem combined Fig. 48 and balance termination circuit for XBR No. 5 intertoll and tandem combined Fig. 49 are modified to provide proper operation of the S relay by removing the wiring portions of options YL, YM, YO, and YN.

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DEPT 5822-GJB-WAM

COMMON SYSTEMS
TRANSMISSION TEST LINE OR
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TABLE OF CONTENTS

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit is used for making manual transmission tests on trunks, cords, telephone circuits, and apparatus components in local and toll offices.

1.02 This circuit is also used for making balance and noise tests, and is used for checking repeaters by use of the balance, short circuit, and open terminations.

1.03 This circuit is used for making 2-way transmission tests by providing testing access on incoming trunks without testboard appearances.

2. GENERAL DESCRIPTION

GENERAL

2.01 The circuit to be tested is connected to this test circuit manually by patching or automatically by dialing for access through a switching network. This test circuit provides:

(a) A 1000-Hz test tone.

(b) A 1000- to 3000-Hz sweep frequency test tone.

(c) An ac short.

(d) A balance termination.

(e) An open.

(f) A test jack.

This circuit also provides ringing trip and/or changes in supervision, as required.

BASIC TEST LINES

2.02 Twelve basic terminations are provided by this circuit. They are:

(a) Milliwatt test lines (items using Fig. 1).

(b) Loop-around test lines (items using Fig. 2) with optional connection to a 60A control circuit.

(c) Combination loop-around and milliwatt test lines (items using Fig. 3) with optional connection to a 60A control circuit.

(d) Open circuit terminations (items using Fig. 4 or 48).

(e) Short circuit terminations (items using Fig. 4 and 5 or 48).

(f) Balance terminations (items using Fig. 4 and 6 or 49).

(g) Jack-ended 2-way test trunk (items using Fig. 7).

(h) Combination milliwatt loop-around and balance termination test lines (items using Fig. 54) with optional connection to a 60A control circuit.

(i) Subscriber loop test lines (items using Fig. 1).

(j) Balance termination with timed test tone (items using FS71).

(k) Balance termination and test tone timing circuit for Crossbar No. 5 intertoll and tandem combined (items using FS77)

(l) Combination loop-around, milliwatt, and balance termination test line (items using FS79).

CIRCUIT ARRANGEMENT

2.03 The transmission test circuits are built up from the basic Fig. 1 through 7, 54, and FS71, 77, and 79 by the addition of supplementary figures and FSs required for the particular application.

2.04 Fig. 8 and 9 provide battery supply to the test lines on a common basis. In addition, Fig. 9 has the added feature of being able to provide either of two timing sequences. When connected to Fig. 10, it interrupts the battery supply 1 second out of every 10 seconds. When connected to Fig. 55, it interrupts the battery supply for 2 seconds at 2-minute intervals.

2.05 Fig. 10 provides a flashing circuit for use in flashing the lamps of test lines using Fig. 7 and also supplies pulses which may be used to step the selector in Fig. 9.

2.06 Fig. 11 and 45 provide a means of tripping ringing. Fig. 45 has the added feature of minimizing the possibility of ringing into the milliwatt supply.

2.07 Fig. 16 through 25 provide the various supervisory conditions and pad control features to work with the various systems using this circuit. Fig. 54 does not require these auxiliary figures since it includes its own supervisory features.

2.08 Fig. 13, a building-out capacitor, and Fig. 26, a fixed pad, are provided for use in offices switching at via net loss (VNL).

2.09 Fig. 60 provides an adjustable 900-ohm 2-dB pad in 0.1-dB steps.

2.10 Fig. 27 through 41 and 57, 58, and 59 provide the various sleeve relays or resistors and the connecting leads for use with the various systems.

2.11 Fig. 55 uses ringing voltages to derive control pulses at 12-second intervals to operate the selector of Fig. 9 when a 2-minute cycle is required. The 2-minute cycle is used with the loop checker feature.

2.12 Fig. 56 uses machine ringing potential to time a nominal 60-second test line connection to a loop checker generator. A call by an originating station is connected to the test line circuit for 60 seconds with off-hook supervision. At the end of 60 seconds, the loop checker generator is removed and the supervision is changed from off-hook to on-hook. This condition will remain until the originating end disconnects. After the originating end disconnects, the test line is ready to establish a new connection.

2.13 FS71 provides a balance termination with a timed test tone.

2.14 FS77 provides a balance termination with a timed test tone for crossbar No. 5 intertoll and tandem, combined.

2.15 FS79 provides a combination loop-around, milliwatt, and balance termination with timed test tone.

SUPERVISORY CONDITIONS

2.16 All local office connections to test lines or terminations reached by subscriber number are provided with off-hook supervision. The off-hook supervision is provided in all cases except circuits using the loop checker generator.

2.17 Except where supervision is provided by an associated circuit, the necessary off-hook supervision is provided by this circuit.

2.18 Loop-around terminations are on-hook until both test connections are established, at which time off-hook supervision is returned from both terminations.

2.19 On loop-around test lines for PBX systems, either end provides off-hook supervision at all times when a connection is established in order to prevent flashing of switchboard lamp during timed battery interval.

2.20 On connections to the jack-ended test trunk for access on incoming trunks, the supervision is on-hook until answered, at which time it changes to off-hook supervision.

OFFICES USING FIXED PADS IN CONNECTION WITH 2-WIRE SWITCHING

2.21 A fixed pad is provided in series with the milliwatt test line, and a building-out capacitor is provided on balance terminations to furnish testing circuits comparable to those provided on switching trunks in offices switching on a 2-wire basis with fixed pad operation.

SECTION II - DETAILED DESCRIPTION

1. MILLIWATT TEST LINE

1.01 The various applications for the milliwatt test line per Fig. 1 function similarly, therefore, the description here will be of a typical example such as the one for a crossbar No. 1 office shown as Item 120 in Table A, where some of the trunks into this office are N carrier facilities (inband signaling). Fig. 1, B, 9, 10, 15, 16, 33, and 45 with options R, T, W, and ZH will be furnished. The value of resistor L is determined by reference to Table B after the loss in the office wiring has been determined. (The loss in the office wiring is determined by tests covered by BSP information.)

1.02 When the test trunk is seized by the line choice connector, ground over lead ANS operates relay S. The T and R continuity check is made through capacitors T and R and resistor A. Relay S operated:

(a) Connects the ANS lead to the ALS lead.

(b) Connects the G lead to the H lead of Fig. 45 for use in operating relay R1 and relay OS when ringing is received.

(c) Connects the G2 lead to the TM lead of Fig. 9, which operates the TM relay.

1.03 After the incoming trunk has been cut through, ringing potential is connected to the T and R leads. The ringing potential on the R lead is of sufficient voltage to break down tube B which fires, operating relay R. Relay R operated:

(a) Shunts the operating path for relay OS after relay R1 operates to prevent the operation of relay OS. This prevents ringing into the milliwatt supply.

(b) Connects tube A across the T and R leads. Tube A ionizes and its low impedance trips ringing.

(c) Operates relay R1.

Relay R1 operated:

(a) Locks up under control of lead H.

(b) Closes a path to operate relay OS after relay R releases.

Relay OS operated:

(a) Operates relay OSA.

(b) Opens operate path of relay OSB.

Relay OSA operated:

(a) Locks operated to relay R1.

(b) Releases slow-release relay OS.

(c) Connects terminals 1 and 4 of inductor to return off-hook supervision and to trip ringing if not already tripped by tube A.

Relay OS released:

(a) Opens operating path of relay OSA.

(b) Operates relay OSB.

Relay OSB operated:

(a) Removes the voice-frequency termination (resistor A) from tip and ring.

(b) Removes load resistor (L) from the milliwatt supply.

(c) Connects leads T and R to the milliwatt supply.

(d) Grounds lead ST to start the milliwatt generator where a start lead is required.

1.04 Even if the ringing interval is too short to trip ringing on this cycle, the release of relay R at the end of the ringing interval will operate relay OS. In cases where the trunk circuit has a rering or manual ringing, if ringing potential is reapplied, relay R will operate and release relay OSA, then OSB. From the time ringing is applied until relay R operates, the ringing potential will be connected to the milliwatt supply. This will be an infrequent occurrence and of short duration. At the end of the ringing interval, release of relay R will reoperate the OS relay.

1.05 The test line is now in the testing condition. This testing condition will be interrupted once every 10 seconds by the timing circuit to permit recognition of a disconnect at the originating end where joint holding is in the path or inband signaling is used. Wet-dry supervision or joint holding trunks will not disconnect until the wet or on-hook condition is seen at the called end, and inband signaling will not permit disconnection while tones in the voice-frequency range are present.

1.06 The timing circuit, whose operation is described in 2., opens the B lead to release relays OSA and OSB. Release of relays OSA and OSB:

(a) Disconnects the test tone from the T and R leads.

(b) Reconnects the terminations (resistor A) to the T and R leads.

(c) Reconnects the load resistor to the milliwatt supply.

(d) Removes the off-hook supervision.

1.07 After 1 second, the B lead is reclosed and relay OS reoperates, unless

relay S has released because of a disconnection from calling end.

2. 10-SECOND TIMING AND FLASHING CIRCUIT (FIG. 9 AND 10)

2.01 The operation of the S relay, in any test line obtaining battery from Fig. 9, closes the path between leads G2 and TM which results in the operation of relay TM to start the 10-second timing cycle. Relay TM operated:

(a) Grounds the ST lead of the 60-IPM interrupter supply via Fig. 10.

(b) Connects battery to the winding of relay FL which then operates and releases under control of ground pulses from the 60-IPM interrupter supply.

2.02 Relay FL is operated directly and the start lead ST is grounded by the operation of relay S in those cases where connection to Fig. 10 is specified without connection to Fig. 9. Relay FL pulsing:

(a) Supplies 60-IPM battery over lead FL to flash lamps of the associated Fig. 7.

(b) Supplies 60-IPM ground over lead RF to the ROT magnet of the INT selector, causing the selector to step through terminals 1 to 10.

