118

CROSSBAR SYSTEMS
NO. 3
TEST CIRCUIT

CHANGES

D. Description of Changes

D.01 A permanent battery supply is provided for the AT, CO, CCC, and LAC lamps (option ZE) or LEDs (option ZF). It permits CSACS (TASC) control of the indicators and also prevents a ground sneak path via other lamps or LEDs associated with the same battery bus from sending false indications back to CSACS (TASC).

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-DAJ

WE DEPT 45820-GJH-WEA-GLW

Printed in U.S.A.

CROSSBAR SYSTEMS
NO. 3
TEST CIRCUIT

CHANGES

B. Changes in Apparatus

B.01 Added

M1 Lamp - PS911 - Fig. 18A - Option ZK

552B (GR) - PS911 - Fig. 18A - Option ZL
Light Emitting Diode

2 - 446K Diodes - 911-0, 911-1 - Fig. 18 -
Option ZM

D. Description of Changes

D.01 Incorporate options ZK, ZL, and ZM throughout schematic as follows:

Option ZK - FS18
Option ZL - FS18
Option ZM - FS1, 18, 300

F. Changes in CD SECTION III

F.01 Under 2.05 Lamps add the following:

PS911 Permanent Signal 911 trunk

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-DAJ

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CROSSBAR SYSTEMS
NO. 3
TEST CIRCUIT

CHANGES

B. Changes in Apparatus

B.01 Added

LPS1-7 - ED-94823-( ) G162 - Component Assembly

Note: These component assemblies were previously shown as option ZE.

D. Description of Changes

D.01 In FS201 diodes BL0,1,2,3,4 reference of option ZE is removed.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-DAJ

WE DEPT 45820-LG-WEA-GLW

CD-26411-01
ISSUE 2
APPENDIX 2B
DWG ISSUE 9B
DISTN CODE 1C05

CROSSBAR SYSTEMS
NO. 3
TEST CIRCUIT

All Circuit Description modifications were included in Issue 2.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-GFC

WE DEPT 25820-LG-GWC-CB

CIRCUIT DESCRIPTION

CD-26411-01
ISSUE 2
APPENDIX 1AR
DWG ISSUE 8AR
DISTN CODE 1C05

CROSSBAR SYSTEMS
NO. 3
TEST CIRCUIT

All Circuit Description modifications were included in issue 2.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-GFC

WE DEPT 25820-LG-GWC-CB

CROSSBAR SYSTEMS
NO.3
TEST CIRCUIT

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SECTION I - GENERAL DESCRIPTION

Note: The reference lamp is a M1 type lamp option ZE or a light emitting diode (LED) option ZF.

1. PURPOSE OF CIRCUIT

1.01 The test circuit is designed to perform various maintenance operations in a No. 3 Crossbar Switching System.

1.02 The principal functions of the test circuit are:

(a) Originate and/or terminate calls on service linkage under any of various customer and/or connecting office conditions.

(b) Control the selection of lines, registers, markers, trunks.

(c) Manual pulsing ability for multifrequency and dial pulse including the various critical operational tests.

(d) Provide a synchronous test line for incoming and intraoffice type trunks.

(e) Provide critical operating requirements for trunks and common equipment.

(f) Indicate office alarms.

(g) Provide a lamp field for indicating trouble conditions (as encountered) for markers and stuck sender-trunk identifier.

(h) Provide jacks or keys to remove common equipment and trunks from service.

1.03 The test circuit also has several optional features that are provided in plug-ended units as follows:

(a) A voltmeter circuit that utilizes a patching arrangement at distributing module for performing various line tests on customer lines and trunks.

(b) A sender test circuit that, when patched to a sender (dial pulse or multifrequency) will accept each digit as outpulsed and light corresponding lamp in lamp display panel.

(c) A transmission test package providing a one-milliwatt supply (900 ohms) used with a jack ended circuit for manual 2-way tests and incoming combined loop around and balance test. Also provided is a termination for an "open" circuit a termination for a "short" circuit.

(d) A TOUCH-TONE® test circuit that provides frequencies for manual pulsing into originating registers. Several critical test functions are also provided.

(e) Remote and/or local permanent record on magnetic tape trouble recording which provides ability to send trouble records to a distant maintenance center where the record is displayed on the trouble analyzer and display panel.

(f) Remote make-busy and restore circuit that provides the remote maintenance location the ability to take trunks and common equipment out of service.

2. GENERAL DESCRIPTION

2.01 All test calls are established as service calls on service linkage. Therefore it is necessary to originate and/or terminate calls with dedicated line link locations used exclusively for testing. The incoming call testing is accomplished using any incoming trunks through patching arrangement.

ORIGINATING TEST LINE

2.02 This line enables the test circuit to originate calls under various controlled conditions to test originating registers. Tests of trunks, common equipment, and miscellaneous functions will be performed using this line by pulsing assorted digit combinations that directs call into desired areas. This line has capability of changing class of service and ring combinations. Various calling customer conditions may be imposed on the tip and ring leads by a remotely located loop and leak circuit and a No. 3A pulse generator. The dedicated line location for the OTL is LLO, LBO, LGO, LO (referred to as 000).

TERMINATING TEST LINE

2.03 This line provides a termination for incoming and intraoffice trunks where called customer conditions can be imposed over the tip and ring leads by various key operations. Ring potential and polarity can be verified by observing lamps. The dedicated TTL line location is LL1, LBO, LGO, LO (referred to as 100).

INCOMING TEST LINE

2.04 This portion of the test circuit provides various pulsing and line conditions that can be imposed on tip and ring

leads to incoming trunks and on to the incoming registers using a patching arrangement. (Loop and leak ability is also provided by patching through remote unit.) Multifrequency and dial pulsing directs calls to desired areas. The E and M supervision is also provided.

INCOMING - INTRAOFFICE TRUNK TEST

2.05 This portion of the test circuit provides an automatic test sequence performed on the trunk that was used to access it. A dedicated line location with a directory number is assigned to it. If call was originated in test circuit, lamps will indicate test progress. On other than test circuit calls various audible signals are returned to indicate test progress.

TRANSMISSION TEST LINES

2.06 A jack ended circuit (101TM) is provided to allow distant test employee to terminate into test circuit where manual transmission tests can be made far-to-near or near-to-far. A directory number is assigned to this function.

2.07 A short circuit termination is provided to return an ac short circuit across the tip and ring back toward originating end. A directory number is assigned to this function.

2.08 An open circuit termination is provided to give an ac open termination but allow a dc path for supervision toward originating end. A directory number is assigned to this function.

2.09 A combined milliwatt, loop around, and balance termination test line is provided for testing into No. 3 office. Two directory numbers are assigned. The first acts as a milliwatt test line which returns 1000-Hz tone at 1-mW level. The second provides a balanced termination. When both lines are called loop around ability is provided to allow comparison tests of trunks used.

PATCHING ARRANGEMENTS

A. TST Jack (CDM)

2.10 When it is desired to originate a call from a line other than OTL, a patch is established from jack TST located at CDM to desired line. This patch may be inserted into 303-type connector (remove protector) or directly onto tip and ring of desired line location. In either case when plug is inserted into jack TST the OTL is replaced by desired line and test circuit is ready.

B. ORDL - IRDL Jack

2.11 When it is desired to pulse test call from another source using handset, TOUCH-TONE instrument, pulse generator, etc, the external source is patched into jack ORDL or IRDL.

C. ITT Jack

2.12 To test incoming registers/trunks, a patch is made from T jack of desired trunk into ITT jack. Operation of key ITT then presents that trunk tip and ring into the incoming test line of test circuit.

D. SP Jack

2.13 This jack is provided at all frames and can be used for various functions including talking path, E and M pulsing path for testing incoming trunks and extension of loop pulsing path when desiring to locate external pulsing source at any other frame location.

TEL A AND TEL B

2.14 These jacks are used to converse with anyone that calls test circuit telephone line as there is no handset. These jacks are located on other frames around office to allow test employee to move to other locations and still converse with distant end.

REMOTE CONTROL JACK

2.15 This jack allows test circuit to be controlled from another frame using a 32A test set.

VMT T AND VMT R JACK

2.16 These jacks located on CDM allow test employee to use test circuit voltmeter to test or observe customer lines and trunks. Removal of protector from 303 connector and insertion of patch puts meter on tip and ring leads.

TST JACK (SENDER)

2.17 This jack located in each sender allows monitoring of the senders outpulsing using the test circuit. A patch between TST

jack of sender and SP jack puts the test circuit receivers at output of sender. When sender outpulses, lamps will be lighted at test circuit.

101 TM JACK

2.18 When this jack is patched to jack 1000-0-900, 1-mW tone is sent to distant test employee after call has terminated. Other 2-party tests can be performed.

TAD JACK

2.19 Provides access to trouble record sender when trouble analyzer and display unit is used on a local basis.

ALARMS

2.20 A lamp display indicates several alarm conditions that are controlled by the connecting alarm circuit. When an alarm becomes apparent a relay operates in alarm circuit which lights a lamp on test circuit (if alarms are transferred, the alarm leads are cut through to trouble recorder to be sent to central point) and sounds an audible alarm. Another lamp is lighted on test circuit to indicate aisle that alarm is located in.

TROUBLE INDICATING

2.21 Preferance relays for markers and SSTI are arranged so only one trouble record may be accepted at a time. When a request for trouble record is made and preference is granted (circuit appears busy to any other request) trouble indications operate and lock memory reed packs which in turn light a lamp on display panel.

2.22 The trouble record sender portion of test circuit (if provided) scans memory reed relays to transmit signals to TAD for permanent recording.

2.23 Provide preference for remote make-busy restore feature and test pattern request to indicate to TAD via trouble sender, all made busy circuits in office.

MISCELLANEOUS KEYS, LAMPS, AND JACKS

2.24 Various keys, lamps, and jacks are provided to perform functions such as make-busy, in-use, progress, transfer, alarm release, reset, etc, during maintenance routines.

VOLTMETER CIRCUIT

2.25 Various voltmeter tests, listed below, can be performed on customer lines or trunks by patching VMT-T and VMT-R jacks into 303 connector of desired line. The test employee has the ability to test "IN" (receipt of dial tone heard on speaker in test circuit) or test "out" which allows these tests to be performed:

(a) Check for shorts.

(b) Check for grounds and resistance.

(c) Customer line continuity.

(d) Customer line continuity on customer sets equipped with cold cathode tubes.

(e) Check for foreign battery.

(f) Ballistic capacity of line.

(g) Check for continuity on battery and ground trunks.

(h) Provide ability to converse with customer.

(i) Coin control.

(j) Ringing control.

SENDER TEST CIRCUIT

2.26 Sender outpulsing is checked by patching the senders TST jack to SP jack. With proper keys operated and trouble recorder preference chain normal a test call is started from test circuit into sender to be checked. When sender is seized and supervision is completed test circuit responds to prepare for receiving DP or MF outpulsing. As sender outpulsed test circuit

receives pulse and proceeds to light corresponding lamps on display panel. A steering circuit enables all digits to be received and displayed except KP pulses until and including ST pulse. Up to 21 digits can be displayed during certain ANI outpulsing.

"TOUCH-TONE" TEST

2.27 Test of TOUCH-TONE receivers can be performed using pulsing pad on test circuit. Normal pulsing of TOUCH-TONE digits is performed after dial tone is requested. Complete marginal testing functions are performed using FCA and FCB/MF switches along with pulsing pad to insert critical requirements on tip and ring to the originating register.

3. DESCRIPTION OF TESTS

GENERAL

3.01 The test circuit provides facilities for overall circuit operational tests of equipment in a No. 3 crossbar office. Tests are made by originating calls on a one at a time basis from an originating test line (OTL) or at an incoming trunk using a patching arrangement with the incoming test line (ITL). The test circuit is connected to an originating or incoming register in the same manner as on a regular service call depending on the type of test being made. Once the test circuit is connected to the register the test employee outpulses into the connected register. When dialing is complete the register seizes a marker which proceeds to set up the required connection based on digits pulsed into the register. The connection established depends on the test being performed and the results desired. A terminating test line (TTL) is provided for directing test call into the test circuit so that various operating features can be checked. The test circuit can direct test calls to specific pieces of equipment by making the idle undesired equipment appear busy, and the desired equipment appear idle at the time selection is being made.

DIAL TONE TEST

3.02 A call is originated either from the OTL or from a particular line using a patching arrangement. The call may be directed to select a particular originating register or particular trunk switch or both. Control of marker selection, trunk switch selection and register selection is provided by keys and switches. When the register is attached, dial tone will be received and the call may be released if no further tests are to be made.

MARKERS

3.03 Markers are tested by pulsing specific digits that direct calls into particular areas. A trouble record may be taken to verify actions taken by markers in processing the call. The record is taken prior to releasing the F relay in register or trunk by the marker.

ORIGINATING REGISTERS

3.04 Testing of originating registers is accomplished following the receipt of dial tone. Various digit combinations are pulsed in the register that cause it to react accordingly. Pulses are generated by the dial or TOUCH-TONE pad on test frame or they can be generated by an external source (3A pulse generator, or equivalent, handset, etc) plugged into ORDL jack. When dialing is completed a marker is attached to process the call. A trouble record can be requested to verify action in marker and to verify digits sent to marker are the same as those dialed.

INTRAOFFICE TRUNKS

3.05 Testing intraoffice trunks is performed by pulsing digits of intraoffice code followed by directory number of TTL after receiving dial tone. Control of called-end supervisory and charge conditions can be imposed through TTL and can be observed by watching test lamps. If call is made using OTL, control of calling end supervision can be performed. Pretrip and trip ringing tests can be made in any case.

REVERTING TRUNKS

3.06 Testing reverting trunks is accomplished by originating a call from OTL and after dial tone, pulse the intraoffice code followed by directory number of OTL into the originating register. When marker sets up to reverting trunk tone is returned at test circuit as an indication that station digit can be pulsed. The ringing combination of OTL can be varied to make check of all ringing codes. Pretrip and trip ringing tests can be made after observing ringing lamps.

OUTGOING TRUNKS

3.07 Tests of outgoing trunks are made on a call-through basis to distant end terminating test line. Pulsing digits of the various office codes (and area codes, if necessary) followed by digits of terminating test line allow calls to complete. Observance of various lamps indicate supervisory functions.

SENDER TEST

3.08 Sender tests can be performed in two ways.

(a) Originate a call from the OTL. After dial tone is received, pulse the outgoing route office codes followed by digits of the terminating test line located in that distant office. Several calls, using different office codes, are necessary to check all outpulsed digit combinations and various types of supervision including ANI codes.

(b) When sender test circuit is provided, a patch arrangement is made from sender TST jacks to the SP jack on its frame upright. Sender must be selected by keys and switches. A call is originated from OTL. After dial tone is received, pulse a working distant office code followed by digits as desired. After supervision the sender proceeds to outpulse into the test circuit which "reads" each pulse and displays each digit, serially on the lamp LED or display panel. Multifrequency or dial pulse can be received. Keys are operated to set up test circuit to accept pulses. Critical operational tests, key controlled, are also provided.

INCOMING TRUNKS

3.09 Testing incoming trunks is accomplished by using a patching arrangement which presents the tip and ring to the test circuit ITL. A patch from trunk T jack to ITT jack or trunk jacks T1 and T2 to ITT and SP jacks after the trunk is made busy at distant office will allow the ITL to simulate originating end. Various conditions may be imposed or applied, by key operations, to the tip and ring or E and M leads to match the variety of different trunks. When seizure is applied toward trunk, it seizes an incoming register. Pulsing the directory number of TTL allows call to complete into test frame. A variety of tests can be performed by key operations to simulate supervision-ringing test, timed disconnect, etc.

INCOMING REGISTERS

3.10 Testing incoming registers is performed by establishing calls using incoming trunks. After the register is attached and digits are pulsed, a marker is seized. Verification of the registers action can be made by taking a trouble record when marker is processing the call to determine if digits and supporting information are correct. Pulsing from an external source may be done using IRDL jack.

LOOP AND LEAK TESTS

3.11 Performing loop and leak tests on incoming registers, originating registers, and reverting trunks can be accomplished through a patching arrangement involving the loop and leak unit mounted on the register frame and on external 3A pulse generator or equivalent and associated test sets.

TRANSMISSION TESTS

3.12 Performing transmission tests on outgoing trunks is accomplished by using the test circuit (OTL) to select outgoing trunk and dialing distant office codes followed by appropriate digits for test line termination. When call is completed to test line, the test employee in No. 3 office can send 1-mW by patching jacks 1000-900 to TM and operating key TM or patching jack TM to a transmission measuring test set to check level coming into No. 3.

SECTION III - DETAILED DESCRIPTION

1. DIAL TONE CONNECTION - SC1

Note: The reference lamp is a M1 type lamp option ZE or a light emitting diode (LED) option ZF.

GENERAL

1.01 With all keys and switches normal the test frame is nothing more than a telephone that allows outgoing calls to be dialed or pulsed and awaits terminating calls to arrive. Operating the ST compares to lifting a handset on a telephone.

1.02 Assigned a dedicated line location that is used for identification purposes on all test calls, the test frame enables the operator to request dial tone using any class of service.

1.03 The originating test line (OTL) that is used on all test calls has a dedicated line location of line link 0, line block 0, line group 0, line 0.

METHOD OF OPERATION

1.04 Operation of key ST causes relays ST and MMB to operate and lamp MMB to light. Operation of relay ST operates relay ONG which in turn operates relay MTR and along with operated MMB causes relay OLC to operate. With all keys normal relay MMB causes marker 0 relay MCB to operate which in turn operates its connector CB relays. Connector CB relays direct calls to available marker and in this case only marker 1 will be idle when test call comes through. Operation of relay MTR cuts through these test leads to marker 1 (if relay MTR is normal test leads are cut through to marker 0).

1.05 Relay MMB operated also causes TM7 to start which allows 700-770 ms for test to complete. The timer function is described in 1.12 to 1.14.

1.06 Operation of relay OLC causes relay FB to operate and also closes a loop to the line relay of OTL through the primary and secondary windings of relay S. The loop which has ground on the tip causes relay S to operate along with the line relay in the line link unit if polarity is correct. Relay S operated causes lamp S to light. To reverse polarity of relay S operate key PPK which operates relay PPK.

1.07 Relay FB operated lights lamp FB and also controls the make-busy control described later.

1.08 When the line relay operates, a request is made for a marker to attach an originating register to the line. When linkage is set from register to line, relay OS operates from ground on the sleeve which in turn operates relay OSA and lights lamp OS. Dial tone is also heard in the speaker and ORMB key lamp lights for seized registers.

1.09 When the marker is processing the call, the OTL line location is identified operating relay MK1 in the test circuit. Relay MK1 operates marker relay OTF. This test call identification will be described later.

1.10 Relay OSA operating releases relays FB (lamp FB is extinguished) and MMB along with lamp MMB. Relay FB normal restores make-busy control. Relay MMB normal turns off TM7 timer.

1.11 Relay OTF in the marker allows several test leads to be cut through which will indicate marker reaction during test call. Assuming nothing abnormal occurs on test call the marker on disconnect will operate its DISC relay. Ground on lead MRL from the marker causes the originating register to release and also operates relay MRL in the test circuit. Lamp MRL lights. Relay MRL operating causes relay DIS to operate. Relay DIS releases relay MK1. Relay MK1 releases marker OTF relay which in turn releases relay DIS in test circuit. Relay MRL releases and lamp MRL is extinguished when ground is removed from lead MRL.

TM7 TIMER - FS10

1.12 Timer operation is started when ground is removed from lead I by the operation of relay MMB, RB, and TRP. The length of time is controlled by the discharge of capacitor TM. When TM capacitor is completely discharged relay TM1 will operate causing relay TF to operate and it will also light lamp TF. For detailed operation of timer refer to SD-94820-01.

1.13 When relay TF operates it locks operated relay TM1. Relay TF operating:

(a) Holds OTL off-normal.

(b) Holds TTL off-normal.

(c) Release relay FB to restore make-busy control.

(d) Opens incoming test line.

(e) Opens operate path for marker relay TST.

(f) Opens operate path for relay MST.

(g) Opens TST lead into marker connector.

Relay TM1 operated:

(h) Holds TM7 timer off-normal.

(i) Releases relay MMB.

(j) Releases relay RB.

1.14 All functions listed in 1.13 are necessary to remove test frame operations from normal service functions of the markers.

CLASS-OF-SERVICE CONTROL - FS7

1.15 Proper routing of a call through the office requires a class of customer service. The OTL line location can provide any of 32 classes of service using the CS switch and one of four CS- keys. When the marker seizes a line number translator for the class of service of the OTL resistance battery (AF2) is applied to lead CSL to this circuit through line number 000. Depending on operated CS- key and setting of CS switch, one B-C- lead is returned to the line number translator allowing the resistance battery to operate BO-3 and BL-03 relays (normally a cross connect will provide this) and passed on to the marker to operate RC- and BL- relays. Marker relays RCO-7 and BLO-3 will operate marker relays CSO-7 and CSA or CSB which is then passed on to the originating register along with the calling line location.

1.16 The breakdown of all classes of service are:

CSA-DP
CSB-DP — Each one of these groups
CSA-TT — have associated CO-7 leads.
CSB-TT

TIP PARTY

1.17 To simulate a tip party customer on a 2-party line key TP is operated. With key TP operated a 1900-ohm ground is applied to the tip lead. When the originating register makes its 2-party test, relay 2P must be first operated by the marker, relay TPA will then be operated by 1900-ohm ground.

1.18 Key TP must remain operated during entire test call so that the second 2-party test made by the originating register is successful.

COIN OPERATION

1.19 To test coin function in the No. 3 crossbar office, the OTL must have an auxiliary coin line circuit cross connected to it at the CDM. If no spare auxiliary coin line exists coin test calls should be made from a line location arranged to work with coin substations. To perform this test the setup and functions of the test frame are described in 8. and SC8. The next paragraphs will describe coin functions as when the OTL has an ACL associated with it.

1.20 Prior to start of test key CND is operated to allow relay CD to monitor line for coin potential. Class of service (switch CS) is set to that assigned to coin class.

1.21 Operation of key ST starts for dial tone as described in 1.04 to 1.11. When relay OLC closes loop to OTL the LA relay operates in ACL circuit causing relay L to operate in line link. The marker is then seized and when it closes crosspoints the ACL relay OH operates which then causes other relays to function in ACL in preparation of called party answer as described in 2.35 and 2.36.

2. PULSING INTO ORIGINATING REGISTER - SC2

PULSING OPERATION

2.01 After hearing dial tone, the originating register is ready to receive pulsing in the form of dial pulses or TOUCH-TONE. Operation of key DIAL enables the use of a 20 pps dial located on the test frame and shown in FS4.

2.02 If TOUCH-TONE testing, App Fig. 103, is provided operation of key TT operates relay TT. Relay TT operated removes relay S from the loop (relay S releases extinguishing lamp S) cuts through leads to TOUCH-TONE oscillators and operates relay TTA. Relay TTA turns on oscillators and enables TT pad for pulsing.

2.03 Loop and leak tests on dial pulse or marginal tests on TOUCH-TONE will be described later.

2.04 Pulsing of office code and directory number as required is now performed to direct call to route or equipment to be tested. Most tests will be performed by pulsing the dedicated terminating test line (TTL) of the test frame.

TEST CALL IDENTIFICATION

2.05 Most test calls require the marker be controlled to some extent, such as when a particular originating register, sender, or trunk is to be selected or when the marker is to take a trouble record and others. In order to gain control the test call must be identified. This is accomplished by using an originating test line (OTL) that has a dedicated line location described in 1.03.

2.06 When the originating register is seized the line location making the call is identified by the marker which operates the registers storage relays LB-, LG-, and L-. On a test call from the OTL, register memory relays MBLBO, MBLGO, and MBLO are operated causing relay MBA to operate. Ground at the test frame through normal TST- and FB relays is present on lead MB- that is multipled to all registers. When the OTL memory relays are operated on register seizure ground on the MB- lead causes the MB relay to operate in that register as shown in FS11.

2.07 With its MB relay operated, the registers ST lead to the marker connector is transferred to the test frame MST relay as shown in FS10. When the register receives proper amount of digits it operates relay MST. Battery on lead STO operates test frame relay MST which locks through its own contact.

2.08 Relay MST operated causes relays FB and MMB to operate and lights lamp MMB and puts resistance battery on TSO-12 lead if switch TRK-SEL is operated, releases relay TT if operated, and prepares to operate marker TST relay all in FS10. In FS5 prepares for selection of a sender and in FS6 prepares lock path for marker reaction lamps.

2.09 Operation of relay MMB controls which marker is to be available by making unwanted marker busy as shown in FS15 and starts TM7 timer. Relay TB operated lights lamp FB, cuts through marker control leads and removes ground from MB- leads to originating register causing its MB relay to release.

2.10 When the originating register MB relay releases ST battery operates associated RS relay in marker connector to put in a bid for a marker. After the marker is seized, cut through relays in marker connector operate to pass information marks from register to marker. One such information mark is designated TST and has ground applied to it from the operated MBA relay as shown in FS10.

2.11 The TST lead ground is passed through the marker and on to the test frame on lead MK0 or MK1 depending on which marker is processing the call. At the test frame relay MK0 or MK1 will operate which in turn operates relay OTF in that marker to monitor all marker reactions on this test call (FS6).

2.12 At completion of its processing of the test call, the marker will release as described in 1.11.

CONNECTION TO TERMINATING TEST LINE - FS3

2.13 After dial tone is received, key DIAL or TT is operated depending on desired method of pulsing. The IAO office code and directory number of terminating test line is pulsed into originating register. When proper amount of digits are received the register will request a marker to process the call. When linkage is set up to the trunk, ground on the sleeve S lead will operate relay TS and light lamp TS. Ringing detector lamps T+, T-, R+, and/or R- will flash as ringing is applied and removed on tip and ring from the trunk.

2.14 The ringing that is received from the trunk can be varied over several test calls by changing the RING COMB switch to different positions. A ring combination is used on every call to TTL regardless of setting of RING COMBO switch. The circuit functions are similar to that described in 1.15 and 1.16 utilizing lead RTO from line number translator. Table A shows relationship between ringing combination and resulting ringing applied to line:

TABLE A

PARTY	DIGIT DIALED	OPERATED TRUNK RELAYS			RING COMB	RING COMB SWITCH POS	RING LAMP	CODE	0 1 2 3 4 5 6
		R2	R3	TPR					
1	2	O	O	O	O	OFF OR O	R-	CODE 1 GEN BR1	———
1	2	O	O	O	O	OFF OR O	R-	CODE 1 GEN BR2	———
1	2	O	O	O	O	OFF OR O	R-	CODE 1 GEN BR3	———
2	3	O	O	X	1	1	T-	CODE 1 GEN BR1	———
2	3	O	O	X	1	1	T-	CODE 1 GEN BR1	———
2	3	O	O	X	1	1	T-	CODE 1 GEN BR1	———
3	4	X	O	O	2	2	R+	CODE 1 +	———
4	5	X	O	X	3	3	T+	CODE 1 +	———
5	6	O	X	O	4	4	R-	CODE 2 GEN	— —
6	7	O	X	X	5	5	T-	CODE 2 GEN	— —
7	8	X	X	O	6	6	R+	CODE 2 +	— —
8	9	X	X	X	7	7	T+	CODE 2 +	— —
TIN		O	O	X	TEMP OR TBL INTERCEPT		T-	CODE 1 GEN	———
REG I		O	O	O	BLANK # OR REG INTERCEPT		R-	CODE 1 GEN	———

RINGING PRETRIP

2.15 After observing correct ringing interval and during the silent interval momentarily operation (approximately 2 seconds) of key PTP which operates relay PTP. Relay PTP operated connects a nonoperate condition of 2700 ohms to the trunk RT relay which should not operate. Release of key PTP releases relay PTP to restore ringing interval as observed on R+, R-, T+, and T- neon lamps which continue to flash.

RINGING TRIP

2.16 Momentarily operation of key TRP (approximately 1/2 second) operates relay TRP which connects an operate condition of 1740 ohms to the trunk RT relay causing it to operate.

2.17 Operation of trunk relay RT causes trunk relay RC to operate which stops ringing. Trunk relay CS could operate while relay TRP is operated.

2.18 Relay TRP releases when key TRP is released. Ringing lamps R+, R-, T+, and T- no longer flash. If ringing lamps continue to flash trunk relay RT did not operate and should be checked for its requirements.

PRETRIP FAILURE

2.19 If ringing lamp R-, R+, T-, and T+ do not continue to flash after release of key PTP as described in 2.15 trunks RT relay has operated on the nonoperate current value and should be checked for its requirements.

ANSWER CONDITION

2.20 Operation of key ANS operates relay ANS and turns on multifrequency generator shown in FS16. Operation of relay ANS disconnects ringing detection lamps from the loop and presents a loop of 1840 ohms including polarized relay TTL which will operate trunk relay CS and if polarity is correct relay TTL will also light. Relay TTL operated lights lamp TTL.

2.21 If positive battery is used on trunks, key RVT can be operated which will reverse the loop presented to relay TTL.

2.22 Trunk operations started by relay CS operating is continued after 685 to 800 ms when TM timer causes relay CH to operate. With relay MRP previously operated relay CH allows message rate potential to be applied to the sleeve for 225 to 830 ms which is the release time of relay MRP, (relay CH also causes relay MRP to release).

2.23 The message rate potential indicating trunk is in changed mode can be observed by the lighting of lamp RP/GB or TP/AK. These lamps are lighted as a result of the message rate potential applied to sleeve by trunk through the linkage and on to the OTL where electron tubes MRT and MRR are monitoring the sleeve. The breakdown of tubes MRT (tip party) or MRR (ring party) causes relays TP or RP to operate respectively. Relay TP or RP in operating causes TPA or RPA to operate which then lights the lamps.

2.24 When trunk relay MRP is completely released the message rate potential is removed from the sleeve restoring normal condition to electron tubes MRT or MRR and releasing relays TP or RP.

TRANSMISSION CHECK

2.25 Operation of key TONE allows 1700-cycle tone to be applied to the ring side of the line towards the trunk. Return ground through a 1-MF capacitor is applied to tip side of the line. The tone is heard on this speaker through the network. Restoration of key TONE removes tone from line.

SOAK TEST

2.26 Operation of key SOAK presents a 660-ohm (winding of relay TTL) loop to trunk CS relay to maintain its operation in a soak condition.

CALLED PARTY DISCONNECT

2.27 Release of key SOAK and operation of key RLS1 (simultaneously if possible) which operates relay RLS1 presents a 9840-ohm loop to trunk CS relay. Relay CS will release simulating disconnect.

2.28 Trunk operation continues if relay CS releases when after 685 to 800 ms the TM timer causes relay CH to operate. When relay CH operates it starts the slow-release (245 to 475 ms) of relay S1 that starts release of trunk by releasing trunk switch and channel crosspoints.

CALLING PARTY DISCONNECT

2.29 Using a handset equipped with a 310 plug and its key off-hook, insert plug into jack ORDL. Relay S releases extinguishing lamp S. Operation of handset key to its on-hook position removes the loop to trunk relay S releases which releases the L relay in line switch. This releases relay CO and crosspoints in line link.

2.30 With trunk relay S normal TM timer will operate relay CH in 685 to 800 ms. Trunk relay CH operated causes the release of trunk relay S1. Relay S1 is a slow-release relay with timing of 245 to 475 ms. When the S1 relay is released all channel crosspoints to the calling party are released causing relay OS to release. Relay OS releases relay OSA which extinguishes lamp OS.

TRUNK RELEASE

2.31 Release of crosspoints is indicated by release of relays TTL and TS followed by lamps TTL and TS extinguished.

2.32 The trunk at this time is not completely released because the OTL has not been released at the test frame.

2.33 In the No. 3 Crossbar System after conversation has been established and either party subsequently releases (the other party remains off-hook) the trunk does not completely release, however, it does appear to be idle if and when the marker looks for this trunk. If the marker then seizes the trunk in this condition, the party that remained off-hook will be put to lock-out at which time the party will receive overflow.

2.34 Release of ST key will restore test frame and trunk to normal.

COIN INTRAOFFICE CALL

2.35 After getting dial tone as described in 1.19 pulse TTL number into originating register. All functions are as described in 2.01 through 2.34 except additional functions for the auxiliary coin line circuit as follows. When lamp TP/AK or RP/GB light in 2.23 relay ANS operates in ACL to prepare collection of the coin which in our case lights a lamp. If IAO trunks does not receive answer supervision relay ANS does not operate in trunk and coin would be returned.

2.36 When handset key is put into on-hook position as described in 2.29 and 2.30 relay S in the trunk releases the OTL line switch relay L followed by relay CO and its associated crosspoints. When relay CO releases relay OH releases in auxiliary coin line circuit at which time coin potential is applied to the tip of the line.

2.37 Relay CD is a double wound polarized relay that monitors tip lead for the +130 volts or -130 volts coin potential applied by auxiliary coin line circuit ANS relay. Cross connections under Y or Z options are provided as determined by office records for expected potential. One-half of relay CD operates for duration (525 ms) of collect potential. Relay CD operated causes relay CC to operate which lights lamp CC. The operated CC relay locks to previously operate OSA relay and opens the ground on the back side of relay CD through the operated CND key. When coin collect potential is removed from line relay CD releases.

2.38 Coin return potential is monitored by other half of relay CD. Operation of relay CD is identical to that of relay CC.

3. INCOMING REGISTER SEIZURE - SC3

GENERAL

3.01 To seize a register an incoming trunk with loop supervision is selected and made busy at distant office. Using a through conductor cord patch the trunk T jack to jack ITT located on frame upright. When test frame goes off-normal the incoming trunk A relay is operated which causes the incoming register link to seize an incoming register. Various tests can be applied using dial pulses or multifrequency pulsing. Digits pulsed will determine register actions.

3.02 Most test calls should be directed to the terminating test line. Whenever using digit combinations other than that of TTL, key CB should be operated so call is not set up by marker and a trouble record is then taken for verification.

3.03 Register seizure using trunks with E and M supervision is described in 6.

TEST PREPARATION

3.04 Depending on type of trunk used, various keys must be operated to match working conditions of trunk. Operate the following keys prior to start of test when necessary as trunk loop conditions apply:

RV - Battery on tip when trunk is normal.

SLP - When trunk has short loop.

GS - If "ground shunt" option is provided in trunk - (loop resistance is less than 3115 ohms).

DP - Dial pulse operation.

MF - Multifrequency operation - turns on generator.

Keys ITT, IR, and SOAK are always operated prior to start of test to put test frame into incoming mode. Relay RMB operates from the operated IR key to provide a path (MB- leads) to operate relay MB in the incoming register through diodes RB-.

TRUNK "A" RELAY NONOPERATE TEST - FS2

3.05 Operation of ST key causes relay ST to operate followed by relay ONG. Relay ST operated (with key OA normal) applies a loop towards the A relay in the trunk from polarized relay OFHK to jack ITT through the

patch cord to the T jack in the trunk. The resistance in the presented loops is controlled by operating keys GS (7458 ohms) or SLP (11913 ohms). With keys GS and SLP normal a loop of 14303 ohms would be presented. When the nonoperate value loop is presented toward the trunk, relay OFHK operates if polarity is correct but trunk relay A does not operate. Lamp OFHK lights when relay OFHK operates.

TRUNK "A" RELAY OPERATE TEST

3.06 Operation of key OA operates relays OA and RB and prepares for selection of desired register per setting of switch IR-SDR. Relay RB turns on TM7 timer (described in 1.12 to 1.14) and completes path for selection of a register which will be described in 3.11 to 3.13.

3.07 Relay OA operated presents a loop to trunk "A" relay (through winding of OFHF) that is of its operate value as determined by operated keys SLP or GS. The normal loop with all keys normal is 6000 ohms. With key SLP operated the loop is 3610 ohms while key GS operated presents a loop of 3285 ohms. With the correct loop trunk relay A will operate causing battery to be sent to incoming register link circuit that in turn attempts to seize an incoming register. Relays TP-, RP-, and C operated in IRL operates ON relay in the incoming register which closes crosspoints back in the IRL. After several tests are made by the register its L relay operates and subsequent relays operations cause the trunk CO relay to operate.

3.08 When trunk CO relay operates, battery through winding of trunk relay CT is sent over S conductor of patch cord in ITT jack to test frame to operate marginal relay IS, however, current is not sufficient to operate trunk relay CT. Relay IS operates relay ISA which lights lamp IS indicating the incoming register is attached. Trunk relay CO operating also reverses loop causing relay OFHK if key RV is normal and trunk relay A to release as "on-hook" signal. Relay OFHK released causes relay OFK to release which extinguishes OFHK lamp.

3.09 Relay ISA operated transfers loop into one of two modes. With key MF operated and DP normal the loop is at resistance 5 dB. With key MF normal and key DP operated relay DP will operate to present the test frame DIAL as the loop. Relay ISA releases relay RB to turn off TM7 timer and if RV key was operated releases relay OFHK followed by release of OFK which extinguishes lamp OFHK. The register is now ready to receive pulses using DIAL or MF keys as described in 3.18.

TEST CALL IDENTIFICATION

3.10 For use during test call identification when a trouble record is to be taken, relay ISA operated operates relay ISB which locks through a normal FB relay contact. Relay ISB operates relay MBR and also opens RB relay operate path. Relay MBR operated allows ground through a normal RB relay contact, then switch IR-SDR selected position and on to selected register to reoperate that register MB relay. The operated MB register relay then operates the registers MBA relay which when seizing a marker applies ground on lead TST to marker and on to test frame to operate relay MB- as shown in FS.10.

SELECTION OF A PARTICULAR INCOMING REGISTER

3.11 Switch IR-SDR has a position for each of the seven incoming registers. When switch IR-SDR is set to desired IR, ground is applied on lead MB- to the register which will operate that registers MB relay if register is not serving an incoming call. Ground toward register MB relay is furnished through a normal contact of relay RB, normal SDR relay contact and through IR-SDR switch position (section 1 front) on to lead MB-. Key lamp IRMB- will light.

3.12 When key OA is operated after start of test, relay RB will operate followed by relay RBS, relay RB will allow ground through back contact of relay ISA to the common contact on switch IR-SDR (section 1 rear). All RB leads except desired one will then have ground applied by section 1 rear of switch IR-SDR to operate MB relays in each of the undesired incoming registers.

3.13 When relay RB operated ground is removed from switch IR-SDR switch section 1 front and likewise lead RB- (depending on switch setting) which will cause desired incoming register MB relay to release. At this point only desired register will appear idle to seizure if incoming register link caused by operation of trunk A relay by applying loop.

3.14 After relay ISA operates on register seizure ground is removed from common contact of section 1 rear of switch IR-SDR releasing all MB relays in unwanted registers because ground is removed from RB- leads. Relay RB then releases to further open ground path.

TEST FAILURE - FS2

3.15 A test failure can occur when the trunk A relay operates on the applied nonoperated loop and an incoming register is not seized in 700 to 770 ms. In either case the TF lamp will indicate test failure when relay TF operates and the loop towards the trunk A relay is opened so as to release the trunk and incoming register.

3.16 When the A relay operates on the non-operate value when 3.05 is applied a register is seized as stated in 3.06 to 3.08 except that key OA (and OA relay) is normal. When relay IS operates a back contact of relay OA provides an operate path for relay TF which operates to light lamp TF and open loop to trunk which releases also releasing incoming register.

