

CIRCUIT DESCRIPTION

163

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CD-25960-01
ISSUE 13AC
APPENDIX 1A
DWG ISSUE 45A

CROSSBAR SYSTEMS
TANDEM OFFICE
TRUNK AUTOMATIC TEST CIRCUIT
ARRANGED FOR AMA

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CHANGES

B. Changes in Apparatus

B.1 Added

RCT Network, 185A

C. Changes in Circuit Requirements Other Than Those Caused By Changes in Apparatus

C.1 Circuit requirements table is changed to show relay WKOK as an AJ15 instead of AQ33 to agree with manufacture.

D. Description of changes

D.1 During the E&M wink test and dual channel receiver control portion of the AMATT a race condition exists which may block the test circuit falsely.

D.11 When the EMP2 relay operates, in response to coin return tone, the break of its EMB8 contact starts release of the WKOK relay and the make of its EMB12 contact locks relay RCT. If relay WKOK releases before relay RCT locks it will release opening the tone leads to the dual channel receiver causing relay EMP2 to release prematurely and the test circuit will block.

D.12 This condition is prevented from occurring by placing a 185A network across the winding of the RCT relay which slows its release to cover the transit time of the EMP2 relay contacts.

D.13 This change need only be applied in those offices arranged for testing TSP incoming trunks.

D.2 When testing SD-27067-01 or any TSP trunk the reseizure of the trunk when held busy by the THB key results in the test proceeding to the A relay operate stage, recycling, and repeating.

D.21 The RT relay in the trunk held busy is operated at the time it is seized and does not have to wait until trunk busy timing is completed (PXT1 or ST01 operated) before making the A relay operate test. With the A relay in the trunk operated the ADK relay in the test circuit is operated and provides an operate path for the CA1 (circuit advance) relay through the PXL1 operated and PXT1 normal for SD-27067-01 or the PPT operated and the ST01 normal for person-to-person trunks.

D.22 This problem of recycling is corrected by inserting a contact of relay CPB (cancel pass busy), which operates when seizing a trunk held busy, in the operate path of the CA1 relay.

D.23 This change need only be applied in those offices specifying "YP" or "YW" options and requires minor wiring only.

D.3 The following changes are made to correct minor drawing errors:

D.31 Contacts 3 and 4T and 3 and 4B relay TKG should be shown as 3 and 4B and 7 and 8T relay TKG respectively on OS7.1.

D.32 Contact 6 and 7T relay DR2 should be shown as make contacts on OS10.

D.33 Position 7 of Trunk Type 1 Switch, Sect. 1 should be designated CMB on OS12.

D.34 The XD relay contact 1 now shown as a make contact should be shown as a break contact on OS14.

D.35 The CIA relay transfer contacts 4 and 5T are shown as break contacts and 5 and 6T as make contacts. Contacts 4 and 5T should be shown as make contacts and 5 and 6T as break contacts on OS17.

D.36 Lead "ES" is improperly shown connected to the E capacitor on sheet 01040. It should be shown connected to opposite side.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5623-RMW-RBC-LM

AMATT.O

CROSSBAR SYSTEMS
TANDEM OFFICE
TRUNK AUTOMATIC TEST CIRCUIT
ARRANGED FOR AMA

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SECTION I - GENERAL DESCRIPTION

1. GENERAL FUNCTIONS

This circuit provides maintenance features in the crossbar tandem AMA office by operating in the following manner.

- 1.1 Connects to any associated trunk for test purposes.
- 1.2 Tests each trunk by simulating a call placed through the trunk and by manipulating certain trunk relays during the test call. Trunk features tested in this manner include:
 - 1.21 trunk supervisory functions, and
 - 1.22 trunk charging functions.
- 1.3 Advances automatically from one trunk to another to permit tests on all trunks.
- 1.4 Provides means to avoid disrupting service on the incoming PCI or non-ANI MF trunk cable pairs.
 - (a) When testing the service trunk, or
 - (b) when holding the trunk busy under manual control.
- 1.41 When reserve trunks are used to provide alternate trunk circuits on the incoming cable pair, includes reserve trunk auxiliary relays.
- 1.42 When reserve trunks are not used, provides features to make the originating end of the trunk cable pair appear busy.
- 1.5 Provides necessary information to the sender through the sender link in behalf of reserve trunks according to the service trunks that are replaced.
- 1.6 Provides additional maintenance features on a semiautomatic basis, including means for
 - (a) placing a call through a trunk to any accessible distant office
 - (b) connecting the trunk to jacks for transmission test purposes
 - (c) introducing a transverter trouble indicator display to permit verification of information originating on cross-connections in the sender link controller and in the trunk test circuit, and

- (d) connecting the message register associated with the incoming trunk from PBX and the trunk incoming tip and ring leads to jacks in the miscellaneous circuit for message register rack for test purposes.

2. GENERAL METHOD OF OPERATION

2.1 Trunk Connection Functions

2.11 Connector and Connector Control

Trunks are associated with the test circuit by means of connectors composed of relays and crossbar switches. Each connector serves a maximum of 100 trunks associated with a call identity indexer and recorder. Trunks are assigned to the crosspoints on the connector in a set pattern with the call identity index of the trunk determining the location. The number of the verticals on the crossbar switch correspond to the tens digits of the call identity index and the numbers of the horizontal levels correspond to the units digits of the call identity index.

Trunk assignment to call identity indexers and test connectors are made on the basis of the pulsing type of the trunks. On connectors serving PCI trunks the PCI reserve trunk occupies the 00 crosspoint. On connectors serving MF trunks requiring reserve trunks, the reserve trunk occupies the 90 crosspoint.

The first trunk to be selected for test under automatic progression or a particular trunk to be selected for special test purposes is determined by presetting the group tens, group units, hold, and select switches on the key and lamp panel. Operation of the ST key will set the connector up to the trunk selected, and then disassociate the group, hold and select switches from the connector control.

Control of the connector is provided by operating a relay in each of three chains, S- for select level, H- for vertical, and G- for connector. Automatic progression of the connectors from one trunk to the next is obtained by advancing the G- relay chain one step at a time. The H- chain is advanced one step each time the G- chain recycles and the S- chain is advanced one step each time the H- chain recycles. At the end of the connector sequences the connector is released and the end of the cycle condition appears.

Progression may be limited to connect in succession only the trunks associated

with a particular recorder by preoperating the PRT key. Under this condition the automatic progression from one trunk to the next is obtained by locking the G- relay corresponding to the particular recorder (as determined by the setting of the group tens and group units switches) and advancing the H- relay chain one step at a time. The S- chain is advanced one step each time the H- chain recycles. At the end of the connector sequence the connector is released and the end of the cycle condition appears.