2.03 When the selector reaches terminal 10, relay LO is operated by ground through arc 2 of the INT selector. Relay LO operated:

(a) Locks up under control of the selector ON contacts or the FL relay.

(b) Opens the path for operating the ROT magnet.

(c) Partially closes the operate path for the RLS magnet under control of the selector ON contacts and the FL relay.

(d) Opens the B leads of the associated test lines to cause on-hook supervision and tone-off conditions for about 1 second as described in 1.

When relay FL releases, just after relay LO operated, it:

(a) Closes a locking path to hold relay LO operated.

(b) Operates the RLS magnet.

2.04 When the selector restores to normal, the ON contacts open and cause the RLS magnet to release. The next operation of relay FL opens the lockup path for relay LO, causing LO to release. Relay LO in releasing recloses the operate path of the ROT magnet to start another cycle unless relay TM has released because of a disconnect on the test line.

2.05 Should disconnection occur when the selector is at some point between terminals 1 through 9, and no other test line is in use to hold relay TM operated, the release of relay TM closes a path to operate relay LO through terminals 1 to 9 of arc 2 of the INT selector, thereby restoring the timing circuit as described.

2.06 Should the timing circuit be in a timing cycle for a test line, the first period for the second test line may be shorter than 10 seconds.

3. 2-MINUTE TIMING CIRCUIT (MFR DISC.) (FIG. 9 AND 55)

3.01 The operation of the S relay, in any test line obtaining battery from the Fig. 9 associated with Fig. 55, closes the path between leads G2 and TM which results in the operation of relay TM to start the 2-minute timing cycle. Ground is also supplied to the TM lead to relay W for future use.

3.02 When relay TM operates, it closes the path between leads ST and ST1 to apply ringing pulses to relay AC. The ringing machine will supply ac ringing potential for a 2-second interval followed by an idle 4-second interval. This results in the AC relay operating for 2 seconds out of each 6 seconds. The first operation of relay AC:

(a) Supplies ground to the windings of relays W and Z through break contacts of relay W. Relay W operates and locks up to ground on lead TM.

(b) Shunts the winding of relay Z through break contacts of relay Z to prevent it from operating.

3.03 When relay AC releases, it removes the shunt ground on the winding of relay Z, permitting it to operate to ground on lead TM via the lockup path of relay W. The second operation of relay AC:

(a) Supplies ground through make contacts of relay Z to shunt the winding of relay W, causing relay W to release.

(b) Provides ground through break contacts of relay W (after W releases) to hold relay Z operated.

3.04 During the 2-second interval now started, relay W remains released and relay Z remains operated. Under this condition, ground from the TM lead is connected to lead RF through make contacts of relay Z and break contacts of relay W. The ground on lead RF operates the ROT magnet on the INT selector, causing the selector to move up one step.

3.05 When relay AC releases, it removes the ground from the windings of relays Z and W, allowing Z to release. This removes the ground from the RF lead, and Fig. 55 is now in its initial condition, completing the first 12-second cycle.

3.06 In the manner just described, ground pulses at 12-second intervals are supplied to the selector ROT magnet via the RF lead until the selector reaches terminal 10 at the end of about 2 minutes.

3.07 When the selector reaches terminal 10, relay LO is operated by ground through arc 2 of the INT selector. Relay LO operated:

(a) Locks up under control of the selector ON contacts.

(b) Opens the path for operating the ROT magnet.

(c) Partially closes the operate path for the RLS magnet under control of the selector ON contacts and relay Z (via lead RL). Relay Z is operated at this time, so lead RL is open.

(d) Opens the B leads of the associated test lines to cause on-hook supervision and tone-off condition for about 2 seconds as described in 1.

3.08 The conditions described while relay LO is operated are maintained for about 2 seconds, at the end of which time relay AC releases followed by release of relay Z. Relay Z released:

(a) Connects ground to lead RL which causes selector magnet RLS to operate, restoring the selector to normal.

(b) Removes ground from the RF lead.

3.09 When the selector is restored to normal, the ON contacts open, releasing the RLS magnet and releasing relay LO. Relay LO released:

(a) Partially closes the operate path of the ROT magnet to put it under control of the W and Z relays.

(b) Opens the operate path of the RLS magnet via lead RL.

(c) Restores battery to the B leads to the associated test lines to restore the off-hook and tone-on conditions unless a disconnection has taken place.

3.10 The timing circuit is now ready to start the next 2-minute cycle unless the TM relay is released by disconnection of all the associated test lines.

3.11 If all associated test lines should be disconnected during the timing cycle while the selector is on any terminal from 1 to 9, the release of the TM relay closes an operating path for the LO relay through arc 2 of the INT selector. Relay LO operates and closes the operate path for the RLS magnet. The selector restores to normal as already described.

3.12 If a second test line is activated while the timer is in a timing cycle for the first test line, the first period for the second line may be less than 2 minutes.

4. 60-SECOND TIMING CIRCUIT (FIG. 56)

4.01 When Fig. 56 is used to supply battery to any test line, the operation of S relay closes G2 and TM leads resulting in the operation of relay TM. Operation of TM starts a nominal 60-second timing cycle. Machine ringing voltage is connected to the AC relay, which causes the AC relay to operate for 2 seconds and be released for 4 seconds.

4.02 While relay AC is operated, the operate path to the INT SEL ROT magnet is closed. INT SEL will step from terminal 1 to 10 as the AC relay operates and releases. Upon reaching terminal 10 of arc 1, relay LO operates. Relay LO operated first time:

(a) Locks up through INT SEL ON contacts.

(b) Opens INT ROT magnet path.

(c) Partially closes INT RLS magnet path.

(d) Operates LO-1 relay.

Relay LO-1 operated:

(a) Closes INT SEL RLS magnet path.

(b) Locks up to TM lead.

(c) Connects partial ground path to wiper of INT SEL arc 2.

4.03 When INT SEL RLS magnet is energized INT SEL releases. When INT SEL has returned to normal, ON contacts open and release relay LO. Relay LO released first time:

(a) Closes ground path to wiper of arc 2.

(b) Opens INT SEL RLS magnet path.

(c) Closes INT SEL ROT magnet path, causing it to again step under control of relay AC.

4.03 INT SEL steps to terminal 2 of arc 2 where ground on wiper causes TM-1 to operate.

4.04 With operation of TM-1, the 60-second timing cycle is complete. Relay TM-1 operated:

(a) Locks up to TM lead.

(b) Opens test line battery supply, B lead.

(c) Opens INT SEL ROT magnet path.

(d) Operate relay LO.

Relay LO operated second time:

(a) Locks up to INT SEL ON contacts.

(b) Opens INT SEL ROT magnet path.

(c) Closes INT SEL RLS magnet path.

4.05 When INT RLS magnet is energized, the INT SEL releases. Upon INT SEL returning to normal, INT ON contacts open and release LO. Relay LO released second time:

(a) Opens INT SEL RLS magnet path.

(b) Prepares INT SEL ROT magnet path for future test line connection.

4.06 The test line is now on-hook and relays TM, LO-1, and TM-1 operated require a disconnect from the originating end in order to release relay S which will in turn release relays TM, LO-1, and TM-1.

4.07 Should the originating end disconnect when the INT SEL is between terminals 1 through 9 of arc 1 or arc 2, the release of relay TM will close a path through INT SEL ON contacts and energize INT RLS magnet, causing INT SEL to restore to normal. With INT SEL at normal, the INT ON contacts will then open and open the operate path to INT RLS magnet.

4.08 The test line is now ready to start a full timing cycle on the next call.

5. LOOP-AROUND TEST LINE

5.01 The various applications for the loop-around test lines per Fig. 2 function similarly. In pad control or fixed pad offices, the near-to-far reading includes a 2-dB pad in the test line or in the trunk. On loop-around test lines, the reading will include total pads of 4 dB to agree with two times the loss of one trunk. The description here will assume the installation of a loop-around test line for an SXS tandem office shown as Item 62 in Table A which provides Fig. 2 with two Fig. 27, D with options R, T, and W with a battery supply connection from Fig. 8.

5.02 When this circuit is seized at its first code entry by the tandem selector, the short circuit on the T and R leads from the connected circuit will operate relay A of the first Fig. D. Operation of relay A operates slow-release relay SR of the first Fig. 27. Relay SR in operating connects ground to the S lead to hold the tandem connection, since the A relays may release during supervision changes.

5.03 When the second code entry to this circuit is seized by a tandem selector, the A relay of the second Fig. D operates, in turn operating relay SR of the second Fig. 27. With both SR relays operated, a path is closed from battery on the B lead of Fig. 8 through the LA relay winding in Fig. 2, through make contacts in the second Fig. 27 via leads H and G, through make contacts in the first Fig. 27 via leads H and G, and thence to ground. Closure of this path operates relay LA. Relay LA operated:

(a) Removes the voice-frequency termination from the T and R leads of each entry.

(b) Connects the T and R leads of the two entries together through capacitors T1 and R1.

(c) Reverses the polarity of battery and ground from the A relays of both Fig. D as applied to the T and R leads in Fig. 2 to provide off-hook supervision.

5.04 When option YU is specified for Fig. 2, a connection to a 60A control circuit is provided. The 60A control circuit is so arranged that if any voice frequencies are present, such as would occur if the loop-around test line is used for unauthorized voice-frequency communication, the 60A control circuit will terminate the office ends of the two calling lines. However, the 60A control circuit will permit 1000 Hz to be passed over the loop-around connection. The 60A control circuit will terminate both office lines if voice frequencies or tones are present during the presence of the 1000-Hz test tone. If frequencies other than 1000 Hz are to be passed through the loop-around circuit, an LCT key (loop cut-through) on the 60A control unit should be operated to its LCT position. The LCT key should be at its NOR (normal) position for prevention of unauthorized communication over the loop-around circuit.

5.05 When testing is completed and one end of the loop-around is disconnected, relay LA is released which then opens the loop-around connection and changes the supervision to on-hook. The circuit is restored to normal when both ends are disconnected, releasing their respective A and SR relays.