3.17 When a register is not seized (release of relay RB) as in 3.09 within 700 to 770 ms after key OA is operated (3.06), TM7 timer causes relay TM1 to operate which operates relay TF, lights lamp TF, opens ground to TM7 timer (I lead), and opens operate path to relay RB causing it to release. Operation of relay TF lights TF lamp and opens loop to trunk which releases also releasing incoming register.

PULSING INTO INCOMING REGISTER

3.18 Digits pulsed into the register are dependent on what type of test is desired. To check all digit combinations, register time out, partial dial, etc, it is suggested that a particular register be selected as previously described and key CB (call block) be operated so marker routing can be checked from resulting trouble record. The call does not complete. For detailed reaction see SC23 and 22. With key REC operated in place of key CB allows call to complete after trouble record is taken. See SC4 and 4.

3.19 When testing incoming trunks it is not necessary to select a particular register as the terminating test line (described in 4. or 5.) or incoming-intraoffice trunk test line (described in 6.) is pulsed.

MARGINAL PULSING TESTS

3.20 When performing marginal pulsing into incoming registers two different methods, dial pulsing and multifrequency pulsing, are provided. Dial pulse marginal tests are performed using a patching arrangement (see Note 319A on schematic) using Loop and Leak Test Circuit - SD-26450-01, MF marginal tests are performed as described in 20. and shown in SC21 on schematic.

4. INCOMING CALL TO TERMINATING TEST LINE (LOOP SUPERVISION) - SC4

END OF PULSING

4.01 After register seizure described in 3., pulsing the directory number of terminating test line is performed. When register receives proper amount of pulses it requests a marker to process call by operating relays MST and TC1. With these relays operated, ground is applied to lead CT to the trunk where relay CT operates. The same ground is apparent on sleeve lead at T jack of trunk which is patched to ITT jack which now shunts down relay IS at test circuit. Relay ISA releases so that polar relay OFHK is put across loop, extinguishes lamp IS and releases relay DP if key DP is operated. If RV key is operated (expecting battery on tip) relay OFHK will operate followed by relay OFK and lamp OFHK.

4.02 When register relay TC2 operates, battery which is diverted from lead ST to marker connector to lead STI to test frame by the operated MB relay, operates relay MST which locks to off-normal battery. Operated relay MST operates relay MMB and lights its associated MMB lamp, operates relay FB and prepares for several marker functions depending on test desired which will be described when they occur.

4.03 Operation of relay MMB starts TM7 timer described in 1.12 to 1.14 and operates MCB relay in marker 0 unless key MKR 0 key is operated which will then operate relay MCB in marker 1. In any event the TM7 timer monitors test call to make sure both markers are serving customer traffic in less than one second.

4.04 Operation of relay FB performs several functions depending on type of test desired. For this call lamp FB lights, prepares for various marker functions, releases maintenance make-busy plug conditions, and release relay ISB. Relay ISB releases relay MBR.

4.05 Release of relay MBR removes holding ground (lead RB) toward incoming register as shown in FS5 and FS12 which releases MB relay in register. Release of register MB relay now applies battery on ST lead to marker connector operating its RS relay. The RS relay operates connector relays IRB-, MS-, MA-, and MC- to cut through all register information leads to the marker. The marker now will process the call as if it were a service call.

4.06 One of the information leads, grounded from operated register relay MBA, is

the TST lead. The TST lead in the marker is connected to lead MK0 or MK1 depending on which marker is processing the call as shown in FS10. The ground is applied on MK- lead to this circuit which results in operation of relay MK- which identifies the marker serving call. The operation of relay MK- allows test circuit to control and monitor the marker reactions during test call. For this incoming call, the effects of an operated MK- relay are:

(a) Release MCB relay in unused marker.

(b) Operates relay OTF in marker with test call.

(c) Provides its own locking path to relay DIS.

(d) Other functions not used on this call.

4.07 Relay OTF operating in the marker cuts through several control and monitor leads between test frame and marker shown in FS6 and described in 24. For this test call we will assume marker processes call without difficulty. Several optional and controlled tests can be accomplished during this type of call which will be functional at this point. They are:

Function	Paragraph and Sequence Chart
Trouble Record Request	7
Call Block	22
Channel Test	13
Call to PBX	12

CALL TERMINATED

4.08 At the completion of the marker processing this call, relay TS operates and lamp TS lights to indicate termination test line is seized. When the marker releases the incoming register by operating relay DISC, which applies ground to lead MRL, relay MRL in this circuit also operates and lamp MRL lights. Operation of relay MRL operates relay DIS which locks to the previously operated MST relay. Relay DIS causes several functions:

(a) Release relay FB followed by lamp FB extinguished.

(b) Release relay MMB which recycles TM7 timer.

(c) Extinguish lamp MMB.

(d) Release operated MK- relay.

The above functions return all test frame controlled conditions to original state as before test was started. The linkage from incoming trunk on trunk switch to termination test line line location on line switch remain operated until test circuit is released which can be done at any time.

4.09 Operation of relay and lamp FB is caused by grounded sleeve lead through linkage from incoming trunk used to make this call. Ringing potential when applied from trunk can be observed on neon lamps R+, R-, T+, and/or T- and should be heard from speaker. The ringing potential applied by trunk is determined by setting of switch RING COMB which was selected prior to start of test and in 2.14 and Table A.

4.10 Key RV (if operated) should be released at this time which will release relay OFHK because polarity of tip and ring of the loop changes. Relay OFK releasing extinguishes lamp OFHK.

PRETRIP RINGING TESTS

4.11 Operation of key PTP followed by relay PTP for approximately 2 seconds imposed a 2700-ohm loop toward RT relay in the incoming trunk. Trunk RT relay should not operate. Release key PTP followed by release of relay PTP will remove 2700-ohm loop. Ringing lamps R+, R-, T+, and/or T- will again flash as incoming trunk continues to apply ringing.

PRETRIP FAILURE

4.12 If trunk RT relay operates during time relay PTP applies 2700-ohm loop, trunk relays RC (releases), S (operates) and CO (releases) will follow. Operation of S relay in trunk returns "off-hook" reversal of tip and ring to test frame where polar relay OFHK operates in turn operating relay OFK and lighting of lamp OFHK. Relay TF operates from ground through operated OFK relay, keys ITT and PTP operated and locks through its own contact of off-normal ground.

4.13 Relay TF operated releases A relay in trunk which releases trunk relay CT, provides its own locking contact to off-normal battery (ST relay) and lights lamp TF. The incoming trunk should not release because the TF relay applies a ground to the sleeve of terminating test line line

location and relay TS from an operated ST relay contact. Release of key PTP and relay PTP causes trunk relay S to release. The crosspoints remain closed until ST key and ST relay are released.

TRIP RINGING TESTS

4.14 Operation of key TRP operates relay TRP imposing a 1740-ohm loop toward trunk RT relay which should operate. Trunk relay RT relay releases trunk relays RC and CO and operates trunk relay S. Trunk relay S in operating returns "off-hook" reversal to this circuit to operate relay OFHK. Relay OFHK operates relay OFK which lights lamp OFHK indicating ringing is tripped. Key TRP should be operated for approximately one-second.

4.15 Release of key TRP releases relay TRP which removes 1740-ohm loop toward trunk releasing relay S in the trunk. When trunk relay S releases relay OFHK releases followed by relay OFK release which extinguished lamp OFHK. The ringing detection lamp R+, R-, T+, and/or T- should not flash and ringing is not heard in speaker.

ANSWER SUPERVISION

4.16 Within 13 seconds after key TRP is released key ANS should be operated which operates relay ANS. With key SOAK operated at start of test relay ANS imposes a loop of 660 ohms to operate trunk S relay in a soak condition through the winding of polarized relay TTL. Relay TTL will operate lighting lamp TTL. Relay OFHK reoperates from operating trunk relay S. Relay OFK operates from the operated OFHK lighting lamp OFHK. Key ANS also turns on MF generator in FS16.

TRIP RINGING FAILURE

4.17 If relay OFK does not operate within approximately 700 to 770 ms (refer to 4.14) timer TM7 will cause the operation of relay TM1 indicating that trunk relay RT did not operate. The operation of relay TM1 operates relay TF and lights lamp TF to block further tests. Functions of relay TF are described in 4.13.

TRUNK "S" RELAY RELEASE TEST (SOAK CONDITION)

4.18 With key SOAK still operated, key RLS1 is now operated. Relay RLS1 operates to impose a loop of 8660 ohms which should decrease the current toward trunk S relay causing it to release as indicated by the lighting of lamp OFHK. Lamp OFHK is extinguished when relay OFK releases when relay OFHK released. Note that TTL lamp remains lighted indicating TTL relay has loop to trunk S relay. Key RLS1 should be released within 13 seconds to prevent timed disconnect.

4.19 Release of key RLS1 causes relay RLS1 to release changing loop toward trunk S relay to 660 ohms (soak condition) again which operates relay S. Relay OFHK reoperates in turn operating relay OFK which lights lamp OFHK. Repeat 4.18 and 4.19 for a total of three times with same results each time.

4.20 Release of key SOAK inserts 1180 more ohms into loop for a total of 9840 ohms that should allow sufficient current for trunk S relay (release valve) to remain operated.

4.21 Release key ANS which releases relay ANS which opens loop to trunk S relay and releases relays TTL and TS. Lamps TTL and TS are extinguished. Trunk S relay releases which releases OFHK followed by release of relay OFK causing lamp OFHK to extinguish.

TRUNK "S" RELAY OPERATE TEST

4.22 Reoperate ANS which reoperates relay ANS to reapply a loop of 9840 ohms toward trunk to operate its S relay. Relays TTL and TS operate indicated by lamps TTL and TS. Relay OFHK operates followed by relay OFK and lamp OFHK. Repeat 4.21 and 4.22 with the same results.

TONE APPLICATION (TRANSMISSION)

4.23 Operation of key TONE allows 1700-Hz tone to be applied to ring lead toward terminating test line. Ground through 0.1

MF capacitor (return path) is applied to tip side of terminating test line. The tone should be heard in the speaker as it passes through linkage, incoming trunk and back to test frame by way of ITT jack through capacitors ANSR, ANST, ANR, and ANT. The speaker and telephone circuit of FS4 will be explained elsewhere. Release of key TONE removes 1700-Hz tone from line.

CALLED STATION DISCONNECT

4.24 Release of key ANS releases relay ANS. The loop presented to trunk S relay is removed causing relays TTL and trunk relay S to release. Lamp TTL is then extinguished. Lamp OFHK is extinguished when relay OFK is released by relay OFHK releasing. When trunk relay S is released thermal relay RL in the trunk is energized. In 13 to 32 seconds thermal relay RL contacts make causing trunk relay RC or equivalent to operate which removes ground from sleeve causing linkage hold magnets to release. When linkage releases relay TS releases and lamp TS is extinguished. Release of key ST will completely release trunk.

CALLING STATION DISCONNECT

4.25 Release of key ITT releases relay ITT which opens loop of relay OFHK to trunk A relay causing both relays to release. Relay OFHK releasing causes relay OFK to release followed by lamp OFHK extinguishing. Trunk reaction when its A relay is released is releasing of relay CT followed by release of relay DS which removes ground from sleeve causing linkage hold magnets to release. When linkage is released relay TS releases, lamp TS is extinguished, the trunk S relay releases, and relay TTL releases. Lamp TTL is now extinguished. Release of key ST completes the release.

5. INCOMING CALL - E AND M SUPERVISION - SC5

GENERAL

5.01 Incoming trunk to be tested is made busy at far (control) end. Two patch cords are necessary to attach trunk to test circuit at the equipment location of the trunk. Patch trunk T1 jack to jack ITT on frame upright and patch trunk T2 jack to jack SP on frame upright. Jacks ITT and SP, shown on miscellaneous circuit, are multipled throughout the office including the test frame. The test frame is set up to pulse in dial pulse or multifrequency mode. The digits of the terminating test line are pulsed followed by various tests on trunk being used.

TEST PREPARATION

5.02 After patching at trunk, keys ITT and IR are operated which operates their respective relays. Switch IR-SDR is set to an IRO-6 position. The MB relay will operate in the register corresponding to switch position. Key lamp IRMB- will light to indicate the register control. If operation is dial pulse operate keys DP and DPEM. Relay DP1 and DPEM operate. Relay DPEM operates relay EM. If operation is multifrequency operate keys MF and MFEM. Relay EM operates from key MFEM. The MF generator is turned on by key MF. Operation of key SOAK operates relay SOAK to prepare for operational tests on trunk S relay after termination to terminating test line.

START OF TEST

5.03 Operation of key ST operates relay ST which operates relays RB and ONG. Relay RB starts TM7 timer, releases desired register (setting of switch IR-SDR) MB relay and operates all remaining registers MB relays to await seizure. Relay ST allows ground to be applied to tip of SP jack to operate relay E in trunk through patch cord in trunk T2 jack. Operation of trunk E relay returns battery through ring of T2 jack (M lead) to light M lamp and also applies battery on ST lead to incoming register link circuit where relay TP operates followed by relay RP of selected register.

5.04 Relays ON, ON1, MF, MF1, DP, RV1, and/or L operate in the register or determined by pulsing to be used. Crosspoints are closed on incoming register link followed by operation of relay CO in the trunk. Marginal relay IS is operated in this circuit by battery applied to sleeve of jack T2 by trunk CO relay from winding of trunk relay CT which does not operate. After a short timing period in the register, its RV relay operates trunk RV/RD relay to remove battery from M lead of T2 jack to extinguish lamp M.

5.05 Relay IS operates relay ISA which releases relay RB, puts MF pad across tip and ring of ITT jack, removes ground from MB leads to unwanted registers where their MB relays release, operates relay ISB, and lights lamp IS. Relay RB released recycles TM7 timer. Relay ISB operates relay MBR which reoperates MB relay in register being used. Register relay MBA is now operated to apply ground on identification lead TST to marker.

PULSING INTO REGISTER

5.06 Pulsing can be performed by dialing or keying MF signals into register.

Dial pulsing is performed using test frame dial over tip of SP jack to jack T2 of trunk. The MF signals are sent over tip and ring of ITT jack to jack T1 of trunk.

DIAL PULSE

5.07 Ground from a ST relay contact through a DPEM contact through the DIAL contact through ITT relay contact over tip of SP jack to tip of T2 jack in trunk operates and holds trunk E relay upon seizure. Lighting of lamp M indicates register is ready. After DIAL is pulled and released, opening and closing of DIAL contact releases and operates trunk E relay which removes and applies ground on R lead to register L relay. The L relay counts and stores number of pulses in each digit until all digits are stored.

MULTIFREQUENCY

5.08 After seizure of IR, ground, through ST relay contact MFEM relay contact over tip of SP jack to tip T2 jack in trunk operates trunk E relay. Lighting of M lamp indicates register is ready. Pulsing is performed using key pad. When desired key is depressed signals from MF generator are passed of tip and ring of ITT jack to tip and ring of trunk jack T1 and onto receiver in the register. Detailed description can be found in 20. and on SC21.

END OF PULSING

5.09 When register has proper amount of digits a marker is requested by operating its MST and TC1 relays. With these relays operated ground is applied to lead CT to the trunk where relay CT operates. The same ground is apparent on sleeve lead of trunk T2 jack which through patch jack SP shunts down relay TS in this circuit. Relay ISA releases to extinguish lamp IS and removes pulsing pad on MF calls. Operation from this point is described in 4.02 to 4.09.

PRETRIP RINGING TESTS

5.10 Operation of key PTP followed by relay PTP for approximately 2 seconds imposes a 2700-ohm loop toward RT relay in the trunk. The RT relay should not operate. Release of key PTP followed by relay PTP will remove 2700-ohm loop. Ringing lamps R+, R-, T+, and/or T- will again flash as incoming trunk continues to apply ringing.

PRETRIP FAILURE

5.11 If trunk RT relay should operate during time relay PTP is applying 2700-ohm loop, trunk relays RC (releases) S (operates) and CO (releases) will follow. Operation of trunk S relay returns "off-hook" indications to test frame by putting battery on M lead to light M lamp. After release of key and relay PTP ringing lamps R+, R-, T+, and/or T- will not flash.

TRIP RINGING TEST

5.12 Operation of key TRP operates relay TRP imposing a 1740-ohm loop toward trunk RT relay which should operate. The RT relay releases trunk relays RC and CO and operates trunk relay S. Trunk relay S in operating returns "off-hook" indication to this circuit by applying battery to M lead to light M lamp.

5.13 Release of key TRP releases relay TRP which removes 1740-ohm loop toward trunk releasing its S relay. Lamp M is then extinguished and ringing lamps R+, R-, T+, and/or T- should not flash.

ANSWER SUPERVISION

5.14 Within 13 seconds after key TRP is released, key ANS should be operated which operates relay ANS. With key SOAK operated (prior to test start) relay ANS imposes a loop of 660-ohms to operate trunk S relay in its soak condition through winding of polarized relay TTL. Relay TTL will operate lighting lamp TTL. Lamp M will light when trunk applies battery to M lead at its T2 jack.

TRIP RINGING TEST

5.15 If RT relay in the trunk does not operate when TRP relay applies 1740-ohm loop across tip and ring M lamp will not light. When relay TRP is released, ringing lamps R+, R-, T+, and/or T- will flash as trunk continues to apply ringing potential.

TRUNK "S" RELAY TESTS, TONE APPLICATION AND DISCONNECT

5.16 Trunk tests continue with application of various tests by manipulation of keys at test circuit. The tests are performed as described in 4.18 to 4.25 with one exception. Where reference is made to relays OFHK and OFK with lamp OFHK, substitute lamp M in all cases.

6. INCOMING, INTRAOFFICE TRUNK TEST LINE - FS21 - SC6

GENERAL

6.01 Incoming, intraoffice trunk test line starts its operation when a marker connects it to an incoming or intraoffice trunk. Tests are applied automatically and progress in a sequential manner.

6.02 Steering control relays A, B, C, D, and E provide distinctive positions to test the different trunk functions. Steering control relays are advanced by the functions of relays W, W1, and Z. Relays TT1 through TT5 and CNTR in conjunction with 60- or 120-IPM interrupters control test actions at specific times.

6.03 Tests are only advanced when the previous test is satisfactory and can be observed by lamp display at the test frame if the test was originated by the test circuit. When a trouble is detected, the test circuit blocks and a signal is returned to the originator. The called supervisory relay release and operate test, however, is applied without interruption since the results must be observed by the originator. A test complete signal (and/or lamp) is returned to indicate the end of sequence. The test returns to normal when released by the originator (incoming/IAO TRK).

6.04 All tests return to normal from any point and at any time when released by the originator (incoming/IAO TRK).

SEIZURE

6.05 The S5 relay operates when this circuit is seized by the marker. The operated S5 relay immediately advances this circuit to the first test position where it waits for the trunk to be cut through. When relay S5 is operated, the S6 relay is operated through the A thermistor causing it to operate in about 300 ms. During this time marker functions are completed. The operation of relay S6 connects the R relay and the ringing detection bridge across the tip and ring leads allowing relay R to operate when the trunk under test applies ringing.

6.06 The ringing detection network consists of the A varistor and C capacitor. When ringing is applied, relays R, RS, and Z will operate. Relay RS operated prepares this circuit for ringing polarity check.

RINGING POLARITY CHECK

6.07 In the ringing polarity check position the circuit waits for ringing to be removed. As soon as this occurs, R and RS release. The latter is made slow-release to hold over any momentary release of R during the ringing cycle. The RS release, operates ST1. The ST1 operated:

(a) Starts to 60-IPM interrupter causing the pulse counter to start a 3-second timing interval.

(b) Disconnects the ringing detection network from the tip and ring.

(c) Connects the ring lead through the PCR relay to ground to check the ringing polarity.

6.08 Ringing combination 1 presents ground on the ring. Therefore, when the ringing polarity is correct, PCR will not operate. In this case the circuit advances after relay TT2 is operated which operates relay RSA. Relay RSA completes a path to light lamp RPC (ring polarity check) if the test circuit originated the call and also prepares for pretrip test.

RINGING POLARITY CHECK FAILURE

6.09 Should the trunks tip and ring be reversed to the PRTD circuit, relay PCR will operate from battery supplied at the PRTD. The PCR operated, operates PCR1 and when TT2 is operated, TMG operates. The TMG locks and the test blocks at this position. Since ringing is not tripped, the originator will receive ringing indication tone as an indication of the failure.

PRETRIP TEST

6.10 When the circuit is in the pretrip test position, the operation of P causes TT1 and RSA to release. The tip lead is now connected to ground through the pretrip test resistors F11, F12, and G. The ring lead remains connected to ground through the PCR relay.

6.11 Assuming that the trunk does not trip ringing at this time, the circuit is advanced in preparation for trip test when RSA operates at the end of the 500-ms interval. The RSA complete a ground path to light lamp PTC (pretrip check) if the test circuit originated the call.

PRETRIP TEST FAILURE

6.12 Should the trunk trip ringing, relays PCR, PCR1, will operate shortly after the trunk connects battery to the ring lead through its supervisory relay. The latter, however, does not operate due to the high-resistance of the PCR relay.

6.13 Under this condition TMG will operate at the end of the 500-ms interval. The TMG locks operated, thus blocking the circuit. TMG operated also releases ST1 which releases the 60-IPM interrupter and returns the counter to normal. When CNTR is released, ST2 operates which causes 120-IPM interrupted tone to be sent to the originating office. This is the indication that the pretrip test failed.

TRIP TEST AND RING CONTINUITY TEST

6.14 When the circuit is in the trip test position, the operation of P causes TT1 to operate and RSA to release. At this time the tip lead is connected to ground through the trip test resistors L1 and G. The ring lead remains connected to ground through the PCR relay. Assuming the trunk trips ringing, PCR, PCR1 will operate shortly after the trunk connects battery to the ring lead through its supervisory relay. The latter does not operate because of the high-resistance of the PCR relay. The circuit is advanced when RSA operates following the operation of TT4 at the end of the 500-ms interval. Relay RSA operating releases relays PCR and ST1. Relay ST1 releasing, releases relays TT1 through TT4, and provides for lighting of lamp TPRK (trip test ring check) if the call was originated by the test frame.

TRIP FAILURE OR RING CONTINUITY FAILURE

6.15 Should PCR, PCR1 be normal at the time TT4 operates, TMG will operate and block the circuit. The PCR, PCR1 will remain unoperated:

(a) Because the trunk fails to trip ringing, or

(b) Because the trunk presents an open ring lead after it has tripped ringing.

6.16 The TMG operated in this test position is an indication of either trouble. However, under the first condition ringing induction tone will be received by the originator, under the latter no signal is returned.

TIP LEAD CONTINUITY TEST

6.17 Relay ST1 released after a successful trip and ring continuity check releases relay TT1 through TT4 which in turn releases relay CNTR which allows relay W to operate. Relay W operated operates relay B along with relay RSA places the PCR relay across the tip and ring. This relay will operate provided the trunk has ground on the tip lead. The trunks supervisory relay does not operate because of the high-resistance in the circuit. The PCR operated, operates PCT which advances the circuit to the supervisory relay tests position and also provides for the lighting of lamp TCK1 (tip continuity check) if the call was originated by the test circuit.

TIP LEAD CONTINUITY TEST FAILURE

6.18 When there is no ground on the tip lead, PCR does not operate and the circuit blocks. Note that this test is performed through the pretrip and release resistors F11, F12, G, H, J, and K. In other words an open resistor also causes the circuit to block. A faulty resistor, however, will soon be located because this circuit will now block on every test call. This self-checking feature is necessary to prevent false indications, for an open resistor always results in a satisfactory pretrip test or a satisfactory release test, respectively. No signal is returned to the originator when this test position blocks. It is the absence of the first synchronizing pulse, normally following five seconds after the ringing cycle terminates, that should alert the originator to the trouble.

CALLED SUPERVISORY RELAY RELEASE AND OPERATE TEST

6.19 Relay PCT previously operated in 6.17 operates relay Z followed by relay ST2. Relay ST2 is used to start the 120-IPM interrupter and synchronize this circuit with it. At the beginning of the first full length pulse the SKR relay operates.

6.20 The SKR operated, closes a short across the tip and ring to operate the trunks supervisory relay. It remains operated for 1.3 seconds and this long closure is known as the first synchronizing pulse. It is meant to synchronize the distant test circuit with the release test which is about to begin. The long closure is followed by two short closures of 0.3 second each. Between closures, when the SKR relay

is released, the H, J, K release resistance network is connected across the tip and ring each time for 0.2 seconds. At the end of the last short closure the circuit advances and relay SPO operates.

6.21 The SPO operated, causes another long closure of 1.3 seconds to be sent to the originating office. This is known as the second synchronizing pulse and meant to synchronize the distant circuit with the operate test which is about to begin. The long pulse is again followed by two short pulses of 0.3 second each during which the operate resistance network K is placed across the tip and ring. Between pulses, when SPO is released, the tip and ring are opened to ensure the release of the trunks supervisory relay.

6.22 At the originating end the number and regularity of the release and operate flashes must be observed in order to determine whether the called supervisory relay in the trunk is responding correctly. At the end of the last operate pulse, relay TC operates which advances this circuit to the test complete position.

TEST COMPLETE

6.23 Relay TC operated provides a locking path for relay ST2. This relay, therefore, remains operated holding the 120-IPM interrupter engaged. TC operated, however, releases relays TT1, 2, and 5 followed by the release of relay CNTR. When CNTR is released a tick-tock tone is sent to the originator as an indication that the test is completed. Relay TC also reoperates relay W followed by relay E which provides for the lighting of lamp TC. This lamp indication along with the tick-tock tone is an indication that the test is completed if originated by the test frame.

DISCONNECTION (INCOMING TRUNK)

6.24 The circuit remains in the test completed condition until:

(a) The calling end releases the trunk which is recognized by the release of relay S5.

(b) A timed disconnect of the incoming trunk after a 13- to 32-second time-out. This time-out results in the operation of trunk relays RL, DL, and release of trunk relay S1. The release of relay S1 forces a linkage release which is recognized by the release of relay S5.

DISCONNECTION [INTRAOFFICE TRUNK (IAO)]

6.25 Relay SPO released prior to the operation of relay TC also releases the supervisory relay in the IAO. After a time interval of 930 to 1275 ms IAO relay TM operates followed by the operation of IAO relay CH. Relay CH releases trunk relay S1 which forces a linkage release thereby releasing relay S5.

RELEASE (RELAY S5 RELEASED)

6.26 Relay S5 released releases relay W and E, followed by the release of relays ON and W1. Relay ON released, removes all off-normal grounds are removed and all relays which are operated at this time will release, returning the circuit to normal. If the originating call was made by the test frame, the release of the ST key results in the ultimate release of the RPC, PTC, TPRK, TCT, and TC lamps.

7. TROUBLE RECORD REQUEST - SC7

GENERAL

7.01 To verify input information when markers are seized or check marker reactions from information received, a trouble record can be requested by operating key REC. It should be noted that when a record is wanted (REC key operated), the trouble recording part of this circuit (FS200) must be normal. Key CTRS should be operated if display is not wanted on trouble analyzer display. The test call will complete after record is taken.

DIAL TONE RECORD

7.02 Prior to starting test, key REC is operated followed by relay REC operating. Key ST is operated and test call is started if relay CRL is normal. If relay CRL is operated the trouble display must be released (key RLS) to allow test call to start. Call then proceeds as described in 1.04 to 1.11. When MK- relay operates ground is applied to REC lead to the marker. When relay OTF operates in the marker relay REC operates in the marker to prepare marker to request a trouble record to be taken.

7.03 The marker proceeds to select an originating register. When the marker GTK relay is operated ground is applied through a contact of relay REC to operate relay TRST in the marker. Relay TRST then operates relay MPR-0 or MPR-1 depending on marker serving the call described in 1.01.

7.04 Memory relays are operated by input leads from the marker as described in 1.03 and 1.04. The lamp display indicates marker functions. When TRB lead is grounded marker relay TRB operates followed by relay RCC. Relay TRB releases marker relay CIT and this circuits MPR- relays. Relay CIT released causes all cut-in relays TIA-M and MKA- to release. When relay RCC operates, a path is provided in the marker to operate relay RTF allowing the marker to continue processing call and then release.

COMPLETING FUNCTION RECORD (CALL BACK ONLY)

7.05 To take a trouble record during the completing function of marker usage the CRL relay must be normal. Prior to start of test momentarily operate key RLS to release the display. Do not operate key REC until after dial tone is heard or sometime prior to pulsing the last digit. Detailed functions after start of call and receipt of dial tone is explained in 2.01 to 2.12. Upon identification of call (2.11) relay MK- operates which applies ground to REC lead to the marker. When marker relay OTF operates, relay REC operates to prepare marker to make a trouble record request.

7.06 The marker proceeds to select an intra-office trunk and set linkage to terminating test line. When marker relay GTK on the call back linkage relay REC directs ground to operate marker relay TRST. Relay TRST operates relay MPRO or MPR1 depending on which marker is serving the call as described in 1.01.

7.07 Memory relays are operated by input leads from the marker as described in 1.03 and 1.04. The lamp display indicates marker functions. When the TRB lead is grounded marker relay TRB operates followed by relay RCC. Relay TRB releases marker relay CIT and this circuits MPR- relays. Relay CIT released causes all cut-in relay TIA-TIM to release. When marker relay RCC operates a path is provided to operate marker relay RTF allowing the marker to continue processing the call and then release.

COMPLETING FUNCTION RECORD (FORWARD LINKAGE)

7.08 A trouble record with key REC cannot be requested during the forward linkage process of the marker. However, if a record is desired on the FLG portion of the call it is suggested that the call block (CB) key be operated instead of REC key. The call will not complete but a trouble record will be taken. See 22. and SC23 for CB function.

INCOMING CALL RECORD REQUEST

7.09 A trouble record cannot be requested on seizure of an incoming register, however, with key REC operated prior to start of test call followed by pulsing into the register, a trouble record can be requested when the register seizes a marker. The test is started as described in 3. or 5.01 to 5.05 depending if incoming trunk has loop supervision or E and M supervision. After pulsing the marker is seized as described in 4.02 to 4.07. When relay MK- operates ground is applied to lead REC through the operated REC relay in this circuit. When relay OTF operates in the marker relay REC will operate in the marker to prepare for record request. Functions from this point are the same as types of calls and described in 7.06 and 7.07.

8. OTLP CALL

GENERAL

8.01 This paragraph describes the function of originating a call from a line location other than the originating line location assigned to test frame. This procedure is necessary when control of marker and its functions is desired. To gain control of marker function we have to identify the test call when it seizes a marker. To identify the call, ground must be present on lead TST in the marker connector when marker is seized and then passed on to test circuit to operate relay MK-. After dial tone is heard any office code and directory number can be pulsed. Using an OTLP type call and requesting a trouble record would verify all line number translator cross-connections.

TEST PREPARATION

8.02 At the CDM a patch must be made from jack TST to the desired line location as shown in Note 319C on schematic. Three different cords can be used. When the plug of the cord is patched into jack TST the OTL is no longer functional.

8.03 At the test frame operate key ORMB FO, register 0. Key lamp in operated key will flash at 120 IPM when MB relay in register is operated as shown in FS11. If key lamp lights steady, the register may be used on a service call. If so wait for flashing light. Operate switch TRK SEL (TTO) to select originating register 0 on register frame 0. Operate keys TSO, OR, OTLP, and BY-TRK. Operate key LLO or LL1 depending on frame of line location under test.

Operate key REC to take a trouble record. Operate key MKRO/MKR1 for marker to be used on test.

Note: Any originating register can be used for this test. However the register desired must be made busy (ORMB- key) prior to test start. That register must be selected (TRK-SEL switch) to reoperate its MB relay after seizure shown in FS11.

START OF TEST

8.04 Operation of relay ST by operated ST key causes relay ONG to operate which provides off-normal ground through the circuit. Relay ONG also provides a path for operation of relay MP and MMB in FS10. When all RS relays in the marker connector are normal, ground is applied to lead TSTB through a contact of relay ONG, through the operated LL- key, through MP diode which operates relay MP. The same TSTB ground is then applied through an MP relay contact, an operated OTLP key contact to operate relay MMB and light MMB lamp.

8.05 Relay MMB starts TM7 timer and operates relay OLC. The OLC relay operates relay FB and applies ground on CI lead through an operated MP relay onto lead TSTA to the marker connector circuit. In the marker connector circuit the operated RS9 (to be operated in 8.06) relay will allow the ground to be present at TST lead which will identify test call when marker is seized after connector relays are operated.

8.06 The OLC relay also causes a loop to be applied toward the TST jack where patch is made on CDM. The L relay now operates at line location under test caused by loop to relay S in this circuit. Relay S operates lighting lamp S. The operated L relay starts for a marker by operating relay LBS which in turn operates MST relay followed by operation of relay RS9. The marker connector relays now operate to pass various grounded information leads to the seized marker. The grounded TSTA lead is now passed on to the marker (becomes TST lead) where lead is returned to this circuit (MK- lead) to operate relay MK0 or MK1 depending on which marker is used.

8.07 When relay FB operated ground is applied on FB1 lead to the marker through operated key TSO to operate relay FB1 in the marker to force that marker to select originating registers on trunk switch 0. Lamp FB lights and relay TSTO operates to release MB relays in all trunks and registers assigned to trunk switch 0 including register 0 made busy in 8.03.

8.08 When relay MK- operates the test circuit has control of the marker used on test call. Relay OTF operates in marker. Relay MKB releases in unused marker allowing it to serve other traffic. Relay TST is operated by ground applied on lead TST through the operated OR key to remove all battery from TT- relays in marker shown in FS10. Battery is now applied to TSO lead to marker through the operated OR relay and normal RA1 and TRK SEL switch forcing the marker to select desired register.

8.09 After relay TTO is operated in the marker, the register is seized by operating its F relay followed by closing crosspoints on trunk switch and line switch. Ground through closed crosspoints is applied to S lead to operate relay OS which lights lamp OS and operates relay OSA. Relay OSA operated releases relays FB (lamp FB is extinguished) and MMB and extinguishes lamp MMB. Relay MMB recycles TM7 timer.

8.10 The marker continues to process call and takes a trouble record as explained in 7.03 and 7.04 if key REC is operated. When marker relay RTF is operated register relay F releases operating relay SR followed by operation of relay ON1 allowing dial tone to be heard in speaker. When marker releases it operates relay DISC causing relay MRL to operate in the originating register which releases the marker connector relays. The same ground on MRL lead through operated OTF relay in marker operates relay MRL and lights lamp MRL.

8.11 Operation of relay MRL operates relay DIS which locks operated through contacts of operated relays ONG and OR, normal TT relay and normal DIAL key as shown in FS6. Relay DIS releases relays FB and MK- and operates relay OTLP. The released MK- relay releases marker relay OTF, REC, and TST. The released FB relay releases relay FB- in the marker and extinguishes lamp FB. It also releases relay TSTO which restores original make-busy condition prior to test start in trunks and registers assigned to trunk switch 0 by reoperating their MB relays.

8.12 The operation of relay OTLP locks to an ONG relay contact and operates relay OTLP1. When relay OTLP1 operates the seized register MB relay is operated, from ground on lead RB through operated ORMB- key to the just released TSTO relay, through the operated ON1 relay in the register. Register relay MBA operates to apply ground on TST lead for identification on marker seizure. Register relay MB remains operated so as to enable the test frame to detect when registers MST relay operates prior to marker seizure after dialing is completed.

PULSING

8.13 Pulsing into originating register can be performed using test frame dial or if provided TOUCH-TONE generator as provided in FS103 and described in 19. If a trouble record is to be taken after pulsing is complete, the indicator lamp display must be normal. If a display is lighted, momentarily operate key RLS which will release display. Key REC should be operated.

8.14 Operation of key DIAL puts the dial in series with the S relay providing loop to line location and opens locking ground toward relay DIS causing it to release. Relay MRL releases and lamp MRL is extinguished by relay DIS releasing. Dial office code and directory number as desired. If ANI type call, dial access code prior to other digits.

END OF PULSING

8.15 With its MB relay operated the register ST lead to the marker connector is transferred to the test frame MST relay winding as shown in FS10. When the register receives proper amount of digits it operates its MST relay putting battery on lead STO to operate test frame MST relay which locks through its own contact.

8.16 Relay MST operated causes relay FB and MMB to operate and lights lamp MMB. Operation of relay MMB controls selection of marker and starts TM7 timer. Relay FB operated lights lamp FB, cuts through several marker control leads and operates relay TSTO through TSO key, OTLP relay, and BY-TRK key contacts. The operated TSTO relay removes ground from RB lead to the register causing its MB relay to release.

8.17 When originating register MB relay releases, ST battery operates associated RS relay in marker connector to put in a bid for a marker. After marker is seized cut through relays in marker connector operate to pass information marks from register. Lead TST, grounded by the operated MBA relay in the register, is connected to lead MK- in the marker. Lead MK- operates relay MK- in the test circuit which operates relay OTF in the marker. With key REC operated relay REC operates in the marker to prepare it to take a trouble record.

TEST COMPLETION

8.18 The marker continues to process calls. When marker GTK relay operates ground through a contact of relay REC operates marker relay TRST. Relay TRST operates relay MPRO or MPR1 depending on marker serving call as described in 1.01. The trouble record is displayed as described in 1.03 and 1.04. When marker relay RCC operates the marker proceeds to release after selecting a sender if an ANI call. When marker relay DISC operates relay MRL is operated in register and test circuit. Lamp MRL is also lighted. The register then releases its marker connector.

8.19 Relay DIS is operated by the operation of relay MRL. Relay DIS is locked operated through operated MST relay. The DIS relay releases relays FB, MMB, and MK- and extinguishes lamp MMB. The released FB relay releases marker FB- relay and extinguishes lamp FB. Release of relay MMB recycles TM7 timer. The release of relay MK- releases marker relays OTF and REC and TSTO relay in this circuit.

8.20 If call is allowed to complete to called number, lamp TP/AK or RP/GB will light when trunk CH relay operates when answer supervision is returned. Trunk relay CH allows message rate potential to be applied to S lead causing tube MRT/MRR to fire operating relay TP/RP followed by operation of relays TPA/RPA.

9. SENDER OUTPULSING TEST - FS101

PREPARATION - SC9

9.01 When sender testing per FS101 is to be performed, the sender to be tested must be made busy by operating the relative SMB- key. At the sender a patch is made from the TST jack to the SP jack mounted on the frame upright. The IR-SDR switch is set to the position to automatically select the busied sender. The SDP key is operated to accommodate sender dial pulse calls, the SMF key is operated to accommodate sender MF calls. The ANI key in addition to the SMF key is operated if the call is to be ANI routed. The CPAD key operated and relay MF operated removes a 16.5-dB pad from the fundamental circuit. The reverse is true with the CPAD key normal. The operation of the SDP or SMF key with or without the ANI key is predetermined by the routing information of the called number. The operated key DLCN, allows off-hook supervision toward the sender when testing ANI "delete called number." Only the ANI calling number will be outpulsed from sender.

SDP OR MF KEY OPERATED - SC9

9.02 The SDP or SMF key operated closes a path to operate relay DP2 or MF respectively. Relay DP2 or MF operated:

(a) Operates relay UNL.

(b) Opens the MMB relay operate path.

(c) Prepares the operate paths for relays DB and IB.

Relay UNL operated locks under control of the L relay on dial pulse calls, relay 10 on MF non-ANI calls or relay IOP on MF ANI calls. Relay UNL also disables the pulse counting circuit which prevents false registration of dial pulses on DP calls, supplies BAT1 battery to the signal receiving circuit which brings it to an off-normal state for MF calls, and also prepares the second wink circuit required for ANI calls.