2.12 Operation With Trunk Circuits Associated With the Traffic Service Position No. 100A

2.121 Introduction

The basic test philosophy for trunk circuits associated with the traffic service position (TSP) is the same as other trunk circuits tested by this circuit except that new test features have been added and some existing ones have been modified. This section describes these changes in general form.

2.122 Test Variation

Major test features have been programmed in the main sequence of the test. Secondary test features are introduced by the operation of the test-variation key SM. Major test features test trunk functions used on every call, and secondary test features test less frequently used trunk functions.

2.123 Access for Testing

Access to these trunks for testing is obtained by the test connector augmented by new auxiliary connecting relays and by a new connection through the TSP position link and connector circuit where the trunk test circuit has a special appearance. Associated with this appearance is the trunk test simulated position (TTP).

2.124 Trunk Test Simulated Position (TTP)

The TTP is a part of the trunk test circuit that simulates the actions of an operator and a position circuit. It is arranged to signal and receive various signals from the trunk under test and the attached sender, depending on the type of test performed.

2.125 Sender to Trunk Test Connection

A direct sender to trunk test circuit connection exists when testing TSP trunk circuits. This connection exists because of the need of the trunk test circuit to control the release of the sender. It is also needed because of the elimination of sender control via the present "SPI" lead connection between trunk circuit and sender on TSP trunk test calls.

2.13 Trunk Class Identification

Trunks are identified to the test circuit by class marks which indicate the type of pulsing employed and the variety of operational test sequence required.

The operation of a connector cross-point grounds a lead which is cross-connected to indicate whether or not a trunk is associated with the crosspoint and the variation of test sequence required to test the particular trunk functions. A vacant terminal (VT) indication advances the connector to the next crosspoint. Any class indication other than VT sets the test circuit for operational tests for the type of trunk encountered. For example, class BEM causes the test circuit to be arranged for tests on a bylink "E" and "M" lead signaling trunk. On PCI trunks an identification is also given if it is or is not an ANI trunk.

Grounds from the connector hold magnet off-normal springs are extended to the test circuit to indicate the pulsing type of the trunk, to prepare busy test paths to the trunk and associated reserve trunk and to cut through other test leads between the trunk and the test circuit. On MF and DP trunks it also indicates if it is or is not an ANI trunk.

Identification of the pulsing type prepares the pulse generator for proper outpulsing control and trunk test functions. The ability of the trunk test circuit to select trunks of a particular pulsing type for test and exclude all others is provided by means of the trunk type 2 switch. This switch permits selection of the following pulsing classes: (1) ALL (2) PCI (3) DP, and (4) MF.

The test circuit may also be made to select particular trunk types for test and exclude all others by means of the trunk

type 1 switch. This switch permits selection of the following types of trunks regardless of pulsing class: (1) ALL associated trunk circuits (2) CAMA incoming trunk circuits (3) PBX incoming trunk circuits (4) dial zero trunk circuits (5) special toll noncoin trunk circuits (6) special toll coin trunk circuits, and (7) combined trunk circuits.

By the combined use of both trunk type switches a further division of selection is possible.

When a combined trunk is selected the trunk will be tested either as a special toll coin trunk (CDZ key normal) or as a dial zero trunk (CDZ key operated).

The trunk test circuit excludes from routine testing the DP Incoming Trunk SD-27067-01 when used for wide area telephone service (WATS). This trunk will be tested only when the WATS key is operated. This testing should only be done when a trouble condition arises in the trunk to avoid suspending the customers full time usage of the trunk.

Identification of an ANI trunk prepares the steering and pulse generator circuits for MF outpulsing of the "X" identification digit on receipt of the start identification signal from the sender.

For loop dial bylink trunks the crosspoint also extends ground to the trunk circuit over the "RV" lead to prebusy the trunk pair back to the originating office. The trunk type switch is provided permitting testing on all trunks or just those of one pulsing type.

2.14 Trunk Class Identification (A&M Only)

Trunks are identified to the test circuit by the type of pulsing employed, one type of trunk in each pulsing class tested with certain "basic" test functions. Other types of trunks in the pulsing class require suitable variations in the test functions.

The operation of a connector crosspoint grounds a lead which is cross-connected to indicate whether or not a trunk is associated with the crosspoint, and whether or not the trunk requires a variation in the test functions.

A VT indication advances the connector to the next crosspoint. An RC indication sets up just the basic test functions

and the variation indications (VA and VB) set up the variations. A 3WS indication serves to prepare the circuit to test trunks from code selector multiple in the same building.

Operation of the RC relay either from the RC indication or the VA, VB, or 3WS indication prepares busy test paths to the trunk and the associated reserve trunk and partially closes other test leads between the trunk and the test circuit. The crosspoint operated also completes the busy test path to the trunk and prepares a path for operating the trunk RT relay.

For DP bylink trunks the crosspoint also extends ground to the trunk circuit to prebusy the trunk pair back to the originating office.

Ground from the connector hold magnet off-normal springs is extended to the test circuit to indicate the pulsing type of the trunk under test and to start the busy test of the trunk. Identification of the pulsing type of the trunk prepares the appropriate pulse generator and trunk test functions. The trunk type switch is provided permitting testing on all trunks or just those of one pulsing type.

2.15 Busy Tests

(PCI) - When the trunk and its associated reserve trunk are idle the RT relay in the trunk is operated to transfer the incoming trunk cable pair to the reserve trunk (keeping the tandem trunk pair in service) and to complete the connection between the trunk and the test circuit. Once operated for a test the RT relay is held operated over its locking path to insure that the RT can be locked to the reserve or the THB (formerly RTL) key. If the associated trunk is "nonsupervisory", the NS relay in the reserve trunk, if provided, is operated to maintain the nonsupervisory features of the service trunk.

(BL-Loop Dial) - After the prebusy function a short delay is inserted before busy test to cover simultaneous trunk seizure by the customer and the test circuit. When the trunk is idle the RT relay in the trunk is operated to connect a "make-busy" condition which makes the trunk cable pair appear busy at the originating end and to complete the connection between the trunk and the test circuit. Once operated for a

test the RT relay is held operated over its locking path to insure that the RT can be locked to the THB key.

(BL - "E" and "M" Lead) or (MF - "E" and "M" lead) - When the trunk is idle the RT relay in the trunk is operated to connect a "make-busy" condition which makes the trunk at the originating office appear busy by means of the "E" and "M" lead signaling circuit, and to complete the connection between the trunk and the test circuit. Once operated for a test the RT relay is held operated over its locking path to insure that the RT can be locked to the THB key.

(WS - MF or DP from No. 5 Crossbar) - When the trunk is idle the RT relay in the trunk is operated to connect a "make-busy" condition which makes the trunk cable pair appear busy at the originating end and to complete the connection between the trunk and the test circuit. Prior to Issue 15D the make-busy condition included a source of reorder tone (provided for second dial tone operation) which is extended to the customer in the event of simultaneous trunk seizure by the customer and the test circuit.