6. COMBINED MILLIWATT AND LOOP-AROUND TEST LINE

FIG. 3 PROVIDED

6.01 For this example, we are assuming the provision of test line for crossbar No. 5 office shown as Item 27 in Table A for testing interlocal trunks. Fig. 3, F, 10, 12, and 15 with two each of Fig. 16, 34, and 45 would be provided. The figures would be equipped with options R and ZI and battery would be supplied from Fig. 9.

6.02 When the first number is called, the test line functions as a milliwatt test line; and when the second number is called, the milliwatt supply is disconnected and the two entries are looped together.

6.03 When this circuit is seized on a milliwatt call, ground over lead S operates the S relay of the associated Fig. 34. Relay S operated:

(a) Closes the path through leads G and H in Fig. 34 for future operation of relays R1 and OS when a ringing pulse is received.

(b) Connects lead G2 to lead TM to operate TM relay of Fig. 9 to start the 10-second timing cycle.

6.04 After the trunk has cut through, ringing potential is connected to the T and R leads. This potential causes tube B to fire followed by operation of relay R. Relay R operated:

(a) Shunts the operating path for relay OS after relay R1 operates to prevent ringing into the milliwatt supply.

(b) Connects tube A across the T and R leads to trip ringing.

(c) Operates relay R1.

Relay R1 operated:

(a) Locks up under control of lead H.

(b) Closes a path to operate relay OS after relay R releases.

Relay OS operated:

(a) Opens operate path of relay OSB.

(b) Operates relay OSA.

Relay OSA operated:

(a) Locks operated to relay R1 and non-operated relay LA.

(b) Releases slow-release relay OS.

(c) Connects terminals 1 and 4 of inductor A to return off-hook supervision and to trip ringing if not already tripped by tube A.

Relay OS released:

(a) Opens operating path of relay OSA.

(b) Operates relay OSB.

Relay OSB operated:

(a) Removes the voice-frequency termination (resistor A) from tip and ring.

(b) Removes dummy load resistor (L) from the milliwatt supply.

(c) Connects leads T and R to the milliwatt supply.

(d) Grounds lead ST to start the milliwatt generator where a start lead is required.

6.05 Even if the ringing interval is too short to trip ringing on this cycle, the release of relay R at the end of the ringing interval will operate relay OS. In cases where the trunk circuit has rering or manual ringing, when the ringing potential is reapplied, it will again operate relay R which will release relay OSA, then OSB. During the short interval between the time ringing is received and the time relay R operates, the ringing potential will be connected to the milliwatt supply. This is not serious because of the short duration and infrequency of such events. When relay R releases, relay OS will reoperate.

6.06 When the B lead is opened by the timing circuit as described in 2., relays OSA, OSB are released. The tone path is opened and the supervision is changed to on-hook to permit the signaling equipment to recognize disconnection by the originating end.

6.07 If a loop-around test is to be made after the milliwatt test, a second number is dialed on the other trunk to be tested. Seizure of the second entry with this circuit operates the S relay of the second Fig. 34 as explained for the first Fig. 34.

6.08 When the second relay S operates, relays R, R1, and TM respond according to previous explanation in first Fig. 34. However, second relay S operates the LA relay. Relay LA will not operate unless first relay S is also operated. Relay LA operated:

(a) Releases relays OSA and OSB.

(b) Removes voice-frequency termination (resistor B) from the second T and R leads.

(c) Completes loop-around connection.

(d) Connects terminals 1 and 4 of second tip-ring inductor to return off-hook supervision and to trip ringing if not already tripped by tube A.

Relay OSB released:

(a) Removes ground from milliwatt supply ST lead.

(b) Reconnects the idle termination (resistor L) to the milliwatt supply.

6.09 As the timing circuit functions, relay LA will release each time lead B is

opened, causing both entries to be opened and closing on-hook supervision each time the LA relay releases. Disconnection of either entry will release relay LA when the associated S relay releases. Disconnection of both entries and release of the associated S relays restore the circuit to normal.

FS79 PROVIDED

6.10 For this example, we are assuming the provision of the test line for crossbar No. 5 office shown in Item 336 in Table A for testing intertoll and tandem trunks. FS79 and two Fig. 34 would be provided. The figures would be equipped with option ZI.

6.11 When the first number is called, the test line functions as a milliwatt test line; and when the second number is called, the milliwatt supply is disconnected and the two entries are looped together.

6.12 When this circuit is seized on a milliwatt call, ground over lead S operates the S relay of the associated Fig. 34. Relay S (first Fig. 34) operated:

(a) Connects terminals 2 and 4 of inductor A to trip ringing and to return off-hook supervision.

(b) Partially closes operating path of relay LA.

(c) Partially closes operating path of relay OSM.

(d) Operates relay ST.

Relay ST operated:

(a) Grounds lead ST to start the milliwatt generator where a start lead is required.

(b) Provides off-normal ground to FS79.

(c) Activates 175-millisecond TM1 timer which operates relay T1.

Relay T1 operated:

(a) Locks operated to relay T2 released.

(b) Deactivates TM1 timer.

(c) Operates relay OSM which locks operated to relay S.

Relay OSM operated:

(a) Removes the voice-frequency termination (resistor RL1) from leads T and R.

(b) Removes dummy load resistor RL2 from the milliwatt supply.

(c) Connects milliwatt supply to leads T and R.

(d) Deactivates TM1 timer.

(e) Releases relay T1.

(f) Removes off-normal ground from FS79.

6.13 If a loop-around test is to be made after the milliwatt test, a second number is dialed on the other trunk to be tested. Seizure of the second entry of this circuit operates the S relay of the second Fig. 34 as explained for the first Fig. 34.

Relay S (second Fig. 34) operated:

(a) Connects terminals 2 and 4 of inductor B to trip ringing and to return off-hook supervision.

(b) Releases relay OSM.

(c) Operates relay LA.

Relay OSM released:

(a) Disconnects milliwatt supply from leads T and R.

Relay LA operated:

(a) Releases relay ST.

(b) Removes the voice-frequency termination (resistor RL3) from leads T and R.

(c) Loops together, through capacitors CT1 and CR1, leads T and R of both Fig. 34.

6.14 Disconnection of either entry will release relay LA when the associated S relay releases. Disconnection of both entries and release of the associated S relays restore the circuit to normal.

60A CONTROL UNIT

6.15 When option YU is specified for Fig. 3, a connection to a 60A control circuit is provided. The 60A control circuit is so arranged that if any voice frequencies are present, such as would occur if the loop-around test line is used for unauthorized voice-frequency communication, the 60A control circuit will terminate the office ends of the two calling lines. However, the 60A control circuit will permit 1000 Hz to be passed over the loop-around connection. The 60A control circuit will terminate both office lines if voice frequencies or tones are present during the presence of the 1000-Hz test tone. If frequencies other than 1000 Hz are to be passed through the loop-around circuit, an LCT key (loop cut-through) on the 60A control unit should be operated to its LCT position. The LCT key should be at its NOR (normal) position for prevention of unauthorized communication over the loop-around circuit.

7. BALANCE TERMINATION

FIG. 4 PROVIDED (WITHOUT TEST TONE)

7.01 Balance terminations may be used for noise and repeater tests and on toll switchboards may be provided for use as holding jack circuits. Since all applications function similarly, for the purpose of description we will assume that Item 165 of Table A is provided for a panel (BCO) office where wet-dry supervision may be encountered on incoming toll switching trunks. Item 165 provides the following: Fig. 4, 6, 16, 31, and 46 with options T, ZE, and E or F and connection to Fig. 9.

7.02 When this circuit is seized by the final selector, ground on lead S operates relay S. With E wiring, the sleeve is nominally 615 ohms and is a single or last line of a hunting group. With F wiring, the sleeve is nominally 2600 ohms and will cause trunk hunting when the terminal is busy. Relay S operated:

(a) Connects G2 lead to lead TM to operate relay TM which starts a timing cycle to open the battery supply.

(b) Operates relay RV by closing the G and H leads.

7.03 Ringing on the tip and ring leads is tripped by the 500-ohm short circuit consisting of inductor D and Fig. 16. The tip and ring are connected to a 900-ohm voice frequency termination consisting of 2-mF capacitor D and 900-ohm resistor D.

7.04 The operation of relay RV provides off-hook supervision. Each time the battery is opened by the operation of relay LO in the timing circuit, relay RV is released. Release of relay RV provides on-hook supervision. When the originating end disconnects, relays S, RV, and TM will release, restoring the circuit to normal.

FS71 PROVIDED (WITH TEST TONE)

7.05 For this example, we are assuming the provision of the test line for a BCO panel office shown in Item 320 in Table A. FS71 and 74 would be provided. The FS would be equipped with options XE, XF, and XI.

7.06 When this circuit is seized by the final selector, ground on lead S operates relay S. With E wiring, the sleeve is nominally 615 ohms and is a single or last line of a hunting group. With F wiring, the sleeve is nominally 2600 ohms and will cause trunk hunting when the terminal is busy. Relay S operated:

(a) Grounds start lead to milliwatt generator when required (XJ option).

(b) Connects terminals 2 and 4 (through resistor RO) of inductor A to trip ringing and return off-hook supervision.

(c) Provides an off-normal ground for FS71.

(d) Activates 175-ms TM1 timer which operates relay T1.

Relay T1 operated:

(a) Locks operated to relay T2 released.

(b) Deactivates TM1 timer.

(c) Operates relay OS.

(d) Activates 5.5-second timer TM2 which operates relay T2.

Relay OS operated:

(a) Connects milliwatt supply to leads T and R.

(b) Removes the voice-frequency termination (resistor RL1) from leads T and R.

(c) Removes dummy load resistor RL2 from the milliwatt supply.

Relay T2 operated:

(a) Locks operated to relay T4 released.

(b) Partially closes operate path of relay T4.

(c) Deactivates TM1 timer.

(d) Releases relay T1.

Relay T1 released:

(a) Deactivates TM2 timer.

(b) Partially closes operate path of relay T4 (through XI option).

(c) Releases relay OS.

OS relay released:

(a) Disconnects milliwatt supply from leads T and R.

(b) Connects the voice-frequency termination (resistor RL1) to leads T and R.