ST KEY OPERATED - SC9

9.03 Normally the operation of the ST key followed by relays ST and ONG would prime the OTL to bid for dial tone (SC1). However, back contacts of relays MF or DP2 prevents relay MMB from operating thereby disallowing a dial tone start.

9.04 To circumvent this condition the trouble indicator per FS200 must be normal and made to appear busy to its connecting circuits, in order that, this circuitry has exclusive access to the trouble indicator lamp display for sender digit outpulsing display.

TROUBLE INDICATOR NORMAL - SC9

9.05 Relay DB normal (FS200) is an indication that the trouble indicator is normal. An operated ONG relay completes a path to operate relay DB. Relay DB operated is a signal to all connecting circuits that the trouble indicator is busy and also completes a path to operate relay IB. Relay IB operated which is verified by the IB lamp LIT is an indication to the craft force that the originating test line in process in bidding for dial tone. See 9.08 for continuation of call.

TROUBLE INDICATOR BUSY - SC9

9.06 A trouble indicator off-normal condition denying originating test line dial tone is the result of one of three conditions.

(a) TIB-MB key operated (trouble indicator made busy).

(b) Local trouble indicator display busy.

(c) Remote trouble indicator busy.

To return condition (a) to normal, the TIB-MB key is released. Key TIB-MB normal allows relay DB to remain operated and completes a path to operate relay IB. To return condition (b) to normal, momentarily operate the RLS key which returns the lamp display to normal. The release of the RLS key allows relay DB to remain operated and completes a path to operate relay IB. Return of condition (c) to normal occurs automatically at the conclusion of the transmitted record to the far end with the release of relays SRLS, RLS. Relay RLS normal and relay DB remaining operated closes a path to operate relay IB.

9.07 Relay DB operated is a signal to connecting circuits that the trouble indicator is busy. Relay IB operated which is verified by the IB lamp LIT is an indication to the craft force that the originating test line is in process in bidding for dial tone.

9.08 Relay IB operated operates relays MMB and TRN. Relay TRN transfers battery ground function of reed packs MO2 (40-44), (SO-54) and MO3 (OO-04), (10-14), (20-24), (30-34), (40-44), (50-54). Relay MMB operated allows the dial tone seizure sequence to continue (SC1) to completion when dial tone is returned and heard.

DIAL TONE AND DIALING - SC9

9.09 After dial tone is heard, the craft force dials a working distant office code followed by any digits required. The code dialed must be compatible to the test frame setup of keys (MF, DP2, ANI).

SENDER SELECTION - SC22

9.10 At the completion of dialing, the originating register calls in a marker for the completing function of the call. The marker in so doing finds all the senders busy except the sender selected to be tested. Verification that that sender is seized by the operation of relay SON via the sleeve of the SP jack through the patch cord arrangement to the sleeve of the TST jack on the sender through a front contact to ground of sender relay ON. Relay SON operating lights lamp SON.

DIAL PULSE SENDER OUTPULSING - SC10

9.11 Prior to sender seizure relay ONG operated, completed paths to operate steering relay AS, register advance relay

RA2 and momentarily operates and releases relay RA3. The sender after seizure operates sender pulsing relay CPG, PG which operates relay L via the patch cord. Relay L operated releases slow-release relays UNL and RA2. Relay RA2 releasing completes a path to operate relay RA3. This circuit is now prepared to receive dial pulses from the sender.

9.12 The sender will proceed to outpulse when supervision with the distant office is completed and the SD start dialing relay in the sender has operated. The SD relay operating forces an abandoned call condition thereby releasing the distant office and completes the transfer of the sender pulsing path to this circuit.

PULSE COUNTING AND REGISTRATION - SC10

9.13 The dial pulse counting circuit counts the number of pulses in each digit and when the dialing of the digit is completed, transfers this circuit to the digit register, then recycles to make itself ready for reception of the next digit. For any digit, a train of pulses consisting of from one to ten approximately equally spaced line openings is generated by the sender. By recognizing the start and completion of these pulses for each digit, the circuit controls the digit registration.

9.14 The L relay is a magnetically biased polarized mercury contact type relay. The winding of this relay appears on the ring lead of the patch cord arrangement and is controlled by a PG front contact to ground of the sender under test. The release and operation of relay PG results in the release and operation of the L relay.

PULSE COUNTING RELAYS - SC10

9.15 The pulses of each digit as detected by the release and reoperation of the L relay are counted on the P1 to P5 relays. The P1 and P2 relays are wired as a pulse divider and contacts on these relays control the P3, P4, and P5 relays. The first release of L closes ground through L contacts No. 3 and 4 and through a break-contact of P2 to operate P1. The P1 locks to an ONG contact. When L reoperates, ground through L contacts No. 3 and 2 through a P1 make-contact operates P2. The P2 locks to the ONG ground and opens its operating circuit on a continuity contact and transfers the holding circuit for P1 on a continuity contact from the ONG ground to the ground at the L No. 2 contact. On the next release of L, P1 releases. The P1 in releasing opens the holding circuit to the ONG ground for P2, but P2 is held to the ground at the L No. 4 contact. When L reoperated on the second pulse P2 releases. This cycle will then repeat with P1 and P2 remaining operated at the end of each odd number of pulses and remaining normal at the end of each even number of pulses.

9.16 At the beginning of the second pulse when P1 releases with P2 operated, P3 is operated. The P4 and P5 operate at the end of the third and sixth pulses, respectively. A separate and distinct combination of these five relays remain operated at the end of each digit. The sequence of operation for these relays is given in the following table and is given in graphical form on Sequence Chart (SC10).

Pulse		Relays L	P1	P2	P3	P4	P5	Counting Relays Remaining Operated	Register to Lamp Display Grounded
1	B	R	O						
	M	O		O				P1, P2	O,1
2	B	R	R		O				
	M	O		R				P3	O,2
3	B	R	O						
	M	O		O		O		P1, P2, P3, P4	1,2
4	B	R	R						
	M	O		R				P3, P4	O,4
5	B	R	O		R				
	M	O		O				P1, P2, P4	1,4
6	B	R	R						
	M	O		R			O	P4, P5	2,4
7	B	R	O						
	M	O		O				P1, P2, P4, P5	O,7
8	B	R	R		O				
	M	O		R				P3, P4, P5	1,7
9	B	R	O						
	M	O		O		R		P1, P2, P3, P5	2,7
10	B	R	R						
	M	O		R				P3, P5	4,7
11	B	R	O		R				
	M	O		O				P1, P2, P5	O
12	B	R	R						
	M	O		R				P5	O

It should be noted from this table that if due to some trouble condition the counting circuit counts more than 10 pulses it grounds the single O lead.

9.17 The P2A is connected to operate in parallel with P2 during the counting of the first pulse. The P2A locks and opens its operating circuit on a continuity transfer contact.

REGISTER ADVANCE RELAYS - SC10

9.18 The register advance relay RA2 is a fast-operate slow-release relay which operates during the first pulse, remains operated during pulsing, and then releases during the interdigital interval. This relay is equipped with two windings. The primary winding is used for energizing the relay and is controlled by the No. 5 back contact of the L relay through a contact on the ONG relay. The secondary winding is used to delay the release of the relay by retarding the decay of flux when the circuit to the primary winding is opened when L operates. This winding is precision wound with a resistance tolerance of only ± 3 percent so that the release timer variation is held to reasonably close limits.

9.19 When RA2 operates, the secondary winding is short-circuited by a contact on RA2 to cause this reaction. By having the short circuit removed during the operation of the relay the operating time is reduced. The RA2 operates at the start of a digit to provide a locking circuit for the P- relays and releases at the end of a digit to cause transfer of the count from the counting relays to the digit memory reed packs [M-(--)]. The auxiliary register advance relay RA3 works in reverse to RA2, operating when RA2 is normal between digits and releasing when RA2 is operated during the counting of a digit. The RA3 aids in holding the counting relays and in transferring the count to the digit memory reed packs, and controls the steering advance from one digit to the next.

DIAL PULSE DIGIT STEERING CIRCUIT - SC10

9.20 The digit steering circuit consists of a single relay per digit and is wired so as to connect the five output leads from the counting circuit progressively to the digit memory reed packs. When relay ONG operated as stated in 9.11 steering relay AS operated. The AS locks through a back contact of BS and through the back contacts of CS, DS, etc, GS relays to an ONG ground. When P2A operates it closes a path to operate BS when RA3 operates at the end of the A digit. The BS operates, locks on its continuity transfer contact, and opens its operating circuit. The BS on a continuity contact transfers the locking circuit for AS from the ONG ground to the front contact of RA3. When the RA3 releases at the start of the B digit, AS releases closing the digit leads to the B digit memory reed packs through the operated BS relay. On subsequent digits when RA3 operates, the next steering relay is operated through contacts on the operated steering relay and when RA3 releases, the steering relay for the digit last registered releases. In this manner the circuit advances under control of RA3.

DIGIT REGISTRATION - SC10

9.21 After a short interval, long enough to insure that no more pulses are to be received after L operates for the last closure of a digit, RA2 releases and through to separate break-contacts closes an ONG ground to the translating contacts of the P-relays. The contacts of the P- relays are wired so that two of the output leads 0, 1, 2, 4, and 7 will be grounded depending on which combination of relays is operated. These five leads are carried through separate transfer contacts on the steering relays to the memory reed packs where two of the relays will be operated and locked. Another back contact on RA2 operates RA3 which opens the five leads at the output of the counting relay translating contacts and releases the counting relays. The memory reed packs are required to operate during the operate time of RA3. The RA3 operates the next steering relay. The pulsing circuit is now ready to count the next digit and when the L relay releases on the first pulse, RA2 operates and releases RA3. The RA3 releases the steering relay for the digit just registered. The operated 2-out-of-5 coils of the memory reed pack via their load contacts, light the related lamps on the lamp display panel. When all the digits have been outpulsed, the end of pulsing (EP) relay is operated in the sender. The EP releases relay SON which closes a path to operate relay channel release (CHRL). Relay CHRL opens the originating test line thereby releasing forward linkage and returns the originating test line to normal. The display of the outpulsed digits from the sender remain displayed on the lamp panel until the ST key is released as described in 9.33. The sender after operation to relay EP starts its release function. At the completion of the release function the sender is returned to its original made busy state.

MULTIFREQUENCY SENDER OUTPULSING - SC11, 12

9.22 Relay ONG operated prior to sender seizure completed paths to operate steering relay AS and also relay ANI if the ANI key was operated. The sender after seizure and completion of its marker and supervisory function with the distant office operates its start dial (SD) relay. Relay SD operated appears as an abandoned call to the distant office therefore allowing the distant office to return to normal. A path of the tip and ring through the TST, SP jack patch cord arrangement through this circuit to the signaling receiving circuit is accommodated.

FREQUENCIES AND CODE

9.23 Each multifrequency digit transmitted by the sender consists of a pulse of 2-out-of-5 audio frequencies: 700-, 900-, 1100-, 1300-, 1500-Hertz, designated 0, 1, 2, 4, and 7, respectively. In addition, a keypulse using frequency two and a sixth frequency of 1700 Hertz, designated ten is transmitted as a gate opener. The keypulse digit will never be lamp displayed since

this pulse is absorbed by the signaling receiving circuit. All other digits transmitted will be displayed. If an ANI call is displayed, the calling number contains an arbitrary "information" digit which is sent immediately after the keypulse but before the 7-digit directory number. A start pulse using frequencies seven and ten is transmitted after the last digit as an end of start signal. Operation with traffic service positions, variable start frequencies may also be displayed. The entire code used is as follows. This is the standard additive 2-out-of-5 code and the two frequency designations may be added to obtain the corresponding digit for digits 1 through 9.

Digit	Designations	Hertz Per Second
0	4,7	1300, 1500
1	0,1	700, 900
2	0,2	700, 1100
3	1,2	900, 1100
4	0,4	700, 1300
5	1,4	900, 1300
6	2,4	1100, 1300
7	0,7	700, 1500
8	1,7	900, 1500
9	2,7	1100, 1500
KP	2,10	1100, 1700 (Never Lamp Displayed)
ST	7,10	1500, 1700

INTERLOCKING OF SIGNALING RECEIVING (MF RECEIVER) AND TEST CIRCUIT - SC11, 12

9.24 The receiver is maintained in a disabled condition until it receives the keypulse or gate opener so that it will not react to unwanted signals that may appear on the line due to inductive pickup or to speech. The KP signal is received entirely by the signal receiver without being registered in the memory reed pack or subsequently as a lamp display. Each subsequent digit causes the receiver signal present relay SP to operate. The signal present relay in turn provides ground to receiver channel relays 0, 1, 2, 4, 7, and 10 over the leads J, L. When the channels corresponding to the frequencies received operate, the corresponding receiver channel relays operate. The operation of a channel relay grounds the corresponding lead 0, 1, 2, 4, 7, or 10 causing operation of the corresponding digit memory reed pack coil via the steering contacts and also operates the REG relay over lead S. Operation of REG operates the next digit steering relay. This interlock insures that each pulse locks in and that the steering does not advance to the next slot until the end of a pulse. When the signal has ended ground is removed from the S lead thereby releasing REG thus allowing steering to advance.

MF DIGIT STEERING - SC11, 12

9.25 The digit steering circuit consists of a single relay per the first eleven digits (excluding KP pulse) relay AS through LS. If the number of digits transmitted by the sender is greater than eleven, a steering recycle feature provides a capability of steering to a maximum of 21 digits. The steering is advanced by a contact of the REG relay. On the seizure of this circuit, ONG operates and operates AS which locks through series back contacts of steering relays BS-GS relay AS opens its operate path. On the first operation of REG, BS operates through front contacts of AS. The BS locks through a back contact of CS and opens its operating circuit on one set of continuity transfer contacts. The BS, on another set of continuity transfer contacts, transfers the locking circuit of AS from the ONG ground to the REG controlled ground so that when REG releases AS will release. The next operation of REG will operate CS through back contacts of AS and front contacts of BS and the next release of REG will release BS. This action continues with each operation of REG, operating the steering relay for the next digit, and each release of REG releasing the steering for the digit just registered.

RECYCLED STEERING - SC12

9.26 When the number of digits to be registered exceed eleven, steering is recycled in the following manner. At the conclusion of the tenth pulse, relay REG releases and in turn releases KS. On the next operation of REG, a path from ONG through the front contact of REG, front contact of LS, through a series of back contacts BS through KS, the front contact of LS to the original operate path of AS. Relay AS operates and locks through the series

back contacts of relay BS- GS to ONG ground. At the conclusion of the eleventh pulse, REG releases, releasing relay LS thereby completing steering recycle. Steering now continues in the same manner as described in 9.25.

REGISTRATION OF THE "A" MULTIFREQUENCY DIGIT - SC11, 12

9.27 The A-digit steering relay AS is operated from ONG when this circuit is seized. When the A-digit frequencies enter the receiver, the receiver signal present relay SP operates; SP connects ground via the J, L leads to the windings of receiver channel relays. When the channels corresponding to the frequencies received, operate, corresponding leads are connected to the memory reed pack. These grounds are carried through the back contacts of steering relay LS, front contacts AS, back contacts RS1 to operate the corresponding A-digit memory reed pack coils which lock.

9.28 When the signaling receiving circuit detects one or more frequencies, the corresponding numerically designated relays of the receiving circuit operates and causes operation of REG over lead S. At the conclusion of the pulse, receiver relay SP releases allowing release of the numerically designated channel relays and the release of REG. The REG releasing completes the steering advance by causing the release of AS. Subsequent digits are received and recorded in a similar manner.

RECYCLED DIGIT REGISTRATION - SC12

9.29 At the conclusion of reception of the tenth pulse, REG releases, allowing KS to release. The REG, KS normal, LS operated closes a path to operate RCY which locks to ONG ground. Relay RCY operates relays RS1, RS2, and RS3. Relay RS1 operated transfers A and B slot registration paths of steering relay AS, BS to M and N slot respectively. The RS2 operated transfers C and D slot registration paths of steering relay CS, DS to P and Q slot, respectively. The RS3 operated transfers E and F slot registration of steering relays ES, FS to R and S slots, respectively. After the recycle of steering when relay AS, BS are both operated, a path is closed through a front contact of RCY to operate and lock relay RCY1. Relay RCY1 operates relay RS4 and RS5. Relay RS4 operated transfers G and H slot registration of steering relays GS, HS to T and U slots. Relay RSS operated transfers J and K slots registration of steering relays JS, KS to V and W slots.

ANI SUPERVISION - (D OPTION) - SC12

9.30 The ANI key operated, operates the ANI relay via ONG ground. The ANI relay prepares this circuit to return ANI supervision. As described in 9.12 the distant office was released after initial supervision was completed. Therefore, this circuit must assume the responsibility of providing the necessary supervision to allow the call to continue with the outpulsing of the identification digit and remaining digits.

9.31 This function is initiated when the TEN frequency of the ST pulse is detected after the called number has been transmitted by the sender. The numerical channel relay IO in the receiver operates the IO relay of this circuit which locks through its own contact, the front contact of UNL to ONG ground. Relay IO allows the registration of IO to the memory reed pack and also prepares a path to operate relay IOP. At the conclusion of the start pulse, relay REG releases and completes a path to operate relay IOP which lock to ONG ground. Relay IOP operated returns the signaling receiving circuit to normal by the removal of BAT1 battery, completes in part the fundamental reversal circuit to the sender, and starts the slow-release of the UNL relay. The release of UNL, releases relay 10, returns BAT1 battery to the signaling receiving circuit, and completes the fundamental tip and ring circuit to the sender which is interpreted as a CAMA sender wink. With the off-hook signal simulating that the CAMA sender is ready to receive the calling number information, the sender outpulses the KP, (X) information digit, 7-digit directory number, and ST pulse. All digits are displayed on the lamp panel, again with the exception of the keypulse which is absorbed in the signaling receiving circuit. Following the ST pulse the sender releases to a made busy state.

ANI SUPERVISION (C OPTION) - SC12

9.31.1 The ANI key operated causes relay ANIS to operate. When relay ANIS operates, a path is closed to operate relay DP2 followed by the operation of relay UNL. Operation of relay DP2 also lights key lamp SDP. After the operation of ST key and pulsing of required ANI digits, a sender is seized by operating its ON relay which, in turn, operates relays SON and SONA in this circuit. Lamp SON lights. The called ANI number is now dial pulsed into the test circuit as described in 9.11 through 9.20.

9.31.2 After the sender outpulses the called number, it operates its R and R1 relays. Relay R1 operates sender relay MF which, in turn, releases relay L in this circuit to prepare for receiving the MF outpulsed calling number. Relay R1 also removes ground from sleeve of TST and SP jacks to release relay SONA in this circuit which, in turn, operates relay UNLA.

9.31.3 Operation of relay UNLA releases relay DP2 (SDP lamp extinguishes), KS and ANIS. This causes operation of relay SONB which turns on the MF receiver. Relay SONB also operates relay MF to return CAMA wink supervision to the sender and lights key lamp SMF.

9.31.4 The sender now outpulses, MF into our receiver, the calling number as described in 9.24 through 9.29.

9.31.5 When testing the "delete called number" feature in a sender, relay DIN is operated in the sender on its seizure. After the sender SD relay operates, a CAMA sender "wink" is simulated by the operated DLCN key which immediately operates sender relay OF. The sender then outpulses the calling number.

MF DIGIT LAMP DISPLAY - SC11, 12

9.32 When all the digits have been outpulsed, the EP relay is operated in the sender. The EP releases relay SON which closes a path to operate relay CHRL. Relay CHRL opens the originating test line thereby releasing forward linkage and returns the originating test line to normal. The display of the outpulsed digits from the sender remains displayed on the lamp panel until the ST key is released as described in 9.33. The sender after operation of relay EP starts its release function. At the completion of its release function the sender is returned to its original made busy state.

ST KEY RELEASED - SC10, 11, 12

9.33 To return the lamp display trouble recorder and this circuit to normal, the ST key is released. The ST key normal completes a path to operate RLS by way of a back contact of the ST key and front contact IB relay. Relay RLS operated, opens the holding paths of the memory reed pack thereby extinguishing the lamp display and completes a path to operate relay SDRL. Relay SDRL releases relay ST which in turn releases relay ONG. Relay ONG released:

(a) Dial pulse call (SC10)

(1) Releases operated steering relays

(2) Releases relays RA3 and P2A

(3) Releases relay DB

(b) MF call w/o ANI (SC11)

(1) Releases operated steering relays

(2) Releases relay DB

(c) MF call with ANI (SC12)

(1) Releases operated steering relays

(2) Releases ANI and IOP relays

(3) Releases all recycle relays RCY, RCY1, RS1-5

(4) Releases relay DB

Relay IB released, releases relays SDRL, CHRL, RLS, extinguishes the IB lamp and reoperates relay UNL.

SDP KEY RELEASED - SC10

9.34 The release of key SDP releases relay DP2 which in turn releases relay UNL.

SMF KEY RELEASED - SC11, 12

9.35 The release of key SMF releases relay MF which in turn releases relay UNL and returns the signaling receiving circuit to normal.

CPAD KEY

9.36 Key CPAD operated removes the -16.5 dB pad between the sender under test and the input of the signaling receiving circuit.

10. TWO-LINE HUNT - 2LN

GENERAL

10.01 This paragraph will explain methods performed to verify 2-line hunting ability using test numbers within the test frame. Operation of key REC after dial tone will allow verification of line location and assigned ring combination.

TEST PREPARATION

10.02 Determine directory number of telephone circuit and 101 test line along

with their respective line locations. Operate key ST to seize a register. After dial tone is heard, operate key DIAL or TT depending on type of pulsing to be used. Test circuit is now ready for pulsing.

CALL UP

10.03 Operate key TEL HOLD key to close a loop to line location of telephone circuit. After receiving dial tone in speaker (from OTL) pulse the directory number of the telephone circuit. After the marker is seized, it attempts to set linkage telephone circuit line location. When the marker finds it busy, its LBT relay operates and because its relay 2L is operated, from ring combination RC8, relay 2LA operates to release the line switch circuit. The marker now attempts to set linkage to 101TM line location. When termination is completed, key lamp 101TM lights and minor alarm sounds.

RELEASE UP

10.04 Release ST key to release OTL and linkage to 101TM line location. Release key TEL HOLD momentary operation of key MAR releases alarm.

CALL DOWN

10.05 Using convenient patch cord, plug one end into jack 101TM. Do not plug other end and be sure it is not grounded. Operate key 101TM to close loop to 101TM line line location. After receiving dial tone, pulse directory number of 101TM line. The marker finds it busy resulting in the operation of marker relay LBT causing relay 2LA to operate (ring combination RC9 is used) thereby releasing line switch circuit. The marker now attempts to set linkage to telephone circuit line location. When termination is completed key lamp TEL lights and minor alarm sounds.

RELEASE DOWN

10.06 Release ST key to release linkage between OTL and telephone circuit. Momentarily operate key MAR to release alarm.

LINE-BUSY

10.07 Operate key TEL HOLD to close a loop to line location of telephone circuit. (Plug remains in jack 101TM and key 101TM is operated.) After receiving dial tone pulse directory number of telephone circuit. Marker will find both lines busy. Line-busy (60 IPM) should be heard in speaker.

TEST OF WORKING LINES

10.08 To test customers 2LN hunt assignments, operate key PBX and PXGB. After dial tone is heard operate key CB. Pulse first listed directory number. Marker processes call but does not complete call. A trouble record will be taken showing called line information and ring combination. If called line is busy, 60 IPM (line-busy) will be heard because relay PBXT is operated in marker which does not allow marker relay 2LN to operate. Repeat procedure using second listed directory number.

11. VOLTMETER TESTS

GENERAL (VM KEY OPERATED)

11.01 The various voltmeter tests described below may be made on trunks or lines through the VMT T and R jacks mounted in the combined distributing main (CDM) frame. A patch arrangement from the VMT T and R jacks by means of a W4CJ cord to a 303 connector of a trunk or customers line is required to accommodate voltmeter testing. Access and control is available by the operation of the IN, OUT keys which provides for looking in at a trunk or line location or out to a trunk pair or customer line.

TEST FOR SHORT CIRCUITS

11.02 In testing for a short circuit the G key must be operated. If the line is short-circuited the voltmeter needle will show a constant deflection when the REV key is operated and restored. With the milliammeter connected to the line and the G key restored to normal, if the meter returns to 0 it indicates that the line is short circuited.

GROUND AND RESISTANCE TEST

11.03 Tests for foreign battery (11.07) should precede the tests for ground and resistance. With only the VM key operated the 100V test battery through the 100,000 ohms resistance of the meter is connected to the ring lead, to test for grounds on the ring. With the 20,000 ohms or the 1000 ohms key operated, 20-volt test battery, through the 20,000 ohms or 1000 ohms meter resistance, is connected to the ring lead and with the AM key operated the 45- to 50-volt office battery through 200 ohms and the meter is connected to the ring lead. With the REV key operated the circuit is set up to test for grounds on the tip. To make metallic tests the G key should be operated in addition to the desired voltmeter range key or AM key. The resistance

to ground or loop resistance may be read directly from the curves of Information Note 309. The point of intersection of a line corresponding to the observed meter deflection and the curve corresponding to the meter range in use gives the resultant external resistance to ground or loop resistance in ohms. As seen from the curves, more accurate readings of resistance are obtained by using the 100,000-ohm range for resistances above 10,000 ohms, the 20,000-ohm range for resistance between 2000 and 200,000 ohms, the 1000-ohm range for resistances between 100 and 10,000 ohms and the milliammeter range for resistances below 2000 ohms. There is considerable overlap of these ranges permitting the accurate reading of resistances from below 20 ohms to over one megohm.

11.04 The value of resistance may also be computed when using the voltmeter ranges by multiplying the difference between the test battery voltage and the voltmeter reading by the resistance in series with the voltmeter and dividing by the voltmeter reading. When using the AM scale the resistance may be computed by multiplying the milliammeter readings by 203, subtracting from the test voltage, and dividing by the milliammeter reading.

CUSTOMER LINE CONTINUITY TEST

11.05 When making this test, the G key is operated. If the line is equipped with a common battery customer set having a capacitor in series with the bell, no appreciable permanent deflection will occur unless the receiver at the station is removed from the switchhook. If it is not convenient to have the receiver removed, a satisfactory test may be made by operating the REV key quickly back and forth. This will give a deflection of the voltmeter needle due to the charge and discharge of the capacitor in the customer set. If the needle does not return to zero after each operation of the REV key it indicates trouble or line leak. Tests for ground should always precede the test for continuity.

CONTINUITY TEST OF CUSTOMERS LINES EQUIPPED WITH COLD CATHODE TUBE TYPE CUSTOMER SETS

11.06 Continuity tests of customer lines equipped with cold cathode tubes are made by operating key -STA or +STA. The operation of these keys causes 116-volt potential to be connected through the 100,000-ohm voltmeter shunted by 8000 ohms, resistances STA and STB to the ring of the line. With the -STA key operated, the negative potential on the ring of the line will cause the control gaps of the tube in the customer sets connected to the ring of the line to break down and the voltmeter needle to deflect slightly. If there is a negative station on the ring of the line there will be a flow of current through its ringer and consequently the deflection of the voltmeter will be greater than would be the case with no negative station connected to the ring. Similar conditions apply if the +STA key is operated in checking the positive stations. Connection on the tip of the line are checked by the operation of the REV key as well as the -STA or +STA key.

VOLTMETER TEST FOR FOREIGN BATTERY

11.07 To test for foreign potential, the FEMF key is operated which disconnects the test battery from the meter and connects the meter to ground in series with the ring side. If the polarity is such as to give a positive reading it indicates the voltage of a negative battery which is grounded. If the polarity is such as to give a negative reading the VREV key should be operated. This will reverse the meter with respect to the line and indicate the voltage of a positive battery which is grounded. Tests for foreign grounded battery on the tip side of the line are made as above with the REV key operated.

TEST FOR CONTINUITY ON BATTERY AND GROUND TRUNKS

11.08 This test is used for testing the continuity and polarity of potential on trunks supplying battery and ground from the distant end or for metallic battery connected across the line. The FEMF and RG key are operated to test for battery having its negative side connected to the ring and positive side connected to the tip. The FEMF, RG, and VREV keys are operated to test for battery having its positive side connected to the ring and the negative side connected to the tip.

BALLISTIC CAPACITY TEST

11.09 This test is to determine the approximate capacity of the line, the total capacity of capacitor connected to the line, and to detect an open. To test the line for grounded capacity the G key is operated, then after the needle comes to rest the REV key is operated several times. This causes a deflection proportional to the capacity on the ring side when the REV key is normal, and proportional to the capacity on the tip side when the REV key is operated.

MISCELLANEOUS FEATURES (VM KEY NORMAL)

11.10 When the VMT - T and R jack is patched to a 303 connector of a customers line and the out key is operated, talking, ringing, and coin control functions are made available.

TALKING

11.11 Key T operated connects ground and battery to the tip and ring through

the windings of relay LT and one side of the TST repeating coil. Key T operated also operates relay T connecting the telephone circuit to the other side of the TST repeating coil and lights lamp LTK. If the customer receiver is off-hook relay LT will operate, in turn, extinguishing lamp LTK. When the receiver is placed on the switchhook at the customer station relay LT releases thereby lighting lamp LTK.

RINGING

11.12 Operation of ± key connects ringing current to the ring lead and ground to the tip. With the ± and REV keys operated ring current is connected to the tip and ground to the ring. In testing multiparty lines it may be desirable to apply ringing current to one side line without applying ringing ground to the other side if the customer receiver is off-hook. Operation of the RG key opens the ringing ground lead so ringing current may be applied without ground to the ring lead by operation of the ± key and to the tip lead with the operation of the ± and REV keys.

COIN CONTROL

11.13 If test of a coin box line indicates a stuck coin an attempt may be made to return or collect the coin to release the line. Operation of the CR or CC key operates relay C1 and connects coin return or coin collect potential through the contacts of the CR or CC key, winding of relay coin, and resistance CN3 to the tip lead. If a coin is present relay coin operates on the current over the customer line through the coin magnet to ground lighting lamp coin. When the CR or CC key is released, coin potential is removed from the line releasing coin to extinguish lamp coin and C1 relay is released. The C1 is slow-releasing to permit discharge of the line and coin magnet through resistance CN2 and capacitor CN, before the tip and ring are cut through for subsequent test. Resistance CN1 provides a high-resistance shunt around capacitor CN to remove any charge remaining in the capacitor when the coin control circuit is returned to normal.

12. CALL TO PBX - SC13

GENERAL

12.01 After dial tone is received from OTL a working PBX group pilot number is pulsed. Idle lines of that PBX will cause HLNO-9 lamps to light. The call will terminate at the PBX unless the call block (CB) key is operated at which time a trouble record would be displayed and call will not be completed. Marker reaction can be verified with operation of PXGB (makes all lines appear busy) or PBX1 (forces marker to look at second group of ten numbers) with results shown by lamps at test circuit. A call to a particular line of a PBX does not use ring combination RC10.

TEST PREPARATION

12.02 Decide on a working PBX with ten or less lines or arrange terminating test line to appear as PBX. Operate key PBX on all tests. During test call if marker 1 is used relay PBX operates to isolate leads to marker 0. The normal PBX relay isolates leads from marker 1. This test should be performed during low traffic conditions to have minimum busy lines. Test call is performed using originating test line for call identification purposes. Key CB is not operated until after ST key is operated followed by dial tone. After dial tone is heard operate key DIAL or TT after which pulsing is performed.

START OF TEST

12.03 Operation of ST key causes the OTL to seize an originating register for dial tone as described in 1., and shown on SC1. Pulsing into the originating register is described in 2.01 to 2.04 and test call identification is described in 2.05 to 2.12.

Note: To prevent test call from completing operate key CB after dial tone.

IDLE LINES CHECK (FIRST GROUP)

12.04 After dial tone pulse pilot number of PBX. The marker seizes line number translator. When relay LTA- operates in LNT, the marker operates relay LT- also in LNT, to allow battery of all idle line locations associated with that PBX to pass into the marker on the LO-9 leads. The battery operates marker relays HLO-9. When relays HL- operate, ground through the operated OTF relay, is applied to leads HLNO-9 to this circuit.

12.05 Ground on HLNO-9 leads from marker operates associated HLO-9 relays. The HLO-9 relays lock operated to a contact of relay ONG. Relay ONG also applies ground through the operated HLO-9 relay contacts to light corresponding HLNO-9 lamps. The marker proceeds to process call by selecting one of the idle lines in PBX. The call completes to that line or if key CB is operated, a trouble record is taken to show which line was chosen on lamps HLO-9 and call does not complete.

ALL LINES BUSY (GROUP BUSY)

12.06 After dial tone operate key PXGB and then pulse pilot number of PBX. When marker is seized ground GB lead operates marker relay PBXT through the operated OTF relay. Operation of relay PBXT removes ground from windings of all HLO-9 relays. Marker seizes LNT, operates its LTA- and LT- for the called PBX. The operated LT- allows battery from assigned line locations that are idle to be applied to windings of marker HLO-9 relays, however as ground is removed from winding none can operate. No need to operate CB key.

12.07 With all HLO-9 relays normal, battery is applied on lead A from the marker to LNT where cross-connect HA- to GB allows some battery to return to marker where relay GB operates.

Note: If a second group of lines is assigned marker will operate LNT relay A which allows marker relay AK to operate causing it to look for idle line in second group. The operated GB relay in the marker applies ground from OTF relay to lead GB1 to this circuit. Ground on GB1 lead operates relay RPA which locks to operated MST relay. The operated RPA relay lights lamp RP/GB. Note: Lamp TP/AK may operate if second group of lines is assigned this PBX. Because all lines are made to appear busy, line-busy (60 IPM) should be heard in speaker as marker proceeds with test call.

ADVANCE CHECK (IDLE LINES-SECOND GROUP)

Note: PBX must have second group (more than ten lines) assigned with at least one line in second group idle.

12.08 After dial tone operate key PBX1 and then pulse pilot number of PBX. When marker is seized ground on lead AK operates marker relay PBXT through the operated OTF relay. Operation of relay PBXT removes ground from windings of all HLO-9 relays. Marker seizes LNT, operates its LTA- and LT- for the called PBX. The operated LT- allows battery from idle line locations to be applied to windings of marker HLO-9 relays, however, as ground is removed from winding, none can operate.

12.09 With all HLO-9 relays normal, battery is applied on lead "A" from the marker to LNT where cross-connect HA- to A- operates relay A in LNT. The operated A relay operates marker AK relay to prepare for advance to second group of lines. Relay AK operated allows ground on lead AK1 to operate relay TPA in this circuit which locks to relay MST operated. Relay TPA operated lights lamp TP/AK.

12.10 The marker continues to process call by releasing the first group translation and operates relay CKR in marker. Relay CKR releases marker relay PBXT which restores ground on winding of relays HLO-9 and operates LTA- and LT- relays in LNT for second group. When battery is applied on LO-9 leads into marker from idle line locations relays HLO-9 operate. Lamps HLNO-9 light from operated HL relays in marker. If no idle lines are encountered RP/GB lamp will light in this circuit as described in 12.07.

12.11 Test call will terminate to the line chosen by marker unless key CB was operated prior to pulsing at which time marker releases before linkage is completed.

CALL TO PARTICULAR LINE IN PBX

12.12 After dial tone is received operate key CB. Pulse directory number assigned to a line in PBX other than pilot number. Trouble record is taken showing translation that LNT made. The marker and LNT process this call as it would any non-PBX or 2LN number using a ring combination other than RC10.

13. CHANNEL TEST SC14

GENERAL

13.01 Testing of channels should be performed during light traffic. A channel that is service busy cannot be seized. If channel tests are to be performed during a heavy traffic period, it is suggested that a make-busy plug be used in desired CHB-jack for a period of time (to allow service calls to release) prior to test. When test is performed ground is applied to PB- leads to trunk switch connector circuit that is passed onto the marker to operate PB- relays when connector relays are operated. Ground is not applied to PB lead of desired channel. Likewise if make-busy plug is inserted ground is removed at time of seizure.

TEST PREPARATION

13.02 Operation of key CHT prepares for operation of relays CHT and CHT1 during marker control. Set switch CHT to desired channel.

13.03 If a particular link within a channel is desired, one of two methods can be used. When line switch link is desired, an OTLP type call (see SC8) is performed at line switch with access to channel under test. When trunk switch link test is desired, select a trunk or register (see SC15) on trunk switch with access to channel. Call is then directed to trunk by pulsing appropriate access digits.

SELECTING DIAL TONE CHANNEL

13.04 After the operation of key OR the operation of ST key allows test circuit to request dial tone by operating relay OLC which closes a loop to line location. When marker is seized, ground is present on lead TST from marker connector either from OTL (LAO- LGO- LBAO) or from test circuit (lead TSTA) if OTLP type call. In either case, that ground is passed on to test circuit where relay MK- operates which then controls several test operations including operating relays CHT and CHT1.

13.05 Operation of relay CHT and CHT1 allows all PB- leads from both trunk switch connectors to be connected to switch CHT. A contact of relay CHT1 also applies ground to common contact of switch CHT. The ground on common contact is then applied to all PB- leads except those that CHT switch is set on. Ground on PB- leads is passed to both trunk switch connectors and on to the marker serving one test call where corresponding PB- relays will operate. The PB relay not operated (desired channel) will allow test call to use that channel.

Note: If desired channel is service busy marker will find all channels busy as all PB relays in marker will be operated. The marker should route advance.

SELECTING COMPLETING FUNCTION CHANNEL

13.06 Before requesting dial tone key CHT should be normal so as not to force channel selection on dial tone function. After dial tone is heard operate key CHT prior to pulsing digits of terminating test line or predetermined route for access to particular trunk. When originating register receives necessary amount of digits, it will request a marker to process the call. Lead TST through marker connector relays will be grounded resulting in the operation of test circuit relay MK- for marker used on test call. The remaining function is as described in 13.05.

ALL CHANNELS BUSY

13.07 To force an all channels busy condition it will be necessary to block operated a PB relay in a marker. An operated PB- relay in the marker makes that channel busy to that marker. Set switch CHT to position of blocked PB- relay. Proceed with test as described in 13.04 and 13.05 or 13.06.

Note: Preselect marker where PB- relay is blocked by operating key MKR-.

14. TRUNK OR REGISTER SELECTION - SC15

GENERAL

14.01 Selection of any originating register or trunk when idle or on maintenance make-busy can be performed with various key and switch operations. Switch TRK SEL is set to TT- position of desired trunk or register. When the marker is seized and the test call is identified by operation of relay MK- in this circuit, the test frame forces the marker to select trunk or register by making all undesired trunks or registers busy. If selecting a previously made busy trunk or register, it is made to appear idle at the time all others are made busy.

TEST PREPARATION

14.02 Operate the following keys as necessary for type of test desired:

OR - When selecting originating register.

ALB - When IAO trunk is in allotter "B".

TRK SEL - When selecting a trunk.

BY TRK - When selected trunk or register is maintenance busy.

WALK - Sets W-Z circuit to select IAO route B (IRB).

TSO/TS1 - Trunk switch location of trunk or register.

14.03 Set TRK SEL switch to position of desired trunk or register.

SELECTING AN ORIGINATING REGISTER

14.04 Operate OR key. Operate TSO or TS1 key for selection of trunk switch where desired register is located. Set TRK SEL switch to position of desired register:

Switch Position	Register	Frame	Key
TT0	0	0	TS0
TT1	0	1	TS0
TT2	0	2	TS0
TT3	0	3	TS0
TT4	0	4	TS0
TT5	0	5	TS0
TT0	1	0	TS1
TT1	1	1	TS1
TT2	1	2	TS1
TT3	1	3	TS1
TT4	1	4	TS1
TT5	1	5	TS1

14.05 Operate ST key, relay ST operates relays ONG and OLC. Relay ONG operates relay MTR if key MKRO is normal and provides locking ground for various relays throughout test circuit. Relay OLC operates relay FB and closes a loop to OTL (OOO). Relay FB lights lamp FB and operates FBO/1 relay in marker depending on operated TS- key to allow marker to look for idle trunks in desired trunk switch.