(WS - MF Non-ANI From No. 1 Crossbar or Panel) - When the trunk and its associated reserve trunk are idle the RT relay in the trunk is operated to transfer the incoming trunk cable pair to the reserve trunk (keeping the tandem pair in service) and to complete the connection between the trunk and the test circuit. Once operated for a test the RT relay is held operated over its locking path to insure that the RT can be locked to the reserve or the THB key. If the associated trunk is "nonsupervisory", the NS relay in the reserve trunk, if provided, is operated to maintain the nonsupervisory features of the service trunk.

(AIP - ANI - MF From No. 1 Crossbar or Panel) - ANI-MF trunks from No. 1 crossbar and panel are tested without reserve trunk substitution. The trunk at the originating end is seized after three dial pulls but no connect signal (low resistance bridge) is sent to the tandem incoming trunk until completion of dialing which may be 7- or 10-digits. The tandem incoming trunk appears idle until the connect signal is received. The test circuit checks the originating end for such a condition. The test circuit reverses the conductors toward

the originating office as a make-busy signal but does not proceed with the test until a timed interval of 0.5 seconds minimum expires. This interval is to allow the No. 1 crossbar marker to complete its switching functions and establish a busy condition (low resistance bridge) on simultaneous seizures. If an originating busy is encountered the trunk is passed as busy when the APB key is operated, or the trunk is restored to service and retested for busy after a timed interval of about 17 seconds when the APB key is unoperated. Should a seizure of the distant outgoing trunk be detected after the test has been started the test circuit immediately restores the tandem incoming trunk to service and makes a completely new busy test. (This feature is canceled in offices which complete traffic from an outgoing panel or No. 1 crossbar trunk which returns a timed low-bridge interval during busy test.) The test count register is not scored and the action following retest is controlled by the APB key condition.

When the trunk or its reserve (if provided) is busy, with the APB key normal, the action of the circuit will be suspended until both the trunk and the reserve are idle. After approximately 5 minutes the time alarm will be sounded, and will remain on until either the busy conditions ends to start the test or the circuit is advanced under manual control.

When the trunk or its reserve (if provided) is busy with the APB key operated, the automatic pass busy function will advance the connector to the next trunk, skipping all trunks for which a busy condition is encountered, and scoring each "pass busy" on the PB register.

(PXL - DP From PBX) - When the trunk is found idle a timed delay is inserted before the trunk RT relay is operated to apply a busy condition to the PBX. The delay is introduced to allow sufficient time for complete release of the outgoing trunk if it was in the process of releasing on a service call at the time of busy test.

A source of reorder tone is provided and is extended to the PBX customer in the event of simultaneous trunk circuit seizure by the customer and the test circuit.

2.151 Busy Tests - TSP Trunk Circuits

Make-busy rather than reserve trunk testing is used with all TSP trunk circuits. The busy condition is transmitted to the originating end by a trunk polarity reversal for loop signaling trunk circuits and resistance battery on the "M" lead for E and M signaling trunk circuits. Because of the nature of these trunk circuits, care is exercised in applying the busy condition to be sure that no subscriber line is kept out of service while the trunk is being tested. Also, arrangements are made for the trunk test circuit to withdraw in cases of simultaneous seizures of the trunk circuit by the originating end and by the trunk test circuit. The TSP trunk circuits are arranged so that they cannot be made busy by means of a plug unless seized by the trunk test circuit. The test circuit after performing the appropriate busy test will signal the trunk that it is safe to apply the make-busy condition.

2.1511 Preliminary Busy Test

The following preliminary busy test procedure is common to all TSP trunk circuits. After seizure of the trunk by the connector the "A" and "S" leads of the trunk circuit are tested for busy conditions. If the trunk is found busy the circuit advances; if it is found idle a timing period of 1.8 seconds minimum is initiated. This timing is necessary to insure proper release of originating end facilities, if not already released at the time of seizure. Any new seizure at this time will advance the test circuit. After the expiration of this interval, a second-stage busy test is made as described below.

2.1512 Busy Test of TSP Trunk Circuits From Panel of No. 1 Crossbar Offices

Following the preliminary busy test described above TSP trunks from No. 1 crossbar and panel offices regardless of whether they are arranged for ANI are tested by an exchange of signals as described, in SECTION I, under 2.15, (ANI).

2.1513 Busy Test of Special Toll Trunk Circuits From No. 5 Crossbar Offices

All special toll trunk circuits from No. 5 crossbar are tested by applying a standing reversal toward the originating end after the conclusion of the preliminary busy test.

2.1514 Busy Test of Dial Zero Trunk Circuit From No. 5 Crossbar and No. 1 ESS and All TSP Trunk Circuits From Step-by-Step Offices

Following the preliminary busy test described in 2.1511 a monitoring interval of 500 to 700 msec is introduced before actual testing of the trunk is started. During this interval any simultaneous seizure of the trunk by a subscriber and trunk test circuit will be recognized and the test circuit will be advanced, restoring the trunk circuit to service.

2.16 Advance Control (END)

Upon successful completion of the test on the trunk the END test sequence relay is operated by the OK indication of the previous test function. The END operated extends ground through a test line and trunk down check and an OK "CH" lead release check network to advance the circuit at the end of the test.

If the repeat key is normal the CT register is operated to score a "circuit tested" and, in turn, operates the CA, CAA, and CAL relays to advance the test connector and prepare the busy test for the start of the test on the next trunk.

If the repeat key is operated the RST register is operated to score a "repeat on same trunk" and, in turn, operates the CAL relay to prepare the busy test for the start of the next test on the same trunk, the connector not being advanced at this time.

2.17 Control Advance (CA)

The operation of the CA key (control advance) advances the test circuit to the next trunk if the REP key is normal. This can also be done from the transverter trouble indicator or the trouble recorder frame by using a 32A test set in the RC jack or TRT jack respectively. This is provided because of the display trouble indication function (DTI test) of the test frame (See 3.13). This test is used to check sender link class cross-connection by introducing a trouble in the transverter causing it to block and give the desired information either to the transverter trouble indicator or to the trouble recorder. Since the test frame will also block, it is desirable to control advance it from the above locations. If the REP key is operated, operation of the CA key will cause a trunk to be retested without going through

the entire testing sequence. This can also be done from the trunk, trunk link, sender link, register link, recorder, timer link, TSP link controller, TSP link and connector, test frame miscellaneous circuit, call identity indexer, or transverter trouble indicator, by using a 32A test set in the RC jacks of these equipments or in the TRT jack of the trouble recorder. This permits circuit operation to be observed at each of these locations.