(c) Connects dummy load resistor RL2 to the milliwatt supply.

(d) Operates relay T4.

Relay T4 operated:

(a) Locks operated to S relay.

(b) Deactivates TM1 timer (through XE option).

(c) Releases relay T2.

7.07 When the originating end disconnects, relays S and T4 will release, restoring the circuit to normal.

FS77 PROVIDED (WITH TEST TONE)

7.08 For this example, we are assuming the provision of test lines for a crossbar No. 5 office shown as Item 310 in Table A. FS77 and 78 would be provided. The FS would be equipped with option XJ.

7.09 When, in establishing the test call connection, the marker does not operate relay TC, reverse battery supervision is returned to the incoming tandem trunk, and the balance termination is 900 ohms.

7.10 When, in establishing the test call connection, the marker operates relay TC, simplex supervision is returned to the incoming intertoll trunk, and the balance termination is 600 ohms.

7.11 The marker will check the condition of the FT, F, and BT leads for an idle condition, selects one of the frames with available test lines, and supplies a ground on the F lead to all test lines of the type appearing on the frame. This ground operates relay F through break contacts of released relays SL and H to battery on the BT lead that had been selected by the marker. Relay F operated:

(a) Connects lead TC to relay TC which will be operated by marker, if required.

(b) Connects ground to the FA lead which will operate the trunk auxiliary relay in the trunk link frame circuit.

(c) Closes locking path for relay F.

(d) Operates relay H.

Relay H operated:

(a) Grounds lead RC to satisfy marker check.

(b) Closes locking path of relay TC, if operated, and extends ground to lead TC which satisfies marker that relay TC has operated.

(c) Opens lead FT and leads F and BT.

7.12 The marker is now satisfied and removes ground from the F lead and battery from the BT lead allowing the F relay to release. Relay F released:

(a) Disconnects leads RC, TC, and FA.

(b) Releases trunk auxiliary relay (in trunk link circuit) which connects leads T, R, and S from incoming trunk via the switches. Ground on S lead operates SL relay.

(c) Releases slow-release relay H.

Relay SL operated:

(a) Closes locking ground to TC relay (if operated) before the release of relay H.

(b) Opens lead FT and leads F and BT before the release of relay H.

(c) Provides off-normal locking ground for FS77.

(d) Grounds start lead to milliwatt generator.

(e) Activates 175-ms TM1 timer which operates relay T1.

Relay T1 operated:

(a) Locks operated to relay T2 released.

(b) Deactivates TM1 timer.

(c) Operates relay OST/OSI.

(d) Activates 5.5-second timer T2 which operates relay T2.

Relay OST/OSI operated:

(a) Connects milliwatt supply to leads T and R.

(b) Removes the voice-frequency termination (resistor RL1/RL3) from leads T and R.

(c) Removes dummy load resistor RL2/RL4 from the milliwatt supply.

Relay T2 operated:

(a) Locks operated to relay T3 released.

(b) Deactivates TM1 timer.

(c) Partially closes operate path of relay T3.

(d) Releases relay T1.

Relay T1 released:

(a) Deactivates TM2 timer.

(b) Partially closes operate path of relay T3.

(c) Releases relay OST/OSI.

Relay OST/OSI released:

(a) Disconnects milliwatt supply from leads T and R.

(b) Connects the voice-frequency termination (resistor RL1/RL3) to leads T and R.

(c) Connects dummy load resistor RL2/RL4 to milliwatt supply.

(d) Operates relay T3.

Relay T3 operated:

(a) Locks operated to relay T4 released.

(b) Releases relay T2.

Relay T2 released:

(a) Activates 5.5-second TM1 timer which operates relay T1.

Relay T1 operated:

(a) Locks operated to relay T4 released.

(b) Returns on-hook supervision to incoming trunk.

(c) Deactivates TM1 timer.

(d) Activates 1-second TM2 timer which operates relay T2.

Relay T2 operated:

(a) Deactivates TM1 timer after release of relay T1.

(b) Operates relay T4.

Relay T4 operated:

(a) Locks operated to off-normal ground.

(b) Releases relay T1.

(c) Deactivates TM1 timer after release of relay T2.

Relay T1 released:

(a) Deactivates TM2 timer which releases relay T2.

(b) Returns off-hook supervision to incoming trunk.

Relay T2 released:

(a) Releases relay T3.

7.13 When the originating end disconnects, relays SL and T4 will release, restoring the circuit to normal.

8. SHORT CIRCUIT TERMINATION

8.01 The short circuit termination consists of Fig. 5 connected to Fig. 4 to provide an ac short circuit (capacitor E) across the tip and ring. The application of these test lines is covered in Table A, and the operation is similar to that described in 7. for balance terminations.

9. OPEN CIRCUIT TERMINATION

9.01 Fig. 4 in the absence of connections to Fig. 5 or 6, provides an ac open circuit termination in which a dc path may be closed for supervisory purposes through the isolation inductor D. The application of these test lines is covered in Table A, and the operation is similar to that described in 7. for balance terminations.

10. JACK-ENDED TEST TRUNK FOR ACCESS ON INCOMING TRUNKS

10.01 The jack-ended test trunk will normally be used in determining the location of a trouble with the aid of a testman at the far end, the circuit in trouble having previously been found as a result of loop-around tests or Code 104 tests.

10.02 The operation of all applications of test trunks per Fig. 7 is similar. For the purpose of description of the operation, we will assume provision of Item 74 as shown in Table A and as connected to a lamp and key in the local test cabinet No. 3. With Item 74, the following figures will be provided: Fig. 7, 11, 16, 29, and options A, T, and W, and connection to Fig. 10; also, since in this case the test cabinet No. 3 is equipped with 2Y lamps, Fig. 7 will be provided with option X.

10.03 When the connector seizes this test trunk, ground on the S lead will operate relay S. Relay S operated:

(a) Connects G3 lead to ST lead of Fig. 10 to start the interrupter where an interrupter start lead is required.

(b) Connects J lead to Fig. 7 to J1 lead of Fig. 10, causing relay FL to pulse at a 60-IPM rate.

(c) Connects G lead to H lead of Fig. 7 to operate the auxiliary signal circuit of the No. 3 test cabinet.

(d) Connects K lead of Fig. 7 to the K1 lead of Fig. 10 which flashes the associated lamp of the No. 3 test cabinet as an incoming call signal.

10.04 Ringing on the tip and ring leads from the connector is tripped by cold cathode tube C (Fig. 11) and audible ringing tone is connected to the tip lead under control of relay K.

10.05 When the call is answered at the No. 3 test cabinet by operation of the trunk key, ground is closed to the K lead, operating relay K. Relay K operated:

(a) Changes the lamp from flashing to steady-lighted as a busy indication where the lamp is multipled.

(b) Opens the audible ringing tone path.

(c) Closes a short circuit (Fig. 16) across inductor E as an off-hook indication.

(d) Removes the ground from the A or A1 lead to silence the auxiliary signal circuit.

(e) Removes battery from the J lead to release relay FL.

10.06 The test trunk is now in a talking condition; by agreement, 1000-Hz tone or a measuring set may be plugged into the TM jack for a predetermined time for testing. The talking path bridge is removed from the testing path when a plug is in the TM jack, providing a clear testing path.

10.07 When testing is completed, release of the trunk key will release relay K. Relay K released will remove the off-hook supervision and permit disconnection against wet-dry supervision. If disconnection at the originating end has not released relay S, the trunk lamp may again flash until it has released. To prevent this, the testman at the incoming end should not restore the key until he is aware that the originating end has disconnected.

11. PAD CONTROL (A&M ONLY)

11.01 Fig. 20, 22, and 25 for pad control are rated A&M Only to agree with their use and are only provided in an office where pad control is employed. Fig. 24, however, is used as a discriminating mark for all test trunks appearing on a No. 1B or 3B toll tandem switchboard. For those trunks, a pad control resistor per Fig. 25 is not required.

12. TEST LINES USING FIG. 48 AND 49

12.01 Test lines for use in crossbar No. 5 offices where both intertoll and tandem are provided may combine these test lines on the trunk link frame by use of Fig. 48 and 49 instead of Fig. 4, 5, or 6. In these test lines, when relay TC is normal, the test line is set up for a tandem connection. When the marker grounds lead TC operating relay TC, the test line is set up for a toll connection. In the case of Fig. 48, a CN relay is also provided to change from an open to a short circuit termination when the marker grounds lead CN, operating relay CN. These test lines function similar to those described in 3., 6.01 through 6.03, and 7.01 through 7.04, except for the above noted differences.

13. COMBINATION MILLIWATT, LOOP-AROUND, AND BALANCE TERMINATION TEST LINE USING FIG. 54

13.01 For this example, we are assuming the provision of test lines for a crossbar No. 5 office shown as Items 45 and 46 in Table A for testing interlocal and tandem trunks on subscriber lines. The following figures and options should be provided: Fig. 9, 10, 15, 45, 54, H, and two Fig. 34, equipped with options ZI and YS.

13.02 When code AB+5 is called across the first Fig. 34, the test line acts as a milliwatt test line; when code AB+5 is called through the second Fig. 34, the test line acts as a balance termination test line; and when AB+5 is called across both Fig. 34, the test line is used as a loop-around test line.

MILLIWATT TEST

13.03 When the circuit is seized on a milliwatt call, ground over the S lead operates the S relay. Relay S operated:

(a) Connects the G and H leads of Fig. 34 for operating relay R1 and relay OS when ringing has been received.

(b) Connects the G2 lead to the TM lead and operates the TM relay for the 10-second timing cycle.

13.04 After the incoming trunk has been cut through, ringing is connected to the T and R leads. Ringing potential fires tube B, operating the R relay. Relay R operated:

(a) Shunts the operating path for relay OS after relay R1 operates to prevent ringing into the milliwatt supply.

(b) Connects tube A across the T and R leads to trip the ringing.

(c) Operates relay R1.

Relay R1 operated:

(a) Locks under control of lead H.

(b) Connects terminals 1 and 4 of inductor A to return off-hook supervision and to trip ringing if not already tripped by tube A.