14.06 Operated relay OLC operates L- relay at line switch and if polarity is correct relay S will operate from loop which lights lamp S. The marker connector is seized which in turn seizes the marker. When the OTL line location relays LGO, LAOO, LBAOO operate in the marker, ground on TST lead will operate relay MK- in the test circuit.

14.07 Operated relay MK- provides several grounded leads to the marker for various control functions. Marker relays that can operate are TST, OTF, ALA, or ALB. When marker OTF relay operates, its W-Z walking circuit is returned to "O" state (no relays operated). If key WALK is operated, relay W1 will operate. When marker relays TST and TST1 operate, battery is removed from windings of TTO-12 relays. Depending on setting of switch TRK SEL, the test circuit provides battery to TT- relay for desired register (or trunk).

14.08 With battery on one TT- relay, the marker will see only idle register (or trunk) that is desired. The marker now provides ground to that register (or trunk) which passes it through trunk switch connector to the marker which operates relay TT- where we provided battery.

Note: If desired register (or trunk) is service busy the marker will route advance. The marker now proceeds to set up linkage. Verification of register seizure can be observed by the lighting of key lamp ORMB- for that register. Verification of seizure of a register (or trunk) can also be obtained by taking a trouble record with key REC or CB.

SELECTING AN OUTGOING TRUNK

14.09 Operate key TRK SEL. Operate key TSO or TS1 for selection of trunk switch where desired trunk is located. Set switch TRK SEL to position of desired trunk. Operate ST key to get dial tone from register. Pulse office code and directory number of terminating test line for route with access to that trunk.

14.10 When the register receives proper amount of digits, it will attempt to seize a marker to process the call. The test call is identified and functions as described in 2.05 to 2.12 resulting in the operation of relay MK-. When relay MK- operates the control functions are the same as those described in 14.07 and 14.08 to select desired outgoing trunk.

SELECTING AN INTRAOFFICE TRUNK
(WALK KEY OPERATED AFTER THE DIAL TONE)

14.11 Operate key TRK SEL. Operate key TSO or TS1 for selection of trunk switch where desired trunk is located. Operate key ALB if trunk is in allotter "B". Allotter "A" is used when key ALB is normal. Operate key WALK when trunk is assigned in TB2 and TB4 which is route "B" in the allotter (IRB). Set switch TRK SEL to position TT- of desired trunk.

14.12 Operate key ST to get dial tone from an originating register. Pulse office code and directory number of terminating test line. When the register receives proper amount of digits, it will attempt to seize a marker to process call. The call is identified as described in 2.05 to 2.12 resulting in operation of relay MK- when relay MK- operates, control functions are the same as described in 14.07 and 14.08 to select IAO trunk.

SELECTION OF A MAINTENANCE BUSY TRUNK OR REGISTER

14.13 To make a register busy operate, key ORMB-. The ORMB- key lamp will flash at 120 IPM indicating control. To make a trunk busy a 329A MB plug is inserted into associated TRUNK MB jack. Prior to functions described in 14.04, 14.09, or 14.11, operate key BY TRK. When test call is

identified (2.05 to 2.12) by the operation of relay MKO or MK1, relay TSTO or TST1 will operate. Operation of TST- relay causes MB relays of all trunks (FS14) and registers (FS11) to release allowing the marker select desired trunk. Either TSTO or TST1 relay will operate as determined by operated TSO or TS1 key.

ALL TRUNKS BUSY

14.14 To test marker route advance, described in 14., set switch TRK SEL to position OFF. Operate other keys as directed in 14.04, 14.09, or 14.11. Operate ST key and verify results of marker actions as it will not have battery on any TT- relay causing route advance.

15. FORCING MARKER ROUTE ADVANCE

GENERAL

15.01 When the marker attempts to select a register or trunk in a route and not finding one idle will cause it to route advance. Selecting a trunk as described in 14.09 or 14.11 after the marker route advance is accomplished by making all trunks appear busy at the appropriate time and then allowing one to become idle. The test frame setup is as described in 14. Key RAV or STEP is operated after dial tone is heard. Switch TRK SEL is set to position desired (after marker route advances) along with operated TS0 or TS1 key. The OR key should be normal.

TEST START

15.02 Operation of ST key allows dial tone to be heard. Pulse office code and necessary amount of digits of route to be advanced from. The test call is identified as described in 2.05 to 2.12 resulting in operating MK- relay which provides the several control functions in the marker including the operation of marker relay TST. With its TST relay operated, the marker cannot find an idle trunk. The operated RA1 relay in test circuit, operated by operation of key RAV, opens battery toward TRK SEL switch.

15.03 Subsequent marker operation includes relays ATB, TB, RAV, and/or STP. Relay and lamp ATB function in test circuit. When relay RAV or STP operates in marker lead RA is grounded to test circuit where relay RAV operates and locks. Lamp RADV lights. Lamp RA/STP lights after relay RA operates from grounded RA lead from marker. The marker proceeds to release first route and establish advanced route. When marker attempts to find idle trunk for new route, battery is applied to desired TT- lead from TRK SEL through operated RAV contact. Call completes using new route.

16. OPERATOR TOLL SWITCHING INCOMING - SC17

GENERAL

16.01 These tests are performed with the assistance of an operator at the switchboard position. The test employee calls an operator on the POTS network requesting that the originating test line (OTL) be called back. When OTL is reached by the operator the test employee can monitor coin control, ring back features, and ringing verification along with the ability of performing pretrip and trip tests.

PRELIMINARY OPERATIONS

16.02 Prior to starting test operate keys coin deposited (CND), opens terminating test line (TTLD) and RC to detect ringing potential. Originate a call to the operator using telephone circuit on test frame. Request the operator to dial or key the OTL. Maintain original connection to operator.

METHOD OF OPERATION

16.03 The operator dials or keys number of OTL on trunk under test. Crosspoints are closed by marker as indicated by operation of relay OS which lights lamp OS and operates relay OSA. Depending on setting of switch RING COMB, ringing potential applied by trunk can be observed on lamps R-, R+, T- and/or T+. Ringing is started by operator.

RINGING TESTS

16.04 After verification of ring potential received matches setting of switch RING COMB as shown in 2.14 Table A, momentarily operate key PTP during silent interval for approximately two seconds. A nonoperate condition of 2700 ohms is applied to trunk RT relay. After release of key PTP ringing potential is still observed. If ringing is not observed trunk relay RT has operated causing a pretrip failure.

16.05 When ringing is observed after pretrip test, operate key TRP for approximately 1/2-second. The operation of relay TRP applies 1740 ohms to trunk RT relay which

should operate to trip ringing by releasing trunk relay RC which should cause trunk relay CS to operate.

16.06 After release of key TRP ringing lamps R+, R-, T+, and/or T- should not light indicating ringing has been tripped in trunk. If ringing is still apparent trunk RT relay did not operate on its operate value. Trunk CS relay will release when key and relay TRP are released.

ANSWER

16.07 Operate key OPR and release key RC. Relay OLC is operated and relay RC is released to present loop to relay S which operates as indicated by lighted lamp S. Trunk CS relay operates also from loop. With an operators headset plugged into jacks TEL A and TEL B followed by operation of key TALK which operates relay TALK, the test employee is now able to converse with the operator. The operator should also see answer supervision at this time.

COIN CONTROL

16.08 The test employee now requests the operator to return coin. When operator performs coin return function, the trunk causes 130 volts to be applied to tip of loop resulting in operation of relay CD which in turn operates relay CR. Lamp CR lights. When trunk removes 130 volts from loop (operator restores CR function) relay CD releases and talking path is reestablished. The test employee now releases key CND which releases relay CR as indicated by lamp CR extinguished.

16.09 The test employee now reoperates key CND to prepare for next functions. Conversing with operator, the test employee requests that the coin collect function be performed. When 130 volts is applied to tip of loop as a result of the operator coin collect function, relay CD operates which operates relay CC. Relay CC lights lamp CC. When trunk removes 130 volts (operator restores CC function) relay CD releases. Release of key CND releases relay CC which extinguishes lamp CC. Talking path is reestablished.

RERING

16.10 Conversing with operator request that the rering function be performed. When operator rerings ringing can be heard in headset.

16.11 Conversing with operator request another rering function after a delay of about 5 seconds (to give test employee time to perform following key operations). Release key OPR. Relays OLC and S release. Lamp S is extinguished. Test employee now operates key RC which operates relay RC to put ringing detection lamps on loop. When the operator rings, lamp R- lights in unison with application of ringing potential. Release key RC and operate key OPR. Relay RC releases and relays OLC and S (S lamp lights) operate. Conversing again with operator, indicate test is completed.

REPEAT TESTS

16.12 To verify application of all ringing codes, several calls are made by the operator with test employee changing positions of switch RING COMB and observing ringing application.

17. TRANSMISSION TESTING - SC18

GENERAL

17.01 Three different tests can be performed by distant test employee into the No. 3 office. They are:

(a) A 101-type 2-party test.

(b) Short circuit termination.

(c) Open circuit termination.

101 TYPE TEST

17.02 A test employee at distant office pulses directory number assigned to 101 TM jack located in test frame. After incoming trunk is cut through lamp 101 TM flashes at 60 IPM and minor alarm sounds as a result of relay SJ operating from ground on the sleeve from network linkage. Answering the call is accomplished by operating key 101 TM which operates relay K. Relay K provides a loop through inductor JE, operates relay K1 and provides ground to talking circuit in test frame. Operation of relay K also causes lamp 101 TM to light ready. Operation of relay K1 cuts through tip and ring to 101 TM jack.

17.03 Conversing with test employee can now be accomplished by using a handset plugged into 101 TM jack or using a headset inserted into TEL A and TEL B jacks. At this time transmission tests in both directions can be performed:

(a) Far to near - the test employee at distant office provides one-milliwatt which can be measured by patching from 101 TM jack to transmission measuring set.

(b) Near to far - the test employee in No. 3 office patches jack 101 TM to jack 1000-0-900 to send one-milliwatt to distant office where it can be measured.

The talking bridge is removed from testing path when a plug is inserted into 101 TM jack. When testing is completed, restore key 101 TM to release trunk.

Note: If distant office does not release immediately, lamp 101 TM will flash again.

SHORT CIRCUIT TERMINATION

17.04 A test employee at distant office pulses directory number assigned to short circuit terminations. After incoming call is cut through, ground on sleeve lead operates relay SS through thermistor SS. The operation of relay SS closes a short circuit across tip and ring using capacitor SS and inductor SS.

OPEN CIRCUIT TERMINATION

17.05 A test employee at distant office pulses directory number assigned to open circuit termination. After the incoming call is cut through, ground on sleeve lead operates relay SO through thermistor SO. The operation of relay SO closes DC path (for supervisor) through inductor SO. An AC open circuit is now provided.

TRANSMISSION TEST FROM TEST FRAME

17.06 When test employees desires to test outgoing trunks from No. 3 office for transmission checking, a call is originated using originating test line (OTL). This enables the test employee to select a desired trunk after pulsing distant office test line or 101 test.

17.07 Operation of ST key provides dial tone. Pulsing distant test line will allow termination to, for example, one-milliwatt which can be heard from test frame speaker. Operation of key TM operates relay TM which provides a DC, high-impedance AC holding path across trunk loop through TM inductor and TMT-TMR capacitors.

17.08 The tip and ring of trunk loop now appear at jack TM which can now be patched to either jack 1000-0-900 to send one-milliwatt or into a transmission measuring test set to measure one-milliwatt from distant office.

17.09 Operation of TM key removes internal portion of test circuit from trunk loop.

18. COMBINED MILLIWATT, LOOP AROUND AND BALANCE TERMINATION TEST LINE - SC19

GENERAL

18.01 When a test employee at a distant office wants to perform manual tests into the No. 3 office, directory numbers assigned to specific functions must be pulsed. As a combined circuit, three different transmission tests can be performed:

(a) One-milliwatt test tone (1000-Hz).

(b) Balance termination.

(c) Loop around test line.

Off-hook supervision is provided in all cases.

18.02 The 71A type milliwatt generators are used to provide reference power to four outlets with one spare. The nominal output from each outlet is one milliwatt (ODBM) in a 900-ohm terminating resistance. The distributing networks A-B-C- and D are adjustable, to compensate for any loss, and should be stopped according to Note 114 in the schematic with reference to SD-95277-01 figures 1 and 7. Another reference can be made to BSP Section E30.223.13 (A204.474.13).

18.03 The output from the generator is continuous. A jack "600" is provided on the unit for calibration purposes based on a 600-ohm termination.

ONE-MILLIWATT TEST LINE

18.04 When the number assigned to this test line is called, ground through networks linkage on lead SLA operates relay S3. Relay S3 operated:

(a) Connects terminals 2 and 4 of inductor LPA to trip ringing and to return off-hook supervision. (Trunk relay RT operates followed by relay RC.)

(b) Partially closes operating path of relay LA.

(c) Partially closes operating path of relay OSM.

(d) Operates relay ST3.

18.05 Relay ST3 operated:

(a) Provides off-normal ground for FS102.

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

18.06 Relay T1 operated:

(a) Locks operated to relay T2 released.

(b) Deactivates TM1 timer.

(c) Operates relay OSM which locks to relay S3.

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

18.07 Relay OSM operated:

(a) Removes the voice-frequency termination of resistor RL1 from leads TLA and RLA.

(b) Removes dummy load resistor RL2 from the "B" distributing network.

(c) Connects the "B" distributing network to leads TLA and RLA.

18.08 Relay T2 operated:

(a) Locks operated to relay T3 released.

(b) Deactivates TM1 timer after relay T1 releases.

(c) Releases relay T1.

(d) Partially closes operating path to relay T3.

18.09 Relay T1 released:

(a) Deactivates TM2 timer.

(b) Operates relay T3.

18.10 Relay T3 operated:

(a) Locks to relay T4 released.

(b) Releases relay T2.

18.11 Relay T2 released:

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

18.12 Relay T1 operated:

(a) Locks operated to relay T4 released.

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

(c) Returns on-hook supervision by releasing relay OSM.

18.13 Relay OSM released:

(a) Restores the voice-frequency termination of resistor RL1 on leads TLA and RLA.

(b) Restores dummy load resistor RL2 on the "B" distributing network.

(c) Disconnects the "B" distributing network from leads TLA and RLA.

18.14 Relay T2 operated operates relay T4. The operate T4 relay releases relay T1 which in turn releases relay T2 which in turn releases relay T3 which releases relay T4 to activate 175-millisecond timer which then operates relay T1.

18.15 Relay T1 operated starts new cycle as described in 18.06 to 18.14. The cycles continue to repeat until:

(a) Disconnection of incoming call which releases S3 relay allowing this circuit to return to normal.

(b) Seizure of balance termination portion of this circuit to enable loop around testing.

BALANCE TERMINATION

18.16 When the number assigned to this test line is called, ground through network linkage on lead SLB operates relay S4 relay. Relay S4 operated:

(a) Connects, via resistor RO, terminals 2 and 4 of inductor LPB to trip ringing and to return off-hook supervision. Trunk relay RT operates followed by relay RC.

(b) Operates relay ST3.

18.17 Relay ST3 operated:

(a) Provides off-normal ground to FS102.

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

18.18 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 OSB1.

18.19 Relay T2 operated:

(a) Locks operated to relay T3 released.

(b) Deactivates TM1 timer after relay T1 releases.

(c) Releases relay T1.

18.20 Relay OSB1 operated:

(a) Removes the voice-frequency termination of resistor RL3 from leads TLB and RLB.

(b) Removes dummy load resistor RL2 from the "C" distributing network.

(c) Connects the "C" distributing network to leads TLB and RLB.

18.21 Relay T1 released:

(a) Deactivates TM2 timer.

(b) Releases relay OSB1.

18.22 Relay OSB1 released:

(a) Restores the voice-frequency termination of resistor RL3 to leads TLB and RLB.

(b) Restores dummy resistor RL2 to "C" distributing network.

(c) Disconnects "C" distributing network from leads TLB and RLB.

(d) Operates relay T3.

18.23 Relay T3 operated:

(a) Locks operated to relay T4 released.

(b) Releases relay T2.

18.24 Relay T2 released:

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

18.25 Relay T1 operated:

(a) Locks operated to relay T4 released.

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

(c) Returns on-hook supervision.

18.26 Relay T2 operated:

(a) Deactivates TM1 timer after relay T1 releases.

(b) Operates T4 relay.

18.27 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.

(d) Releases relay T1.

18.28 Relay T1 released:

(a) Returns off-hook supervision.

(b) Deactivates TM2 timer which releases relay T2.

18.29 The released T2 relay releases relay T3. The circuit remains in this state until:

(a) Disconnection of incoming call which releases S4 relay allowing this circuit to return to normal.

(b) Seizure of milliwatt test line portion of this circuit to enable loop around.

LOOP AROUND TEST

18.30 When a loop around test is to be performed, both the milliwatt test line and the balance termination assigned numbers must be called. Either number can be called first. When the milliwatt test line is called functions described in 18.04 to 18.15 are applicable. When the balance termination is called functions discussed in 18.16 to 18.29 are applicable.

18.31 The second call can arrive at any sequence that the first call may be at. However, to operate relay LA (which loops leads TLA to TLB and RLA to RLB) this circuit may continue in its "first call" function until relays are in a particular sequence. Relays OSM and OSB1 must be released and relays S3 and S4 must be operated. When timing functions (relays T1, T2, T3, and T4) are set relay LA operates.

18.32 Relay LA operated loops together, through capacitors CT1 and CR1, leads TLA-TLB and RLA-RLB.

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

MILLIWATT GENERATOR

18.34 The translator oscillator is of the Hartley type designed to operate with a nominal supply voltage of approximately 45 volts. The frequency of oscillation is determined by the tuned circuit of network (MW) which is resonant of 1000 Hz + 1 percent. Resistor (MW1) determines the amount of feedback from the emitter of the transistor to the LC network. The value of (MW1) is chosen to obtain that critical amount of feedback which permits the peak AC base voltage to equal the DC collector-to-base voltage. When the base is at collector potential, limiting occurs, thus stabilizing the oscillating amplitude. Capacitors (MW and MW1) provide the necessary bypassing.

18.35 The amplitude of oscillation is directly dependent upon the DC voltage applied between base and collector of the transistor. This DC voltage is regulated by diodes (MW and MW1) and is established at the correct value by adjustment of potentiometer MW ADJ. One setting is adequate for a supply voltage range of greater than 10 volts, and should be changed only when necessary on subsequent occasions, and then only when suitably accurate means of checking this power of one milliwatt in 600 ohms is available. Adjustment procedure is given in Chart 1, BSP Section E40.376.01 (A702.629.01). Resistor MW4 serves to limit current through the diodes, and MW, through the transistor. The MW1 makes the oscillating amplitude almost completely insensitive to battery voltage changes.

18.36 The 600- and 900-ohm output taps are provided on the secondary of transformer MW. The impedance looking toward the transformer is approximately 6 ohms for the full winding. Because it is low, each outlet operates from nearly the open circuit voltage of the transformer.

GENERATOR OUTPUT

18.37 The 71A generator in Figure 1 is provided with one jack outlet on the front panel. While the primary purpose of this outlet is for calibration of the generator, it may also be used for routine tests. It is built out to 600 ohms with MW5, MW6, and MW7, and terminated in 600 ohms by MW8. The 600-ohm terminating resistance, MW8, is lifted off the outlet jack when the outlet is used.

18.38 No provision has been made for blocking DC from the generator. Separate blocking arrangements are provided where DC voltages are present on the circuits to be tested.

18.39 The output is continuously available since no switch is provided.

DISTRIBUTING NETWORKS

18.40 The distributing networks A, B, C, and D are designed to build out the output impedance of the generator to 900 ohms. The networks are adjustable, providing a means of reducing the amount of resistance between the generator and the outlet to compensate for central office wiring and equipment loss.

18.41 Adjustment of the distributing network to compensate for wiring and equipment loss is made by strapping out specific values of resistance in the network which corresponds to changes of 0.02 dB in 900-ohm outlets and 0.03 dB in 600-ohm outlets. The range of adjustment is approximately 0.3 dB in 900-ohm outlets and 0.45 dB in 600-ohm outlets. The procedure for adjusting this distributing network, and the output power at individual outlets is given in BSP Section E30.223.13 (A204.474.13).

1000-0-900 JACK (1000 HZ)

18.42 Provision of jack 1000-0-900 enables access to 1000 Hz for testing purposes. Resistance MWT provides an idle termination for distributing network "A" which is removed when patch cord is inserted into jack. Capacitor MWR and MWT are provided to prevent DC from generator.

19. "TOUCH-TONE" TESTING - FIG. 103 - SC20

GENERAL (TT KEY OPERATED)

19.01 An originating register is selected as described in 14.01 to 14.10. Key TT operated operates relay TTA which enables the TOUCH-TONE oscillators. Connection to the originating test line is made as described in 1. with the class of service assigned for TOUCH-TONE pulsing. When the dial tone connection is established, the terminating test line is dialed by means of a TOUCH-TONE pad located on the jack lamp and key panel of the test frame.

DIGIT VERIFICATION

19.02 This test checks the ability of the TOUCH-TONE receiver to accept all ten digits. After a dial tone connection is established the CB key is operated. Using the TOUCH-TONE pad, dial a working office code and a directory number using digits not apparent in the office code. The CB key operated is used to force a trouble record display on a test call and also prevents it from completing. From the trouble record display verification is made of the digits dialed. It may be necessary to make a number of these calls to verify all digits.

HIGH- AND LOW-LEVEL TESTS

19.03 This test checks the ability of the TOUCH-TONE receiver circuit to function over a fixed range of signal input levels. The test is made with either the low-level LLV or high-level HLV key operated. The output level of each TOUCH-TONE oscillator is adjusted to +3 dBm. On normal tests the oscillator outputs are passed through the low-loss LL pad which inserts a -10 dBm loss in the tip and ring to furnish a -7 dBm signal to the TOUCH-TONE receiver. When the LLV key is operated, the HL pad is placed in series with the LL pad adding an additional -15 dBm loss to furnish a -22 dBm signal. When the HLV key is operated neither pad is inserted in the line and a +3 dBm signal is transmitted. In all other respects the test is the same as a normal test.

MAXIMUM AND MINIMUM FREQUENCY TEST

19.04 This test checks the ability of the TOUCH-TONE receiver to function properly when it receives TOUCH-TONE signals comprised of frequencies which are (1.8 percent + 0.1 percent) higher or lower than the normal frequencies. With the FCA switch in the off position, set the FCB switch to the MNF (minimum frequency) or MXF (maximum frequency) position. Relay MNF or MXF operate under control of relay TTA. Establish dial tone and proceed to key called number. The LF- and HF- relays the digits keyed and with either the MNF or MXF relay operated the AO- and BO- capacitors will be connected to form tuned circuits in the high- and low-frequency oscillators. This will cause the oscillators to generate frequencies above or below the nominal frequencies for all digits. In all other respects the test is the same as normal test.

SINGLE FREQUENCY TEST

19.05 This test checks the ability of the TOUCH-TONE receiver to ignore signals comprised of a single TOUCH-TONE frequency. When this test is made a single-frequency pulse is keyed (transmitted) ahead or in between digits of the office code or directory number. The FCA and FCB selector switches are set to the positions as outlined below. The FCA switch operated to one of its four positions and the ST/SSR key activated will cause the transmission of a single frequency from the high group of four frequencies with the FCB switch in the SFH position, or a single frequency from the low group of four frequencies with the FCB switch in the SFL position. The switch positions and the designations of the frequency transmitted are tabled below.

Switch Positions		Frequencies Transmitted	
FCB	FCA	Designation	Hz
SFH	(1	H1	1209
	(2	H2	1336
	(3	H3	1477
	(4	H4	1633
SFL	(1	LO	697
	(2	L3	770
	(3	L6	852
	(4	L9	941

With dial tone established, the ST/SSR key activated prior to or in between digits of an office code and directory number, operates relay SF1. The SF1 will operate either

the HF or LF relay depending on the position of the FCB switch. The HF- or LF- relay for the selected frequency operates and connects the single frequency tone to the tip and ring of the originating test line. In all other respects the test is the same as normal test.

SPECIAL FREQUENCY TEST

19.06 This test checks the ability of the TOUCH-TONE receiving circuit to ignore signals comprised of three frequencies two of which are valid combinations of TOUCH-TONE frequencies at a normal level (-7 dBm) and the third a frequency above the band of the TOUCH-TONE frequencies at a higher level (-6 dBm). For this test a 2000-Hz signal is used as the third frequency. When this test is made a 3-frequency pulse is sent in the same manner as described for the single frequency test. Set the FCB switch to the 3FS position, and the FCA switch is set to one of the 1-4 positions. The switch positions and the designations of the frequencies transmitted are summarized below. The actual frequencies are listed in the previous paragraph.

Switch Positions		Frequencies Transmitted
FCB	FCA	
3FS	1	H1, LO, 2000 Hz
	2	H2, L3, 2000 Hz
	3	H3, L6, 2000 Hz
	4	H2, L9, 2000 Hz

With dial tone established, the ST/SSR key activated prior to or in between digits of an office code and directory number, operates relay SPF. Relay SPF operated starts the 2000-Hz oscillator, operate the HF- and LF- relays (depending upon the position of the FCA switch) which generate frequencies representing one of the digits 0, 1, 5, or 9. Consequently,a valid combination of TOUCH-TONE frequencies and a 2000-Hz signal will be generated and placed on the tip and ring of the originating test line. The test then proceeds in the same manner as for a normal test.

SPECIAL SIGNAL (LEFT OR RIGHT)

19.07 This test checks the ability of the TOUCH-TONE receiver to accept special frequencies corresponding to the TOUCH-TONE dial number sign (#) and asterisk (*). The ST/SSR key is in accordance with the number sign (#) and the KP/SSC in accordance with the asterisk sign (*). Set the FCA, FCB switches to the off position and establish dial tone. Activate ST/SSR key (HF3, LF9) or KP/SSC key (HF1, LF9). The originating register after recognizing the identification of these signals from the TOUCH-TONE receiver will return overflow to the originating test line.

20. MULTIFREQUENCY TESTS - SC21

GENERAL

20.01 After seizing an incoming register, digits can be pulsed as desired beginning with a keypulse (KP) and ended with a start pulse (ST). Several critical tests can be performed. Multifrequency signals are sent to the register as various keys are operated allowing frequencies from the generator to be imposed on tip and ring toward the register.

20.02 The transistorized generator is turned on when test frame is started by operating relays or keys.

20.03 An incoming trunk must be used to access the register from the test frame. The ITT jack provides the loop into test circuit. Operation of keys presents a loop to trunk A relay which makes a request for a register.

TEST PROCEDURE

20.04 Test cord patching and preliminary key operations are described in 3. and shown on SC3. Operation of key ST followed by operating key OA, seizes the trunk which then seizes a register. Lamp IS lighted indicates register is ready to receive pulses.

20.05 Using procedures described in following paragraphs, desired tests and their results can be performed.

20.06 The loop from the register MF receiver is provided to the test frame through ITT jack. The tip and ring leads through

various relay contacts are capacitors RR-TR and to make-contacts of the various digit keys that when operated allow frequencies from generator to be sent to registers receiver.

20.07 Each digit transmitted consists of a pulse of 2-out-of-5 audio frequencies: 700-, 900-, 1100-, 1300-, and 1500-cycles per second, designated 0, 1, 2, 4, and 7, respectively. In addition, a keypulse using frequency two and a sixth frequency of 1700 cycles, designated ten, is transmitted as a gate opener; also, a start pulse using frequencies seven and ten is transmitted after the last digit as an end of start signal. The entire code used is as follows. This is the standard additive 2-out-of-5 code and the two frequency designations may be added to obtain the corresponding digit for digits 1 through 9.

Digit	Designations	Actual Frequency Cycles Per Second
0	4,7	1300,1500
1	0,1	700, 900
2	0,2	700,1100
3	1,2	900,1100
4	0,4	700,1300
5	1,4	900,1300
6	2,4	1100,1300
7	0,7	700,1500
8	1,7	900,1500
9	2,7	1100,1500
KP/SSL	2,10	1100,1700
ST/SSR	7,10	1500,1700

20.08 In each of the following tests, the receiver must be unlocked prior to actual test. The receiver is unlocked by operation of key KP/SSL which allows frequencies of 1100 and 1700 cycles to be sent.

THREE FREQUENCY TEST

20.09 Operation of key 3F allows frequencies 700, 900, and 1100 cycles to be sent. When the receiver detects these three frequencies, it informs the register to seize a marker which causes the trunk to return reorder tone. Overflow tone should be heard in test frame speaker.

20.10 This test can be made with the three frequency pulse being sent on the A digit only.

SINGLE FREQUENCY TEST

20.11 Operation of any digit key for the "A" digit followed by the operation of key SF which sends a single frequency of 1100 Hz in the "B" digit slot. Any two digit keys can now be operated for digits "C" and "D". Operation of key ST/SSR causes the register to request a marker to process the call.

20.12 When the register connects to a marker, the marker will recognize the 1-out-of-5 digit in the "B" digit slot and cause a trouble record to be taken. The trouble record will show the 1-out-of-5 in the "B" digit as (2).

20.13 This test (operation of SF key) can be made with the single frequency pulse being sent on any digit resulting in a trouble record indicating a 1-out-of-5.

MAXIMUM LOSS TEST

20.14 Prior to start of test operation of switch FCB/MF to position ML causes operation of relay ML which inserts a -22 dB pad (-3 dB with key normal) into the loop between the registers receiver and the MF generator in the test circuit. Now when digits are pulsed through resistors ML1 to ML5 the tones sent to the receiver are at the minimum test level and call should complete as pulsed.

TWIST TEST

20.15 A twist test is made to determine if a receiver will record both frequencies of a signal in which the level of the two frequencies composing it differ in

level by as much as 8 dB. The twist network, resistors TW1 to TW5, provided to simulate this condition will introduce 6.25 ± 0.25 dB more loss at 1500 cycles than at 700 cycles.

20.16 To check this condition a normal call is made with the FCB/MF switch in the TW position. The called number must include the digit 7 which is composed of the two frequencies 700 and 1500 cycles. The test trouble record can be examined to determine if 7 was correctly recorded.

20.17 The twist network is inserted into the loop when relay TW operates by the position of switch FCB/MF.

MODULATION PRODUCTS TEST

20.18 The nonlinear characteristics of the amplifier in the MF receiver causes additional frequencies which are equal to twice one of the signal frequencies minus the other signal frequency to be produced. The level of the addition frequency in extreme cases may be high enough to operate detector transistors in the receiver.

20.19 To check the operation of the receiver under this condition a normal pulsing test is made with the FCB/MF switch in the MP (modulation products test) position and with a ground connected to the W lead in the multifrequency signal receiving circuit associated with the register under test. This introduces a pad in the transmission circuit for bringing the signal level to the optimum value and alters the voltage on the detector transistors base. This will produce a more severe condition than will be encountered under normal operating conditions. A reorder signal will be sent to the marker if a third frequency turns on the detector transistor.

20.20 The signal frequencies which may be produced due to modulation are shown on the table below. Pulsing tests made to check this condition should include all the digits that produce modulation products at signal frequencies.

Digit Pulsed	Modulation Frequencies at Signal Frequencies
0	1100~ (2) and 1700~ (10)
1	1100~ (2)
2	1500~ (7)
3	700~ (0) and 1300~ (4)
4	None
5	1700~ (10)
6	900~ (1) and 1500~ (7)
7	None
8	None
9	700~ (0)
KP	None
ST	1300~ (4)

20.21 A normal call is made after switch FCB/MF is positioned on MP which operates relay MP. The operated MP relay inserts a 1640-ohm resistor (MPT) into the tip lead of loop. The call should complete normally.

MISCELLANEOUS INCOMING REGISTER TESTS

20.22 To check the ability of a register to recognize several reorder conditions can be performed using procedures listed below. A register will give a reorder signal to the marker when any one of the conditions is encountered. Reorder tone should be heard in test frame speaker. A normal test call is started after which the following conditions are performed.

(a) A start signal (ST) is received by the register before a full number of digits required to match the trunk class

of call being handled by register has been recorded. To simulate this, operate key ST/SSR after the second digit.

(b) A start signal (ST) is received by the register after more than the full number of digits for the trunk class of call being handled has been received. To simulate this, operate key ST/SSR after the sixth digit.

(c) A second keypulse signal is received by the register before full complement of digits has been recorded. To simulate this operate KP/SSL after the second digit.

(d) A start signal is not received in 16 to 19 seconds after register is seized. To simulate this, do not operate ST/SSR key after five digits have been pulsed.

(e) To cause an operator error by sending two digits at once after the register is seized. To simulate this after the second digit is sent, operate two keys at the same instant. The register should immediately seize a marker which then causes the trunk to return reorder.

MF GENERATOR - FS16

20.23 The frequency generator of App Fig. 16, wired per FS16, makes use of a transistor oscillator for each of the six frequencies. The power for operating the oscillators is obtained from the -48 volt source through a voltage divider circuit used in common by all six oscillators. The power is applied under control of relays ON1, OA, or keys ANS and MF, thus, the oscillators are started when any of the above relays or keys are operated.

20.24 The transistor operates as a current amplifier. A change in current in the emitter will cause a larger change in current in the collector when operating with the normal voltage between the collector and the base. Voltage amplification is also obtained since the emitter circuit is much lower in impedance than the collector. The emitter current and the collector current are in phase with each other.

20.25 Sufficient amplification is obtained from a transistor for it to be used to drive a tuned circuit and, therefore, to act as an oscillator. In the arrangement used in this circuit, energy is fed from a winding inductively coupled to the tuner circuit, consisting of the transformer winding and the capacitor to the emitter. The transformer is designed so that the collector is connected to the point of proper impedance on the tuned circuit. Bias current for the emitter is obtained by connecting the base to a low negative voltage. The direct current voltage for the emitter is supplied through part of tne tuned circuit.

20.26 Oscillation starts when the direct current voltage is applied. The voltage across the tuned circuit will build up to the point where the power losses in the tuned circuit at the various loads connected to it will equal the power supplied by the translator. Since the power that is obtainable from a transistor decreases sharply as the peak of the ac voltage applied to the collector closely approaches that of the dc voltage between the collector and base, the output stabilizes at this point and is approximately the same for all transistors. The output level is also fairly independent of the load applied so long as the ability of the transistor to supply power is not exceeded.

20.27 The F- resistors in the output leads are provided to improve the impedance match with the trunk. The V- cross-connections to the V- point on the voltage divider are made so that the proper output voltage will be available. The P- potentiometers serve to control the amount of feedback so that the output level can be controlled. The power supplied by an oscillator to a trunk, connected to the output of the transformer in the sender, is -8 dBm +1 dB. The voltage at the output of the oscillator is approximately 2.4 volts RMS and varies little with the load.

21. SENDER SELECTION - SC22

GENERAL

21.01 During the marker usage after the test call is identified, the undesired senders are made busy while the desired sender (if made busy) will be idle. Upon completion of marker usage unused senders are returned to normal to serve customer traffic.

PRELIMINARY OPERATIONS

21.02 Operate key SDR which operates relay SDR. Relay SDR operates relay SMB to prepare test circuit for subsequent control. Operate switch IR/SDR SEL to position

of desired sender. The MB relay of selected sender should operate.

TEST PROCEDURE

21.03 Operation of ST key enables the originating test line to select an originating register. After dial tone is heard, pulse an office code with access to desired sender. When register receives proper amount of digits, it requests a marker to process the call. When test call is identified by operation of relay MK in test circuit ground is removed from MB lead to desired senders whose MB relay releases. At the same instant ground, through the operated MK- and MST relays, is applied to section 1 (rear) of switch IR/SDR SEL which further applies ground on SB- leads through the operated SMB relay to all undesired senders where their MB relays operate.

21.04 When the marker attempts to seize a sender it will find all but desired sender busy. After selecting the desired sender, the marker continues to process the call.

22. CALL BLOCK

GENERAL

22.01 Operation of key CB enables the test employee to perform tests where a trouble record would be taken and the call would not be processed. This is especially necessary when performing verification of line number translator cross connection tests where any number can be called but marker cannot complete linkage thus preventing ringing of that customers telephone.

22.02 If CB key is operated prior to ST key, a trouble record will be taken of that marker usage after ST key is operated. However, as the originating register is released, pulsing is impossible.

TEST PROCEDURE

22.03 When test call is identified by operation of relay MK-, ground through the operated CB key, through relay MK- operates OTF1 in the marker serving the test call. When relay OTF1 operates, marker relay FLK on forward linkage of an IAO call or relay RTF on all other calls, cannot operate. Failure to operate either relay causes the work time (WT) timer to operate in the marker which operates its WT relay.

22.04 When marker WT relay operates a trouble record is taken of the test call followed by the operation of marker relay TRL. Marker relay TRL operates test frame relays CTR and CTR1. Relay CTR1 grounds lead TRL to the marker where it is passed on to the marker connector which operates relay TRL in the register or line switch connector. The call is then released. Lamp CTR lights at test circuit.

23. REVERTING CALL - SC24

GENERAL

23.01 Starting a call from the originating test line and pulsing the IAO code followed by the directory number of OTL allows the marker to set up to a reverting trunk using the test frame. The station digit is then pulsed and after operation of key RC, the test employee can observe ringing applied by the trunk into the ringing detection lamps on the test frame.

23.02 It may be necessary to change settings of CS switch for proper class of service. Also, changing the setting of switch RING COMB allows different ringing combinations to the OTL.

23.03 A type of ringer test can be performed by using a flat rate class of service. The various ring codes can be observed after the operation of key RC. No station digit is required.

Note: Marker screening must be applicable.

START OF TEST (WITH STATION DIGIT)

23.04 After setting CS switch to a class of service where a station digit is necessary, operate key ST to seize a register from the OTL. After receipt of dial tone, pulse the IAO code and directory number of the OTL.

23.05 The registers MST relay operates followed by relay MST in this circuit. Relay MST operates relay FB which releases the MB relay in the register which immediately seizes a marker. Lamp FB lights while relay FB is operated. The test call is identified by operation of MK- relay followed by operation of relay OTF in that marker. The marker continues to process the reverting call and operates its RR relay and the registers RR relay.

23.06 The marker releases by operating its DISC relay which operates relay MRL in this circuit which lights lamp MRL and operates relay DIS. Relay DIS releases relays MK- and FB. The release of relay FB reoperates relay MB in the register (shown in FS11). Relays RD and RDK operate in the register to release its MST relay. The second dial tone should be heard indicating the register is ready to receive the station digit.

STATION DIGIT

23.07 Operation of key TTLD operates relay TTLD which releases relay MST followed by relays DIS and MRL. Lamp MRL is extinguished. Operation of key RD prepares a path to later operate relay MST.

23.08 Pulse desired station digit for party 1 to 8, (digits 2 to 9, respectively) digit 0 and 1 are excluded. Steering relay JS operates in the register upon receipt of digit followed by relay MST which operates relay MST in this circuit. Relay FB (lamp FB lights) operates to release the MB relay in the register allowing it to request a marker. Relay MMB operates and lamp MMB lights. The test call is identified by the operating of relay MK- which operates relay OTF in marker serving the test call.