2.2 Trunk Test Functions - Communication With the Sender

2.21 Test Start

As the trunk is connected for test off-normal grounds are closed and maintained for the duration of the test on the particular trunk. One of three pattern relays is operated under control of test function keys and jacks to determine which of the test functions are enabled.

Relay CTP (call through test) operates if CTT key is operated. Relay ABR (abbreviated test) operates if CTT is normal and any of the following are operated: DTR key, SM key, FDTR key, DTI key, FOT key, and FOT1 key, or a plug inserted into the R Jack. Relay NML (normal test) operates if all of the above are normal.

Connection to each of the test functions in turn is made by the test sequence relay chain, each relay on operating releasing the previous test sequence relay, cutting in the test function, and, when necessary, extending a start ground to the test function. Each test function performs its cycle, and upon successful completion of the cycles extends an OK check signal to advance the test sequence chain to the next test sequence relay as determined by the pattern relays.

2.22 Relay A Operates Tests

2.221 (PCI) A Relay Operate Test (AOP)

Connection of the AOP test function simulates the seizure of the trunk by the originating office by operating the trunk A relay on minimum current. Trunk A relay operated extends a start signal to the sender link and when the tandem sender is attached it opens the originating loop by operating trunk T relay. The test circuit recognizes the opening of the originating loop and checks that the A relay has released. Successful completion of the cycle advances the circuit to the PLA test function.

2.222 (BL - Loop Dial) A Relay Operates Test, (AOD)

(BL - "E" and "M" Lead) A Relay Operate Test (AO)

Connection of the AOD or AO test functions prepares the trunk for reorder tone test by opening "start" leads from the trunk to the register and sender links. At this time if a "three-wire" trunk is being tested, ground will appear on the "S1" lead to set up a (3W) test condition connecting appropriate test features. The seizure of the trunk by the originating office is simulated by operating the trunk A relay on minimum current. When testing Loop Signaling Bylink Trunk Circuits; SD-27010-01, SD-27079-01, and SD-27104-01 the test circuit checks the nonoperate requirements of the trunk A relay by applying the nonoperate test current to the loop before operating the trunk A relay. This is followed by a dial pulse, which, because "start" leads have been opened, appears to the trunk to be a "preliminary pulse", that is, prior to register attached. The trunk returns reorder tone which the test circuit tone detector recognizes. After two spurts of tone are counted the call is "abandoned" and the trunk is checked down. If the test is successful, the test sequence is advanced to the PLA test function.

2.223 WS and MEM A Relay Operate Test, AOD

Connection of the AOD test function simulates the seizure of the trunk by the originating office by operating the trunk A relay on minimum current. Trunk A relay operated extends a start signal to the sender link and when the tandem sender is attached it reverses the potential toward the originating loop by operating the trunk T or CS relay, connecting the loop into the sender. The test circuit recognizes by the reversal that the sender is attached and then recognizes by the prompt removal of this reversal that the sender is ready to receive pulsing. The brief period that the reversal is on the loop is the "wink start" signal. After the wink the test circuit advances to the PLA test.

2.224 Test Indication to Sender

During AOP or AOD test function (PLA for bylink trunks) a ground is extended to the sender through the trunk and sender link on the "SPI" lead to identify the test call as such for the sender and transverter. On receiving this indication the sender cancels all timing, does not call in a position, and extends the trunk test indication to the

transverter. This indication is omitted on call through test.

2.225 (PXL) A Relay Operate Test (AOD)

Connection of the AOD test function simulates the seizure of the trunk by the originating dial PBX by operating the trunk A relay on minimum current. Trunk A relay operated extends a start signal to the sender link and when the tandem sender is attached it causes the operation of relays in the trunk circuit which ground the "S" lead to the test circuit. Ground on the "S" lead is detected by the test circuit and is taken as a sender attached signal.

When the trunk "T" and "R" leads are transferred into the sender by the trunk relay which the sender operates, dial tone is returned to the test circuit causing release of a tone detecting relay. The release of the tone detecting relay is taken as an A relay operated check.

2.23 Office Code Outpulsing (PLA) ("WS" Option "Mfr Disc.")

Connection of PLA test function provides for outpulsing of the office code. In addition, the TH digit of the called number is also outpulsed on tests of bylink trunks in offices arranged for foreign area translation (A&M Only). For loop dial BL trunks the A relay is reoperated which extends start signals to both register and sender links. In all cases the pulse generator is started. Cross-connections provide the test code which leads to the connection of the trunk through the tandem office links to the return test line. Pulsing is interrupted after the C digit has been transmitted ("Mfr Disc.") or after the TH digit for the bylink foreign area translation condition (A&M Only) mentioned above, to permit the test circuit to ready the return test line for the marker. For BL trunks a check is made that the sender did not operate the marginal trunk TMG relay. The test sequence is advanced at this time to the RTL test function.

When testing TSP trunks, other than dial zero, or SD-27092-01 (non-TSP) the test code plus the thousands, hundreds, tens and units digits are outpulsed during the PLA test to satisfy the tandem sender. On ANI trunks the units digit will be followed by the OI ANI identification digit as soon as the sender transmits the start identification signal (See 2.28).

When testing dial zero trunks the test number is not outpulsed by the test circuit but passed to the sender from the simulated position via the data transfer circuit. However, on dial zero ANI trunks the test circuit will outpulse the OI ANI identification digit which causes the tandem sender to signal the trunk to request connection to the simulated position. When the simulated position is attached the test number is given to the sender as described in the position and data transfer test.

2.231 Office Code Outpulsing (PLA)

Connection of PLA test function provides for outpulsing of the office code followed immediately by PLB line number outpulsing (See 2.27).

2.24 Position and Data Transfer Test

This test checks the ability of the trunk to connect to the TTP and checks that the required information is passed by means of the data transfer circuit between the trunk, simulated position and sender, if attached. Multifrequency pulsing or dial pulsing trunks, other than dial zero non-ANI, request connection to a sender or dial pulse register immediately after the A relay operate test. The test circuit will outpulse the test number as described in the PLA test when the sender or register is attached. When registration has been completed in the sender, the sender signals the trunk to bid for connection to a position. The trunk passes this position request signal to the trunk test circuit which in turn grounds either a test start lead or a regular start lead through the trunk into the traffic service position No. 100A link and connector circuit depending on whether a regular test or a call-through test is being made. Ground on the test start lead is a signal to the link controller to connect to a specific point on the link output which is the appearance of the TTP. Ground on the regular start lead signals for a connection to a service position. When the trunk and TTP are attached the link controller releases and the TTP seizes the data transfer circuit which establishes a data channel between the TTP, trunk under test and sender. When the information for the test call has been passed between TTP, trunk and sender, the data transfer circuit transmits a data check signal to the sender and TTP and is in turn released. If an information error is detected, the data transfer circuit sends

a data error signal to the TTP blocking the test circuit and lighting a trouble lamp which indicates the type of information error causing test failure. The data transfer circuit will also cause a trouble record card to be perforated which will contain all information in the data channel at the time of failure.