(c) Closes a path to operate relay OS after relay R releases.

Relay OS operated:

(a) Opens operate path of relay OSB.

(b) Operates relay OSA.

Relay OSA operated:

(a) Locks operated to relay R1.

(b) Releases slow-release relay OS.

Relay OS released:

(a) Opens operating path of relay OSA.

(b) Operates relay OSB.

Relay OSB operated:

(a) Removes the voice-frequency termination (resistor A) from tip and ring.

(b) Removes dummy resistor L from the milliwatt supply.

(c) Connects leads T and R to the milliwatt supply.

(d) Grounds lead ST to start the milliwatt generator where a start lead is required.

13.05 Even if the ringing interval is too short to trip the ringing on this cycle, the release of relay R at the end of the interval will operate relay OS. If the trunk circuit has rering or manual ringing, when ringing potential is reapplied, relay R in operating will release relay OSA, then OSB. During the short interval from the time ringing is applied until the R relay operates, the ringing will be connected to the milliwatt supply. This will be an infrequent occurrence and of a short duration. At the end of the ringing interval, release of relay R reoperates relay OS.

13.06 When the B lead is opened by the timing circuit as described in 2., relays OSA, OSB are released and the tone path is opened. Supervision remains off-hook to permit the signaling equipment to recognize disconnection by the originating end.

LOOP-AROUND TEST

13.07 When the circuit is seized for a loop-around test, ground over the S lead in the first Fig. 34 operates the OS, OSA, OSB relays as described in the milliwatt test call. Ground on the S lead of the second Fig. 34 operates relay S on second Fig. 34. Relay S operated:

(a) Connects the G and H leads of the second Fig. 34 and operates relay BT.

(b) Connects the G2 and TM leads to operate the TM relay for a timing cycle.

13.08 After the incoming trunk has been cut through, ringing across the T and R leads fires tube C which trips the ringing. Relay BT operated:

(a) With relay OSA operated, closes the loop-around connection.

(b) Removes voice-frequency termination from the second T and R leads (resistor B).

13.09 As the timing circuit functions, relays BT, OSA, and OSB will release each time lead B is opened.

13.10 When option YU is specified for Fig. 54, a connection to a 60A control circuit is provided. The 60A control circuit is so arranged that if any voice frequencies are present, such as would occur if the loop-around test line is used for unauthorized voice-frequency communication, the 60A control circuit will terminate the office ends of the two calling lines. However, the 60A control circuit will permit 1000 Hz to be passed over the loop-around connection. The 60A control circuit will terminate both office lines if voice frequencies or tones are present during the presence of the 1000-Hz test tone. If frequencies other than 1000 Hz are to be passed through the loop-around circuit, an LCT key (loop cut-through) on the 60A control circuit should be operated at its NOR (normal) position for prevention of unauthorized communication over the loop-around circuit.

BALANCE TERMINATION TEST (WITHOUT TEST TONE)

13.11 If the circuit is seized on a balance termination call, ground on the S lead of the second Fig. 34 operates the S relay of the second Fig. 34. Relay S operated:

(a) Connects the G and H leads of the second Fig. 34 and operates the BT relay.

(b) Closes the G2 and TM leads to operate the TM relay.

13.12 After the incoming trunk has been cut through, ringing potential across the T and S leads of the second Fig. 34 fires tube C which trips the ringing. Seizure of the second entry immediately establishes connection for the balance termination line. Release of the S relay will restore the circuit to normal.

14. COMBINATION MILLIWATT, LOOP-AROUND, AND BALANCE TERMINATION TEST LINE USING FS79 (XE OPTION)

MILLIWATT AND LOOP-AROUND TESTS

14.01 Refer to 6.10 through 6.14.

BALANCE TERMINATION TEST (WITH TEST TONE)

14.02 If the circuit is seized on a balance termination call, ground on the S lead of the second Fig. 34 operates the S relay of the second Fig. 34. Relay S (second Fig. 34) operated:

(a) Connects, via resistor RO, terminals 2 and 4 of inductor B to trip ringing and to return off-hook supervision.

(b) Operates relay ST.

Relay ST operated:

(a) Grounds lead ST to start milliwatt generator where start lead is required.

(b) Provides off-normal ground to FS79.

(c) Activates 175-ms TM1 timer which operates relay T1.

Relay T1 operated:

(a) Locks operated to relay T2 released.

(b) Deactivates TM1 timer.

(c) Activates 5.5-second TM2 timer which operates relay T2.

(d) Operates relay OSB.

Relay OSB operated:

(a) Removes the voice-frequency termination (resistor RL3) from leads T and R.

(b) Removes dummy load resistor RL2 from the milliwatt supply.

(c) Connects milliwatt supply to leads T and R.

Relay T2 operated:

(a) Locks operated to relay T3 released.

(b) Deactivates TM1 timer after relay T1 releases.

(c) Releases relay T1.

Relay T1 released:

(a) Deactivates TM2 timer.

(b) Releases relay OSB.

Relay OSB released:

(a) Connects the voice-frequency termination (resistor RL3) to leads T and R.

(b) Connects dummy resistor RL2 to the milliwatt supply.

(c) Disconnects milliwatt supply from leads T and R.

(d) Operates relay T3.

Relay T3 operated:

(a) Locks operated to relay T4 released.

(b) Releases relay T2.

Relay T2 released:

(a) Activates 5.5-second TM1 timer which operates relay T1.

Relay T1 operated:

(a) Locks operated to relay T4 released.

(b) Activates 1-second TM2 timer which operates relay T2.

(c) Returns on-hook supervision.

Relay T2 operated:

(a) Deactivates TM1 timer after relay T1 releases.

(b) Operates relay T4.

Relay T4 operated:

(a) Locks operated to off-normal ground.

(b) Holds operated relay T3 until relay T2 releases.

(c) Deactivates TM1 timer after relay T2 releases (through XE option).

(d) Releases relay T1.

Relay T1 released:

(a) Returns off-hook supervision.

(b) Deactivates TM2 timer which releases relay T2.

Relay T2 released:

(a) Releases relay T3.

14.03 Release of the S relay will release relay ST and restore the circuit to normal.

15. SUBSCRIBER LOOP TEST LINE

15.01 The operation of Fig. 1 and the associated figures for the subscriber loop test is similar to that described for the milliwatt test line, with the exception that Fig. 55 (Mfr Disc.) and Fig. 56 are used instead of Fig. 10. This provides a 2-minute (Mfr Disc.) or a 60-second timing cycle instead of the 10-second cycle.

16. CROSSBAR NO. 5 4-WIRE CONNECTING CIRCUIT

16.01 Fig. 58 provides a combined connecting circuit with an appearance at the trunk link and the line link frame. A call from a subscriber outgoing or an intertoll trunk through, for a test line, appears at the trunk link frame. Calls from an inter-

toll trunk terminal, for a test line, appear at the line link frame.

16.02 For a test line arranged similar to Table A, Item 7, the operation of Fig. 58 is as follows.

16.03 Any call appearing at the trunk link or line link frame must see an idle test line in order to complete. If the BY relay is operated by any previous call, the marker will recognize the busy condition by an open condition of the FT lead and a ground on the S lead of the number group. There is an FT lead for each trunk link frame and an S lead for the number group for each trunk link and the line link frame on which the test line appears. Each idle test line supplies a ground on the FT lead through the contacts of the released BY relay. The S lead to the number group of the trunk link and line link, that associates with the test line, has -48 volts with a 1600-ohm series resistor for an idle condition.

CALL APPEARING AT TRUNK LINK FRAME

16.04 Upon a call appearing at the trunk link frame, the marker will check the condition of the FT, F, and BT leads for an idle condition, selecting one of the frames with available test lines, and supplies a ground on the F lead to all test lines of the type appearing on the frame. This ground reaches the inner end of the F relay winding through closed contact of the BY relay in each test line that is idle. The marker then determines which of the test lines is idle by looking for ground on the individual BT lead through the low resistance F relay winding. The marker having selected an idle test line, supplies battery on the BT lead to operate relay F which locks to the F lead through its own contacts. Relay F operated:

(a) Operates BY relay.

(b) Connects ground to the FA lead which will operate the trunk auxiliary relay in the trunk link frame circuit.

(c) Connects a ground from the marker over the S1 lead to operate S1 relay if the call is from a subscriber line or connects a ground from the marker to the RC lead to operate TM relay if the call is an intertoll through type.

16.05 Assume that a call is at the trunk link and S1 lead is grounded. S1 relay operates. The S1 lead grounded is an indication to the test line that the call at the trunk link is a subscriber outgoing call. Relay S1 operated:

(a) Closes a 10-ohm ground to the S lead of the trunk link circuit.

(b) Closes a second operating path for the BY relay.

(c) Opens the path between lead MB and the B1 lead to prevent the origination of a test call from the master test frame.

(d) Connects a ground to a contact of S relay for a future locking path of S1 relay.

(e) Disconnects 1600-ohm battery from S lead to the number group for a busy indication.

(f) Grounds H lead to Fig. 1. (See SECTION II, 1., for a description of Fig. 1.)

(g) Grounds TM lead to Fig. 9. (See SECTION II, 2., for a description of Fig. 9.)

(h) Closes a path for T1 and R1 leads to the T and R leads of first Fig. 4.

(i) Closes a path for T and R leads to the T1 and R1 leads of second Fig. 4.

Relay BY operated:

(a) Disconnects a ground from the FT lead.

(b) Opens the operate path of F relay.

(c) Opens the operate path of the LS relay to the S lead to the line link frame.

16.06 The marker is now satisfied and removes ground from F lead and battery from BT lead allowing F relay to release. Relay F released:

(a) Removes a ground from the FA lead which releases the trunk auxiliary relay in the trunk link frame circuit.

(b) Removes the operate path to S1 relay. S1 relay is slow release, and during the release interval, the S relay has operated and provides a locking path for S1 relay.

Relay S operated (from closure through network):

(a) Closes a locking path for S1 relay. Relay S1 is made slow-release to hold over the interval between release of the F relay, the release of the trunk auxiliary relay, and the operation of S relay.