23.09 The marker proceeds to set linkage to a reverting trunk and starts to release. When the marker operates its DISC relay, relay MRL operates and lamp MRL lights in this circuit while relay MRL operates in the register causing it to release. Relay MRL operated causes relay DIS to operate and lock to relay MST. Relays FB, MMB, MK-, and OTF in the marker all release. Lamps MMB and FB are extinguished. Busy tone should be heard in the speaker indicating trunk is ready for on-hook.

RINGING DETECTION

23.10 Operation of key RC operates relay RC which presents on-hook to trunk and puts loop into ringing detection lamps R+, R-, T+, and T-. The ringing lamps flash as trunk applies ringing (refer to 2.14 Table A for ringing codes etc).

RINGING TESTS

23.11 Application of ringing tests, pretrip and trip are now applied as described in 4.11 to 4.15.

TWO-PARTY REVERTING CALL

23.12 Prior to start of test, switch CS is set to the position assigned to 2-party class of service. The call is started and proceeds as described (23.04 to 23.06) for reverting call station digit, up to the point where busy tone is heard in place of second dial tone.

23.13 Operation of key RC allows ringing detection lamps to be inserted onto loop and also simulates originating party on-hook.

FLAT RATE RINGER TEST

23.14 If marker screening allows a flat rate single line to pulse its own directory number, a test call can be originated with CS switch in the position of that class of service. The call functions like that described in 23.12 and 23.13. Changing of switch RING COMB to various positions allows selection of all ringing codes.

24. MARKER CONTROL REACTION LAMPS - FS6

GENERAL

24.01 Observing marker reaction and functions informs the test employee as to what is or has occurred during test call. Several lamps and relays provided for this purpose are controlled through an operated OTF relay.

24.02 When a specific lead is grounded by the marker, a reed relay will be operated and locked. The operated reed relay lights its associated lamp and in some cases operate relay DIS. The operated DIS relay releases relays FB and MMB that are used to control the make-busy program during the test call. Relay DIS is locked operated through:

(a) An operated OR relay with keys DIAL and TT normal (dial tone).

(b) An operated MST relay.

MRL LAMP

24.03 The lighting of lamp MRL indicates that the marker DISC relay has operated. This means the marker has completed its functions and has applied ground on MRL

lead to release the register or line switch connector. Lamp MRL could also be lighted when the marker operates its TOA relay. In this case an alarm is sounded and lamp TA is lighted at the marker frame.

RA/STP LAMP

24.04 The lighting of this lamp indicates that the marker has route advanced or stepped. In either case, with key RAV normal, relay CTR1 is also operated from grounded RA lead. The operated CTR1 relay returns ground to marker on TR lead which is then passed on to a register or line switch connector where relay TRL operates causing an immediate trouble release. Operation of relay CTR1 also lights lamp CTR.

CTR LAMP

24.05 This lamp indicates the marker has operated its trouble release (TRL) relay. On a call that is not a test call the grounded CTR lead to the marker connector causes an immediate release of the connector by the operation of its TRL relay. However, on a test call the CTR lead to the marker connector is opened (relay OTF) and passed on to this circuit to operate relays CTR and CTR1. Relay CTR operates relay DIS. Relay CTR1 lights lamp CTR and grounds lead TR back to the marker and onto the marker connector to eventually operate relay TRL in a register or line switch connector. This causes register or line switch to release.

ATB LAMP

24.06 This lamp indicates the marker on a test call has encountered an all trunks busy condition. Diode CTR allows ground applied on CTR lead. The subsequent action is described in 24.05. Meaning the marker cannot complete the call as directed.

24.06 This lamp indicates the marker on a test call has encountered an all trunks busy condition. Meaning the marker cannot complete the call as directed.

OF LAMP

24.07 Lamp OF lighted indicates relay PB has operated in the marker. This means the marker cannot proceed with call because there are no channels available.

TR LAMP

24.08 The TR lamp will light when ground is applied by the marker on lead TR when the marker encounters a trouble release (TRL) condition during a second trial usage only. The same ground is applied to TRL lead to marker connector to operate relay TRL in a register or line switch connector.

LBY LAMP

24.09 This lamp indicates the marker encountered a line-busy condition resulting in operation of relay LBT in the marker. The grounded LBT lights lamp LBY.

TP/AK LAMP

24.10 This dual function lamp indicates a tip party was registered in the trunk used by the call after a charge condition (off-hook by called party). This lamp also indicates the marker has operated its AK (advance check) relay when advancing to second group of lines on a PBX termination.

RP/GB LAMP

24.11 This also is a dual function lamp indicating that:

(a) A ring party was registered in the trunk used on the call after a charge condition (off-hook by called party).

(b) The marker encountered a group busy when terminating to a PBX.

25. TELEPHONE CIRCUIT - FS4

GENERAL

25.01 The test frame is equipped with one telephone circuit to enable incoming or outgoing calls. When call is terminated into the test circuit by pulsing one assigned directory number a minor central office alarm is sounded along lamp indications. The telephone circuit also controls a test pattern request when it is called with the office alarms transferred during unattended hours.

ORIGINATING A CALL

25.02 To make a call using the telephone circuit operation of key TEL operates relay TEL which presents a loop through the DIAL and TEL A inductor to operate the L relay in the line link frame. The originator can dial desired number after hearing dial tone either through the speaker or using an operators headset plugged into TEL A and TEL B jacks with key TALK operated.

INCOMING CALL

25.03 When the directory number of the telephone circuit is called, the marker

sets linkage to its line location. When trunk applies ringing across the loop (RING varistor) relay RING operates. Relay RING lights key lamp TEL and causes a minor alarm to sound. When ringing cycle is silent RING relay is released. Alarm discontinues, also. Relay RING operations continue until key TEL is operated which will trip the ringing. A conversation can now be accomplished using an operators headset inserted into jacks TEL A and TEL B with key TALK operated.

SCO KEY

25.04 With key sound cut off (SCO) operated transmitter battery is removed from telephone loop at the TEL transformer.

TELH KEY

25.05 With key TELH operated, relay TELH is operated to put loop into a hold condition. This would allow a test call to be made without feedback from telephone loop.

CALL TO TELEPHONE WHEN OFFICE IS UNATTENDED

25.06 When alarms are transferred during unattended period relay UN releases. A call directed to the telephone circuit during this time allows relay TREQ to operate from relay RING which will operate and release as ringing is applied. Relay TREQ allows battery to winding of relay RTSP which then operates making a request for a trouble record. Key CTRS is normal causing the trouble record sender to outpulse that trouble record.

VOLUME CONTROL FOR SPEAKER

25.07 Rotation of VOL switch controls amount of current allowed on grid of AMP electron tube which causes reduction or gain in amplitude.

TEL LINE

25.08 In the miscellaneous circuit, telephone jacks TEL A and TEL B are multipled throughout the office. This allows access to the test frame telephone circuit at any location in the office. When using the telephone jacks without the telephone circuit key TALK must be operated to provide talking battery and ground.

26. NO TEST

GENERAL

26.01 On occasion it may be necessary to make a test call on a "no test" basis to facilitate completion to a busy line for testing purposes. To perform a "no test" function it is accomplished by using an incoming trunk which has the "no test" class mark assigned to it. Office records will determine trunk equipment location where patching from trunk T jack to ITT jack is done.

METHOD OF OPERATION

26.02 After selection of the trunk and patching is completed, the test frame is set up as described in 3. for an incoming trunk test. Using the DIAL or MF pulsing keys, pulse the directory number of desired line.

26.03 The marker when processing the call must have its NT relay operated from the trunk used.

27. JACKS, KEYS, AND LAMPS

GENERAL

27.01 Miscellaneous functions associated with a maintenance center are necessary to provide telephone personnel with conditions that occur in the No. 3 office. In-use lamps, alarm lamps, make-busy and alarm transfer facilities are included in this portion.

MARKER CONNECTOR MAKE BUSY - FS17

27.02 Four jacks designated MCMB- are provided to enable removal of any marker connector circuit from service. A 329A plug inserted into a jack applies ground on a CB- lead to the connector where relay CB operates.

ROUTE TRANSFER JACK

27.03 One jack is provided to enable the transfer of a cross-connected route in both markers. A 329A plug inserted into jack RT applies ground on lead RT to the marker cross-connect terminal RT. This function can also be performed remotely,

using code point 175 in the remote make-busy translator or CSACS control.

CSACS LAMPS AND JACKS

27.04 Jacks and lamps are provided to enable observation and control when an office is equipped for CSACS control. Jacks and lamps with their meaning are:

KT Jack - Control Transfer

CO Lamp - Control Operated

CC Lamp - Call Central

LAC Lamp - Local Alarm Control

AT Lamp - Alarms Transferred

PERMANENT SIGNAL COUNTER - PSC

27.05 A permanent signal counter circuit is provided in a miscellaneous frame, that registers or counts each time a trouble permanent signal is encountered by the marker. The circuit is preset as to how many permanent signals occur in same length of time. When that threshold is reached lamp PSC lights (and alarm sounds). To reset counter circuit back to zero, operate key PSC.

MAR KEY

27.06 The master alarm release (MAR) key is provided to enable the local maintenance personnel to release nearly all alarms in the No. 3 Crossbar System. Momentary operation of key MAR causes relay AR, located in alarm sending circuit, to follow its operation. Relay AR in the alarm sending, opens the locking grounds, to various alarm relays in various equipment, on most alarms. Operated fuses cannot be released.

TR KEY

27.07 Operation of key TR releases relay NTR in the alarm sending circuit which releases all UN- relays in the test frame and causes any subsequent alarm to be sent to distant maintenance center by way of the alarm sending circuit and the trouble record senders if provided. This key is usually the last key function when a test employee leaves the office or first key function when arriving at the office.

27.08 The TR key is equipped with a lamp that will light only when alarms are transferred from the remote distant office if inadvertently forgotten.

27.09 If, when key TR is operated, a minor alarm sounds if a make-busy plug or an operated key (common equipment make-busy) provides a ground through diode MB5 to hold relay NTR operated. The NTR relay will remain operated until ground is removed. This feature was incorporated to encourage removal of local make-busy when office is unattended. If a make-busy condition is to remain while office is unattended, the test employee can use switches H, T, U, and keys MB, UB, and EXC as explained later in this CD.

27.10 The function described in 27.09 is functional of course, only when remote make-busy and restore translator is provided. If not provided the make-busy plugs and keys do not cause an alarm when TR key is operated.

ALARM LAMPS

27.11 Following is a list of lamps that are equipped on the test frame to indicate an alarm function has occurred. The lamps are controlled by relay operations in the alarm circuit:

Designation	Meaning
PWR Line Up CDF Line Up LNT Line Up TST Line Up MISC Line Up	Lamps for respective line ups indicate a minor or major alarm has occurred somewhere in that line up
ABS	Alarm Battery Supply
AMB	All Markers Busy
CAR F	Carrier Failure
CLI	Nuisance Call Trap
ERL	Emergency Reporting Line
IPM	Interrupter Circuit
IPS	Incoming Trunk Permanent Signal
IRB	All Incoming Registers Busy
LA	Load Alarm
MBA	All Marker Busy (Extended time)
MR	Message Rate Supply
ORB	All Originating Registers Busy

Designation	Meaning
PABS	Power Alarm Battery Supply
PUA	Pickup Alarm
R-S TOA	Register Sender Time-Out Alarm
SDRB	All Senders Busy
VA	Voice Alarm (Announcement)

27.12 Other alarm indications that are not controlled by the alarm circuit. These alarms are controlled by their respective circuit.

Designation	Meaning
MCTO O/1	Marker Connector Time Out
LSCTO O/1	Line Switch Connector Time Out
SSTI	Outgoing Sender Link Trunk Identifier
TRA	Trouble Analyzer Alarm
TREC	Trouble Record Has Been Taken

IN-USE LAMPS

27.13 There are six lamps equipped that indicate usage of that equipment as traffic is being handled within the switches. Those lamps and their meaning are:

Designation	Meaning
LSCO/1	Line Switch Connector
TSCO/1	Trunk Switch Connector
MCO/1	Marker Connector

TST JACK

27.14 This jack is located on the combined distributing module (CDM). Its purpose is to enable the test circuit to originate a call from any line location by patching a cord from the test jack to desired line. When the plug of a cord is inserted into jack TST, the originating test line is no longer functional. The TST jack is provided in the miscellaneous circuit.

ORDL JACK

27.15 The ORDL jack is used to enable an external pulsing source to be used in place of the test circuit. It can also be used when patched to SP jack for pulsing at a location away from the test frame again using an external pulsing source. A good example of this can be seen in Note 319A on this schematic where the loop and leak test arrangement is shown.

Note: When jack ORDL has a plug inserted into it, supervisory relay S is no longer providing the loop, so it cannot operate.

IRDL JACK

27.16 The IRDL jack is used exactly like jack ORDL when making incoming call test when external pulsing is required.

TM JACK

27.17 The TM jack is used to send or measure one milliwatt, after a call has been made by the test circuit, by using a patch cord. The TM inductor and TMT-TMR capacitors provide a holding termination after relay TM is operated from operation of key TM.

ITT JACK

27.18 This jack is used for patching an incoming trunk to the test frame. It can also be used for patching purposes when a test other than incoming is being performed. This jack is multipled throughout the office by the miscellaneous circuit.

SP JACK

27.19 As this jack is also multipled throughout the office by the miscellaneous circuit, it can be used in several ways by using patch cords. One such use is testing E and M type incoming trunks. Another is when testing of sender outpulsing by patching to sender TST jack.

CHBO-7 JACKS

27.20 These jacks are used to remove a channel from service. Plugging in a 329A plug provides ground toward the marker that makes that channel appear busy.

RC JACK (REMOTE CONTROL)

27.21 This jack, also multipled throughout the office, is used to control the start and release of the test frame from anywhere in the office. Using a 32A test set, operation of its red button provides ground from sleeve of RC jack to operate relay RCC in the test circuit. Relay RCC operates relay ST. When the white button is depressed on 32A test set, ground from sleeve of RC jack, is applied to tip of RC jack which shunts down relays RCC and ST in the test circuit.

ORMB- KEYS

27.22 Each ORMB key is associated with a particular originating register. Operation of the key will, if not service busy, operate the MB relay in the register. The operated MB relay (or ON relay) returns ground to the lamp under the cap of the key. With the BAT2 relay operated battery is furnished to lamp causing it to light. When the ORMB- key is operated, ground is also applied by the pulsing OFT relay in the interrupter circuit causing a shunt at the lamp resulting in a flashing on-off condition.

27.23 If key ORMB- is not operated the key lamp serves as a in-use lamp when relay BAT2 is operated. When relay ON of a register is operated on a service call, ground is applied to LP lead causing the key lamp to light for duration of service call.

IRMB- KEYS

27.24 Each IRMB key is associated with a particular incoming register. The function of the key and lamp is as described for the originating registers (ORMB-).

SMB- KEYS

27.25 Each SMB key is associated with a particular sender. The function of the key and lamp is as described for the originating registers (ORMB-).

TRK MB JACKS

27.26 Each trunk, except incoming, has an MB jack associated with it for the purpose of removing that trunk from service. When a 329A plug is inserted into the MB jack ground is applied to the MB lead toward that trunk resulting in operation of its MB relay. A table showing relationship of a numbered MB jack, 000-159 and 200-299 is shown in Note 318 on the schematic.

MMB- KEYS

27.27 Key MMB0 is associated with marker 0 and key MMB1 is associated with marker 1. When either key is depressed the MCB relay operates in the associated marker. If both keys are operated at the same time only marker 0 will have its MCB relay operated. Each key has a lamp under its cap and it is used to indicate in-use when steady or maintenance busy when flashing at 120 IPM.

VMT-VMR JACKS (CDM)

27.28 These jacks are used as described in 12. during voltmeter testing.

TRB-M0 KEY

27.29 Operation of this key denies marker 0 access to the trouble indicator by application of ground on lead TRB to marker 0. When that marker attempts to take a trouble record, its TRB relay operates forcing it to abandon the attempt. This is used when troubleshooting in the marker when a trouble record is not desired.

TRB-M1 KEY

27.30 This key controls marker 1 as described in preceding paragraph.

SSTI-MB KEY

27.31 This key controls the outgoing sender link and trunk identifier in the same manner as markers are controlled as described in preceding paragraph.

TR-MB KEY

27.32 Operation of this key operates relay DB. Relay DB takes the trouble indicator out of service by denying all record request with ground on applicable TRB leads.

ALM-MB KEY

27.33 This key controls the alarm sending circuit in the same manner as the markers are controlled as described in preceding paragraphs.

RMB- JACKS

27.34 These jacks control the MPA receivers by making the receivers busy to the originating registers.

MKR-DL- LAMPS

27.35 These lamps indicate a marker had attempted to take a trouble record but was not accepted. One lamp per marker.

TIB LAMP

27.36 A lighted lamp indicates that the trouble indicator is off-normal through an operated CRL relay.

SP LAMP

27.37 A lighted SP lamp indicates that the trouble record sender, FS300 has started to outpulse.

28. TROUBLE RECORDING - SC100-115

GENERAL

28.01 The FS200 connects markers 0 and 1, and the OSL- trunk identifier circuit to the trouble record lamp display. In addition to the circuits above, alarm records and the test pattern/remote make-busy and restore features are selectively connected to the trouble record sender (FS301) in preparation for remote or local transmission of trouble records.

PREFERENCE

28.02 The preference relays are arranged so that only one call may be accepted at a time in case of simultaneous or overlapping attempts by two or more circuits.

28.03 In order to meet the above conditions the preference relays are arranged so that any relay may operate if all succeeding relays are normal or if preceding relay is operated. Two or more relays may operate simultaneously. The preference is accorded the relay nearest the end of the chain. Preference relays operated for trouble record calls which are locked out are released after the call, which obtained preference, has started.

MARKER PREFERENCE - SC100

28.04 Marker trouble record preference request is recognized by the detection of resistance battery on the TRST lead from marker 0 or 1.

28.05 Granted preference to allow the call to proceed is indicated by the return of ground to that marker via the CI lead.

28.06 Signal the trunk switch and connector circuit to close the switch and level recording leads (battery TRA lead).

28.07 To prepare for identifying the line number translator connector which may be connected to the marker (grounded CNG- lead) and to identify the marker connector along with connecting register information (grounded RGG- lead).

28.08 To provide a busy indication to all circuits except for the circuit involved in the call (ground TRB leads).

28.09 When the trouble record is registered the calling circuit is released by placement of ground on the TRB lead.

28.10 To remain off-normal when connecting circuits release and until the trouble recorder is released.

28.11 In restoring to normal, to remove ground from the TRB lead to all circuits.

28.12 To permit another call to enter the trouble recorder when released.

OUTGOING SENDER LINK TRUNK IDENTIFIER PREFERENCE - SC101

28.13 To recognize a start signal from the outsender link trunk identifier, resistance battery is present on the TRST lead.

28.14 To allow the call to proceed if it obtains preference.

28.15 To perform functions 28.07, through 28.11.

ALARM RECORD PREFERENCE (FS300 REMOTE RECORDS ONLY) - SC103

28.16 To recognize a start signal by the operation of relay ALST. Relay ALST provides resistance battery to preference relay ALP.

28.17 To allow the call to proceed if it obtains preference is to open the preference request function with the removal of the start resistance battery and provide a busy indication to other circuits in the preference chain.

28.18 Perform functions 28.09 through 28.11.

REMOTE MAKE-BUSY AND RESTORE PREFERENCE - SC102

28.19 To recognize a start signal by the operation of relay RBT. Relay RBT provides resistance battery to preference relay RBP.

28.20 To allow the call to proceed if it obtains preference and to open the test circuit preference request function by the removal of resistance battery from lead TRST.

28.21 To provide a busy indication to other circuits in the preference chain.

28.22 To operate relay TREQ when the remote make-busy and restore translator circuit has completed its function.

28.23 Perform functions 28.09 through 28.11.

TEST PATTERN REQUEST PREFERENCE - SC102

28.24 To recognize a start signal by the operation of relay TREQ which provides resistance battery to preference relay RTSP.

28.25 To allow the call to proceed if it obtains preference.

28.26 To perform functions 28.07 through 28.11.

TROUBLE RECORD LAMP DISPLAY - FS201

28.27 Trouble record information stored in memory (M--) relays provide grounds to operate related trouble record lamps.

TROUBLE RECORD SENDER (FS300) CONTROL

28.28 The trouble record sender in conjunction with the trouble recorder is used to transmit trouble record or remote make-busy and restore information to an auxiliary trunk circuit and/or trouble analyzer and display circuit on local or remote basis. This circuit provides for seizure, control of records passed, and the release of the sender.

29. MARKER SEIZURE OF TROUBLE RECORDER - FS200 - SC100

29.01 When a marker encounters a cross or times out due to trouble, it connects resistance battery to the TRST lead to this circuit. This causes the corresponding MPR- relay to operate and lock, and to connect ground to the CI lead to the marker if the preference conditions outlined in 28.03 and 28.04 are met. Ground on the CI lead is transferred to the marker to operate relay CIT and starts the TM4 timer (FS300). Relay CIT returns ground via the CIT lead operating relay MKA-.

29.02 The MKA- relay connects resistance battery to the TRA lead to the trunk switch and connector circuit. This lead is used to operate a trouble relay in the trunk switch and connector circuit which may be associated with the calling marker, in order that it may close switch and level recording leads. The MKA- connects ground to the CNG- lead through line number translator connector circuit 0, 1 for line number translator connector identification, and also connects ground to RGG- lead to the marker connector circuit. These leads are returned on recording leads for identifying connector circuits, registers and line link which may be connected to the calling marker.

30. OUTGOING SENDER LINK TRUNK IDENTIFIER SEIZURE OF TROUBLE RECORDER - FS200 - SC101

30.01 When the outgoing sender link and trunk identifier has record information to pass this circuit, it connects resistance battery to the TRST lead. This causes the SSP relay to operate and lock if the succeeding RTSP preference relay is normal or if a preceding preference relay is operated. If preference is successful, ground is forwarded via the CI lead to the outgoing sender link trunk identifier which then returns ground on the SSO lead to operate relays SSO, SS1, and SS2 and starts the TM4 timer (FS300).

30.02 If preference is unsuccessful, relay SSP releases. However, the outgoing sender link trunk identifier remains off-normal with its record information instored and will again attempt to gain preference as soon as it recognizes that the trouble recorder circuit has returned to normal by the removal of ground from lead TRB.

30.03 Relays SS0, SS1, and SS2 operated connect recording leads used for identifying the stuck sender and trunk involved in this trouble and supersede second trial scanning.

31. TROUBLE RECORDER CONTROL - FS200 - SC100, 101, 102, 103

31.01 The operation of any of the following relays MKA-, SS0, SS1, and SS2, ALCI, or RTSP will operate relay DR.

31.02 Relay DR operated operates relay CRL, and provides an operate path for relay SAST (FS300) if the CTRS or 2TR keys are normal.

31.03 The CRL operated closes a path to operate relay DB and provide lock paths for relays DR, CRL, and DB under control of relay RLS. The CRL relay provides positive control if key REC is operated or sender outpulsing test is attempted. The CRL relay also prepares an operate path for lamp TIB and relay MBO. Another operate path is prepared for relay RLS to release first trial calls when it is desired to register second trial trouble records only, and provides a locking path for relays SRLS and SAST during remote trouble record sending function.

31.04 Relay DB operated ground all TRB leads to associated connecting equipment, the operation of relay TRBA causing the release of the equipment calling for the trouble record and making the trouble recorder busy to all equipment until released. Relay DB also prepares a start path for sender outpulsing test, provides a "record" mark for the trouble analyzer display, prepares remote make-busy and restore functions and controls a start signal path to the TM4 timing circuit.

32. TROUBLE RECORD MEMORY RELAY OPERATION

32.01 Ground and battery from connecting calling circuit will operate respective M-- memory reed pack relays, which will lock through their own contacts and normal back contacts of the RLS relay.

32.02 The operated memory relays serve four functions:

(a) Light their respective trouble record lamps when UN2 relay is operated. Office alarms transferred back (TR key and UN- relays operated) operates relays BAT1 and BAT2 which provides -48 volts battery (option ZE) M1 lamp operation or connects the A, B, or C DC to DC converter which provides -5 volt battery (option ZF) for light emitting diodes (LED) for all trouble indications.

(b) Light lamps corresponding to digits received by the sender outpulsing test circuit (FS101) as they are received from the sender being tested.

(c) Light lamps corresponding to operated magnetic latching relay thereby identifying the status of made busied code points.

(d) Pass memory locking ground to associated LN-- connector relays make-contacts, which when operated are scanned by the trouble record sender (FS301) for binary to octal conversion in preperation for remote or local trouble record transmission.

33. SECOND TRIAL RECORD FUNCTION - SC105

33.01 When it is desired to register only the record from a second trial failure of markers the 2TR key is operated which operates relay 2TRA. With the 2TR key and 2TRA relay operated the first trial records of markers is released as soon as the CRL relay operates. When a second trial record request from a marker; or an alarm record, outgoing sender link trunk identifier record, test pattern/remote make-busy and restore record is registered, ground from the source requesting the record operates the 2TR relay which allows the trouble recorder to function in the normal manner.

34. ALARM RECORD SEIZURE OF TROUBLE RECORDER FOR REMOTE TROUBLE RECORDING ONLY - FS300 - SC103

34.01 With office alarms transferred (TR key and UN relay normal) ground present on lead ALST as a result of an alarm condition encountered in the alarm sending circuit, or ground on lead ST as a result of relay PABS operated or relay FAA released in the alarm circuit operates relay ALST.

34.02 Relay ALST locks through its own contact and back contact of key ALM-MB. It also connects resistance battery through a normal TRBA contact to operate and lock relay ALP. Relay ALP if preference is granted connects ground via the CI lead to operate relay ALC and starts the TM4 timer. If preference is unsuccessful, relay ALP releases. However, relay ALST remains operated and will again attempt to gain preference as soon as it recognizes that the trouble recorder returns to normal.

34.03 Relay ALC operated connects ground to operate relay ALMR, ALC1, SST, supersedes second trial scanning and connects 17 alarm record leads to the M10(--) memory reed packs.

34.04 Relay SST primes the trouble record sender (FS301) for two line message transmission (20 pulses). Relay ALMR prepares the TM5 timer in FS302. Relay ALC1 operates relays ALC3, DR, and connects 16 alarm record leads to the M10,11(--) memory reed packs.

34.05 Relay ALC3 transfers the locking path of relay ALST to relay ALC. Relay DR operates relays CRL and SAST. Relay CRL is described in 31.03 and relay SAST in 35.11. Relay DB subsequently operates and closes a path to operate relay TRBA. Relay TRBA opens the operate resistance battery to relay ALP which releases. Relay ALP releasing releases relay ALC followed by relay ALC1 and recycles the TM4 timer. Relay ALC, ALC1 removes the alarm record leads from the memory reed packs. Relays ALST and ALC3 will remain operated until start ground on lead ALST from the alarm sending circuit or ground on lead ST from the alarm circuit is removed. This arrangement prevents reseizure of the preference chain until the initial alarm is answered in the alarm sending or alarm circuit.

35. TROUBLE RECORD SENDER CONTROL - FS300 - SC106

GENERAL

35.01 The trouble recorder FS200 in conjunction with the trouble record sender FS301 and auxiliary outgoing trunk FS302 is used to transmit trouble record information via multifrequency to the trouble record trunk circuit and/or trouble analyzer and display circuit on a remote or local basis.

35.02 The function of this FS300 is to seize, control, and to sequentially pass information stored in the memory relay circuit via the LN-- connector relays to the trouble record sender. It is also the function of this circuit to recognize sender release, a stuck sender condition, trouble recycle, and to prime the alarm sending circuit when necessary.

TROUBLE RECORD IDENTIFICATION

35.03 The trouble recorder in its function of granting preference has allowed one of the following relays to operate.

(a) MKA0 or 1 indicates marker preference.

(b) SS0, SS1, and SS2 indicates outgoing sender link trunk identifier preference.

(c) ALC indicates alarm record preference.

(d) LNT indicates test pattern/remote make-busy and restore preference.

35.04 To accommodate trouble record sender control seizure, the cancel trouble record sender (CTRS) key must be normal. If the CTRS key is operated, the trouble record lamp display becomes the only means for record display.

35.05 Relay DR operating closes a ground path to operate relay SAST. Relay SAST operated locks through its own contact, transfers the control of relay RLS from the RLS key to a front contact of relay SRLS, and closes a ground path through a normal SST relay to operate relay LAS, or an operated SST relay to operate relay LLS.

35.06 Relay ALC or SSO operated operates relay SST. Relay SST prepares an operate path for relay SST1 which primes the trouble record sender for the length of record to be transmitted (20 record pulses). Relay SST and SST1 normal prepares a path to operate relay MKT which primes the trouble record sender for a 120 record transmission.

35.07 Relay LAS or LLS operated completes a path to operate relay C2. Relay C2 operated closes ground paths that operate relay G, relay FTG when key FTH is activated, relay MKT or SST1 as described in the previous paragraph, and in addition the calamity alarm function is deactivated for the duration of the call.

35.08 Relay G operated operates relay LN00 if relay LAS was operated; operates relay LN10 if relay LLS was operated with relay LNT normal. Provides a lock path for relay C2, prepares for the advance of steering relays controlling relays LN--, and later provides a lock path for relay END. In addition, relay G provides recycle ground for TM4 timer, starts the TM timer and operates relay ON1 of the trouble record sender FS301.

LN-- CONNECTOR RELAYS

35.09 An LN-- connector relay operated connects through 30 memory relay contacts via leads LN00-04, 10-14, 20-24, 30-34, 40-44, and 50-54, to the trouble record sender FS301. The LAS- LMS steering relays control the sequential operation of the LN-- relays.

STEERING CIRCUIT FOR LN-- CONNECTOR RELAYS

35.10 The steering circuit consists of a single relay per LN-- connector relay. It is advanced by a contact on the steering advance relay LADV. The state of the SST relay determines where steering starts. With relay SST normal steering begins with relay LAS, the SST operated steering begins with relay LLS. The last relay to operate in this circuit is END. The following circuit description is made by assuming that the SST relay is normal.

35.11 The operation of relay SAST closes a path to operate relay LAS which locks through series back contacts of all the steering relays. The subsequent operation of relay G opens the operating circuit of LAS. On the first operation of LADV, LBS operates through front contacts of LAS. The LBS locks through a back contact of LCS and opens its operating circuit on one set of continuity transfer contacts. The LBS, on another set of continuity transfer contacts, transfer the locking circuit of LAS from the SAST ground to the LADV controlled ground so that when LADV releases, LAS will release. The next operation of LADV will operate LCS through back contacts of LAS and front contacts of LBS and the next release of LADV will release LBS. This action continues with each operation of LADV operating the steering relay for the next LN-- relay and each release of LADV releasing the steering for the LN-- relay just released.

36. TROUBLE RECORD SENDER - FS301 - SC106

GENERAL

36.01 The trouble record sender FS301 in conjunction with the trouble recorder FS200, is used to transmit trouble record information via multifrequency pulsing, through an auxiliary outgoing trunk FS302 to the trouble record trunk, and/or trouble analyzer and display circuit. This circuit can accommodate these circuits on a local or remote equipped basis. This sender is arranged to outpulse a keypulse, followed by the record identification pulse, plus 120 or 20 display pulses, and the start pulse. It recognizes only "wink start" start pulsing signal.

36.02 When a trouble condition is detected by a marker, outgoing sender link trunk identifier; alarm record or the near or remote maintenance location bids for a display test pattern with or without remote make-busy and restore records, a request for a trouble record is attempted.

36.03 A preference circuit in the trouble recorder FS200 and FS300, is provided that will give preference to one of the requesting circuits and will exclude the others. Upon giving preference, the trouble recorder accepts and stores into memory packs the various grounds and batteries that are present on the leads from the connecting circuit. The trouble recorder releases the circuit which requested the record and seizes this circuit which is recognized by the operation of the off-normal ON1 relay.

36.04 Upon seizure, the trouble record sender prepares its frequency generator and pulsing generator and closes a forward loop through the auxiliary outgoing trunk to the Trouble Trunk (TRT) Circuit, SD-26441-01. After completion of the "wink start" signal, a KP signal is outpulsed to the tape recorder circuit to activate the tape recorder and to the Trouble Analyzer and Display Circuit, SD-26328-05, to prepare the light emitting diodes (LEDs) for operation.

36.05 After a time interval in order to ensure proper tape recorder speed, a record identification signal is outpulsed indicating the starting point of the incoming record to the associated LEDs on the display panel of the trouble record and display circuit. The LED display panel matrix consists of 12 rows of 30 LEDs per row. Trouble records are displayed as follows:

(a) Marker troubles - all 12 rows (1 through 12).

(b) Outgoing sender link identifier record occupy two rows (11 and 12).

(c) Alarm record - two rows (11 and 12).

(d) Test pattern display with or without the remote make-busy and restore feature - all 12 rows (1 through 10).

36.06 Immediately following the record identification signal, the steering circuit of the trouble record sender scans serially by groups of three the storage of record grounds in the memory packs of the trouble recorder circuit. The combination of these grounds are translated from binary information to octal and are accordingly converted to "0" to "7" 2-out-of-5 multifrequency signals.

36.07 The pulsing generator controls the progress of the steering circuit, and in doing so allows the multifrequency signal to appear on the loop during its normal state and removes the signal and advances the steering circuit to the next selection of record grounds in its off-normal state.

36.08 The number of pulses transmitted is determined by the record identification stored in the trouble recorder circuit, and are as follows:

(a) 120 pulses, marker or test pattern record/with or without the remote make-busy and restore feature.

(b) 20 pulses, outgoing sender link trunk identifier record, or alarm record.

Completion of outpulsing is indicated by the transmission of a ST signal. The trouble record sender at end of the ST pulse provides a start signal for the TM3 timer to time for a message verification loop reversal signal from the trouble record trunk circuit. This reversal is an indication to the sender that the proper number of pulses were received by the trunk circuit. The sender releases and transfers control to the trouble recorder circuit.

MESSAGE INTEGRITY (GENERAL)

36.09 There are three message integrity checks monitoring the trouble record transmission. Two are made by the trouble record sender circuit, and the other by the tape recorder, along with the trunk circuit. They are as follows:

(a) One-out-of-7 MFC- Relay Check - This test by the sender insures that only one set of 2-out-of-5 tones are placed on the loop during transmission.

(b) Loss-of-Loop Check - The sender continually monitors for loss of loop during transmission.

(c) Longitudinal Test - The tape recorder and trunk circuit compares the number of pulses received with the number expected which was predetermined by the record identification pulse.

36.10 When any of the above conditions occur, or if trunk guard failure or a stuck sender is detected, the trouble record sender will recycle and attempt to send the entire recording again. If a failure occurs during the second transmission of a trouble record, the trouble record sender effects a minor alarm condition in the trouble recorder circuit and releases.

36.11 The alarm condition will be maintained under key control of the trouble recorder circuit, or if the office is unattended, the alarm condition will be under control of the alarm sending circuit. When the alarm condition is restored, the trouble recorder circuit returns to normal.

DETAILED DESCRIPTION

36.12 When the trouble recorder has given preference to a trouble condition detected by a marker, outgoing sender link trunk identifier, an alarm record, or to a remote make-busy and restore request, a corresponding record identification relay is operated. When relay C2 is operated in FS300, a directly related relay in the trouble record sender is also operated prior to sender seizure. They are as follows:

(a) Relay MKT will operate when preference is given to a marker or test pattern/remote make-busy and restore request. Relay MKT prepares a path to transmit a marker or test pattern/remote make-busy and restore record identification signal (frequencies 0 and 10).

(b) Relay SST will operate when preference is given to the outgoing sender link trunk identifier circuit. Relay SST prepares a path to transmit an outgoing sender link trunk identifier record identification signal (frequencies 1 and 7).

(c) Relays SST and ALMR will operate when preference is given to an alarm record. Relay SST prepares a path to transmit frequencies 1 and 7, and relay alarm extends trunk guard timing in order that the trouble record trunk may identify the transmission as an alarm record.

SEIZURE - SC106

36.13 The trouble record sender (FS301) recognizes a seizure by the operation of relay ON1 as described in 35.08. Relay ON1 operated:

(a) Operates relay KP.

(b) Removes the idle line filter (IL capacitor and resistor) and close forward the tip, ring loop.

(c) Provides a ground path via the ON lead to an auxiliary outgoing trunk (FS302) E and M supervision only.

(d) Sets the pulsing generator (multivibrator) to a zero state.

(e) Starts trunk guard timing.

(f) Frequency generator oscillators are started.

(g) Prepares a number of locking paths.

TRUNK GUARD (FTG KEY NORMAL)

36.14 Relay ON1 operated removed the idle line filter and closed the loop as a seizure signal to the trouble record trunk circuit via an auxiliary outgoing trunk (FS302). The trouble record sender does not distinguish between loop and E and M trunks since the E and M signals are repeated to the sender from the trunk on a loop basis.

36.15 The resistance bridge across the loop simultaneously sends a seizure toward the far end and performs the trunk test of the loop facility. The polarity of the loop is normally on-hook (ground on the tip lead and battery on the ring lead) with the trouble record trunk idle. With loop closure and the polarity of the loop on-hook, relay TG operates. When the far-end polarity changes as the first step of the wink start signal, relay OFS operates; relay TG remains operated. Relay OFS operating completes a path to operate relay OF1 which locks to ON1 ground and is a signal that the sender has recognized reception of the first half of the wink. When the tip and ring supervision returns to on-hook, OFS releases but TG does not. With relays OFS, KP1 normal, and relays TG, KP, OF1 operated, a ground path is closed to operate relay ET. Relay ET operated is the start-dial signal to the sender.

REVERSED TRUNK

36.16 If the trouble record sender upon loop seizure finds the far end in a permanent off-hook condition (ground on the ring lead, battery on the tip lead) the sender interprets this as a reversed trunk and a trouble condition. In this case, relays TG and OFS operates. Relay OFS operates relay OF1. Trunk test is not satisfied without the subsequent release of relay OFS and the operation of relay ET. Therefore, the sender times out and is recycled.

FORCED TRUNK GUARD (FTG KEY OPERATED)

36.17 Forced trunk guard is a function of the trouble record sender to provide its own supervision when a trouble record transmission is made exclusively to a trouble analyzer and display circuit without the benefit of the trouble record trunk circuit.

36.18 The C2 relay and the FTG key operated in the trouble recorder FS300 provides path to operate relay FTG in the sender. Relay FTG operated:

(a) Opens the tip and ring to the auxiliary outgoing trunk circuit (FS302).

(b) Prepares an off-hook polarity on the tip and ring leads. (Ground on the ring and battery on the tip.)

36.19 Relay ON operated closes a resistance bridge across the tip lead and ring lead and completes an off-hook polarity loop which operates relays OFS and TG (a ground path through resistor FRG, a normal OF1, an operated FTG and ON, through the coils of relay OFS and TG, the operated ON and FTG, and normal OF1, to battery through an FTG resistor). Relay OFS operated, operates relay OF1. Relay OF1 locks to off-normal ground and reverses the tip, ring polarity to an on-hook state (battery on the ring and ground on the tip). This condition releases relay OFS and relay TG remains operated. With relays, OFS, KP1 normal, and relays TG, KP, OF1 operated, a ground path is closed to operate relay ET. Relay ET operated is the start-dial signal to the sender.