When testing dial zero non-ANI trunks the trunk does not request connection to a sender immediately after the A relay operate test, instead it bids for connection to a position. When the TTP is attached trunk information is passed via the data transfer circuit. At this time the test circuit will perform the transfer to cord switchboard test as described in 2.241 if the special test key SM is operated to the SMA position. At the end of the transfer to cord switchboard test or if the special test key is not operated to the SMA position the test continues as follows: The TTP is made ready to transmit the test number and signals the trunk to request connection to a sender. When the sender is attached the data transfer circuit is seized by the TTP and the test number is passed to the sender. The data transfer circuit then sends a data check signal to the TTP and is released. Receipt of the data check signal advances the test circuit to the next test.

When a dial zero ANI trunk is seized for test the trunk bids for connection to a sender on completion of the A relay operate test. After the sender is attached and a start identification signal is received, the test circuit will output only the OI ANI identification digit. The sender then transmits a position request signal to the trunk and the TTP is attached. The circuits then function as described above for the dial zero non-ANI trunk to pass the test number into the sender via the data transfer circuit and the test circuit is advanced to the RTL test.

2.241 Transfer to Cord Switchboard Test for Dial Zero Trunks

Following registration of the first data check signal by the TTP as described above for dial zero trunks in the position and data transfer test, the transfer to cord board feature of the dial zero trunk is tested when the special test key SM is operated to the SMA position. The test checks the ability of the dial zero trunk to transfer the call to a cord switchboard operator when signaled from the TTP. When

the "transfer" signal is given to the trunk it will function to transfer the call to a cord switchboard. However, the leads to the trunk finder circuit over which the trunk accomplishes the transfer are opened and are instead brought into the trunk test circuit by the test relay in the trunk. Actions of the trunk are checked over these leads and when the trunk has satisfactorily performed its functions the TTP removes the "transfer" signal. The trunk then restores to the condition before the test and the test advances to complete the position and data transfer test as described above.

2.25 Seizure of Return Test Line (RTL)

Two return test lines are provided on the office multiple to permit the test circuit to simulate the terminating office and subscriber for test calls. The first test line comprises "T", "R", "S", and "Sl" leads while the second test line has only the "Sl" lead. Ground is normally maintained on the "Sl" leads of the return test lines to prevent false connections.

2.251 Regular Seizure

Connection of the RTL test function with the TRL key normal removes the ground from the "Sl" lead of the first test line, making it appear idle to the marker. Grounding of the "Sl" lead by the marker preparing for seizure is recognized by the test circuit and the test sequence is advanced to the FTR test function if pattern relay NML is operated or the PLB if pattern relay ABR is operated. The marker operates the appropriate links to establish a connection between the trunk and the return test line.

2.252 "TRL" Lead Test (TRL)

A test is made of the "TRL" lead in the trunk by manipulating the busy condition of the return test lines at the time the marker attempts to establish the connection, thereby causing the marker to signal the sender over the "TRL" lead. Connection of the RTL test function with the TRL key operated makes the first test line appear idle to the marker while preparing for seizure and then making it appear busy before final connection. The marker makes a second attempt during which the test circuit makes the second test line appear first idle and then busy as above which causes the marker to signal the sender

over the "TRL" lead. The sender seeks another marker and the first test line is again made to appear idle to the marker. Grounding of the "S1" lead by the marker preparing for seizure is recognized by the test circuit which advances the test sequence. The marker is permitted to complete the connection of the trunk through the links to the return test line.

2.26 Test of Fundamental Tip and Ring (FTR)

The FTR test function makes a test of the fundamental tip and ring of the trunk from the return test line back through the links and the trunk to the sender where a low resistance battery is applied to the "FT" lead and high resistance battery is applied to the "FR" lead. By looking at the fundamental with a sensitive and marginal relay arrangement in various ways the tip and ring can be tested, for opens, grounds, crosses, or reversals. Any failure to find the proper condition on the leads will block the test with lamps lighted to identify the nature of the failure. Successful completion of the test will advance the test sequence to the PLB test function.

2.27 Line Number Outpulsing (PLB), NON-TSP Trunks ("Mfr Disc.")

In SECTION I, change the first sentence of the first paragraph of 2.27 to read:

Connection of PLB test function (a) immediately follows the office code outpulse PLA test function, or (b) restarts the outpulsing which had been interrupted after the C digit or after the TH digit for certain bylink trunks as mentioned previously ("Mfr Disc."). The remaining digits of the line number are outpulsed to satisfy the tandem sender and assume the values set on the numerals of the called number switches or the cross-connected test code. On test call codes the test frame is preset for DP and MF trunks to send "ones" to the sender and for PCI the switch settings are "zeros" if switches are set on OFF. When all of the digits have been received the sender seeks a transverter, and, when connected, extends the trunk test call indication to the transverter. The sender, on non-ANI calls, also simulates calling in an operators position for identification and in so doing operates the TMG relay in the BL trunks and the RV relay in the BEM trunk. The test circuit makes an up check of these relays when required.

2.28 Identification Index (X) Digit - MF Outpulsing - ANI

The sender expects an identification index (X) digit when it has received an ANI mark from the sender link trunk decade. This digit, preceded by a keypulse signal, is transmitted to all types of senders by multifrequency signals. The test circuit always transmits a "one" for the X digit. The X digit "one" is the index for "operator identified - nonobserved". The ANI trunk class relays prime the test circuit to pulse the KP and X digit after the called number. If the called number is pulsed DP or PCI the test circuit shifts to MF pulsing for these digits. Pulsing of the X digit is delayed until the sender transmits a start identification signal.

2.29 Initial Entry Test (IET)

The IET test function checks the ability of the trunk to place an initial entry on the AMA recorder tape. The functioning of the "CH", "TC", and "DJ" leads from the trunk to the call identity indexer is thus checked, as well as the continuity of the "OT" and "RC" leads. (The proper functioning of the recorder is indicative of satisfactory conditions on these leads.) At the time this test is made a path is closed from the transverter over which an indication is received if the transverter encounters trouble. In order not to block the trunk test circuit on transverter troubles, a second trial is permitted, for which another transverter, if one is available, is selected. If no trouble is encountered on the second trial the call then proceeds without blocking. The test circuit will block, however, if a trunk trouble caused second trial or, more rarely, if the transverter having a trouble is reselected because no others were idle. Successful completion of the test will advance the test sequence to the DFT test function.