16.07 The test line provides a 1-mW connection to the T and R leads for 10 seconds, followed by a termination for 1 second due to the timed battery at Fig. 1.

16.08 When the calling end disconnects and the test line is in the supervision interval of on-hook for 1 second out of 10, the T1 and R1 leads to double winding S relay will be released by the trunk link circuit and release S relay. Relay S released:

(a) Releases S1 relay.

Relay S1 released:

(a) Removes 10-ohm ground from S lead to release the network connection.

(b) Removes ground from H lead to Fig. 1. (See SECTION II, 1., for description of Fig. 1.)

(c) Removes ground from TM lead to Fig. 9. (See SECTION II, 2., for a description of Fig. 9.)

(d) Releases BY relay.

(e) Partially closes battery with 1600-ohm resistance in series for the S lead to the number group.

(f) Closes MB lead and B1 lead path.

Relay BY released:

(a) Connects a ground to the FT lead.

(b) Completes the path for battery, with 1600-ohm resistance in series, for the S lead to the number group.

(c) Closes an operate path for F relay from the F lead.

(d) Closes S lead operate path to the LS relay from the line link frame.

16.09 The combined connecting circuit is now in condition to handle a call from the trunk link or the line link frame appearance.

16.10 Assume a call at the trunk link appearance and the RC lead is grounded indicating an intertoll trunk through call. The RC lead grounded operates TM relay. Relay TM operated:

(a) Operates BY relay.

(b) Operates H relay through operated F relay to ground.

(c) Opens a circuit between the MB and B1 leads to prevent the origination of a test call from the master test frame.

(d) Removes -48 volts and 1600-ohm series resistance from the S lead to the number group.

(e) Connects a ground to H lead to Fig. 1. (See SECTION II, 1., for a description of Fig. 1.)

(f) Connects a ground to TM lead to Fig. 9. (See SECTION II, 2., for a description of Fig. 9.)

(g) Connects T1 and R1 leads to T and R leads of first Fig. 4 to terminate this transmission path.

(h) Connects C and D leads to Fig. 19 and to A, B, C, D, E, and F leads to Fig. 1, ZZ wiring. (See SECTION II, 1., for description of Fig. 1)

16.11 The A and B leads are connected through A conductor to T and R leads. On-hook and off-hook supervision over T1 and R1 leads is determined by the timed battery to Fig. 1. On-hook for 1 out of 10 seconds provides an interval so that the calling party may disconnect and release the test line. Relay H operated:

(a) Connects a ground to hold TM relay operated.

(b) Connects a ground to RC lead to indicate that TM relay has operated.

Relay BY operated:

(a) Removes ground from FT lead.

(b) Opens operating path to F relay.

(c) Connects ground to the S lead of the number group.

(d) Opens the S lead path to the line link frame to the LS relay.

16.12 After the trunk link circuit has determined that the test line is seized, the F relay releases. Relay F released:

(a) Removes a ground from the FA lead which allows the trunk auxiliary relay in the trunk link circuit to release.

(b) Releases H relay.

Relay H released:

(a) Connects a ground over S lead from trunk link circuit to hold TM relay operated.

16.13 The test line provides a 1-mW connection to the T and R leads for 10 seconds followed by a termination for 1 second due to the timed battery of Fig. 1.

16.14 When the calling end disconnects and the test line is in the on-hook interval, for 1 second out of 10, the on-hook supervision will allow the trunk link circuit to release, removing ground over the S lead and releasing TM relay. Relay TM released:

(a) Releases BY relay.

(b) Closes a path between the MB and B1 leads.

(c) Connects -48 volts and 1600-ohm series resistance to the S lead path to the number group.

(d) Removes a ground to the H lead to Fig. 1. (See SECTION II, 1., for a description of Fig. 1.)

(e) Removes a ground to the TM lead to Fig. 9. (See SECTION II, 2., for a description of Fig. 9.)

(f) Removes T1 and R1 leads' connection to T and R leads of Fig. 4.

Relay BY released:

(a) Connects a ground to FT lead.

(b) Closes on operating path to F relay.

(c) Removes a ground and connects -48 volts and 1600-ohm series resistance to the S lead to the number group.

(d) Closes the S lead path of the line link circuit to the LS relay.

16.15 The combined trunk link and line link connecting circuit is now in a condition to handle another call appearing at the trunk link or line link appearance.

CALL APPEARING AT THE LINE LINK FRAME

16.16 Upon a call at the line link appearance, a ground on the S lead operates the LS relay and indicates an intertoll terminal call. Relay LS operated:

(a) Operates BY relay.

(b) Operates LS1 relay.

(c) Removes -48 volts and 1600-ohm series resistance from the S lead to the number group.

(d) Opens the path between MB and B1 leads to prevent the origination of a test call from the master test frame.

(e) Closes C and E leads to Fig. 45.

(f) Connects T and R leads to Fig. 45 to recognize and trip ringing. (See SECTION II, 1.)

Relay LS1 operated:

(a) Connects a ground to the TM lead to Fig. 9. (See SECTION II, 2., for a description of Fig. 9.)

(b) Connects the T1 and R1 leads through Fig. 26, 2-dB pad, to Fig. 1. (See SECTION II, 1., for a description of Fig. 1.)

(c) Connects a ground to the H lead to Fig. 45. (See SECTION II, 1., for description of Fig. 45.)

Relay BY operated:

(a) Removes ground from FT lead.

(b) Opens operating path to F relay.

(c) Connects a ground to the S lead of the number group.

(d) Provides a locking path of LS relay over S lead to line link frame.

(e) Locks to operated LS relay.

16.17 When the calling end disconnects, the line link circuit removes ground from the S lead releasing LS relay. Relay LS released:

(a) Releases BY relay.

(b) Connects -48 volts and 1600-ohm series resistance for the S lead path to the number group.

(c) Closes the path between MB and B1 leads.

(d) Releases relay LS1.

Relay LS1 released:

(a) Removes ground from TM lead to Fig. 9.

(b) Removes ground from H lead to Fig. 45.

(c) Disconnects T1 and R1 leads from Fig. 26.

Relay BY released:

(a) Grounds FT lead.

(b) Closes an operating path to F relay.

(c) Removes a ground and connects -48 volts and 1600-ohm series resistance to the S lead to the number group.

16.18 The combined connecting circuit is now in a condition to handle a call from the trunk link or the line link frame appearance.

17. CROSSBAR NO. 5 TRUNK LINK CONNECTING CIRCUIT

17.01 Fig. 59 provides a connecting circuit with an appearance at the trunk link frame.

17.02 For a test line arranged similar to Table A, Item 300, the operation of Fig. 58 is as follows.

17.03 Any call appearing at the trunk link frame must see an idle test line in order to complete. If the test line is in use, the marker will recognize the busy condition by an open condition of the FT lead. Each idle test line supplies a ground on the FT lead through the contacts of the released S1 relay.

CALL APPEARING AT TRUNK LINK FRAME

17.04 Upon a call appearing at the trunk link frame, the marker will check the condition of the FT, F, and BT leads for an idle condition, selecting one of the frames with available test lines, and supplies a ground on the F lead to all test lines of the type appearing on the frame. This ground reaches the inner end of the F relay winding through closed contacts of relay S1 in each test line that is idle. The marker then determines which of the test lines is idle by looking for ground on the individual BT lead through the low resistance F relay winding. The marker having selected an idle test line, supplies battery on the BT lead to operate relay F which locks to the F lead through its own contacts. Relay F operated:

(a) Connects a ground from the marker over the S1 lead to operate relay S1.

(b) Connects ground to the FA lead which will operate the trunk auxiliary relay in the trunk link frame circuit.

17.05 The S1 lead grounded is an indication to the test line that the call at the trunk link appearance is a subscriber outgoing type call. Relay S1 operated:

(a) Closes a 10-ohm ground to the S lead of the trunk link circuit. The S lead with the 10-ohm ground holds the linkage for the duration of the test line call.

(b) Opens the operate path of F relay.

(c) Disconnects ground from the FT lead.

17.06 The marker is now satisfied and removes ground from F lead and battery from BT lead allowing F relay to release. When the switches are operated at the trunk link frame, the T and R leads are cut through. Battery on the T lead and ground on the R lead from the associated connecting circuit operates relay S. Relay F released:

(a) Removes ground from S1 lead. (The S1 relay is slow release and holds operated until the S relay is operated.)

(b) Removes ground from FA lead which releases the trunk auxiliary relay in the trunk link frame circuit.

(c) Opens the F lead.

Relay S operated:

(a) Closes the operate path to G and H leads to Fig. 1. (See SECTION II, 1., for a description of Fig. 1.)

(b) Closes a locking path for S1 relay. Relay S1 is slow release to hold over the interval between releases of the F relay, the release of the trunk auxiliary relay, and the operation of S relay.

17.07 The test line provides a 1-mW connection to the T and R leads, through 2-dB fixed pad, Fig. 26, for 10 seconds followed by a termination for 1 second due to the time battery at Fig. 1.

17.08 When the calling end disconnects, battery on the T lead and ground on the R lead is removed which releases S relay. Relay S released:

(a) Releases S1 relay.

(b) Opens the operate path to G and H leads to Fig. 1. (See SECTION II, 1., for a description of Fig. 1.)

Relay S1 released:

(a) Removes 10-ohm ground from S lead to release the switches in the trunk link circuit.

(b) Closes the operate path to the F relay.

(c) Connects ground to the FT lead.