FREQUENCY GENERATOR (ASSIGNMENTS OF FREQUENCIES)

36.20 The multifrequency signals are generated in the sender by means of transistor oscillators. The frequencies are brought to the contacts of the translating relays on a lead per frequency basis. Six frequencies in steps of 200, from 700 to 1700 Hz are used. The frequencies and their assignments are as follows:

MF CONVERSION RELAYS	REED SCAN RELAYS OPERATED			2/6	FREQUENCY COMBINATION		REMARKS
	RSO	RS1	RS2		Hz	Hz	
MFCO				4 + 7	1300	1500	
MFC1			X	0 + 1	700	900	
MFC2		X		0 + 2	700	1100	
MFC3		X	X	1 + 2	900	1100	
MFC4	X			0 + 4	700	1300	
MFC5	X		X	1 + 4	900	1300	
MFC6	X	X		2 + 4	1100	1300	
MFC7	X	X	X	0 + 7	700	1500	
KP				2 + 10	1100	1700	Keypulse Signal
ST				7 + 10	1500	1700	Start Pulse
TRL				4 + 10	1300	1700	Trouble Wipe-Out
MKT				0 + 10	700	1700	Marker or Test Pattern/Make-Busy and Restore Record Request
SST1				1 + 7	900	1500	Outgoing Sender Link Trunk Identifier Record Request or Alarm Record

GENERATION OF FREQUENCIES

36.21 The frequency generator of App Fig. 16, wired per FS16, makes use of a transistor oscillator for each of the six frequencies. The power for operating the oscillators is obtained from the -48 volt source through a voltage divider circuit used in common by all six oscillators. The power is applied under control of contact nine of the ON1 relay and, thus, the oscillators are started when ON1 operates at the start of the call and are stopped when ON1 releases on sender release.

36.22 The transistor operates as a current amplifier. A change in current in the emitter will cause a larger change in current in the collector when operating with the normal voltage between the collector and the base. Voltage amplification is also obtained since the emitter circuit is much lower in impedance than the collector. The emitter current and the collector current are in phase with each other.

36.23 Sufficient amplification is obtained from a transistor for it to be used to drive a tuned circuit and, therefore, to act

as an oscillator. In the arrangement used in this circuit, energy is fed from a winding inductively coupled to the tuner circuit, consisting of the transformer winding and the capacitor to the emitter. The transformer is designed so that the collector is connected to the point of proper impedance on the tuned circuit. Bias current for the emitter is obtained by connecting the base to a low negative voltage. The direct current voltage for the emitter is supplied through part of the tuned circuit.

36.24 Oscillation starts when the direct current voltage is applied. The voltage across the tuned circuit will build up to the point where the power losses in the tuned circuit at the various loads connected to it will equal the power supplied by the transistor. Since the power that is obtainable from a transistor decreases sharply as the peak of the ac voltage applied to the collector closely approaches that of the dc voltage between the collector and base, the output stabilizes at this point and is approximately the same for all transistors. The output level is also fairly independent of the load applied so long as the ability of the transistor to supply power is not exceeded.

36.25 The F- resistors in the output leads are provided to improve the impedance match with the trunk. The V- cross-connections to the V- point on the voltage divider are made so that the proper output voltage will be available. The P- potentiometers serve to control the amount of feedback so that the output level can be controlled. The power supplied by an oscillator to a trunk, connected to the output of the transformer in the sender, is -8 dBm +1 dB. The voltage at the output of the oscillator is approximatley 2.4 volts RMS and varies little with the load.

TRANSMISSION OF FREQUENCIES

36.26 These frequencies are connected to the input side of the T transformer by the contacts of the MKT, SST1, MFC0-7, KP, and STD relays under control of the SP, PG, and PG1 relays. Frequencies 4 and 10 are connected to the input side of the T transformer by contacts of relay TRLO and are <u>not</u> under control of the SP, PG, and PG1 relays. The higher frequency is always connected to one side of the coil and the lower frequency to the other side. In this manner one frequency lead serves as a return path for the other frequency.

TRANSMISSION OF THE KEYPULSE FREQUENCIES

36.27 At the completion of trunk guard testing relays OFS, KP1 normal, and relays TG, KP, OF1 are operated. A ground path is closed to operate relay ET.

ALARM RECORD (RELAY ALMR OPERATED)

36.28 Relay ET operated:

(a) Opens an operate path of relay TRLO, thus preventing its false operation at the end of keypulse timing.

(b) Recycles the TM3 timer which was in the trunk guard timing mode.

(c) Relay ALMR operated transferred the operate path of relay SP through a front contact of relay ATM whose operation is controlled by the TM5 timer. The operation of SP is necessary in order to allow keypulse transmission. Relay ET start TM5 timing with the removal of ground from the I3 lead to the timer. After a time period of 10.75 to 12.5 seconds the timer times-out and allows relay ATM to operate. Relay ATM completes the path to operate relay SP. The time delay as described is a signal to the far end that an alarm record is in progress.

NONALARM RECORD (RELAY ALMR NORMAL)

36.29 Relay ET operated:

(a) Operates relay SP.

(b) Opens an operate path of relay TRLO thus preventing its false operation at the end of keypulse timing.

(c) Recycles the TM3 timer which was in the trunk guard timing mode.

KEYPULSE FREQUENCY OUTPULSED

36.30 Relay SP operated:

(a) Locks to off-normal ground.

(b) Prepares an operate path for the recycling steering circuit.

(c) Connects the 2 and 10 keypulse frequencies (1100 Hz and 1700 Hz) to the input side of the T transformer which results in the transmission of these frequencies over the tip and ring.

(d) Prepares operating paths for relays SP1 and EP1.

(e) Operates the SP lamp in the trouble recorder as an indication of start pulsing.

(f) Provides a start signal to the TM3 timer.

36.31 The operation of relay SP removed ground from lead I3 to the TM3 timer circuit. After an interval of 2 to 2.5 seconds, the TM3 timer operates relay TM4, which in turn operates relay SP1. The SP1 relay operating locks to off-normal ground, recycles the TM3 timer which releases relay TM4, and provides -48 volts to the pulsing generator. At the completion of one cycle of the pulsing generator, relays PG, PG1 operate and open the input side of the T transformer, thereby removing the 2 and 10 keypulse frequencies from the tip and ring. The extended length of the keypulse insures that the tape recorder has attained its proper recording speed.

PULSE GENERATOR (GENERAL)

36.32 The pulse generator is used to control the length of time the multifrequencies are applied to the tip and ring with the exception of the keypulse and trouble pulse frequencies. The pulse generator consists of the PG, PG1 relays and component assemblies containing a three transistor multivibrator and relay driver. The output of the circuit is adjusted to cause the PG, PG1 relays to pulse at the rate of 7.2 pulses per second.

ZERO STATE

36.33 When relay ON1 operates, it connects ground to terminal 8 of component assembly CA5 which sets the multivibrator into the zero state. In this state, transistor Q1 is conducting while transistor Q2 is cut off, capacitor CP2 is charged, and CP1 is discharged. The collector current of Q1 is supplied via resistor R1 and the base current is through resistor R5 and a strapped value of resistors PR6-10.

36.34 The nonoperated SP1 relay withholds base current from Q2 thus preventing the transistor from conducting.

ONE STATE

36.35 The SP1 relay in operating connects -48 volts to terminal 6 of component assembly CA3 which causes Q2 to draw base current through resistor R3 and a strapped value of resistors PR1-5.

36.36 Transistor Q2 collector is drawn through resistor R7. This causes Q2 to start conducting and disable Q1 due to a highly positive potential placed on its base. At this point the multivibrator is in its one state.

COMPLETED CYCLE

36.37 When Q2 starts conducting, the CP1 capacitor charges very rapidly and the CP2 capacitor starts discharging. This lowers the potential at the base of Q1 to a point where it will again draw current. This reoperates Q1 and disables Q2. The multivibrator has now completed one cycle.

36.38 Each time Q1 is operated, the relay transistor Q3 is caused to operate, and each time Q2 is operated, Q3 is disabled. When Q3 conducts, it applies ground to the PG, PG1 relays in series to operate. When Q3 is disabled the ground is removed and PG, PG1 release.

36.39 The CR1 and CR2 diodes are placed in the emitter path of their respective transistors to prevent exceeding emitter-base breakdown voltage when the transistors are disabled.

PULSE RATE

36.40 The time relays PG, PG1 remain operated and released is controlled by the conducing times of Q1 and Q2 chich is, in turn, controlled by the time constant of the discharging capacitors CP1 and CP2. This time constant and, therefore, the operate and release time of the PG, PG1 relays are controlled by the value of resistance connected in the base.

36.41 Resistors PR6-10 are strapped or inserted for controlling pulsing rate, resistors 1-5 are inserted or strapped to control the percent break. The nominal pulse rate is 7.2 pps with a pulse length and interdigital length of 70 ms.

TROUBLE CODED IDENTIFICATION PULSE (GENERAL)

36.42 In the trouble recorder FS200, 300, a preference relay is assigned to each circuit having trouble record access. The operation of a particular preference relay and its successful entry will result in the operation of one of two relays in this FS301 (relays MKT or SST1). The operation of this relay is translated into a 2-out-of-5 frequency combination, and is the first pulse pulsed forward after the keypulse.

36.43 The translation of this identification pulse at the trouble analyzer and display circuit will direct the subsequent record pulse to the proper starting location on the display matrix.

MARKER OR TEST PATTERN/REMOTE MAKE-BUSY AND RESTORE REQUEST IDENTIFICATION PULSE

36.44 Relay MKT operated prepares a path for frequencies 10 and 0 to contacts 11 and 12, respectively, of relay ID at tne input side of the T transformer.

OUTGOING SENDER LINK TRUNK IDENTIFIER/ALARM RECORD IDENTIFICATION PULSE

36.45 Relay SST1 operated prepares a path for frequencies 7 and 1 to contacts 11 and 12, respectively, of relay ID at the input side of the T transformer.

TRANSMISSION OF THE TROUBLE CODED IDENTIFICATION PULSE

36.46 At the conclusion of the first complete cycle of the pulse generator, relays PG, PG1 operate and remove the keypulse frequencies from the tip and ring. In addition, a ground path is closed to operate relay ID. Relay ID operated prepares a path to operate relay AS, transfers the holding ground of relay KP to control of relay PG, and closes a path from one of the operated MKT or SST1 relays to contact 5 of relays PG and PG1 at the input side of the T transformer. During the next cycle of the pulse generator, transistor Q2 is turned "on" and transistor Q3 is turned "off" thereby releasing relays PG, PG1 and allowing the transmission of the predetermined identification frequencies over the tip and ring.

TROUBLE RECORDER MEMORY SCANNING (GENERAL)

36.47 A circuit with access to the trouble recorder after gaining preference and entry, transfers the record information through connector relays which operate corresponding memory relays (293C reed type) that lock. The memory relays connect to LN00 to LN11 connector relays which operate sequentially and pass 30 leads to this circuit with ground appearing on only those leads associated with the operated memory relays.

REED SCANNING (RSC0, 1, AND 2) RELAY OPERATION

36.48 Steering circuit relays ASS through KSS switch through three LN-- leads to relays RSC0, RSC1, and RSC2, respectively. Relay ASS switches leads LN00; 01; 02, relay BSS switches leads LN03, 04, 05 etc; relay KSS switches leads LN52, LN53, LN54. Ground appearing or the absence of ground on these leads under control of the trouble recorder memory reed pack relays will operate, release, or not operate respective RSC- relays as steering progresses. The state of these three relays will determine the binary to octal conversion.

BINARY TO OCTAL CONVERSION AND MULTIFREQUENCY ASSIGNMENT

36.49 Operation of relays PG, PG1 concludes the record identification pulse and in addition operates the ASS steering relay. The ASS steering relay operates relay KP1 which closes a path to operate one of eight MFC0-7 relays. The particular MFC- relay which operates is determined by the state of relays RSC0, RSC1, and RSC2, which in turn provides the binary to octal conversion. A MFC- relay operated will place its assigned frequency combination from the frequency generator to the input side of the T transformer. The binary to octal conversion plus the frequency assignments are shown in a table in 36.20.

36.50 The change of state of the RSC relays and the selection of the corresponding MFC0-7 relay take place during the interdigital time period. If for some condition an MFC- relay is not operated, or if more than one MFC- relay is operated during the transmission period, the sender recognizes this as a trouble condition and will force a trouble recycle.

RECYCLING STEERING CIRCUIT (GENERAL)

36.51 The steering circuit is used to transfer the trouble record information from the LN-- leads to the reed scanner RSC- relays for that portion of record being

transmitted. Since there are a large number of pulses involved in this type of transmission, it is undesirable to have a steering relay for each pulse, therefore, a special recycling steering circuit is used.

36.52 This steering circuit consists of twelve steering relays designated KP, ID, ASS through KSS. The 12 steering relays are sequentially operated through the first cycle, and then recycled to steering relay ASS for subsequent cycles. The number of recycles is controlled by the trouble recorder which is predetermined by the identification of the trouble record to be transmitted. A marker trouble record or test pattern/remote make-busy and restore request requires the steering circuit to recycle 11 times; an outgoing sender link trunk identifier or alarm record requires one recycle.

FIRST STEERING CYCLE (OPERATION OF RELAY KP)

36.53 Sender seizure is recognized by operation of relay ON1. Relay ON1 provides a ground path through a normal SP and EP to operate relay KP. Relay KP locks under control of relay ID and connects the 10 and 2 frequencies to the input side of the T transformer, and prepares an operate path for the ID and ET relays. The transmission of the KP signal is described in 36.30.

FIRST STEERING CYCLE (OPERATION OF RELAY ID)

36.54 The operation of relay PG at the conclusion of the keypulse signal completes a ground path from off-normal ground through the operated SP, PG, and KP relays to operate relay ID and locks under control of relay ASS. Relay ID operated prepares a path to operate steering relay ASS and transfers the holding ground of relay KP to control of relay PG.

36.55 During the interdigital time period in the pulsing generator circuit, transistor Q2 is turned on and transistor Q3 is turned off which releases relays PG, PG1. Relay PG normal removes the holding ground from relay KP which returns to normal. Relays PG, PG1 normal allow transmission of the trouble coded identification pulse as described in 36.42.

FIRST STEERING CYCLE (OPERATION OF RELAY ASS)

36.56 The operation of relay PG at the conclusion of the trouble coded identification pulse, completes a ground path from off-normal ground through the operated SP, PG, the normal KP, and an operated ID which operates relay ASS and locks under control of relay BS. Relay ASS operates relay KP1 which initiates the binary to octal conversion and multifrequency assignment function as described in 36.49 In addition, relay ASS prepares a path to operate relay BSS and transfers the holding ground of relay ID to control of relay PG.

36.57 During the interdigital time period in the pulsing generator circuit, transistor Q2 is turned on and transistor Q3 is turned off, which releases relay PG, PG1. Relay PG normal removes the holding ground from relay ID which returns to normal. Relays PG, PG1 normal allow transmission of the first trouble record pulse as determined by the binary to octal conversion frequency assignment.

STEERING RELAYS BSS THROUGH KSS OPERATION

36.58 When the PG relay operates, to terminate transmission of the previous trouble record pulse, relay BSS operates through a front contact of the ASS relay and locks through a back contact of the CSS relay. Relay BSS also places the locking path for relay ASS under control of the PG relay so that when PG releases at the beginning of the next trouble record pulse, relay ASS releases. Relay BSS transfers the operate paths of relays RSC0, 1, and 2 from leads LN00, 01, and 02 to leads LN03, 04, and 10.

36.59 This circuit continues in a similar manner throughout each cycle of the steering relay chain. Each time the PG relays operate to terminate transmission, the next steering relay operates and the RSC0, 1, and 2 relays are recycled. Each time PG releases to start the next transmission, the steering relay for the preceding relay is released.

STEERING CIRCUIT RECYCLED TO RELAY ASS

36.60 Steering relay KSS operated provides a ground path which operates relay LADV in preperation to steer to the next LN-- relay. (See 35.10 and 35.11.)

36.61 When the PG relay operates, to terminate the last transmission of the first cycle, the ASS relay reoperates through a front contact of the KSS steering relay to start the next cycle of the steering chain. Also, relay LADV is released in FS300 thereby

releasing an LN-- relay assigned to the relative steering relay released in FS300, and allows a subsequent LN-- relay to operate. Therefore, trouble record information appearing on the LN-- leads to the sender are now related to the memory relays assigned to the newly operated LN-- connector relay.

36.62 The procedure for recycling the steering relays in succeeding cycles is the same as for the first cycle.

FINAL STEERING CYCLE

36.63 When relays PG, PG1 operate to terminate the 18th or 118th trouble record pulse during the final steering cycle of an outgoing sender link trunk identifier record or alarm record, or marker or test pattern/remote make-busy and restore record, respectively, relay JSS operates. Relay JSS operated, in addition to its normal functions, operates relay LD. Relay LD operated locks to off-normal ground, prepares a path to operate relay STD, and inserts a STD front contact into the LADV relay path FS300. The steering function continues normally until the conclusion of the final record pulse.

36.64 When relays PG, PG1 operate to terminate the final trouble record pulse (20th or 120th), steering is not recycled to relay ASS and instead, relay STD operates. Relay STD operated locks to off-normal ground, transfers the holding path of relay KSS to relay PG, transfers the STD frequencies 10 and 7 to the input side of the T transformer, prepares operate paths for relay EP and disables the loss of loop trouble path to relay TRL0. At the conclusion of the interdigital time period, the pulsing generator transistor Q3 turns off causing relays PG, PG1 to release, which in turn starts the transmission of the ST frequencies and releases relay KSS. Relay KSS released, reoperate relay LADV which in turn operates relay END.

END OF PULSING

36.65 At the conclusion of the ST pulse, relays PG, PG1 operated, operate relay EP. Relay EP operated locks to off-normal ground, opens the operate path of relay KP, insures the hold of relay PG, PG1, prepares the operate paths of relay EP1, recycles the TM3 timer, extinguishes the SP lamp, and operates relay ET. The sender now awaits longitudinal parity test verification from the trouble record trunk circuit or a forced trunk guard (off-hook) if the trouble record trunk circuit is not used.

LONGITUDINAL PARITY TEST VERIFICATION FROM THE TROUBLE RECORD TRUNK CIRCUIT

36.66 A function of the tape recorder circuit is to count the number of trouble record pulses received and compare it to its memory which contains the number of pulses required as predetermined by the trouble identification pulse received after the keypulse from the sender. If the correct number of pulses are verified to be correct, the tape recorder primes the trouble record trunk circuit to initiate a tip, ring reversal (off-hook) back to the sender indicating that longitudinal parity test is successful. The off-hook polarity on the tip and ring starts, the sender release function. If, however, an off-hook reversal is not received within 650 to 850 milliseconds after the conclusion of the ST pulse, the sender regards this as a longitudinal parity test failure and will trouble recycle.

36.67 At the conclusion of the ST pulse relay EP operates which in turn recycles the TM3 timer and operates relay ET. Relay ET operated locks to off-normal ground under control of relays KP1 and EP. In addition, an ET back contact removes ground from terminal I3 of the TM3 timer which starts 650- to 850-millisecond timing. A successful longitudinal test in the tape recorder and trunk circuit reverses the tip ring polarity to off-hook prior to time-out of the TM3 timer, which results in the operation of relay OFS, and the release and reoperation of relay TG. Relay OFS operated completes a path from off-normal ground through the front contacts of relays SP, EP and back contacts of relays TRLO, EP1, to operate relay EP1. Relay EP1 locked to off-normal ground initiates sender release.

END OF PULSING FORCED TRUNK GUARD OFF-HOOK (FTG KEY OPERATED)

36.68 At the conclusion of the ST pulse relay EP operates which in turn recycles the TM3 timer and operates relay ET. Relay ET operated locks to off-normal ground under control of relays KP1 and EP and in addition an ET back contact removes ground from terminal I3 of the TM3 timer which starts 650- to 850-millisecond timing. The EP relay operating also reverses the tip and polarity to off-hook prior to time-out of the TM3 timer, which results in the operation of relay OFS, and the release and reoperation of relay TG. Relay OFS operated completes a path from off-normal ground through the front contacts of relays SP, EP, and back contacts

of relays TRLO, EP1 to operate relay EP1. Relay EP1 locked to off-normal ground initiates sender release.

SENDER RELEASE - FS301

36.69 Relay EP1 operated releases relay SP which releases relay SP1. Relay EP1 also releases relay LADV which in turn releases steering relay LMS in FS300. Relay LMS releases connector relay LN11 and relay ON1. Relay ON1 released:

(a) Opens the tip and ring circuit which, if used, returns the trouble record trunk circuit to normal.

(b) Recycles the TM timer circuit to normal.

(c) Returns the frequency generator to normal.

(d) Removes all holding off-normal grounds, thereby releasing the remaining operated relays.

SENDER TIMING (TM3 TIMER)

36.70 The sender timing circuit is designated TM3 and is arranged to provide five timing intervals. The timer is associated with a timing relay designated TM4 that operates to indicate the completion of a particular timing interval.

36.71 Timing operation is initiated when circuit requiring time delay removes ground from the charging circuit of the timing capacitor. The function of the timing circuit is obtained through use of a capacitor charged through a low resistance during the normal period or recycled period and discharged at a slower rate by a high resistance during the timing period. When the capacitor is essentially discharged, the decreased current to the input of the associated transistor amplifier will be recognized and the TM4 timing relay operated.

TRUNK GUARD TIMING (5.2 TO 6.3 SECONDS)

36.72 The first timing function begins following the operation of relay ON1 when the sender is seized. The operation of relay ON1 provides a start signal to the TM3 timer by removing ground from lead I3 to the timing circuit. If relay ET is normal and a start dial signal is not received within 5.2 to 6.3 seconds, relay TM4 operates to indicate a time-out. Relay TM4 operated completes a path through the back contacts of relays ET, EP, EP1 to operate relay TRLO which primes a trouble recycle condition. If, however, a start dial signal is received prior to time-out indicated by the operation of relay ET, the timer is recycled by a ground path provided through a front contact of relay ET to lead I3 of the TM3 timer. The function of timing is obtained by the discharge of capacitors TG/KP through resistor TM7.

KEYPULSE TIMING (2.0 TO 2.5 SECONDS)

36.73 The keypulse timing function begins following the operation of relay SP. The operation of relay SP connects the 2 and 10 keypulse frequencies to the input side of the T transformer which results in the transmission of these frequencies over the tip and ring. The operation of relay SP also provides a start signal to the TM3 timer by removing ground from lead I3 to the timing circuit. After a time delay of 2 to 2.5 seconds, relay TM4 operates to indicate a time-out. Relay TM4 operates relay SP1. Relay SP1 recycles the TM timer and turns on the pulsing generator which results in the operation of the PG, PG1 relays, thereby, terminating the transmission of the keypulse signal. The function of timing is obtained by the discharge of capacitor TG/KP through resistors TM7, TM8 in parallel.

PULSE TRAIN TIMING (21 TO 25 SECONDS)

36.74 The pulse train timing function begins following the operation of relay KP1. The operation of relay KP1 provides a start signal to the TM3 timer by removing ground from lead I3 to the timing circuit. If relay EP is normal and the end of pulsing signal is not received within 21 to 25 seconds, relay TM4 operates to indicate a time-out. Relay TM4 operated completes a path through the back contacts of relays ET, EP, EP1 to operate relay TRLO which primes a trouble recycle condition. If, however, an end of pulsing signal is received prior to time-out indicated by the operation of relay EP, the timer is recycled by a ground path provided through a front contact of relay EP to lead I3 of the TM3 timer. The function of timing is obtained by the discharge of capacitors TG/KP, TP, TP1, in parallel through resistor TM7.

LONGITUDINAL PARITY TEST VERIFICATION OR FORCED TRUNK GUARD OFF-HOOK AND RELEASE TIMING - (650 TO 815 MILLISECONDS)

36.75 This timing function begins following the operation of relay ET. The

operation of relay ET provides a start signal to the TM3 timer by removing ground from lead I3 to the timing circuit. If relay ON1 is not released within 650 to 815 milliseconds, relay TM4 operates to indicate a time-out. Relay TM4 operated completes a path from the front contacts of relays ON1, EP, TM4, and the back contact of relay EP1 to operate relay TRLO which primes a trouble recycle condition. If, however, the sender releases prior to time-out indicated by the release of relay ON1, the TM3 timer is recycled by a ground path through a back contact of relay ON to lead I3 of the TM3 timer. The function of timing is obtained by the discharge of capacitor EP through resistor TM7.

TROUBLE TONE TIMING (650 TO 815 MILLISECONDS)

36.76 Trouble tone timing function begins following the operation of relay TRL1. The operation of relay TRL1 provides a start signal of the TM3 timer by removing ground from lead I3 to the timing circuit. After a time delay of 650 to 815 milliseconds, relay TM4 operates to indicate a time-out. Relay TM4 operated completes a ground path through a front contact TRL1 to FS300 via the TRL lead to trigger a TW-TZ circuit function necessary for trouble recycle. Relay TM4 remains operated until relay ON1 releases. Relay ON1 released recycles the timer by providing ground through its back contact to lead I3. The function of timing is obtained by the discharge of capacitor TRL through resistor TM7.

TROUBLE RECYCLE (SENDER REQUESTED)

36.77 Trouble recycle is a combined function of three circuits:

(a) Trouble recorder FS300.

(b) Trouble record trunk circuit (SD-26441-01).

(c) Trouble record sender FS301.

The combined efforts of these circuits provide a means of trouble detection when they cannot complete their prescribed functions or when any other trouble condition is recognized.

36.78 If the trouble record sender while attempting to send a trouble record detects a trouble condition, it terminates transmission of the trouble record, and informs the far end that a trouble condition exists and to disregard information forwarded up to that point. In addition, the sender primes the trouble recorder to make a second attempt to forward the trouble record from its beginning. If the second attempt is successful all circuits are returned to normal. However, if the second attempted trouble record transmission fails, the far end again is informed to disregard information sent and the trouble recorder is informed that the second trail has also failed. The trouble recorder circuit recognizing the second failure, releases the trouble sender and sets a minor alarm to the alarm sending circuit. The trouble recorder circuit will remain in an alarm state until released from the alarm receiving circuit before attempting to process subsequent trouble records.

TRUNK GUARD FAILURE - SC109

36.79 Relay ON1 operates and removes the idle line filter and closes the loop as a seizure signal forward to the far end, and also provides a start signal to the TM3 timer by removing ground from lead I3 to the TM3 timing circuit. If relay ET is normal and a start dial signal is not received within 5.2 to 6.3 seconds, relay TM4 operates to indicate a trunk guard failure. Relay TM4 operated completes a path through the back contacts of relays ET, EP, EP1 to operate relay TRLO. With relay TRLO operated the sender will function as described in 36.84 (trouble recorder recycled).

ONE-OUT-OF-EIGHT MFC- RELAY FAILURE - SC110

36.80 A trouble condition exists if after binary to octal conversion (36.49 and 36.50) none or more than one of the MFC- relays are operated during the transmission mode of the pulsing generator. A ground path through a back contact of relay PG and front contact of relay KP1 through the MFC- one-up-check circuit will operate relay TRLO if none or more than one MFC- relays are operated. With relay TRLO operated the sender will function as described in 36.84 (trouble recorder recycled).

PULSING TRAIN TIME-OUT - SC112

36.81 The pulsing train timing function begins following the operation of relay KP1. A minimum time delay of 21 seconds is

allowed for transmission of all digits of a trouble record. If transmission is not completed within this time period, relay TM4 operates, thereby indicating a trouble condition. Relay TM4 operated completes a path through the back contacts of relays ET, EP, EP1 to operate relay TRLO. With relay TRLO operated the sender will function as described in 36.84 (trouble recorder recycled).

LONGITUDINAL PARITY TEST VERIFICATION OR FORCED TRUNK GUARD OFF-HOOK FAILURE - SC113

36.82 Relay ET operated provides a start signal to the TM3 timing circuit. If relay ON1 is not released within 650 to 815 milliseconds, relay TM4 operates which indicates that longitudinal parity test verification from the trouble record trunk circuit was not received or forced trunk guard off-hook reversal was not initiated. Relay TM4 operated completes a path from the front contacts of relays ON1, EP, TM4, and the back contacts of relay EP1 to operate relay TRLO. With relay TRLO operated the sender will function as described in 36.84 (trouble recorder recycled).

INADVERTENT LOSS OF LOOP - SC111

36.83 Inadvertent loss of loop releases relay TG and returns the trouble record trunk circuit to normal. Relay TG normal provides an off-normal ground path through back contacts of OFS, STD, EP, EP1, and front contacts of relay KP1 to operate relay TRLO. With relay TRLO operated the sender will function as described in 36.84 (trouble recorder recycled).

TROUBLE RECORDER RECYCLED (SENDER REQUESTED)

36.84 Trouble conditions as described in the previous paragraphs provide for eventual operation of relay TRLO. Relay TRLO operated places frequencies 10 and 4 directly to the input side of the T transformer which results in the transmission of these frequencies over the tip and ring. These frequencies decoded at the far end erases (if any) information related to this trouble record transmission. In addition, relay TRLO recycles the TM3 timing circuit which will release relay TM4 if previously operated, and provide an operate path for relay TRL1. Relay TRL1 operates and locks when relay TM4 is normal. Relay TRL1 operated provides a start signal to the TM3 timing circuit, and prepares a ground path via the TRL lead to activate the TW1, TZ function in the trouble recorder FS300. After a time delay of 650 to 815 milliseconds, relay TM4 operates. Relay TM4 operated completes the ground path for lead TRL to the trouble recorder circuit. The function of this ground will depend on the state of the TW1, TZ circuit in the trouble recorder. On first trial recycle relay TW1 will operate, on second trial recycle relay TW1 will be shunted down. In either case the trouble recorder circuit releases the ON1 relay which accommodates the release of the sender.

37. TROUBLE RECYCLE (TROUBLE RECORDER REQUESTED) - SC108

37.01 If the trouble record sender (FS301) fails to complete its function within 37 to 47 seconds after relay G operates, the TM timer times out and operates relay TM2. This time-out is recognized as a stuck sender condition and the TM2 relay operated places ground on the TRL lead to operate relay TW1.

38. TROUBLE RECYCLE OPERATION FIRST TRIAL - SC108, SC114

38.01 First trial trouble recycle provides for the release and reseizure of the trouble record sender (FS301) for a second trial attempt to complete the transmission of the trouble record stored in the memory reed pack.

38.02 Relay TW1 operated by the trouble record sender (FS301) as described in 36.84 or a stuck sender time-out as described in 37., releases relay G and prevents the operation of relay TZ as long as ground appears on the TRL input lead.

FIRST TRIAL TM TIME-OUT - SC108

38.03 Relay G released releases relay C2, recycles the TM timer which releases relay TM2. Relay C2 releases relay MKT or SST1 and relay FTG if operated. Relay TM2 releasing removes ground from the TRL lead which allows relay TZ to operate. Relay TZ operated and after a time delay of 196 milliseconds to 520 milliseconds relay RNG operates allowing relay LAS or LLS to reoperate followed by the reoperation of relay C2. Relay C2 is the start of the second attempt to complete the trouble record transmission.

FIRST TRIAL SENDER RECYCLE - SC114

38.04 Relay G released, releases relay C2, recycles the TM timer and removes off-normal start ground to the trouble record

sender (FS301). The sender returns to normal which forces the near-end and far-end trunks to normal, and recycles the TM3 timer which releases relay TM4. Relay TM4 released removes ground from the TRL lead which allows relay TZ to operate. Relay TZ operated and after a time delay 196 to 520 milliseconds which is necessary for the far end to return to normal, relay RNG operates. Relay RNG completes a path to reoperate relay LAS or LLS which in turn allows relay C2 to reoperate. Relay C2 is the start of the second attempt to complete the trouble record transmission.

SECOND TRIAL FAILURE - SC108, SC115

38.05 If the trouble record sender (FS301) or the trouble recorder (FS300) again encounter a problem during the second trial transmission attempt, ground again appears on the TRL lead. Ground appearing on the TRL lead with relays TW1 and TZ operated shunts down relay TW1. Relay TW1 released and relay TZ operated completes a path from the alarm sending circuit via the LK lead to operate relay ALM. Relay TW1 released also releases relay G any operated steering or LN-- connector relays in FS300.

38.06 Relay G released recycles the TM timer if relay TM2 is normal, releases relay C2 and relays MKT or SST1 and FTG, end if operated. The trouble record sender is held off-normal and alarm indication is affirmed by the operation of relay ALM1. Relays ALM and ALM1 operated starts the release of the sender which results in the release of the near- and far-end trunks, and holds this circuit off-normal until an alarm release signal from the alarm sending circuit releases relays ALM and ALM1.

39. TROUBLE RECORDER RELEASE

CTRS KEY OPERATED - SC104

39.01 With the CTRS key operated, all trouble record calls are lamp displayed only. Therefore, the release of the trouble recorder is initiated by the operation of the release RLS key. A front contact of the RLS key operates relay RLS. See 39.05. Release of the RLS key, releases RLS relay.

CTRS KEY NORMAL - SC106

39.02 With the CTRS key normal, trouble record calls are transmitted to remote or local recording circuits, with or without trouble record lamp displays. The release of this type call is initiated by the operation of relay SRLS. Relay ON1 releasing in the trouble record sender completes a timed delayed operate path via SRLS thermister SRLS to operate relay SRLS. The time delayed operation is required to allow the far-end trunk to return to normal in case of immediate reseizure.

39.03 Relay SRLS operated:

(a) Opens the lock path which releases relay LNT on test pattern/remote make-busy and restore calls.

(b) Transfers the operate path of relay DB from relay CRL to relay SRLS.

(c) Operates relay RLS.

(d) Allows ground to remain at winding of relay TM3 when relay RLS operates.

(e) Releases relay SAST.

(f) Opens the operate battery paths to relays TW1 and TZ.

(g) Releases relay SST if operated.

39.04 Relay SAST released, reinstates the RLS key in to the operate path of relay RLS, and releases relay C2. Relay C2 released, releases the FTG relay in the trouble record sender if previously operated, and also releases relay G. Relay G released recycles the TM time delay circuit and starts the TM4 time delay circuit and releases relay END.

39.05 Relay RLS operated:

(a) Releases relays CRL, DR, and also relay 2TR and ALM1 if operated.

(b) Releases all M-- memory relays.

(c) Release relay DB if relay SRLS is normal.

39.06 Relays CRL and DR releasing releases relay SRLS if previously operated. Relay SRLS releasing allows relays DB and RLS to release.

39.07 Relay DB releasing removes trouble recorder busy indications to all connecting circuits.

40. ALARMS (TROUBLE RECORDER) - SC107, 108, 115

40.01 An alarm condition is required when:

(a) A second trial trouble recycled call failure is recognized.

(b) A time-out of time delay circuit TM4 which indicates that the trouble recorder has failed to accept a seizure request from the preference circuit, or complete a release sequence within 1.4 to 1.6 seconds after the seizure or release has been initiated.

SECOND TRIAL FAILURE ALARM CONDITION - SC108, 115

40.02 Sender oriented second trial failures as described in 36.79 through 36.83 and/or second trial trouble recorder failures that may occur as described in 37., is so recognized by the state of relay TW1 normal and relay TZ operated as described in 38.05.

40.03 Relay ALM operated:

(a) Locks under control of lead LK from the alarm sending circuit.

(b) Operates relay ALM1.

(c) Operates relay TST in the alarm circuit.

(d) Prepares an operate path for relay AR in the alarm sending circuit.

(e) Lights lamp TRA.

40.04 Relay ALM1 operated:

(a) Locks under control of relay RLS.

(b) Opens the "A" lead to the alarm sending circuit.

(c) Prepares an operate path for relay SRLS.

(d) Prevents the recycling of the trouble recorder steering circuit.

(e) Release of relay ON1 allowing the trouble record sender to return to normal.

40.05 This circuit will not release until an alarm release signal is recognized by the removal of ground from the LK lead. Ground removed from the LK lead releases relay ALM. Relay ALM released, releases relay TST in the alarm circuit, extinguishes lamp TRA and operates relay SRLS. Relay SRLS operated starts the circuit release function which returns the circuit to normal.

TROUBLE RECORDER SEIZURE FAILURE ALARM - SC107

40.06 Trouble recorder seizure timing begins with the operation of one of the preference relays, MPR-, SSP, ALP, RBP, or RTSP. The operation of one of these relays provides a start signal to the TM4 timer by removing CI ground from the I lead to the time delay circuit. After a time delay of 1.4 to 1.6 seconds, relay TM3 operates to indicate a timed out condition. Relay TM3 operated operates relay ALM as described in 40.08. However, if relay DB operates prior to time out, the timer is recycled by a ground path by way of:

(a) Front contact of key CTRS through a front contact of relay DB to lead I of the time delay circuit.

(b) The front contact of relay G, back contact of the CTRS key, front contact of relay DB to lead I of the time delay circuit.

TROUBLE RECORDER RELEASE FAILURE ALARM - SC107

40.07 Trouble recorder release timing begins with the release of relay G. The release of relay G provides a start signal to the TM4 timer by removing ground from the I lead to the time delay circuit. After a time delay of 1.4 to 1.6 seconds, relay TM3 operates to indicate a time-out. Relay TM3 operated, operates relay ALM as described in 40.08. However, if relay SRLS releases prior to time-out, the timer is recycled by the CI ground of the preference chain.

RELAY TM3 OPERATED (TM4 TIME-OUT)

40.08 Relay TM3 operated completes a ground path from lead LK via the alarm sending circuit to operate relay ALM, opens the I lead to the TM4 time delay circuit, prevents the operation of relay ALM1, and completes a path to operate relay SRLS. Relay ALM also locks through its own contact to lead LK and closes a path to operate relay TST in the alarm circuit and lights lamp TRA. Relay SRLS operated, operates relay RLS and operates or holds relay DB. Relay DB functions to have the trouble recorder appear busy to connecting circuits.

40.09 This circuit will not release until an alarm release signal is recognized by the removal of ground from lead LK. Ground removed from lead LK releases relay ALM, relay TST in the alarm circuit. Relay ALM released, releases relay SRLS and extinguishes the TRA lamp. Relay SRLS released releases relays TM3 and DB. Relay TM3 released releases relay RLS, and relay DB released is an indication that the trouble recorder is normal.

41. AUXILIARY OUTGOING TRUNK - FS302 - SC106

GENERAL

41.01 A portion of FS302 is used to convert reverse battery supervision to E and M supervision when using carrier or composite signaling facilities between No. 3 crossbar office to its control center when arranged for remote trouble recording and remote make-busy and restore features. When loop supervision is provided, this portion of FS302 is not used other than providing a connecting point between the trouble record sender (FS301) and the central distributing main frame with the dedicated cable pair.

41.02 When used for E and M supervision this FS302 is connected to the applicable transmission facilities from the central distributing main frame. At a distant point the transmission facilities are connected into an auxiliary incoming trunk - SD-27008-01 or equivalent for signaling back to this circuit. This facility is connected to trouble record trunk SD-26441-01 using reverse battery supervision for signaling. The trouble record trunk the tape recorder circuit for receiving and recording trouble records or for preparing the remote make-busy and control circuit for transmission.

41.03 When E and M supervision is not used, a loop, via a dedicated pair at the central distributing main frame connected to this circuit, is provided for signaling with reverse battery supervision directly into the trouble record trunk at the distant point.

CROSS CONNECTIONS - FS302A

41.04 Cross-connection per FS302A provides an arrangement for remote trouble recording feature without remote make-busy and restore and loop supervision.