When testing TSP trunks the TTP gives the transverter start signal to the transverter connector and passes the information required by the recorder for perforating the initial entry into the transverter. The AMA information is passed from the sender and registered in the TTP during the position and data transfer test. When the initial entry has been perforated on the AMA tape and the test circuit checks of the recorder have been satisfied the transverter sends a transverter release signal to the TTP and is in turn released marking successful completion of the test.

2.30 D Relay Function Tests (DFT)**2.31 Regular CAMA Trunk Circuits**

After completion of the recording of the initial entry the transverter gives a release signal to the sender. The sender then makes trunk closure and releases. Signals are passed between the sender and trunk over the "D" and "DC" leads at this time. The purpose of the D function test is to check that the trunk performs properly for this circuit operation. Also, the locking path of the trunk D relay is checked on this test. Successful completion of the test will advance the test sequence to the XM, CST, or ANS test function.

2.32 TSP Trunk Circuits

When testing TSP trunk circuits the test circuit completes registration of the test number in the sender during the PLA test for special toll TSP trunks or during the position and data transfer test for dial zero TSP trunks. With registration completed in the sender, the sender seizes the marker on completion of the position and data transfer test immediately after receiving the data check signal from the data transfer circuit. The trunk is then connected to the return test line and when the marker has completed its functions, the sender would start its release before the test circuit is ready to make the D function test. To prevent sender release at this time a lead is provided from the test circuit directly to the MF sender by means of which the sender is held until the test circuit is prepared to make the D function test. On completion of the initial entry test the sender is permitted to start its release and the test circuit proceeds to check the functions of the trunk D relay as for regular CAMA trunks.

2.4 TSP Trunk Circuits Tandem Hold and Signaling Tests**2.41 Ringback Test**

Following the completion of the D function test, with the special test key SM operated to the SMA position, the trunk is signaled from the TTP to apply the ringback signal to the originating end. The ringback signal for loop signaling noncoin trunks consists of a +130 volt potential on the tip lead and -48 volt potential on the ring lead. For loop signaling noncoin special toll trunks arranged for completion for electronic switching offices the ringback signal is a timed on-hook, -48 volt battery and ground signal on the tip and ring. Ringback signal for a loop signaling coin trunks is a continuous on-hook, off-hook flash except those arranged for completion from electronic

switching offices where the ringback signal consists of a timed wink followed by a quiet period which is followed by 700 and 1700 cycle tones on the tip and ring leads. On E and M signaling noncoin trunks the ringback signal is an on-hook, off-hook wink on the "M" lead. The E and M signaling coin trunks apply the on-hook, off-hook wink on the "M" lead followed by 1700 and 700 cycle tones on the tip and ring leads. The test circuit checks that the proper signal is transmitted by the trunk under test then removes the ringback request signal and advances to the following test in the sequence.

2.42 Position Recall Test of Dial Zero and Special Toll Coin Trunks

Special toll coin trunks (up to 18 or 30 seconds before end of initial period) and dial zero trunks (anytime) will recall the traffic service position when a 200 to 500 msec on-hook, off-hook flash is received from the originating end. Following the completion of the D function test, with the special test key SM operated to the SMB position, the test circuit simulates the 200 to 500 msec on-hook, off-hook flash from the originating subscriber by inserting a high resistance in the incoming tip and ring leads for the proper duration and checks that the trunk recalls the TTP. When the TTP and trunk under test are attached, trunk information including the position recall indication is passed to the TTP via the data transfer circuit. Registration of the position recall indication marks the completion of the test and the test circuit is advanced to the next test following receipt of the data check signal from the data transfer circuit.

2.43 Tandem Operator Hold Test

The tandem holding features permit the traffic service position to hold the trunk when the originating subscriber goes on-hook during the time the position is attached.

Following the D function test, with the TTP attached and the special test key SM normal, the test circuit simulates the originating subscriber on-hook, thereby releasing the trunk A and A1 relays. The test circuit then checks that the trunk D relay locking ground is not removed for the duration of time, one second minimum, that the on-hook condition is maintained. If the D relay locking ground is removed the test circuit will detect this and block. If the D relay locking ground is not removed during the one second minimum on-hook interval a check relay is operated marking successful completion of the test and the test circuit is advanced to the next test in the sequence.

2.44 Coin Collect Test

On completion of the previous test function the TTP signals the coin trunk to apply a distinctive signal to the originating end which, on service calls, causes the local trunk to apply collect potential to the calling line. The coin collect signal to the local trunk consists of -48 volt potential on the ring lead and +130 volt potential on the tip lead for loop signaling trunks except those arranged for completion from electronic switching offices where the coin collect signal consists of an on-hook, off-hook wink on the tip and ring leads followed by a "quiet" period which is then followed by 700 and 1100 cycle tones on the tip and ring. On E and M signaling trunks the coin collect signal is an on-hook, off-hook wink on the "M" lead followed by 1100 and 700 cycle tones on the tip and ring leads. The test circuit checks that the proper signal is transmitted by the trunk and then removes the coin collect request thereby causing the trunk to restore to normal off-hook. The test circuit is then advanced to the next test function.

2.5 Trunk Test Functions - Supervision From the Called Party2.51 CS Relay Test (CST)

The proper adjustment of the polarized CS relay in the trunk is partially checked by the CST test function. A positive soak current, which should operate the relay, followed by a release current which should allow the relay to release, is supplied in succession five times. The number of times the relay releases is counted, and, if due to a defective relay or other cause, the count does not check, the test circuit is then blocked.

The ability of the trunk to accept supervisory flashes before the end of the charge delay interval without making a false charge is also checked during the CST test function. The positive soak closures used for this test have a maximum length only slightly less than the minimum charge delay interval. However, the complete CS relay test takes a time greater than the maximum charge delay interval. Consequently a timing entry placed on the tape at this time from the trunk under test appears as a false charge condition and blocks the test.

For trunks which return supervision to the originating end, a check is made that the supervisory flashes are repeated to the originating end. For trunks which do not return supervision a check is made that the flashes are not repeated. Successful completion of the test will advance the test sequence to the ANS test function.

2.52 Joint Hold Test - Incoming Trunk From PBX, POT-PMR Key Operated to the POT Position (Operator Class Call)

When testing incoming trunks from PBX with the POT-PMR key operated to the POT position a "joint hold test" is made in lieu of the usual "CS relay test". The "joint hold test" checks the ability of the incoming trunk circuit to permit the PBX extension to flash the assistance operator and also checks the joint holding feature which permits the assistance operator to hold the trunk when an on-hook signal is received from the PBX. The checks of the flash and joint holding features are made in the following manner.