17.09 The connecting circuit is now in an idle condition and ready to handle other calls.

18. AUTOMATIC INTERCEPT SYSTEM CONNECTING CIRCUITS

18.01 FS80, 81, and 82 provide the required connecting circuits for operation with the Automatic Intercept System (AIS).

18.02 Upon seizure by the incoming trunk circuit, relay L operates on both windings and returns on-hook supervision. After relay ST operates from relay L or operator answers, off-hook supervision is returned.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

None.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
A	Conventional trunk relay designation
AC	Alternating current
BT	Balance termination
BY	Busy
CN	Coin (used in Fig. 48; nonoperated, open circuit termination; operated, short circuit termination)
F	Frame
FL	Flash
H	Hold
K	K lead
L	Loop supervision
LA	Loop-around
LO	Lock out
LO1	Lock-out auxiliary
LS	Line sleeve
LS1	Line sleeve auxiliary
OS	Oscillator start
OSA	Oscillator start auxiliary A
OSB	Oscillator start auxiliary B; or FS79, oscillator start balance termination test
OSI	Oscillator start intertoll termination
OSM	Oscillator start milliwatt test
OST	Oscillator start tandem termination
R	Ringing
R1	Ringing auxiliary
RV	Reverse
S & SL	Sleeve
S1	Sleeve auxiliary
ST	Start timing
SR	Slow release
TC	Talking charge (used in Fig. 48, 49, FS78; nonoperated, tandem termination; operated, intertoll termination)
TM	Timing or tandem
TM1	Timing auxiliary
T- (1 through 4)	Timing
W & Z	WZ timing combination

3. FUNCTIONS

3.01 Provides test lines per Fig. 1 (and A or B) supplying 1000-Hz tone at 1-mW level.

(a) Systems application of 1-mW test lines is shown in Table A on the schematic drawing.

(b) Provides for tripping machine ringing when required (Fig. 45).

(c) Provides optional off- or on-hook supervision for local office applications.

(d) Provides a timed interruption of the sending tone when required to permit disconnection in those cases where inband signaling or joint hold supervision is encountered.

(e) Provides compensation in the idle condition for office wiring loss so that the busy or idle condition will present the same load to the milliwatt supply circuit.

(f) Provides for 600- or 900-ohm test lines to match the nominal impedance of the circuit under test.

(g) Minimizes the possibility of ringing into the milliwatt supply by establishing the connection to the milliwatt supply only after ringing has been received and a tripping feature has been operated.

(h) Provides a 2-dB pad for use in offices switching at via net loss.

3.02 Provides a loop-around test line per Fig. 2 for use in one-man, 2-way testing.

(a) System application of the loop-around test line is shown in Table A on the schematic drawing.

(b) Provides for off-hook supervision in both directions after connections are established to both ends of the loop-around test line.

(c) Provides for ringing trip in those cases where ringing is present.

(d) Provides for combination 1-mW and loop-around test lines (Fig. 3).

(e) Provides connections for a feature, option YU, for disabling the loop-around circuit to prevent unauthorized usage.

3.03 Provides a test trunk per Fig. 7 for jack access on incoming trunks which do not have testboard appearances. It is used in making 2-way transmission tests.

(a) Systems application of the test trunk per Fig. 7 is shown in Table A on the schematic drawing.

(b) Provides for flashing the incoming call lamp on the associated desk when the test trunk is seized.

(c) Provides for operating the associated night alarm or auxiliary signal circuit.

(d) Provides for use with 24- or 48-volt lamps.

(e) Provides for tripping the ringing, and sending audible ringing tone until the incoming call is answered.

(f) Provides off-hook supervision when answered.

(g) Provides for cutting off the telephone circuit when a plug is inserted in the jack for measure or send.

3.04 Provides balance termination per Fig. 4 and 6 or 49 for use as a holding jack, repeater test line, or in making balance and noise tests.

(a) Systems application of the balance termination is shown in Table A on the schematic drawing.

(b) Provides optional off- or on-hook supervision for local offices.

(c) Provides means for tripping machine ringing.

(d) Provides 600- or 900-ohm terminations to match the nominal office impedance.

3.05 Provides short circuit terminations per Fig. 4 and 5 or 48 and open circuit terminations per Fig. 4 alone or Fig. 48 for use in testing repeaters.

(a) Systems application of short circuit and open circuit terminations per Fig. 4, or 4 and 5, or 48 is shown in Table A on the schematic drawing.

(b) Provides optional off- or on-hook supervision for local offices.

(c) Provides means for tripping machine ringing.

3.06 Provides in crossbar No. 5 offices for combining tandem and intertoll test lines by a mark from the marker circuit.

3.07 Provides for combination 1-mW, loop-around, and balance termination test line per Fig. 54.

(a) Provides option YA or YB for off- or on-hook supervision on the MW connection.

(b) Provides option YA or YB for off- or on-hook supervision on the balance termination connection.

(c) Provides for off-hook supervision only upon seizure of the loop-around connection.

(d) Provides means for tripping machine ringing.

(e) Provides connections for a feature, option YU, for disabling loop-around circuit to prevent unauthorized use.

3.08 Provides subscriber loop test lines using the loop checker generator connection per Fig. 1. This supplies a sweep frequency test signal varying between 1000 and 3000 Hz.

(a) Systems application of subscriber loop test lines is shown in Table A on the schematic drawing.

(b) Provides for tripping machine ringing (using Fig. 45).

(c) Provides a timed interruption of the test tone, when required, to permit disconnection in those cases where inband signaling or joint hold supervision is encountered.

(d) Provides compensation in the idle condition for office wiring loss so that the busy and idle conditions each present the same load on the loop checker generator.

(e) Minimizes the possibility of ringing into the loop checker generator by

establishing the connection to the generator only after ringing has been received and a tripping feature has been operated.

3.09 Provides balance termination per FS71 for use as a holding jack, repeater test line, or in making balance and noise tests.

(a) Systems application of the balance termination is shown in Table A on the schematic drawing.

(b) Provides 600- or 900-ohm terminations to match the nominal office impedance.

(c) Provides off-hook supervision for local offices.

(d) Provides means for tripping machine ringing.

(e) Provides, 175 milliseconds after seizure, a 5.5-second burst of 1000-Hz tone to verify connection from originating end.

(f) Provides (per options XI and XE) quiet termination until disconnect.

(g) Provides (per options XE and XF or XG) 5.5-second quiet termination, 1-second on-hook, then quiet termination, until disconnect.

(h) Provides (per option XD and XF or XG) 5.5-second quiet termination, 1-second on-hook, then quiet termination interrupted by 1-second on-hook every 30 seconds until disconnect.

3.10 Provides balance termination per FS77 and 78 for making balance and noise tests on trunks using No. 5 crossbar intertoll or tandem facilities.

(a) Systems application of balance termination is shown in Table A of the schematic drawing.

(b) Provides 600- and 900-ohm terminations to match the nominal intertoll and tandem nominal office impedance.

(c) Provides off-hook supervision.

(d) Provides, 175 milliseconds after seizure, a 5,5-second burst of 1000-Hz tone to verify connection from originating end.

(e) Provides 5.5-second quiet termination, 1-second on-hook, then quiet termination until disconnect.

3.11 Provides a test trunk per FS79 for making 1000-Hz balance termination or loop-around tests.

(a) Systems applications are shown in Table A of the schematic drawing.

(b) Provides 900-ohm terminations to match the nominal office impedance.

(c) Provides for tripping machine ringing.

(d) Provides off-hook supervision.

(e) Provides, for milliwatt tests, 175 milliseconds after seizure, 1000-Hz tone at the 1-mW level until disconnect.

(f) Provides, for balance termination tests, 175 milliseconds after seizure, a 5.5-second burst of 1000-Hz tone to verify connection from originating end. Then (per option XE), a 5.5-second quiet termination, 1-second on-hook, and quiet termination until disconnect, or (per option XD), a 5.5-second quiet termination, 1-second on-hook, and quiet termination interrupted by 1-second on-hook every 30 seconds until disconnect.

(g) Provides for loop-around tests when connections are simultaneously established to both the milliwatt and balance termination test lines.

4. CONNECTING CIRCUITS

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

MILLIWATT DISTRIBUTING CIRCUITS

(a) 2A Sending Panel - SD-95000-01.

(b) Milliwatt Distributing Circuit (Transistorized) SD-95277-01.

JACK CIRCUITS

(a) Switchboard No. 1, 1C, 1D, 2, 9C, 9D, 10, or 11 - SD-15345-01 or SD-90468-01.

(b) Switchboard No. 12 - SD-15441-01.

(c) Switchboard No. 1, 13C, 13D, 14C, 14D, 15C, or 15D - SD-90468-01.

(d) Switchboard No. 5, 5C, or 5D - SD-68053-01.

(e) Toll Switchboard No. 1, 1B, 3, 3B, 3C, 3CF, 3CL, or Toll Tandem No. 1 or 3 - SD-64545-01 (Mfr Disc.).

(f) Sending Jack Circuit - SD-95101-01.

(g) Operating Room Desk No. 19 - SD-90526-01.

(h) Information Desk No. 2 Supervisors Multiple Jack Circuit - SD-90074-01.

(i) PBX Systems Jack Circuit - SD-65778-01 (typical).

INTERRUPTER CIRCUITS

(a) Panel - GCO - SD-21666-01.

(b) Panel - BCO - SD-21667-01.

(c) Step-By-Step - SD-31606-01.

(d) Crossbar No. 1 or Tandem - SD-25062-01.

(e) Crossbar No. 5 - SD-25814-01.

(f) Toll or Manual - SD-95078-01.

(g) Relay Interrupter - SD-95036-01.

(h) Flashing Circuit - SD-95725-01.

(i) Signaling Circuit 30, 60, or 120 IPM - SD-80771-01.

(j) Toll System 4, 4A, or 4M - SD-68058-01.

(k) Switchboard No. 1260 or 120-IPM Relay Interrupter Circuit - SD-14163-01.

(l) Type F and G Trunk Equipment Busy-Back, Reorder, and Relative Interrupter Circuit - SD-15228-01.

(m) 806 Ringing Power Plant - SD-81337-01 (typical for PBX Systems).

PANEL CIRCUITS

(a) Subscribers Line Circuit - GCO - ES-240292 or SD-21715-01.

(b) Subscribers Line Circuit - BCO - SD-21712-01.

(c) Miscellaneous Circuits for District Selector Test Frame - SD-21222-01.

(d) Automatic Trunk Test Circuit - SD-95889-01.

STEP-BY-STEP CIRCUITS

(a) Connector Bank Multiple Circuit - SD-32128-01.

(b) Selector Bank Multiple Circuit - SD-32123-01.