CROSS-CONNECTIONS - FS302B

41.05 Cross-connections per FS302B provides for remote trouble recording and remote make-busy and restore features and loop supervision.

CROSS-CONNECTIONS - FS302C

41.06 Cross-connections per FS302C provides for remote trouble recording feature without remote make-busy and restore and E and M supervision.

CROSS-CONNECTIONS - FS302D

41.07 Cross-connections per FS302D provides for remote trouble recording and remote make-busy and restore features using E and M supervision.

E AND M SUPERVISION TROUBLE RECORDING - FS302 - SC106

41.08 When a marker, outgoing sender link trunk identifier, alarm or RTSP makes a request that a trouble record be taken, the trouble recorder seizes the trouble record sender FS301. The trouble record sender operates its ON1 relay which causes a loop on T and R leads to this trunk resulting in the operation of relay ON2.

41.09 The trouble record sender via cross-connection also grounds lead ON1 through a back contact of relay ON2 to the T lead. The ON2 relay remains locked operated through its own front contact to lead ON.

41.10 Relay ON2 operated sends a seizure signal to distant end by connecting battery through lamp M to lead M. The distant end sends an off-hook signal back by grounding lead E operating relay E1.

41.11 Relay E1 operated reverses the battery and ground on leads T and R to sender. The sender recognizes this off-hook but will not proceed to pulse until it receives an on-hook signal.

41.12 A short time later the far end will remove ground from lead E releasing relay E1 as an indication that it is ready to receive the tones. The sender, upon receiving this on-hook signal (T and R lead polarity is reversed again) will proceed to outpulse.

41.13 The far end will accept these pulses of tone at the tape recorder circuit via the auxiliary incoming trunk and the trouble record trunk.

VERIFICATION SIGNAL TO TROUBLE RECORD SENDER - FS301

41.14 A function of the tape recorder circuit at distant end is to count the number of pulse tones it receives and compare it to its memory logic to determine if the number of pulses are correct. If verification of pulses is satisfactorily made, the tape recorder forwards a T and R reversal which is sent back to this trunk as an off-hook signal by grounding lead E operating relay E1.

41.15 Relay E1 operated, reverses the battery and ground on leads T and R operating the supervisory relay in the trouble record sender to start its release functions.

41.16 If verification of pulses in the tape recorder circuit is not correct, the off-hook signal is not returned causing the sender to time out to start its release functions.

RELEASE FROM TROUBLE RECORD SENDER

41.17 When the E1 relay was operated from distant end, sending a reversal back to trouble record sender by changing polarity on T and R leads causing its supervisory relay to release. After other functions in sender, its ON1 relay releases causing the ON2 relay in this circuit to release.

41.18 When relay ON2 is released a disconnect signal is sent to distant office auxiliary incoming trunk restoring that trunk which releases the trouble record trunk and also tape recorder circuit.

41.19 When distant trunk restores to normal, ground is removed from lead E releasing relay E1 and restoring this circuit to normal.

SEIZURE WITH REMOTE MAKE-BUSY AND RESTORE FEATURE

41.20 When a test employee at the control center desires to make-busy or restore a trunk to service, this circuit will function after being seized by the test circuit.

41.21 When terminating test line in test circuit is called a loop is closed on leads T5 and R5 by relay RLP in that circuit which operates relay ON2.

41.22 Relay RLP also applies ground via cross-connection on lead ON1 through a back contact of relay ON2 to lead ON.

41.23 Relay ON2 operated sends a seizure signal to distant end by connecting battery through lamp M to lead M. The distant end responds by sending an off-hook signal back by grounding lead E operating relay E1.

41.24 Relay E1 reverses the battery and ground on leads T5 and R5. The FS302 recognizes this off-hook but will not proceed until it receives an on-hook signal.

41.25 A short time later the far end will remove ground from lead E releasing relay E1 as an on-hook indication that it is ready to send pulses.

41.26 The far end will now outpulse MF tones from its remote make-busy and restore control circuit through its trouble record trunk circuit into the auxiliary incoming trunk circuit into this circuit and onto the receiver of the machine.

RELEASE WITH REMOTE MAKE-BUSY AND RESTORE FEATURE

41.27 After completion of its function the remote make-busy and restore translator FS303 discontinues sending high-tone to distant office informing the test employee to place telephone "on-hook." When this is done switching linkage to terminating test line of test circuit causes relay RLP in the test circuit to release.

41.28 Release of relay RLP in test circuit opens loop on leads T5 and R5 to this circuit and also removes ground from lead ON1 which in turn releases relay ON2.

41.29 Relay ON2 released restores this circuit to normal and sends a disconnect signal to distant auxiliary incoming trunk to restore that trunk to normal.

41.30 When distant trunk releases ground is removed from lead E releasing relay E1 restoring this circuit to normal.

42. REMOTE MAKE-BUSY AND RESTORE TRANSLATOR - FS303 - SC116

PURPOSE OF CIRCUIT

42.01 The remote make-busy and restore translator in conjunction with the

remote trouble recording facilities, provides remote make-busy and restore capability for outgoing and intraoffice trunks and common control equipment such as markers, senders, and registers. (Incoming and originating.)

GENERAL DESCRIPTION OF OPERATION

42.02 The craft force located in a centralized maintenance facility now has the capability of not only observing trouble activity in a remote No. 3 machine, but will also be dynamically able to place or remove the equipment from service.

42.03 An incoming call is originated by the craft force at the remote maintenance facility, to the terminating test line. This activates a multifrequency receiver to receive the multifrequency tone combinations associated with the make-busy circuit and in addition makes a bid for the trouble recorder preference.

42.04 If the preference circuit is busy the craft force will hear ringing until the trouble record preference returns to normal.

42.05 With the preference circuit normal, it is seized and then primes a loop closure to the maintenance center. When this is completed high tone is furnished on the line to the craft force.

42.06 When multifrequency tones arrive from the distant office, the multifrequency receiver circuit detects and converts these tones into 2-out-of-6 logic which is relayed to this circuit.

42.07 The logic received is translated into operated relay combinations which prepares an operate or release path to a code point assignment. A potential is then applied to the winding of a 302E magnetic latching coil which is assigned a particular code point. Each 302E relay has a biasing magnet which will hold the winding in its operated position until a current is applied to the winding in its opposite direction. When logic for control tone 10/2 (first of the 5 combinations) arrives relay MB operates or if logic for control tone 10/4 arrives relay UB operates. The operation of the MB or UB relays provides operate or release current for the latching relays. The receipt of logic for the second, third, and fourth tone combination determine which code point is affected. Receipt of logic for the fifth combination ST operates or releases the latching relay and prepares for the release of the remote make-busy translator. Upon releasing, the remote make-busy translator operates its connector relays and prepares the trouble recorder to take a trouble record. Operation of the connector relays momentarily attaches a contact of each latching relay (300) to the memory reed pack relays. Each operated latching relay will provide operating ground to its associated reed relay which will then operate and lock under control of the trouble recorder. The remote make-busy translator releases while the trouble recorder seizes the trouble record sender. A verification record is then sent to the distant office which displays the condition of all the latching relays. The releasing of the remote make-busy translator and associated circuitry in turn removes the high tone from the line indicating to the craft force successful completion of the entire operation. The trouble recorder verification record is sent and in turn releases the trouble record sender.

42.08 Operation of a latching relay in remote make-busy translator causes a relay to operate at its assigned associated equipment which removes that equipment from service. All trunks (except incoming type) markers, originating registers, incoming registers, senders and selected miscellaneous features, have a dedicated MB jack or key associated with each latching relay. Each jack or key is physically wired to a trunk position on a trunk frame, or to a particular trunk on a relay rack, or to a certain piece of common control equipment. A circuit can therefore be removed from service either by operating a latching relay or using a plug inserted into the jack or operating a key when the office is attended. Each latching relay has two contacts. One is used to operate a reed relay in trouble recorder through a connecting relay at a time a trouble record is taken. The other contact operates a MB relay in the circuit to be taken out of service.

42.09 When the No. 3 office is attended or visited for troubleshooting, the above equipment can be made busy by inserting a 329A (tip, ring, sleeve shorting) plug into a jack or operating an associated make-busy key.

42.10 To facilitate testing (seizure of made busy equipment) the operation and release of MB relays in any equipment must be controlled. This is accomplished by providing a ground, through a normal TST-, RB, MK- relays, at the sleeve of all MB jacks, or front contacts of MB- keys through an operated UN- relay. The UN- relay is operated only when office alarms are not transferred. The sleeves of MB jacks or front contacts of MB- keys are also multipled to the aforementioned latching relay contact.

When testing is performed, seizure of a made busy equipment is accomplished by operating relays TST-, RB, or MK. The operation of these relays removes the holding ground of MB relay in the selected equipment allowing it to be seized.

42.11 Latching relays can also be operated or released using switches H, T, and U along with keys MB or UB located on the test panel. This is necessary when office alarms are transferred (when the office is in the unattended mode).

SEIZURE

42.12 With office alarms transferred, (TR key normal) incoming call to the terminating test assigned to this test circuit results in the operation of relay RBT.

42.13 Relay RBT operated is recognized as a bid for preference with the placement of resistance battery to lead TRST in an attempt to operate relay RBP. If the preference is normal, preference is granted and relay RBP is operated and locked and provides a ground path through the preference chain to operate relay RB1.

42.14 Relay RB1 operated prepares an operate path for relay TKR and relay ON3. In addition, time delay circuit TM6 is signaled to start translator timing, and a ground path is closed to operate relay DB.

42.15 Relay DB operating locks relay RB1, operates relay RLP and grounds all TRB leads to connecting circuits thereby making the trouble recorder busy to all equipment. Relay DB also operates relay TRB and recycles time delay circuit TM4. Relay TRB operating releases relay RBP and opens the RTSP relay operate path.

42.16 Relay RLP operated operates relay RLP1 and places a resistance bridge across the trouble record loop which simultaneously sends a seizure toward the far end and performs the trunk test of the loop facility. With the polarity of the loop on-hook, relay TGR operates. When the far-end polarity changes as the first step of the wink start signal, test circuit relay OFR operates. Relay OFR operated completes a path which operates the off-normal ON3 relay which locks through its own contact to ground under control of relay RB1.

42.17 Relay RLP1 operated supplies battery, unlocks and cuts through the multifrequency signaling receiver via leads BAT1, UL, and 0, 1, 2, 4, 7, 10.

42.18 Relay ON3 operated provides various locking paths, prepares a register advance path, reorder path, and closes in part the operate path for relay ON4. Relay ON3 also closes a path which operates relay TRP. Relay TRP operated trips ringing in the incoming trunk and closes an operate path through thermistor RNG to cause relay RNG to slow-operate. Relay RNG operated releases relay TRP and allows relay S of the incoming trunk to operate and HT1 tone is placed on the calling line confirming trouble recorder preference seizure. This circuit is now ready to receive and translate information from the multifrequency receiver in the test circuit.

MAKE-BUSY AND RESTORE IDENTIFICATION

42.19 Identification of make-busy or restore control logic is determined by the first of five 2-out-of-6 relay combinations received from the far-end.

MAKE BUSY

42.20 Make-busy control logic received from the receiver operates relays F10 and F2. The operation of these relays closes a ground path through a 2-out-of-6 checking circuit to operate relay MB. Relay MB operated locks through its own contact under control of relay ON3, and closes a ground path to operate relay AST.

RESTORE

42.21 Restore control logic received from the receiver operates relays F10 and F4. The operation of these relays closes a ground path through a 2-out-of-6 checking circuit to operate relay UB. Relay UB operated locks through its own contact under control of relay ON3, closes a ground path to operate steering relay AST, and also will determine the direction of current flow through the code point circuit when it is finally activated

HUNDREDS, TENS, AND UNITS STEERING AND TRANSLATION (REGISTER ADVANCE)

42.22 Relay UB or MB operated closes a ground path which operates relay AST. Relay

AST operated locks and operates relays ON4 and RA4. Relay ON4 locks through its own contact under control of relay ON3, closes in part the hundreds, tens, and units translation circuit and opens the original operate path of relay AST. Relay RA4 operated closes a path through a front contact of relay AST to operate relay BST. Relay BST operated closes in part the hundreds digit translation circuit and transfers the locking ground of relay AST to control of relay RA4. At the conclusion of transmission of the UB or MB control pulse, the F- relays release which in turn releases relay RA4. Relay RA4 released releases relay AST. Relay AST released completes register advance. The translator circuit is now primed to receive hundreds digit information.

HUNDREDS DIGIT TRANSLATION

44.23 Receipt of logic from the test circuit for the second tone combination is recognized by the operation of two F- relays. These relays complete an operate path to the HD- relays in the hundreds digit translator circuit which was previously set in part by the operation of steering relay BST. Hundreds digit translation is then determined by the state of the locked HD- relays as follows.

Digit Received	F Relays Operated		HD- Relays 1	2	4	5
0	F7	F4	X		X	X
1	FO	F1	X			
2	FO	F2		X		

If none, one, or more than two F- relays operate, a reorder condition is initiated as described in 44.58. An operated HD- relay also completes a path to operate relay RA4. Relay RA4 operated closes a path through a front contact of relay BST to operate relay CST. The removal of logic for the second tone combination, hundreds digit, results in the release of the F- relays. The F- relays releasing in turn releases relay RA4, which releases relay BST. Relay BST released completes register advance and relay CST operated prepares in part the tens digit translation circuit.

TENS DIGIT TRANSLATION

42.24 Third tone combination logic received from the receiver operate related F- relays which completes an operate path to the TD- relays in the tens digit translation circuit. Tens digit translation is determined by state of the TD- relays as follows.

Digit Received	F Relays Operated		TD- Relays 1	2	4	5
0	F7	F4	NONE			
1	FO	F1	X			
2	FO	F2		X		
3	F1	F2	X	X		
4	FO	F4			X	
5	F1	F4				X
6	F2	F4	X			X
7	FO	F7		X		X
8	F1	F7	X	X		X
9	F2	F7			X	X

If none, one, or more than two F- relays operate, a reorder condition is initiated as described in 44.58. An operated TD- relay or if relays F7 and F4 are operated a path is completed to operate relay RA4. Relay RA4 operated closes a path through a front contact of relay CST to operate relay DST. The removal of logic for the third tone combination (tens digit) results in the release of the F- relays. The F- relays releasing in turn releases relay RA4 which releases relay CST. Relay CST released completes register advance and relay DST operated prepares in part the units digit translation circuit.

UNITS DIGIT TRANSLATION

42.25 Fourth tone combination logic received from the test circuit operate related F- relays and completes an operate path to the UD- relays in the units digit translation circuit. Units digit translation is determined by state of the UD- relays as follows.

Digit Received	F- Relays Operated		UD- Relays 1	2	4	5
0	F7	F4	NONE			
1	FO	F1	X			
2	FO	F2		X		
3	F1	F2	X	X		
4	FO	F4			X	
5	F1	F4				X
6	F2	F4	X			X
7	FO	F7		X		X
8	F1	F7	X	X		X
9	F2	F7			X	X

If none, one, or more than two F- relays operate, a reorder condition is initiated as described in 44.58. An operated UD- relay or if relays F7 and F4 are operated, a path is completed to operate relay RA4. Relay RA4 operated closes a path through a front contact of relay DST to operate relay EST. The removal of logic for the fourth tone combination (unit digit) results in the release of the F- relays. The F- relays releasing in turn releases relay RA4 which releases relay DST. Relay DST released completes register advance and relay EST operated prepares in part the "start" digit translation.

START DIGIT TRANSLATION AND CODE POINT EXECUTION

42.26 The fifth and final tone combination logic operates relays F7 and F10. Relays F10 and F7 complete a path to operate relay STR. In addition, a shunt path is completed which prohibits the RLS2 relay to operate until the conclusion of the ST tone logic.

42.27 Relay STR operated locks under control of relay ON3 and operates relay RA4, EXC and prepares an operate path for relay RLS2.

42.28 Relays STR and EXC operated along with the hundreds (HD-), tens (TD-), and units (UD-) relays previously manipulated by the translation of the second, third, and fourth tone combinations determine which code point of 300 is affected. The relationship of these relays are shown as follows.

42.29 The state of the HD- and TD5 relays provides an operate path for a bank of three H-- relays; each bank has an assignment of 50 code points.

HD- Relays 1	2	4	5	TD5 Relay Opr	H-- Relay Bank Operated	Code Points
X		X			00 24 48	000-049
X		X	X	X	50 74 98	050-099
X					100 124 148	100-149
X				X	150 174 198	150-199
		X			200 224 248	200-249
		X		X	250 274 298	250-299

42.30 The state of relays TD1, 2, and 4 determines which TN0-4 relay operates. Each TN- relay is assigned 10 code points in each bank of 50.

TD- Relays 1	2	4	TN- Relay Operated	Code Points
NONE			TNO	000-009,050-059, 100-109,150-159, 200-209,250-259
X			TN1	010-019,060-069, 110-119,160-169, 210-219,260-269
	X		TN2	020-029,070-070, 120-129,170-170, 220-229,270-279
X	X		TN3	030-039,080-089, 130-139,180-189, 230-239,280-289
		X	TN4	040-049,090-099, 140-149,190-199, 240-249,290-299

42.31 The state of the UD- relays determine the unit digit as follows.

Digit	UD- Relays 1	2	4	5
	NONE			
1	X			
2		X		
3	X	X		
4			X	
5				X
6	X			X
7		X		X
8	X	X		X
9			X	X

42.32 A particular code point is therefore determined by the operation of:

(a) One of six banks of H-- relays which identifies the code point location to a particular 50.

(b) One of five TN- relays which further divides the 50 code points to a particular 10.

(c) Relays UD- which identifies the selected code point within the division of 10.

42.33 The earlier operation of the MB or UB relay allows operate or release current to the winding assigned to the selected code point. The windings at each code point are equipped with a biasing magnet which will hold the contacts in the operated position, once it has been operated until a current is applied to the winding in a direction opposite to the operate direction.

42.34 A code point winding operating or releasing, closes or opens a ground through its front contact to a related MB contact to be cut through to the trouble recorder memory reed pack circuit. A second front contact closes or opens a ground path to its related D or MB relay located in a trunk, register, sender, or marker assigned to its code point.

DEDICATED TROUBLE RECORD LOOP RETURNED TO NORMAL

42.35 At the conclusion of the last tone combination (start) the F- relays releases which in turn releases the RA4. In addition, a shunt path is removed which allows the RLS2 relay to operate. Relay RLS2 operated releases relays EXC, RLP, RBT, and TRB and operates relay EG.

42.36 Relay EXC released removes operate or release current from the affected code point. Relay EG operating locks under control of the TS relay (terminating test line). Relay EG operated prevents reseizure for make-busy or restore purposes until the original call had been terminated from the far end.

42.37 Relays RBT, RLP, and TRB released, results in the following.

(a) Multifrequency signaling receiver is returned to normal.

(b) The HT1 tone removed from the terminating test line.

(c) Return of the dedicated trouble record loop to normal.

(d) Primes the trouble recorder preference to send a make-busy or restore verification message.

(e) Relay RLP1 releases followed by relay RNG released.

42.38 Relay RB1 operated and RBT normal competes a path through thermistor TKR which slow operates relay TKR.

MAKE-BUSY AND RESTORE TROUBLE RECORDER VERIFICATION MESSAGE

42.39 Relays RBT and RLP normal and relays RLS2 and TKR operated completes an operate path for relay TREQ. Relay TREQ operated is an indication to the trouble recorder and trouble record sender that a make-busy or restore verification message to the remote maintenance facility is immanent.

42.40 The sequential operation of trouble recorder relays TREQ, RTSP, LNT results in the operation of relay MBO which in turn operates relays MB1 to MB12. The operation of these relays connect the front contacts of all the code point relays to the memory reed packs of the trouble recorder. The reed packs accept and store any grounds present from related code point contacts. Subsequent operation of relay G releases all the MBO-12 relays. The trouble record sender scans the reed packs which results in a message being returned from the crossbar 3 office over the dedicated facilities and recorded on the trouble analyzer and display circuit and also on magnetic tape.

RELEASE

42.41 Trouble recorder relay RTSP operated releases trouble recorder relay RB1. Relay RB1 released open the locking path of relay ON3. Relay ON3 releasing releases all relays locked under its control. Relay RLS2 remains operated until relay STR releases and relay TKR1 operates. Relay EG remains operated until relay RLS2 and relay TS releases. Relay EG releasing completes the release sequence.

LOCAL CONTROL - SC117

42.42 When the crossbar No. 3 office is attended or visited for trouble shooting, apparatus can be made busy by inserting a 329A (sleeve, tip, ring shorting) plug into a make-busy jack or operate a key. The craft force can also make-busy or restore apparatus by manipulating this circuit manually without the necessity of sending and translating multifrequency tone combinations. Code point latching relays can be operated or released using switches H, T, and U along with keys EXC, UB, or MB located in the jack, lamp, and key panel. Verification is made by visual observation of the code point lamp field. The code point lamp will light only when latching code point relay is operated. This indicates the state of each latching code point relay.

LOCAL CONTROL SEIZURE

42.43 With office alarms transferred back to the crossbar 3 office and with a particular code point number set up on the H, T, and U switches along with UN- relays operated, an operate path is prepared for the local control (LC) relay. The make-busy (MB) key or restore (UB) key activated, completes this operate path.

(a) Relay LC operated:

(1) Operates relay LC1.

(2) Prepares operate paths for relays UB, HD1,2,4,5, TD1,2,4,5, UD4 and 5.

42.44 Relay LC1 operated will light lamp TIB if relay CLR is operated indicating that the trouble recorder is in use and the control function cannot continue until it is restored to normal. Relay CRL normal or released provides a path to operate relay TREQ. Relay TREQ operates relay RTSP and starts the TM4 time delay circuit. Relay RTSP operates relay DR and LNT. Relay DR operates relay CRL followed by DB. Relay DB signals all connecting circuits that the trouble recorder is busy and recycles TM4 timer. Relay LNT lights lamp TREQ, operates relay TRB1, and together with relay CRL operates relay MBO followed by MB1-12. Relays MBO-12 cut through code point contacts to the memory reed packs which in turn light lamps corresponding to the memory reeds operated. Relay TRB1 closes a path which operates relay ON3.

42.45 Relay ON3 operated operates relay CANH and prepares an operate path to the translator and completes an operate path through the H, T, and U switches and operated LC, LC1 relays to operate HD-, TD-, and UD- relays associated with the code point number set on the switches.

H Switch Position	HD- Relays Operated			
	1	2	4	5
0	X		X	X
1	X			
2		X		

T or U Switch Position	TD- or UD- Relays Operated			
	1	2	4	5
0	NONE			
1	X			
2		X		
3	X	X		
4			X	
5				X
6	X			X
7		X		X
8	X	X		X
9			X	X

42.46 Selected HD-, TD-, and UD- relays operated in turn operate their related H--, TN- relays and prepares a particular code point path as described in 42.30 through 42.33.

42.47 Key lamp EXC upon lighting indicates to the craft force that the nonlocking EXC key may be momentarily operated which allows current flow in the code point circuit as described in 42.34 and 42.35.

42.48 Verification of busy or restore action can be observed on the code point lamp display.

42.49 Relay CANH operated disables locking paths to all memory reed packs associated with code point lamp assignments. This allows a code point lamp to extinguish if a restore function is exercised.

LOCAL CONTROL RELEASE

42.50 Returning any one of the switches to the "off" position, releasing the MB or UB key, or if office alarms are transferred to the remote location (relay UN- released) starts the release sequence of local control with the release of relays LC, H--, TN-, and key lamp EXC extinguishes. Relay LC normal releases relay LC1 and any operated UD, HD-, TD-, UD4, or UD5 relays. Relay LC1 normal releases relay ON3 and any operated UD1 or UD2 relay.

TRANSLATOR TIMING (TM6) TIMER (GENERAL) - SC118

42.51 The translator timing circuit is designated TM6 and is arranged to provide two timing intervals. The timer is associated with a timing relay designated RTO that operates to indicate the completion of a particular timing interval.

42.52 Timing operation is initiated when circuit requiring time delay removes ground from the charging circuit of the timing capacitor. The function of the timing circuit is obtained through use of a capacitor charged through a low-resistance during the normal period or recycled period and discharged at a slower rate by a high-resistance during the timing period. When the capacitors are essentially discharged, the decreased current to the input of the associated transistor amplifier will be recognized and the RTO timing relay will operate.

OVERALL TRANSLATOR TIMING (21 TO 25 SECONDS)

42.53 The first timing function begins following the operation of relay RB1 in the trouble recorder which is an indication that the trouble recorder has granted preference to the remote make-busy restore translator for seizure.

42.54 The operation of relay RB1 provides a start signal to the TM6 timer by removing ground from lead I3 to the timing circuit. If relay RB1 remains operated for a period of 21 to 25 seconds, relay RTO operates to indicate a time-out. Relay RTO operated completes a path through an RO thermistor to operate relay RO. Relay RO operated is a signal to start reorder as described in 42.58. If, however, relay RB1 releases prior to time-out, the timer is recycled with the replacement of ground to lead I3 of the TM6 timer. The function of timing is obtained by the discharge of capacitors CT3 and CT4 through resistor TM2. The recycled charging path of capacitor CT3 and CT4 through resistor TM10.

RETURN TO ON-HOOK TIMING (10.5 TO 12.5 SECONDS)

42.55 Return to on-hook timing begins following the operation of relay RO1 with relay RB1 in the trouble recorder offnormal. The operation of relay RO1 provides a start signal to the TM6 timer by removing ground from lead I3 to the timing circuit. If relay RB1 remains operated for a period of 10.5 to 12.5 seconds after the operation of relay RO1, relay RTO operates to indicate a time-out. Relay RTO operated completes a path to operate relay EG. Relay EG operated provides end guard as described in 42.62. If, however, relay RB1 releases prior to time-out, the timer is recycled with the replacement of ground to lead I3 of the TM6 timer. The function of timing is obtained by the discharge of capacitor CT4 through resistor TM9.

REORDER - SC119

42.56 Reorder is a trouble condition recognized by the operation of relay RO. Relay RO will operate under the following conditions.

(a) When overall translator time-out occurs (42.55) relay RO is operated by ground through a front contact of relay RTO via the RO thermistor.

(b) Register failure. The MF signaling receiver upon recognition of a detected frequency closes a ground path via lead FCK through a 2-out-of-6 check path in this circuit in order to prime a registration advance. If a 2-out-of-6 failure occurs this ground path is diverted through the RO thermistor to operate relay RO.

(c) Premature start pulse. If start tone combination logic F10, F7 is recognized in any steering slot other than slot ES, relay RO will operate.

(d) Inadvertent loss of the dedicated trouble record loop facility results in the release of relay TGR of the test circuit. Relay TGR released completes a ground path through the front contact of relay ON3, the back contact of relay RLS2, through the RO thermistor to operate relay RO.

42.57 Relay RO operated:

(a) Locks under control of relay ON3.

(b) Opens the register advance circuit.

(c) Releases relay RTO if operated.

(d) Operates relay RO1 if relay RTO is normal.

(e) Simultaneously sends a start signal to the 120-IPM circuit and transfers the appearance of HT1 tone on the TIP circuit of the terminating test line to 120-IPM tone.

(f) Recycles TM6 timer.

42.58 Relay RO1 operating locks under control of relay ON3, and provides a start timing signal to the TM6 timer as described in 42.57. (Return to On-Hook Timing.)

42.59 The transfer of HT1 to 120-IPM tone is an indication to the craft force that this circuit is in a state of reorder and that the call be terminated and reattempted.

END GUARD

42.60 If the call is not terminated within a time period of 10.5 to 12.5 seconds, a TM6 time-out occurs and relay EG in the

trouble recorder operates. Relay EG locks to the remote make-busy, and restore translator seizure ground under control of relay TS. The transfer of this ground path to relay EG, removes the locking ground for relay RB1 in the trouble recorder. Relay RB1 releasing initiates the release sequence as described in 42.42.

42.61 Relay EG locked under control of relay TS, assures that reseizure of the remote make-busy, restore facility will not occur until the originator of the first call releases. The termination of the call is then recognized with the release of relay TS which in turn releases relay EG. Relay EG normal makes available the make-busy restore facility for reception of the next call.

REMOTE MAKE-BUSY AND RESTORE STATUS LAMP DISPLAY WITH REMOTE TROUBLE RECORDING DISABLED (CTRS KEY OPERATED)

42.62 Nonlocking key TREQ operated, completes an operate path of relay LC. Relay LC operated operates relay LC1. Relay LC1 operated will light lamp TIB if relay CRL is operated indicating that the trouble recorder is in use and the display function cannot continue until it is restored to normal. Relay CRL normal or released provides a path to operate relay TREQ. Relay TREQ operates relay RTSP and starts the TM4 time delay circuit. Relay RTSP operates relay DR and LNT. Relay DR operates relay CRL followed by DB. Relay DB signals all connecting circuits that the trouble recorder is busy and recycles TM4 timer. Relay LNT lights lamp TREQ, operates relay TRB1, and together with relay CRL operates relay MB0 followed by MB1-1. Relays MB0-8 cut through code point contacts to the memory reed packs which in turn light lamps corresponding to the memory reeds operated.

42.63 Release of the status lamp display is accommodated by the momentary operation of the nonlocking RLS key which operates relay RLS. (See 39.05.) Release of the RLS key, releases relay RLS.

EXTENSION OF B1 AND B2 LEADS TO THE MAIN DISTRIBUTING FRAME (OPTION ZJ)

42.64 Option ZJ provides for the extension of B1 and B2 leads of outgoing, 2-way and intercept trunks to the main distributing frame.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

OFFICE SIZE

1.01 The test frame is designed to operate on a 2-wire basis in an office where the quantities of equipment do not exceed the following:

Incoming Registers	7
Originating Registers	12
Senders	5
Markers	2
Marker Connectors	2
Line Number Translators	3
Line Number Translator Connectors	3
Line Links	2
Trunk Switch	2
Trunk Switch Appearances	240
Trunk Switch Connectors	2
Line Switch Connectors	2
Intraoffice Trunks	164 max
Reverting Trunks	10 max
Toll Switching - Incoming Trunks	160 max
Incoming Trunks - Regular, No Test, Bylink	160 max
Outgoing Trunks	161 max
Recording Completing Trunks	171 max
Two-Way Trunks, Operator Exchange	144 max
TSPS Trunks, Type	161 max

1.02 The voltage limits for this frame are:

Voltage	Minimum	Maximum
-48	-45	-50
+130	+125	+135
-130	-125	-135
±105	±100	±120

(a) Supply voltage for testing customer lines are: +200, +116, +100, +50, +20, and -116.

1.03 The limits for voltmeter testing of customer supervision are:

(a) Flat rate individual message rate lines, maximum external circuit loop - 1500 ohms; minimum insulation resistance 10,000 ohms.

(b) Two-party message rate lines, maximum external circuit loop - 1500 ohms; minimum insulation resistance - 10,000 ohms; maximum earth potential ±20 volts.

(c) Coin lines, maximum external circuit loop - 1500 ohms; minimum insulation resistance - 10,000 ohms with maximum earth potential of ±20 volts and -12.5 or 30,000 ohms with maximum earth potential of ±20 volts.

1.04 Coin control supervision, maximum external circuit loop resistance, with ±20 volt earth potential and 10,000 ohms minimum insulation resistance, 4000 ohms.

1.05 The loop resistance into which, FS301, the trouble record sender looks is limited by characteristics of the TG and OFS supervisory relays. The loop may also be limited by the capabilities of the MF pulse receiving equipment the limits of relay TG and OFS are:

(a) Minimum voltage terminating office, 45-48V.

(b) Maximum external circuit resistance, 6400 to 6800 ohms.

(c) Minimum insulation resistance, 30,000 ohms.

1.06 Trunk supervision for FS302, auxiliary outgoing trunk, as the maximum external circuit loop resistance is 6400 to 6800 ohms or 60 miles of cable.

1.07 The milliwatt generator of FS102 will function within these limits:

(a) Output - 1 milliwatt, 600- or 900-ohm connections at five outlets; continuously on.

(b) Supply Voltage - 45 to 52 volts office battery.

(c) Current Drain - 23 mA at 48 volts.

2. FUNCTIONAL DESIGNATIONS

2.01 The functional designations of the operating elements of the test frame are given in the following:

2.02 Relays

Designation	Meaning
000-299	Code Point
10	Start Pulse
10P	Start Pulse
1K	1000 Ohms
20K	20,000 Ohms
2TR	Second Trial
2TRA	Second Trial Auxiliary
A	A Steering Control
ALC	Alarm Control
ALC1	Alarm Control
ALC3	Alarm Control
ALM	Alarm
ALM1	Alarm
ALMR	Alarm Record
ALP	Alarm Preference
ALST	Alarm Sending Start
AM	Ammeter (Voltmeter)
ANI	Automatic Number Identification
ANIS	ANI Signal
ANS	Answer
AS	A Steering
ASS	A Supplementary Steering
AST	A Steering Translation
ATB	All Trunks Busy
ATM	TM5 Timer
B	B Steering Control
BAT1, BAT2	Battery Supply
BS	B Steering
BSS	B Supplementary Steering
BST	B Steering Translation
C	C Steering Control
C1	Coin Control Auxiliary
C2	Control Two
CANH	Cancel Hold
CC	Coin Collect
CD	Coin Deposit
CHRL	Channel Release
CHT	Channel Test
CHT1	Channel Test
COIN	Coin-Voltmeter Test
CPAD	Cancel Pad
CNTR	Counter
CR	Coin Return
CRL	Connector Release
CS	C Steering Control
CSS	C Supplementary Control
CST	C Steering Translation
CTR	Connector Trouble Release
CTR1	Connector Trouble Release
CTRS	Cancel Trouble Record Sender
D	D Steering Control
DB	Display Busy
DIS	Marker DTST Operated
DLCN	Delete Called Number
DP	Dial Pulse
DP1	Dial Pulse Auxiliary
DP2	Dial Pulse Sender
DPEM	Dial Pulse E and M Signaling
DR	Display Registered
DS	D Steering

Designation (Cont)	Meaning
DSS	D Supplementary Steering
DST	D Steering Translation
E	E Steering Control
E1	E Supervision
EG	End Guard
EM	E and M Signaling Trunk Test
END	Steering End
EP, EP1	End of Pulsing and Auxiliaries
ES	E Steering
ESS	E Supplementary Steering
EST	E Steering Translation
ET	End Translation
EXC	Execute
F0,1,2, 4,7,10	Frequencies
FB	Frame Busy
FS	F Steering
FSS	F Steering Supplementary
FTG	Force Trunk Guard
G	Guard
GS	G Steering
GSS	G Steering Supplementary
H00	Hundreds Code Point
H24	Hundreds Code Point
H48	Hundreds Code Point
H50	Hundreds Code Point
H74	Hundreds Code Point
H98	Hundreds Code Point
H100	Hundreds Code Point
H124	Hundreds Code Point
H148	Hundreds Code Point
H150	Hundreds Code Point

Designation (Cont)	Meaning
H174	Hundreds Code Point
H198	Hundreds Code Point
HD1	Hundreds Digit
HD2	Hundreds Digit
HD4	Hundreds Digit
HD5	Hundreds Digit
H200	Hundreds Code Point
H224	Hundreds Code Point
H248	Hundreds Code Point
H250	Hundreds Code Point
H274	Hundreds Code Point
H298	Hundreds Code Point
HF	High Frequency TOUCH-TONE
HF1-4	High Frequency TOUCH-TONE
HLN0-4	Hunt Line (PBX)
HLN5-9	Hunt Line (PBX)
HLV	High Level Volume - TOUCH-TONE
HS	H Steering
HSS	H Supplementary Steering
IB	Indicator Busy
ID	Interdigit
IR	Incoming Register
IS, ISA, ISB	Incoming Supervisory and Auxiliaries
ITT	Incoming Trunk Test
JS	J Steering
JSS	J Steering Supplementary
K	Controlled 101 TM
K1	Controlled 101 TM
KP	Keypulse
KP1	Keypulse
KS	K Steering
KSS	K Steering Supplementary

Designation (Cont)	Meaning
L0-14	Line
MB1-12	Make-Busy
MFEM	Multifrequency E and M Signaling
MK0	Marker Check 0
MK1	Marker Check 1
MKA0	Marker 0 Attached
MKA1	Marker 1 Attached
MKT	Marker Test
MMB	Make Marker Busy
MN	Minor Alarm
MNF	Minimum Frequency - TOUCH-TONE
MP	Modulation Products
MPR0	Marker Preference 0
MPR1	Marker Preference 1
MRL	Marker Release
MST	Marker Start
MTR	Marker Transfer
MXF	Maximum Frequency - TOUCH-TONE
OA	Operate Trunk A Relay
OF	Overflow
OF1	Overflow
OFK	Off-Hook Check
OFS	Off-Hook Supervision
OLC	Originating Line Connected
ON	Off-Normal
ON1	Off-Normal
ON2	Off-Normal
ON3	Off-Normal
ON4	Off-Normal
ONG	Off-Normal Ground
OR	Originating Registers

Designation (Cont)	Meaning
OS	Outgoing Sender
OSA	Originating Sleeve Attached
OSB1	Operational Sequence Balance
OSM	Operational Sequence Milliwatt
OTLP	Originating Test Line Particular
OTLP1	Originating Test Line Particular
P	Pulsing
P1	Pulsing
P1A	Pulsing
P2	Pulsing
P2A	Pulsing
P3	Pulsing
P4	Pulsing
P5	Pulsing
PAT	Pattern
PBX	Private Branch Exchange
PCR	Polarity Check Ring
PCR1	Polarity Check Ring
PCT	Polarity Check Tip
PG, PG1	Pulsing Generator
PPK	Positive Polarity Check
PTC	Pretrip Check
PTP	Pretrip Test
R	Ringing
RA	Route Advance
RA1	Route Advance
RA2	Pulsing Advance
RA3	Pulsing Advance
RA4	Register Advance
RAV	Route Advance

Designation (Cont)	Meaning
RB	Register Busy
RB1	Remote Make-Busy Bid
RBP	Remote Make-Busy Preference
RBS	Register Busy Slave
RBT	Remote Busy Transfer
RC	Reverting Call
RCC	Remote Control Cord
RCY	Recycle
RCY1	Recycle
REC	Record
REG	Registered
RING	Ringing
RLP	Return Loop and Auxiliary
RLP1	Return Loop and Auxiliary
RLS	Release
RLS1	Release
RLS2	Release
RMB	Register Make Busy
RNG	Ringing
RO	Reorder
RO1	Reorder
RP	Ring Party
RPA	Ring Party
RPC	Ring Polarity Check
RS	Ringing Start
RS1-5	Reset Steering
RSA	Reed Start Attempt
RSC0-2	Reed Scanner 0-2
RTO	Remote Translator Time Out
RTSP	Remote Translator Start Preference

Designation (Cont)	Meaning
RV	Reverse
RVT	Reverse Terminating Test Line
SO	Sleeve Open Circuit
S3	Sleeve Milliwat Circuit
S4	Sleeve Balance Circuit
S5	Sleeve Synchronize Test Line
S6	Sleeve Synchronize Test Line Auxiliary
SAST	Sender Start
SCO	Sound Cut Off
SDR	Sender
SDRL	Sender Release
SDRS	Sender Slave
SJ	Sleeve Jack (101 TM)
SKR	S Relay Check Release
SMB	Sender Make Busy
SON	Sender Off-Normal
SONA/SONB	Sender Off-Normal Auxiliary
SP, SP1	Start Pulse
SPO	S Operate Current
SRLS	Sender Release
SS	Sleeve Short Cicuit
SS0,1,2	Stuck Sender Connectors
SSP	Stuck Sender Preference
SST	Stuck Sender Trunk Identifier
SST1	Stuck Sender Trunk Identifier
ST	Start Test Frame
ST1	Start 60-IMP Interrupter
ST2	Start 120-IPM Interrupter
ST3	Start Transmission Test