A positive soak condition is set up through the return test line to operate the trunk CS relay. Then the 30,000 ohm winding of the test circuit monitoring relay (which completes the incoming loop to the trunk) is inserted in order to simulate a PBX extension on-hook, thus releasing the trunk A relay. The release of the A relay inserts the 30,000 ohm winding of the trunk CS relay into the outgoing loop to flash the operator. The insertion of the 30,000 ohm winding of the CS relay is checked by the test circuit via the return test line. Five on-hook flashes are simulated as described above, and the test circuit checks that five flashes are transmitted by the trunk towards the operator. The flash duration is approximately 2.5 seconds on-hook .5 second off-hook. The on-hook interval is chosen to be substantially longer than the maximum release time of the trunk D relay so that the joint hold feature might be checked. If the D relay releases on any of the flashes, or if the CS relay fails to hold on its 30,000 ohm winding the test circuit will block immediately. When five flashes are simulated the test circuit checks that five have been returned prior to advancing to the next test. The state of the steering circuit is used to differentiate between the types of failures and corresponding lamp indications are given if trouble is encountered.

When testing the incoming trunk from PBX on an operator class test, a false charge indication will be given and the test frame will block if any charging condition is encountered.

2.53 ANI Supervision

All tandem incoming trunks arranged for ANI operation, whether used for ANI or non-ANI service, provide on-hook supervision until the sender causes an off-hook signal to be transmitted. This off-hook condition, which is recognized as a start identification signal at the originating ANI offices, is then maintained until the trunk is restored to normal. The trunk class relays set the test circuit to expect and check this type of supervision.

2.54 Answer Test (ANS)

After the last release of the trunk CS relay in the CST test, a negative soak is applied from the test circuit. Following this, a positive value of test operate current is applied to the CS relay, thus completing the test of its current flow requirements. Relay CS operation at this time corresponds to customer answer supervision, and for trunks which do not return supervision and for trunks arranged for ANI supervision a check is made that the off-hook signal is not repeated to the originating office. After remaining operated for two to five seconds, a timing entry for the trunk under test should be applied to the AMA tape. The receipt of this indication advances the test call to the SDT or DIS test function. For 3WS class trunks, prior to advance to the DIS test function a check is made that the trunk has transmitted an off-hook signal to the originating end. On special toll coin TSP trunk circuits the tests described under 2.55 are performed as part of the Answer Test.

2.541 Ringback Test - Incoming Trunk From PBX, POT-PMR Key Operated to the POT Position (Operator Class Call)

When testing incoming trunks from a dial PBX with the POT-PMR key operated to the POT position (operator class) the "ringback test" is performed upon completion of the "answer test." The "ringback" test checks the ringback feature of the trunk which permits a service or assistance operator to ring back the originating PBX extension. To do this the operator operates

and releases a key which results in a timed on-hook pulse to be transmitted to the incoming trunk which repeats it back to the PBX. The PBX OGT in turn causes ringing to be applied to the PBX extension.

The test circuit simulates ringback by an operator by applying on-hook pulse to the outgoing loop of the trunk circuit via the return test line and checking that this pulse is repeated by the trunk circuit to the PBX on the incoming "T" and "R" leads. The test circuit does not attempt to simulate the exact length of the ringback pulse. It sends a longer pulse back and maintains a low impedance bridge on the incoming "T" and "R" leads to prevent the release of the trunk circuits.

2.542 Coin Timing and Overtime Position Recall Tests for Coin Special Toll Trunks

2.5421 Accelerated Timing Test

To check the timing function of the coin special toll trunk for the initial timing period and ten overtime periods an accelerated timing test is performed when the special test key SM is operated to the SMA position. Initial and overtime period times are set on separate selector switches provided in the trunk test frame which permit selection of any combination of one to five minutes or no minutes (NM) initial period and ten overtime periods. The selected initial period time is passed to the trunk during the position and data transfer test and accelerated timing pulses are generated in the test circuit and transmitted to the trunk during the timing test. For the accelerated timing test the trunk is not connected to the timer link, instead those leads over which the trunk receives timing pulses are brought into the test circuit by operation of an auxiliary test relay in the trunk. Following registration of the number of pulses equivalent to the initial period time the trunk requests connection to the TTP. If IPT switch is set on no minutes (NM) the trunk, after receiving the CC timing pulse, will prevent additional timing pulses from being transmitted by removing ground from the "HMG" lead. When the TTP is attached the overtime period time set on the overtime selector switch is passed to the trunk via the data transfer circuit. The TTP is then released and accelerated

timing pulses are transmitted from the test circuit to the trunk for overtime period timing. The trunk registers the number of pulses equivalent to ten overtime periods and then requests connection to the TTP. When the TTP is attached the trunk transmits an end of timing cycle mark via the data transfer circuit indicating that it has successfully registered ten overtime periods. The timing pulses transmitted to the trunk are also counted in the test circuit. When the TTP is connected, a check is made that the correct number of pulses have been transmitted. If an early or late TTP connection is detected the test circuit blocks. On completing its checking function the data transfer circuit sends a data check signal to the TTP and is then released, completing the accelerated timing test.

2.5422 Normal Timing Test

When the special test key SM is operated to the SMB position a normal timing test of the coin trunk is made. The timing pulses for this test are generated by the timer link circuit and are transmitted simultaneously to the trunk and trunk test circuit. In this test the initial period time is selected by means of the selector switch set to any position except NM but the overtime period time is fixed at one minute. When the timer link has timed the initial period the trunk requests connection to the TTP. When the TTP is attached the one minute overtime period mark is passed to the trunk via the data transfer circuit. The TTP is then released and the trunk connects to the timer link which starts overtime period timing. When six seconds of the first overtime period have elapsed the test circuit checks the overtime position recall features of the coin toll trunk by simulating first an originating subscriber on-hook and then a terminating subscriber on-hook as described in the overtime position recall test.

2.5423 Overtime Position Recall Test

When the coin toll trunk has timed the initial period and has gone six seconds into the first overtime period, an on-hook signal from the originating end of sufficient duration to release the trunk A1 relay or an on-hook signal from the terminating end of sufficient duration to permit operation of the trunk thermal relay, will cause the trunk to release the connection forward

and recall the traffic service position. These functions of the coin toll trunk are checked during the "timing test" part of the test sequence when the special test key SM is operated to the SMB position. Following the initial period timing check the trunk begins timing the first overtime period. When six seconds have elapsed the test circuit simulates an originating end on-hook and checks that the trunk functions to release its D relay and to recall the TTP. When making this test the test circuit checks that the ground which holds the trunk D relay is removed without permitting release of the D relay, thereby preventing the release of the return test line. When the TTP is attached the originating on-hook signal is removed, thus reoperating the trunk A and A1 relays. Trunk information is then passed to the TTP via the data transfer circuit. On receiving the data check signal from the data transfer circuit the TTP is released and the test circuit then transmits a terminating end on-hook signal to the trunk and makes the same checks described above. When the trunk has successfully completed its functions and the TTP is again attached, the terminating on-hook signal is removed restoring the trunk to the normal off-hook condition. When the TTP is attached the data transfer circuit is seized and when its functions are complete relay DTOK is operated. Operation of relay DTOK advances the test circuit to the next test.