(c) Connector Test Line - SD-32198-01 or SD-31857-01.

(d) Transmission Test and Switchmans Talk Line - SD-32021-01.

(e) Automatic Trunk Test Circuit - SD-32206-01.

(f) Automatic Trunk Test Circuit - SD-32315-01.

(g) Manual OGT Test Frame Test Circuit - SD-32349-01.

CROSSBAR NO. 1 CIRCUITS

(a) Subscriber Line, Line Link, and Controller Circuit - SD-25553-01.

(b) Number Group Connector Circuit - SD-25276-01.

(c) Line Choice Connector Circuit - SD-25034-01.

(d) Miscellaneous Circuits District Junctor Test Frame - SD-25173-01.

(e) Automatic Trunk Test Circuit - SD-95889-01.

CROSSBAR NO. 5 CIRCUITS

(a) Line, Line Link and Connector Circuit - SD-25548-01.

(b) Miscellaneous Circuit for Master Test Frame - SD-25762-01.

(c) Trunk Link Circuit - SD-26032-01.

(d) Miscellaneous Circuit for All Frames - SD-25574-01.

(e) 4-Wire Line, Line Link and Marker Connector Control Circuit - SD-26036-01.

(f) Trunk Link Circuit for Use With 4-Wire Trunks - SD-26037-01.

CROSSBAR TANDEM CIRCUITS

(a) Office Link and Connector Circuit - SD-25033-01.

(b) Miscellaneous Circuits for Tandem Sender Test Frame - SD-25377-01.

(c) Miscellaneous Circuits for Tandem Trunk Frames - SD-25370-01.

(d) Miscellaneous Circuits for Tandem Trunk Automatic Test Frame - SD-25378-01.

TOLL SWITCHING SYSTEM NO. 4, 4A, OR 4M

(a) Miscellaneous Circuits for Automatic Toll Connecting Trunk Test Frame - SD-68209-01.

(b) Automatic Outgoing Intertoll Trunk Test Circuit - SD-68404-01.

(c) Test Line Circuit - SD-68545-01.

(d) Inclusive Sender Test Circuit - SD-68491-01.

COMMON SYSTEMS CIRCUITS

(a) Test Termination Circuit - SD-96540-01.

(b) Local Test Desk No. 12 or 14 or Wire Chief Desk No. 2 - ES-96233-01 (Special Application Only).

(c) Miscellaneous Circuits for OGT Test Circuit - SD-95525-01 or SD-25451-01.

(d) ROT Hunting One Ring Connector (connector multiple) - SD-66144-01 (typical for PBX).

(e) 60A Control Unit - SD-99331-01.

AUTOMATIC INTERCEPT SYSTEM (AIS) CIRCUITS

(a) Incoming-Outgoing Trunk Circuit - SD-1B185-01 (typical incoming trunk circuit).

(b) Key, Telephone, and Supplementary Maintenance Circuit - SD-1B254-01.

AUXILIARY SIGNAL CIRCUITS (TYPICAL FOR USE WITH FIG. 7)

(a) Local Test Cabinet No. 3 - SD-96230-01.

(b) OGT Test Frame - SD-96410-01.

(c) 20-Type Key Cabinets - SD-95407-01.

(d) Transmission Test Line Termination - SD-67025-01 (typical for PBX).

KEY AND LAMP CIRCUITS (TYPICAL FOR USE WITH FIG. 7)

(a) Local Test Cabinet No. 3 - SD-96182-01.

(b) OGT Test Frame - SD-95524-01.

(c) 20-Type Key Cabinets - SD-95404-01.

(d) Transmission Test Line Termination - SD-67025-01 (typical for PBX).

TEST SETS

(a) 2AB Auxiliary Transmission Measuring Set - SD-95253-01.

(b) Transmission Measuring Sets Such as 9A, 12B or 13A.

OTHER CIRCUITS

(a) Repair Clerk Desk No. 2 Telephone Circuit - SD-95717-01.

(b) Loop Checker Generator Circuit - SD-99709-01.

(c) Testing Circuit for E-Type Signaling Circuits - SD-96533-01.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 The milliwatt test line is changed to provide a nominal 175-ms delay in the application of the milliwatt to avoid difficulties with the single-frequency (SF) equipment.

A.2 A new balance test line is added, with a timed test tone (1000-Hz milliwatt) indicating successful connection to the balance test line.

A.3 All on-hook supervision is rated Mfr Disc. except those test lines utilizing the loop checker generator circuit, items 13, 60, and 119 in Table A of SD-98100-01.

A.4 A combination loop-around, milliwatt, balance termination test line is added providing both the timed test tone in the balance mode and the nominal 175-ms delay in the milliwatt application.

A.5 Test lines are added to provide balance milliwatt and jack-ended testing for automatic intercept systems (AIS).

A.6 A balance termination test line is added for switchboards.

B. Changes in Apparatus

B.1 In order to provide the nominal 175-ms delay to exsisting milliwatt test lines, it was necessary to assign a letter designation to the OS relay in Fig. 1, 3, and 54. The OS relay is then superseded by a slow-release relay and an additional AK relay.

B.2 The A relay in Fig. 27 is designated either Fig. C or Fig. D to extend the range over which test lines in step-by-step offices may be used.

B.3

Superseded	Superseded By
A relay, AJ1, Fig. 27, Fig. C (Mfr Disc.)	A relay, AJ29, Fig. 27, Fig. D
OS relay, AF134, Fig. 1, Fig. A	OS relay, AG36, Fig. 1, Fig. B
OS relay, AF134, Fig. 3, Fig. E	OS relay, AG36, Fig. 1, Fig. B
OS relay, AJ5, Fig. 54, Fig. G	OS relay, AG36, Fig. 54, Fig. H

B.4 Option XB is added for step-by-step offices arranged for automatic timed release of calling party holds.

B.5 New circuits FS71 to 85 and their associated App Fig. 71 to 85 are added to provide timing functions and connecting circuits described in A.2 and A.4 through A.6.

B.6 Added

OSA & OSB relays, AK4, Fig. 1, Fig. B

OSA & OSB relays, AK4, Fig. 3, Fig. F

OSA & OSB relays, AK4, Fig. 54, Fig. H

AL diode, 446F, XB option

App Fig. 71 through 85

D. Description of Changes

D.1 The following changes were made on a B basis and were previously forwarded to the WECo on LDIs 18A, 18B, 18C, 18D, and 18E.

D.2 In Fig. 1, 3, and 54, the OS relay has been removed from the figure and redesignated Fig. A, E, and G, respectively. Fig. B, F, and H are added to optionally provide a nominal 175-ms delay in application of the milliwatt tone after the test line is seized. This delay is required where this test line may be used to test trunks having certain types of E signaling units.

D.3 Option XB was added to Fig. 7 to prevent premature disconnect of the jack-ended test trunk in step-by-step offices arranged for automatic timed release of calling party holds.

D.4 Item 122 in Table A is added to provide access to the milliwatt test line from the No. 1 Crossbar DID Test Circuit for testing PBX lines.

D.5 A new balance test line is added which provides a timed burst of 1000-Hz milliwatt tone as verification of connection to the test line. The circuit which is added to provide the desired time intervals is entitled, Balance Termination and Test Tone Timing Circuit (FS71). The required time intervals are as follows:

(a) 175-ms delay from the time off-hook supervision is returned, to the application of the 1000-Hz milliwatt verification tone.

(b) 5.5 seconds of verification tone.

(c) 5.5 seconds of quiet termination in either 600 or 900 ohms.

(d) 1 second return of on-hook.

(e) Off-hook quiet termination until test line is dropped (XE option).

In offices with joint holding, (a) through (d) are identical to the above.

(f) 30 seconds of off-hook quiet termination.

(g) 1 second return of on-hook.

(h) Continuous cycling between (e) and (f) until test line is dropped (XD option).

In step-by-step systems, (a) through (c) are identical with the above sequence. Item (d) is quiet termination until test line is dropped (XI option).

D.6 A new balance test line is added for crossbar No. 5 intertoll and tandem combined. The circuit title is Balance Termination and Test Tone Timing Circuit for Crossbar No. 5 Intertoll and Tandem Combined (FS77). This circuit provides the required timing sequences as explained in D.5 (XE option) and the appropriate connections to the switching system.

D.7 A new 2-port combination test line is added, entitled, Combination Loop-Around Milliwatt and Balance Line Timing Circuit (FS79). This circuit provides a 175-ms delay in application of the milliwatt test tone on both the milliwatt port and the balance port. If the milliwatt port is the one seized, then milliwatt power is applied until the test line is dropped. If the balance port is seized, the timing sequences explained in D.5 are available. If either port is held and the vacant port is seized, a loop-around mode is achieved.

D.8 Three new connecting circuits are added to provide balance, milliwatt, and jack-ended testing for the automatic intercept systems (AIS). The circuits are:

(a) AIS Connecting Circuit for Balance Termination Test (FS80).

(b) AIS Connecting Circuit for Milliwatt Test (FS81).

(c) AIS Connecting Circuit for Jack-Ended Test.

D.9 A new balance termination test line is provided for switchboards by the addition of three new connection circuits:

(a) Switchboard No. 3, 3C, 3CF, or 3CL Jack Connecting Circuit (Mfr Disc.), Toll TDM Switchboard No. 3 or 3B (FS83).

(b) Toll Switchboard No. 1 or 2 or Switchboard No. 1C, 1D, 10, or 11 With Outward Toll In-Line Jack Connection Circuit (Mfr Disc.), Toll TDM Switchboard No. 1 or 1B (FS84).

(c) Switchboard No. 5, 5C, or 5D, Jack Connecting Circuit (FS85).

D.10 The following connecting circuits were added to provide access to FS71 and/or FS79 by the indicated system.

(a) Step-By-Step Sub-Line Connecting Circuit (FS72).

(b) Panel GCO Connecting Circuit (FS73).

(c) Panel BCO Connecting Circuit (FS74).

(d) Crossbar Tandem Connecting Circuit (FS75).

(e) Step-By-Step Tandem Connecting Circuit (FS76).

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