Designation (Cont)	Meaning
+STA	Positive Station Voltage
-STA	Negative Station Voltage
STD	Start Digit
STR	Start Pulse Registered
T	Talk Voltmeter
T1	Timing-Transmission Test
T2	Timing-Transmission Test
T3	Timing-Transmission Test
T4	Timing-Transmission Test
TALK	Talk Telephone Line
TB0-9	Trunk Block
TC	Test Complete
TC1	Test Complete
TCK	Tip Continuity Check
TD1	Tens Digit
TD2	Tens Digit
TD4	Tens Digit
TD5	Tens Digit
TEL	Telephone
TELH	Telephone Hold
TF	Test Failure
TG	Trunk Guard
TKR	Trunk Release
TKR1	Trunk Release
TM	Transmission Measuring
TM1	Timer - Marker Seizure Time
TM2	Timer - 37-47 Seconds
TM3	Timer - 1.4-1.6 Seconds
TM4	Timer in Trouble Record Sender
TMG	Timing For Test Line
TN0-4	Tens digit

Designation (Cont)	Meaning
TP	Tip Party
TPA	Tip Party
TPRK	Tip and Ring Continuity Check
TR	Transfer Digit
TRB	Trouble Recorder Busy
TRB1	Trouble Recorder Busy
TRBA	Trouble Recorder Busy-Alarms
TREQ	Test Request
TRLO	Trouble Release
TRL1	Trouble Release
TRN	Trouble Recorder Normal
TRP	Trip
TS	Terminating Sleeve
TST0	Trunk Switch 0 Test
TST1	Trunk Switch 1 Test
TT	TOUCH-TONE
TT1	Pulse Counter
TT2	Pulse Counter
TT3	Pulse Counter
TT4	Pulse Counter
TT5	Pulse Counter
TTL	Terminating Test Line
TTLD	Terminating Test Line Disconnect
TW1	Walking Circuit
TZ	Walking Circuit
UB	Unbusy
UMB0	Unbusy Marker 0
UMB1	Unbusy Marker 1
UD1	Units Digit
UD2	Units Digit

Designation (Cont)	Meaning
UD4	Units Digit
UD7	Units Digit
UN	Units Digit
UN1	Units Digit
UN2	Units Digit
UNL	Unlock
UNLA	Unlock Auxiliary
W,W1,Z	Steering Control

2.03 Jacks

Designation	Meaning
1000-0-900	1-Milliwat at 0 dB - 900 Ohms
101TM	Jack Ended Transmission Measuring
600	1-Milliwatt at 600 Ohms
CHB0-7	Channel Busy
IRDL	Incoming Register Dial Line
ITT	Incoming Trunk Test
KT	CSACS Control
MCMBO	Marker Connector Make Busy
MCMB1	Marker Connector Make Busy
ORDL	Originating Register Dial Line
RT	Route Transfer
SP	Spare Jack
TAD	Trouble Analyzer Display
TM	Transmission Measuring
TRK MB	Trunk Make Busy
VL	Volume Level - TOUCH-TONE

2.04 Keys

Designation	Meaning
0-9	TOUCH-TONE Pad
101TM	Jack Ended Transmission Measuring

Designation (Cont)	Meaning
1K	1000 Ohms (Voltmeter)
20K	20,000 Ohms (Voltmeter)
2TR	Second Trial
3F	3 Frequency - MF
±	Ringing Control (Voltmeter Test)
ADJ	Adjust - (TOUCH-TONE)
ALB	Allotter "B"
ALM MB	Alarm Make Busy
AM	Ammeter (Voltmeter)
ANI	ANI Control
ANS	Answer
BY TRK	Busy Trunk or Register
CC	Coin Collect
CHT	Channel Test
CND	Coin Deposited
CPAD	Cancel Pad (MF)
CR	Coin Return
CSA TT	Class-of-Service Groups
CSB DP	Class-of-Service Groups
CSB TT	Class-of-Service Groups
CTRS	Cancel Trouble Record Sender
DIAL	Dial From Test Frame Dial
DP	Dial Pulse Class IR
DPEM	Dial Pulse E and M Signaling
EXC	Execute
FEMF	Foreign Electromotive Force (Voltmeter)
FTG	Force Trunk Guard
G	Ground (Voltmeter Test)
GS	Ground Shunt
HDP	Hold Display

Designation (Cont)	Meaning
HFA	High-Frequency Adjust (TOUCH-TONE)
HLV	High Level
IN	In (Voltmeter Test)
IR	Incoming Register Test
IRMBO-6	Incoming Register Make Busy
ITT	Incoming Trunk Test
KP/SSL	Key Pulse/Special Signal Left
LFA	Low-Frequency Adjust (TOUCH-TONE)
LLO	Line Link O
LL1	Line Link 1
LLV	Low Level
MAR	Master Alarm Release
MB	Make Busy
MF	Multifrequency
MFEM	Multifrequency - E and M Signaling
MKRO, MKR1	Marker Selection
MMBO, 1	Marker Make Busy
OA	Operate A Relay (Trunk)
OPR	Operator
OR	Originating Register
ORMB O FO-F5	Originating Register Make Busy
ORMB 1 FO-F5	Originating Register Make Busy
OTLP	Particular Originating Test Line
OUT	Outside Splitter (Voltmeter Test)
PBX	Private Branch Exchange
PBX1	Private Branch Exchange
PPK	Positive Polarity Check

Designation (Cont)	Meaning
PSC	Permanent Signal Counter
PTP	Pretrip
PXGB	Private Branch Exchange Group Busy
RAV	Route Advance
RC	Reverting Call
RD	Reverting Call Digit
REC	Record Request
REV	Reverse Tip and Ring (Voltmeter)
RG	Ring Ground (Voltmeter Test)
RLS	Release
RLS1	Release Supervisory Relay - Trunk
RV	Reverse ITT Jack Tip and Ring
RVT	Reverse Trunk
SCO	Secondary Cutoff
SCTR	Sender Cancel Timed Release
SDP	Sender Dial Pulse
SDR	Sender
SF	Single Frequency-Multi-frequency
SLP	Short Loop
SMBO-4	Sender Make Busy
SMF	Sender Multifrequency
SOAK	Soak Supervisory Trunk Relay
SSTI MB	Stuck Sender Trunk Identifier Make Busy
ST	Start
+STA	Positive Station Test Voltmeter
-STA	Negative Station Test Voltmeter

Designation (Cont)	Meaning
ST/SSR	Start Pulse/Special Signal Right
T	Talk-Voltmeter Calls
TALK	Talk Telephone Circuit
TEL	Telephone
TEL HOLD	Telephone Hold
TM	Transmission Measuring
TONE	Tone Application
TP	Tip Party
TR	Transfer Alarm
TR MB	Trouble Recorder Make Busy
TRB MO	Trouble Recorder Make Busy to Marker
TRB M1	Trouble Recorder Make Busy to Marker
TREQ	Test Request
TRK SEL	Trunk Selection
TRP	Trip Ringing
TSO	Trunk Switch
TS1	Trunk Switch
TT	TOUCH-TONE Test
TTLD	Terminating Test Line Disconnect
UB	Unbusy
VM	Voltmeter
VREV	Reverse Voltmeter
WALK	Walking

2.05 Lamps

Designation	Meaning
ABS	Alarm Battery Supply
AMB	All Markers Busy
AT	CSACS Control
ATB	All Trunk Busy
CARF	Carrier Failure
CC	Coin Collect
CCC	CSACS Control
CDM Line-up	Combined Distributing Module
CLI	Calling Line Identification
CO	CSACS Control
COIN	Coin Voltmeter
CR	Coin Return
CTR	Connector Trouble Release
DS1 (Level Alarm)	Voltmeter Low-Level Alarm
ERL	Emergency Reporting Line
FB	Frame Busy
HLNO-9	Hunt Lines in PBX
IB	Indicator Busy
IPM	Interrupter
IPS	Incoming Trunk Permanent Signal
IRB	Incoming Register Busy
IS	Incoming Seizure
LA	Load Alarm
LAC	CSACS Control
LBY	Line-Busy
Level Alarm	Voltmeter Low-Level Alarm
LNT Line-Up	Line Number Translator
LSCO	Line Switch Connector
LSC1	Line Switch Connector
LSCTO-0	Line Switch Connector Time Out
LSCTO-1	Line Switch Connector Time Out
LTK	Line Test Check

Designation (Cont)	Meaning
M	M Signaling
MBA	Make-Busy Alarm
MC0	Marker Connector
MC1	Marker Connector
MCTO-0	Marker Connector Time Out
MCTO-1	Marker Connector Time Out
MISC LINE UP	Miscellaneous
MKR DL 0	Marker Display Lost
MKR DL 1	Marker Display Lost
MMB	Marker Make Busy
MR	Message Rate
MRL	Marker Release
OF	Overflow
OFHK	Off-Hook
ORB	Originating Registers Busy
OS	Originating Sleeve
PABS	Power Alarm Battery Supply
PTC	Polarity Tip Check
PUA	Pick Up Alarm
PWR LINE UP	Power Alarm
R+	Ring Positive
R-	Ring Negative
RADV	Route Advance
RA/STP	Route Advance/Step
RL	Release
RPC	Ring Polarity Check
RP/GB	Ring Party/Group Busy
RS TOA	Register Sender Time-Out Alarm
S	Supervisory
SDRB	Senders Busy
SON	Sender off-Normal

Designation (Cont)	Meaning
SP	Sender Pulsing
SSTl	Stuck Sender Trunk Identifier
+STA	Positive Station (Voltmeter)
-STA	Negative Station (Voltmeter)
STL	Synchronous Test Line
T+	Tip Positive
T-	Tip Negative
TC	Test Complete
TCKl	Tip Continuity Check
TF	Test Failure
TIB	Trouble Indicator Busy
TP/AK	Tip Party/Advance Check
TPRK	Tip Test-Ring Check
TR	Trouble Release (Marker)
TRA	Trouble Recorder Alarm
TREC	Trouble Recorder
TREQ	Test Request
TS	Terminating Sleeve
TSCO	Trunk Switch Connector
TSCl	Trunk Switch Connector
TST LINE UP	Test Frame Alarm
TTL	Terminating Test Line
VA	Voice Alarm
VM	Voltmeter

2.06 Switches

Designation	Meaning
CHT	Channel Test
CS	Class of Service
FCA	Frequency Control Multifrequency and TOUCH-TONE

Designation (Cont)	Meaning
FCB/MF	Frequency Control Multifrequency and TOUCH-TONE
H	Hundreds
IR-SDR SEL	Incoming Register - Sender Select
RING COMB	Ringing Control
T	Tens
TRK SEL	Trunk or Register Select
U	Units

2.07 Trouble Record Display Lamps

Designation	Meaning
2LA	2-Line Advance - On a call to a 2-line hunt group the marker has found the called line-busy and will advance to the second line.
2LC	2-Line Auxiliary - Having found the first line of a 2-line hunt group busy the marker has advanced, released the LGC- relay in the line link associated with the first line, and has operated the LGC- relay associated with the second line.
AO,1,2,4,7	A Digit - The A-code digit has registered in the marker by a register.
AB	Office A or B - The incoming register has informed the marker that the call may complete to either office A or B and that 5-digit translation must be used for destination.
ADO-4	Arbitrary Digit - The marker informed the outsender to prefix none, or one of four arbitrary digits as cross-connected in the outsender.
AT	Alarms Transfer - CSACS Function

Designation (Cont)	Meaning
AVK	Advance Check - (a) The marker has checked that the sender AV relay locked operated. (b) The marker has checked that the originating register RR relay has locked operated on a register recall to obtain party digit on a reverting call.
BO,1,2,4,7	B Digit - Same as for A digit.
BLO-11	Block - The marker has received a translation from the LNT with the following meaning: (a) The line block location of the called line on number translation. (b) The thousand block indication used for thousand digit generation on an ANI translation. (c) Dial pulse or MF class on class-of-service translation. (d) Type of intercept RI or TI on an intercept number.
BN	Blank Number - The marker recognized that this connection was to an unassigned or unequipped number and routed the call to the intercept level of the trunk switch.
CO,1,2,4,7	C Digit - Same as for A digit.
CB	Call Back - The marker is establishing the call back portion of an IAO call and has completed the checks of the release of the call forward connection.

Designation (Cont)	Meaning
CC	Call Control - CSACS function.
CHO-7 LUO,1,2,4,7	Channel/Level Units - (a) Selected channel. The channel number corresponds to the number of the hold magnet operated on the line switch, the channel switch number, and the trunk switch level number. (b) OSL-TI has caused a record by trunk on this level in outgoing sender link.
CKR	Check Release - The marker is processing a call to a hunt group has found an idle line and released the LNT translation relays to permit reoperation of the U- relay corresponding to the idle line.
CLO-3	Class - The marker has informed the sender of the outpulsing condition required on the call.
CNO,1	Connector Number - Marker connector used. (originating or incoming register)
CNG	Connector Ground - The marker has been seized by a makrer connector.
CNS	Coin Signal - The marker is setting up a call to a trunk that requires a coin signal for coin class customers.
CO	Control Operated - CSACS function.
CSO-7	Class of Service - The class of service as registered in the marker either (a) As transmitted from the originating register or (b) As derived from the LNT on class-of-service identification (dial tone).

Designation (Cont)	Meaning
CSA CS13	Class-of-Service - The class of service indicated on lamps CSO-7 are applicable to office A or office B.
CSK	Class-of-Service Check - (a) The marker has received one of CSO-7 and one of CSA or B indication from the LNT on class-of-service identification. (b) The marker has received correct party and class information from the originating registers.
DO,1,2,4,7	D Digit - Same as for A digit
DCK	Double Connection Check - A double connection did not exist on the selected channel as indicated by the operation of DCT.
DIS1	Disconnect Auxiliary - The marker has completed its function and has dismissed the line link and trunk switch connectors.
DISC	Disconnect - The marker has released the line link and trunk switch connectors and has signaled the register on line link to release the marker connector.
DLO-3	Delete Digit - The marker informed the outsender to delete none or 1 to 3 digits prior to outpulsing.
DLA	Delete ANI - The marker informed the outsender to outpulse the called number and ST signal only.
DLN	Delete Number - The marker informed the outsender to delete the called number including keypulse and start signal.
DPR	Dial Pulse Route - The marker informed the sender to outpulse by dial pulsing on a non-SXS route.

Designation (Cont)	Meaning
DT	Dial Tone - The marker connector has informed the marker that the seizure is from a line link requesting dial tone service.
EO,1,2,4,7	E Digit - Same as A digit.
EK	End Check - The originating register has informed the marker it received 10 digits. The marker will inspect the H-K registers for number check.
FO,1,2,4,7	F Digit - Same as A digit.
FLA	Forward Linkage Advance - The marker has established the call forward position of an IAO call and has released the line link and trunk switch associated with the call forward linkage.
FLG	Forward Linkage Ground - The marker is processing an FLG type call, a connection from a trunk to a line, either an IAO call forward connection or an incoming call from an IR.
FLK	Forward Linkage Check - The marker has established the call forward linkage of an IAO call.
GO-7	G Digit - Same as A digit
GK	Group Check - The marker has operated an LGC- relay in the line link for channel test and has checked that only one LGC relay operated.
GSA GSB	Ground Supply Auxiliary - The marker has route advanced, GSA indicates the advance was from ground supply 1 to ground supply 2. The GSB indicates an advance from supply 2 to 1.

Designation (Cont)	Meaning
GTK	Ground Test Check - The marker has successfully completed continuity or ground test of the selected channel.
HO,1,2,4,7	H Digit - Same as A digit
HLO-9	Hunting Line - The marker is completing a call to a hunt group and has selected an idle line of a units digit corresponding to the HL- number.
HMS	Hold Magnet Start - The marker has selected a channel and has applied potential to operate the channel hold magnets.
HNO-9	Ring Class - 1. The marker has received a translation from the LNT with the following meaning on a call forward linkage; (a) RCO-7, the ring combination for parties 1-8. (b) RC8,9, 2-line hunt group, RC8 indicates hunt up one line group, RC9 indicates hunt down one line group. (c) RC11 indicates intercept condition. 2. On a class-of-service identification RCO-7 indicates class of service O-7. 3. On an ANI SOG call HN O-9 indicates the hundreds digit of the calling number.

Designation (Cont)	Meaning
HTG	Hunting Group - A hunting group pilot number has been dialed and the marker will complete the call to an idle line in the group.
ID1-3	Identification 1-3 - The marker has informed the outsender of the proper start and keypulse requirements of the call as follows ID1 - CAMA route single class. ID2 - ANI route combined O+ or 1+ coin only or noncoin only. ID3 - ANI route combined coin, noncoin O+, O-, 1+ traffic.
IF	Identification Failure - The marker has failed to obtain the calling number on an ANI call from the translator after second trial or has failed in sender storage check of the calling number.
INK	Intercept Check - The marker is making a connection from an incoming or IAO trunk to the intercept level of the trunk switch, and has operated the intercept trunk SL- relay and has verified cross point closure.
IR	Incoming Register Call - The marker connector has informed the marker that the seizure is from an incoming register.
JO,1,2,4,7	J Digit - Same as A digit.
JC-0-9 GO,1,2,4,7 GGO,GG1	Junctor Choice/Group - (a) The operation of the trunk F relay operates a JC- relay corresponding to the electrical trunk switch on which the trunk is assigned. (b) OSL-TI has caused a record by trunk in this vertical group in outgoing sender link. GGO or GG1 represents the OSL-TI switch group.

Designation (Cont)	Meaning
JCK	Junctor Choice Check - The marker checked that only one JC- relay has operated on the trunk switch circuit.
JTA	Junctor Test Auxiliary - The marker has verified line and channel switch hold magnet operation.
JTK	Junctor Test Check - The marker has verified channel cross point closure.
KO,1,2,4,7	K Digit - Same as for A digit.
LO-9	Line - (a) The line selected by the marker for service on a dial tone connection. (b) The line number of the calling line as passed to the marker from the originating register on an OR call.
LAC	Local Alarm Control - CSACS function.
LBO-3	Line Block - (a) The line block selection by the marker for service on a dial tone connection. (b) The line block location of the calling line as passed to the marker from the originating register on an OR call.
LB	Line-Busy - On a call forward connection, the marker has found the called line-busy or off-hook (locked out).
LBK	Register Check/Line Block Check (a) On a marker connector seizure, RGK indicates the call is from an incoming or originating register.

Designation (Cont)	Meaning
LBK (Cont)	(b) On a dial tone connection LBK indicates the marker has selected a particular line block for service.
LC	Local Charge - The marker is setting up a call to a trunk that requires a charge condition for MR or coin classes.
LGO-4	Line Group - (a) The line group selected by the marker for service on a dial tone connection. (b) The line group location of the calling line as passed to the marker from the originating register on an OR call.
LIN	Local Intercept - The marker is informed by the LNT that the called number is on intercept and a local trunk on the trunk switch intercept level is to be used to complete the connection.
LGK	Translation Check/Line Group Check - (a) On a register call TNK indicates successful receipt of register translation information except called number. (b) On a dial tone call LGK indicates the marker has selected a particular line group for service.
LJO,1	Line Junctor/Level Tens - (a) LJ-O indicates the use of the trunk switch "A" junctors indicating a connection to line unit-0 or on a no channel connection LJ-O indicates either a line-busy connection on level 9A or the selection of the intercept trunk on level 8A.

Designation (Cont)	Meaning
LJO,1 (Cont)	LJ-1 indicates the use of the "B" junctors to LU-1, a reorder tone connection to level 9B or selection of the intercept trunk on level 8B. (b) OSL-TI has caused a record by trunk in this vertical group in outgoing sender link.
LJK	Line Junctor Check - The marker has checked that only one LJ- relay has operated in the trunk switch circuit.
LNKO,1	Line Number Start - The marker has determined that the services of an LNT is required and has put out a bid to frame O or 1 or if both LNK O and 1 are operated to LNT frame 2.
LNTC,O,1	Line Number Translator - The line number translator used on the call has operated its marker connector relays. O lamp is LNTO, 1 lamp is LNT1, O and 1 lamp is LNT2.
LPK	Loop Check - The marker is making a continuity on ground test of the channel and relay LGT has operated either: (a) Over the customers loop and dial tone connection. (b) Through the originating register short on outgoing or call back connections. (c) Through local ground on FLG calls.
LR	Link Release - The incoming register link has encountered a trouble condition and the incoming register has sent a trouble indication to the marker.
LSK	Number Check Auxiliary/ Line Select Check - (a) On register calls NK1 indicates a positive lock of number check relay.

Designation (Cont)	Meaning
LSK (Cont)	(b) On dial tone calls LSK indicates selection of a particular line for dial tone service.
LT	Local Translator - The originating register has informed the marker that no prefix was dialed and to translate the number for routing.
LTO,1	Line Tens - Tens digit for L0-L9. LT0 will indicate Lines 0-9 while LT1 will indicate Lines 10-19.
LLO,1	Line Unit - (a) The marker connector has informed the marker that the seizure is from a particular line link having line(s) requesting dial tone service. (b) The line link location of the calling line as passed to the marker from the originating register on an originating register call.
LUO,1,2,4,7	Channel/Level Units - (a) Selected channel. The channel number corresponds to the number of the hold magnet operated on the line switch, the channel switch number, and the trunk switch level number. (b) OSL-TI has caused a record by trunk on this level in outgoing sender link.
LUK	Line Unit Check - The marker has seized a line link and has verified operation of the line link M- relay.
MKRO,1	Marker - Marker processing call.
MF	Multifrequency - The marker is setting a connection to a local trunk which will require multifrequency outpulsing.
MUD	Mutilated Digit - The marker has failed to check the number received from a register.
NC	No Charge - The marker is setting up a call to a trunk that does not return a charge condition.
NCH	No Channel - The marker is establishing a connection that does not require setting a channel through the office, as a connection to either the tone or intercept levels of the trunk switch.
NCR	Nuisance Call Record - A record has been taken because: (a) A particular number which has been cross-connected in the LNT has been translated on a IAO FLG or INC call. (b) A number which has previously been cross-connected on the X and Y bit registers has been dialed on an originating call.
NY	No Hunt - The marker is handling a call from a special incoming trunk marked "no hunt".
NK1/LSK	Number Check Auxiliary/Line Select Check - (a) On register calls NK1 indicates a positive

Designation (Cont)	Meaning
NK1/LSK (Cont)	lock of number check relay (b) On dial tone calls LSK indicates selection of a particular line for dial tone service.
NK	Number Check - On a register call the marker has checked the validity of the called number.
NLK	Number/Line Check - The marker checks that only one N-, L-, or CS- relay has operated in the LNT.
NN	Non-Notest - The marker is handling a call from a special incoming trunk marked NN.
NS	No Sender - (a) The marker will connect to a trunk that does not require outpulsing. (b) The marker is setting up an IAO call back connection.
NSO	No Sender Outgoing - NSO indicates operation of NS and the absence of any other pulsing condition relay associated with the route relay.
NT	No Test - The marker is completing a call from a special incoming trunk on a no-test basis.
OA,OB	Office A, Office B - (a) The incoming register informs the marker of the office destination of the call and that the number consists of 4 digits. (b) The originating register is handling a 4-digit call originated by a PBX.
OR	Originating Register Call - The marker connector has informed the marker that the seizure is from an originating register.

Designation (Cont)	Meaning
OSO-4 SO,1,2,4,7	Outsender/Sender - (a) The number of the outsender the marker has seized. (b) Sender involved with an OSL-TI record.
OSK	Outsender Check - The marker checks that only one OS- relay has operated.
OSL-TI	Outgoing Sender Link-Trunk Identification - Outgoing sender link-trunk identifier has caused the display by requesting a trouble record after encountering a stuck sender condition.
PO	Prefix 0 - A prefix 0 was dialed.
P1	Prefix 1 - A prefix 1 was dialed.
PD	Partial Dial - The originating register signals the marker that dialing was not completed within the allotted time and to provide partial dial routing.
PS	Permanent Signal - The originating register signals the marker to make a permanent signal test of the line due to failure to start dialing within the allotted time.
PSG	Permanent Signal Ground - As a result of a permanent ground test the marker has detected a trouble condition on the line.
PT1-4 (Option ZA)	Party Test - (a) On a call originated by a multiparty ANI identified customer, the originating register will indicate to the marker party number of the originating customer. (b) On non-MPA classes or on a PS or PD call from a MPA class, PT1 is grounded to satisfy class check.

Designation (Cont)	Meaning
RAV	Route Advance - The marker has prepared to route advance by operation of the RAV relay.
RCO-11 HNO-9	Ring Class 1. The marker has received a translation from the LNT with the following meaning on a call forward linkage; (a) RCO-7, the ring combination for parties 1-8. (b) RC8,9, 2-line hunt group, RC8 indicates hunt up one line group, RC9 indicates hunt down one line group. (c) RC10 indicates hunting group. (d) RC11 indicates intercept condition. 2. On a class-of-service identification RCO-7 indicates class of service O-7. 3. On an ANI SOG call HNO-9 indicates the hundreds digit of the calling number.
RD	Reverting Digit - The originating register signals the marker to expect 8 digits on the call and that the eighth digit is the party number of the calling party. The marker will signal the revertive trunk to apply the proper ring code to the calling line based on translation of the number registered in the H-digit register.
RGO-10	Register - The position of register or line link with its connector.
RGK/LBK	Register Check/Line Block Check - (a) On a marker or connector seizure, RGK indicates the call is from an incoming or originating register. (b) On a dial tone connection LBK indicates the marker has selected a particular line block for service.
RO	Reorder - The incoming register has signaled the marker to return reorder to the incoming trunk due to the inability of the incoming register to complete its function within the allotted time.
ROT	Reorder Tone - The marker has determined that it cannot complete the call and will cause reorder tone to the calling customer either by: (a) Releasing the channel and permitting the line circuit to return 120 IPM on an OR or IAO FLG connection. (b) Set the incoming trunk to the tone level of the trunk switch to return 120 IPM.
RP	Ring Party - The originating register informs the marker (a) The calling customer is the ring party of a 2-party line. (b) The calling party is a ring party of a multiparty line that is ANI identified. (c) On all other classes RP is indicated to satisfy class check.
RTF	Release Trunk F - The marker has satisfactorily selected the channel, made storage and other checks and has released the channel to the control of the trunk, originating register or outsender.
RV	Reverting - The marker has determined by comparing the line location from the originating register with that from the LNT that a reverting linkage should be established for the call.

Designation (Cont)	Meaning
NK1/LSK (Cont)	lock of number check relay (b) On dial tone calls LSK indicates selection of a particular line for dial tone service.
NK	Number Check - On a register call the marker has checked the validity of the called number.
NLK	Number/Line Check - The marker checks that only one N-, L-, or CS- relay has operated in the LNT.
NN	Non-Notest - The marker is handling a call from a special incoming trunk marked NN.
NS	No Sender - (a) The marker will connect to a trunk that does not require outpulsing. (b) The marker is setting up an IAO call back connection.
NSO	No Sender Outgoing - NSO indicates operation of NS and the absence of any other pulsing condition relay associated with the route relay.
NT	No Test - The marker is completing a call from a special incoming trunk on a no-test basis.
OA,OB	Office A, Office B - (a) The incoming register informs the marker of the office destination of the call and that the number consists of 4 digits. (b) The originating register is handling a 4-digit call originated by a PBX.
OR	Originating Register Call - The marker connector has informed the marker that the seizure is from an originating register.

Designation (Cont)	Meaning
OSO-4 SO,1,2,4,7	Outsender/Sender - (a) The number of the outsender the marker has seized. (b) Sender involved with an OSL-TI record.
OSK	Outsender Check - The marker checks that only one OS- relay has operated.
OSL-TI	Outgoing Sender Link-Trunk Identification - Outgoing sender link-trunk identifier has caused the display by requesting a trouble record after encountering a stuck sender condition.
PO	Prefix 0 - A prefix 0 was dialed.
P1	Prefix 1 - A prefix 1 was dialed.
PD	Partial Dial - The originating register signals the marker that dialing was not completed within the allotted time and to provide partial dial routing.
PS	Permanent Signal - The originating register signals the marker to make a permanent signal test of the line due to failure to start dialing within the allotted time.
PSG	Permanent Signal Ground - As a result of a permanent ground test the marker has detected a trouble condition on the line.
PT1-4 (Option ZA)	Party Test - (a) On a call originated by a multiparty ANI identified customer, the originating register will indicate to the marker party number of the originating customer. (b) On non-MPA classes or on a PS or PD call from a MPA class, PT1 is grounded to satisfy class check.

Designation (Cont)	Meaning
RAV	Route Advance - The marker has prepared to route advance by operation of the RAV relay.
RCO-11 HNO-9	Ring Class 1. The marker has received a translation from the LNT with the following meaning on a call forward linkage; (a) RCO-7, the ring combination for parties 1-8. (b) RC8,9, 2-line hunt group, RC8 indicates hunt up one line group, RC9 indicates hunt down one line group. (c) RC10 indicates hunting group. (d) RC11 indicates intercept condition. 2. On a class-of-service identification RCO-7 indicates class of service O-7. 3. On an ANI SOG call HNO-9 indicates the hundreds digit of the calling number.
RD	Reverting Digit - The originating register signals the marker to expect 8 digits on the call and that the eighth digit is the party number of the calling party. The marker will signal the revertive trunk to apply the proper ring code to the calling line based on translation of the number registered in the H-digit register.
RGO-10	Register - The position of register or line link with its connector.
RGK/LBK	Register Check/Line Block Check - (a) On a marker or connector seizure, RGK indicates the call is from an incoming or originating register. (b) On a dial tone connection LBK indicates the marker has selected a particular line block for service.
RO	Reorder - The incoming register has signaled the marker to return reorder to the incoming trunk due to the inability of the incoming register to complete its function within the allotted time.
ROT	Reorder Tone - The marker has determined that it cannot complete the call and will cause reorder tone to the calling customer either by: (a) Releasing the channel and permitting the line circuit to return 120 IPM on an OR or IAO FLG connection. (b) Set the incoming trunk to the tone level of the trunk switch to return 120 IPM.
RP	Ring Party - The originating register informs the marker (a) The calling customer is the ring party of a 2-party line. (b) The calling party is a ring party of a multiparty line that is ANI identified. (c) On all other classes RP is indicated to satisfy class check.
RTF	Release Trunk F - The marker has satisfactorily selected the channel, made storage and other checks and has released the channel to the control of the trunk, originating register or outsender.
RV	Reverting - The marker has determined by comparing the line location from the originating register with that from the LNT that a reverting linkage should be established for the call.

Designation (Cont)	Meaning
SO,1,2,4,7	Outsender/Sender - (a) The number of the outsender the marker has seized. (b) Sender involved with an OSL-TI record.
SHA	Sender Hold Auxiliary - The outsender link hold magnet has operated to marker ground.
SHK	Sender Hold Check - The marker has verified sender link cross point closure.
SK1-17	Storage Check - After the operation of CHS and prior to operation of HMS, either SK1-7 or 10-17 or all will operate dependant on type of call. After operation of HMS, local ground is removed and the SK - will hold to external locking grounds in the, trunks, originating registers, or outsenders. The specific SK- which should hold is dependant on type of linkage and type of call.
SKN	Storage Check Normal - The marker has checked the release of all SK- relays and checked other relays not checked previously.
SPC	Special - The incoming register informs the marker that this is a special call (NN, NH, or NT).
SOG	Sender Outgoing - The marker will connect to a trunk which requires a sender for outpulsing.
STK	Storage Check - The marker has satisfactorily operated and checked the external memory relays expected on the type of call being processed.
SXS	Step-By-Step - The marker is informed through operation of a route relay that the call is to a step-by-step office.

Designation (Cont)	Meaning
TO-9	Tens - The marker has received a translation from the LNT with the following meaning. (a) On a number translation TO-9 indicates the line group number and whether the line is in the high or low ten lines of the group, ie, TO and T1 indicate line group O, lines O-9, and 10-19, respectively. (b) On a line translation TO-9 indicate the tens digit of the calling number.
TBO,1,2, 4,7	Trunk Block - By route relay cross connection a particular TB- relay operates in the marker which will operate a corresponding relay in the trunk switch.
TBK	Trunk Block Check - The marker checks that a TB- relay has operated in the trunk switch.
TCH	Test Channel - Channel selection is started with TCH. When the marker checks the operation of LGC- in the line switch and JC- and LJ- in the trunk switch and down checks contain marker relays, channel selection begins.
TCK	Translator Connector Check - The marker has obtained preference in an LNT frame as evidenced by the operation of its M- relay.
TEST	Test Call - The trouble display was made while the marker OTF relay was operated. The record may have been caused by test frame action or a service failure may have occurred.
TGO-7	Trunk Group - By route relay cross connection a particular TG- relay operates in the marker.
TLK	Test Line Check - The marker will examine the line LT- for a busy or idle indication. The LT- lead is accessed through relays

Designation (Cont)	Meaning
TLK (Cont)	operated in parallel with the line select magnets. The TLK indicates the operation of one 0-9 magnet and one steering level magnet.
TNK/LGK	Translation Check/Line Group Check - (a) On a register call TNK indicates successful receipt of register translation information except called number. (b) On a dial tone call LGK indicates the marker has selected a particular line group for service.
TOK	Tone Check - Indicates cross point closure on a connection of a trunk to the tone levels of the trunk switch.
TP	Tip Party - The originating register informs the marker (a) The calling customer is the tip party of a 2-party line. (b) The calling customer is a tip party of a multiparty line that is ANI identified.
TR2	Second Trial - The marker connector informs the marker that the seizure is a second trial attempt.
TREQ	Test Pattern Request - Trouble analyzer control is functional.
TRK	Translation Check - The marker has received a valid translation from the LNT.
TRL	Trouble Release - The marker has taken a trouble record and operated its TRL relay with the following results.

Designation (Cont)	Meaning
TRL (Cont)	(a) On first trial call CTR is grounded to the connector which will make a second attempt to complete the call. (b) On second trial originating the marker will TRL the register resulting in a normal release. (c) On second trial incoming, the trunk will be set to reorder.
TRS	Transfer Start - The marker connector informs the marker that this seizure was the result of a transfer start. The connector was unable to seize a marker on its initial start bid. This indicates a connector trouble rather than a service call failure.
TTO-12 TTT-1	Trunk Test - (a) The marker has selected a particular trunk or register. Analysis of TB- TG- and office records will indicate the trunk location. (b) When an incoming trunk is employed on a call, the TT- number indicates the trunk switch vertical within the electrical switch to which the incoming trunk is assigned. TTT1 along with TT- indicates that the trunk switch vertical is ten or over.
TTK	Trunk Test Check - The marker has selected one from all the trunks that were idle in the TB-, TG- indicated by operation of the route relay.
TUK	Trunk Unit Check - The marker has sezied a trunk switch and has verified operation of the trunk switch M- relay.
TSO,1	Trunk Unit - The marker has been directed to seize a particular trunk switch circuit either by:

Designation	Meaning
ESO,1 (Cont)	(a) Determining by inspection of the test leads that idle trunks or registers associated with the route appear on that circuit. (b) The incoming register has informed the marker of the location of the incoming trunk requesting service.
UO-9	Units - The marker has received a translation from the LNT indicating the units digit of the line on a number to line translation, or the units digit of the calling number on a line to number translation.
UK	Units Check - The marker has verified the operation of a U- and SP- relay in the LNT.
VRF	Verification Request - The display is the result of a match on the X-Y bit registers that is not associated with a nuisance call trap.
XARL	Cross Advance - Release - The marker has detected a cross or false ground on leads RR and RLL to the originating register or on lead AV to the outsender as evidenced by operation of XAR or XRL relays.
XF	Cross F - The marker has detected the operation of more than one trunk F relay or a false ground on leads TFO-11 as evidenced by the operation of XF relay.
XIF	Cross Information - The marker has detected a false locking ground or a cross on a lead(s) to the external memory relay circuits as evidenced by operation of XIF relay.
XLU	Cross Line Unit - The marker has detected the operation of more than one

Designation	Meaning
XLU (Cont)	LB- or LG- relay in the line switch on line identification or the operation of more than one LGC- relay on line switch seizure or a false ground on the supply leads as evidenced by the operation of XLB, XLG, or XG relays.
XOSL	Cross Outsender Link - The marker has detected the operation of more than the required number of select magnets on the OSL, or the operation of more than one VG- relay or a false ground on the supply leads in the OSL as evidenced by the operation of XSS or XVG relays.
XRLS	Cross Release - The marker has detected a false ground or cross on leads MRL, TRL, or CTR to the marker connector as evidenced by operation of XRLS relay.
XSEL	Cross Select - In setting up a channel the marker has detected the operation of more than the required number of select magnets in the group 0-9 on the operation of both steering level magnet or a false ground on the supply leads on the trunk switches, the channel switches or the line switches as evidenced by the operation of XCS1, XCS2, XTS1, XTS2, or XLS relays.
XTR	Cross Translation - In attempting a translation from the LNT, the marker has detected the operation of more than one N- or L- or both CSA, CSB relays in the LNT or a cross on the supply leads, or has detected the operation of more than one marker RC-, BL-, T-, or U- relay due to a cross on foreign battery as evidenced by the operation of XNL, XRC, XBL, XT, XLT, or XU marker relays.

Designation	Meaning
XTU	Cross Trunk Unit - In making trunk or register selection the marker has detected a cross or foreign potential on leads TB- or TG- or has detected the operation of more than one JC- relay or a false ground on lead JCK or a false ground on lead SL as evidenced by the operation of XTB, XTG, XJC, or XSL marker relays.
ZO	Zero Operator - The originating register has informed the marker that the call is to be routed to an operator trunk.

3. FUNCTIONS

3.01 Functions of this circuit are described in General Description of Operation in SECTION I.

4. CONNECTING CIRCUITS

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

(a) Marker Circuit - SD-26384-01.

(b) Originating Register Circuit - SD-26385-01.

(c) Incoming Register Circuit - SD-26386-01.

(d) Outgoing Sender and Connector Circuit - SD-26387-01

(e) Signal Receiving Circuit - SD-99493-01.

(f) Power Ringing, and Tone Distributing Circuit - SD-26414-01

(g) Message Register Supply Circuit - SD-26408-01.

(h) Miscellaneous Circuit - SD-26406-01.

(i) Line, Line Switch and Connector Circuit - SD-26382-01.

(j) Alarm Circuit - SD-26393-01.

(k) Line Number Translator Circuit - SD-26388-01.

(ℓ) Trunk Switch and Connector Circuit - SD-26383-01.

(m) Marker Connector Circuit - SD-26389-01.

(n) Interrupter Circuit - SD-26407-01.

(o) Alarm Sender Circuit - SD-26442-01.

(p) Permanent Signal Counter Circuit - SD-26405-01.

(q) Outgoing Sender Link and Trunk Identifier Circuit - SD-26395-01.

4.02 This circuit is also arranged to function with CSACS E2A Telemetry System, as shown on its status and command remote application schematic.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The test frame test circuit shall be capable of performing all functions covered in this Circuit Description, meeting all the requirements of the Circuit Requirements Table, and meeting all the manufacturing test requirements in the Schematic Drawing.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-LCB

WE DEPT 355-GJM-LG-KLF-CB