2.55 (PCI) Supervision Delay Test (SDT)

In a CAMA Office, the trunk, once an answer has been recorded on the tape, does not immediately pass on-hook supervision back to the originating office. On-hook supervision is delayed until the tandem AMA equipment has placed a timed release disconnect entry on the tape. This was done in order to avoid the lengthening of the timed release interval at the originating office to "cover" the timed delay interval at the tandem office. To check this feature, a short on-hook signal is given to the trunk during the SDT test function and should this signal be repeated by the trunk, a test failure occurs. If not, a check signal is given after restoring off-hook supervision, and the test sequence is advanced to the DIS test function.

2.56 Disconnect Tests (DIS)

As described below the release of a trunk from a test call during the DIS test

function takes place in several ways, as selected by key control. A check is always made that the "CHG" to "CHT" lead continuity in the recorder is restored after disconnect. This test is hereinafter referred to as the "CH" lead release test.

2.561 Normal Disconnect

This test applies the release condition which will probably be encountered most often under actual service conditions, namely that of calling party disconnect. It is applied if the keys, such as the DTR key, etc, controlling other release conditions, are all normal. In the normal disconnect test, a release test current is applied to the trunk supervisory A relay, which then releases and allows the trunk D and (for bylink trunks) B relay to release. The time required for these relays to release is accurately measured by the test circuit and if found to be too long a test failure results. This test is necessary to guard against a false charge condition by which the trunk may be resealed after an abandoned call by a new call. A defective trunk would permit reseizure and the new call would be completed to the number requested by the abandoned call.

A check is then made for the recording of the disconnect entry. After this the "CH" lead release test is made before advancing to the next test stage.

When testing trunks from PBX with the PMR-POT key in the PMR position, a test is made of the trunk circuit message register operate path. The test circuit checks that a resistance battery pulse is applied to the message register at the proper time and that no other long pulses follow it that may cause a double scoring. The same test is applicable to trunk circuits arranged for flat rate service.

When testing special toll coin or dial zero TSP trunk circuits the trunk D relay minimum release time and trunk D2 minimum release time is checked during the normal disconnect test. On completion of this test the test circuit is advanced to the END test function, bypassing the DST test function.

2.562 Disconnect Timed Release Test (DTR)

This test is selected under control of the DTR key. Calling party supervision to the trunk is maintained but an on-hook signal is given from the called party end of the trunk. A check is made that the trunk releases and that the timing entry is placed on the tape. The wink-off feature of the 3W and 3WS trunks is also checked for releasing the test circuit "originating end." The "CH" lead release test then follows.

2.563 False Disconnect Timed Release Test (FDTR)

The purpose of this test made with the FDTR key operated is to check that a false timed release disconnect entry is not made for any calls. Should a false entry occur, the round-off allowance used for calls made by this trunk would be too liberal, resulting in undercharges. In this test, called party disconnect supervision, of less duration than the minimum required to initiate the disconnect timed release condition, is applied and then removed by the test circuit. The test circuit then waits an interval longer than the longest interval for which the disconnect time release function should occur. Blockage occurs if a disconnect entry is applied to the tape. Otherwise, at the end of this long interval, a normal disconnect test, followed by the "CH" lead release test, occurs.

This test cannot be made on incoming trunks from PBX when POT-PMR key is operated to either the POT or PMR position (operator or message register class). When this key is normal (CAMA class) the trunk functions as a DP-CAMA trunk, in this case this test may be performed.

2.564 False Overtime Test (FOT)

The CAMA trunk attempts to place a disconnect entry on the tape at the close of conversation, as indicated by on-hook supervision from either the called or calling party. If the recorder is not available the trunk cancels its request for a recorder after two to five seconds. No disconnect entry is placed on the tape in this case. This feature is used to prevent the subscriber from being charged falsely for overtime, arising from an unusual delay in reaching the recorder. An automatic test of this feature is provided and is referred to as the false overtime test. Since this test will probably be made less frequently than other tests, simultaneous operation of two nonlocking keys, the FOT and FOT1, is required to initiate this test. This provides a safeguard against making the test unintentionally. When this test is being made, a test call proceeds as for other test calls, up to the point in the sequence at which the disconnect entry is to be placed on the tape. At this time, the recorder is made unavailable by opening the "CH" leads to all trunks in a recorder at a common point. This lead is then held open for a timed interval longer than that required for the trunk to remove the request for the recorder. The recorder is then again made available to all trunks served by it. The test circuit checks for a timing entry for the trunk under test to be placed on the tape. If one is not received the

test proceeds. Should one be received the test circuit alarms. Again, the "CH" lead release test is made before the advance to the next test sequence occurs.

This test cannot be made on incoming trunks from PBX when POT-PMR key is operated to either the POT or PMR position (operator or message register class). When this key is normal (CAMA class) the trunk functions as a DP-CAMA trunk, in this case this tests may be performed.

2.565 Special Disconnect Test - TSP Trunk Circuits

2.5651 Cancel Timing Test

The ability of the trunk to initiate a cancel timing entry is checked during the disconnect test when the special test key SM is operated to the SMB position. The cancel timing entry is a distinctive entry which on service calls denotes that the preceding initial and answer entries should be disregarded.

To test the cancel timing feature of special toll coin trunks the CTM key must be operated with the SM key in the SMB position. The test will be made after the calling end recall test is made. The called end recall test will be bypassed. At the start of the disconnect test the trunk is signaled from the TTP to initiate the cancel timing entry and the test circuit checks by means of leads directly to the recorder that the entry has been successfully entered. On completion, the trunk transmits a cancel timing check to the TTP indicating that it has completed its functions and the test circuit advance to the following test.

NOTE: The CTM key must be normal with the SM key in the SMB position to make the called end recall test.

2.5652 Ring Forward Test for Dial Zero Trunks

Following completion of the cancel timing test, the ring forward feature of the dial zero trunk is checked when the special test key SM is operated to the SMB position. The trunk is signaled from the TTP to apply the ringing signal forward which is a pulse of +130 volts on the tip and ring leads. The test circuit checks that the ringing

signal has been applied by observing the tip and ring leads through the return test line and operating a check relay. When the check relay has operated the test circuit is advanced to the next test in the sequence.

2.5653 Release Forward Test

When the special test key SM is operated to the SMA position the release forward feature of the trunk is checked. The release forward signal is given to the trunk from the TTP and the test circuit checks that the trunk removes the ground which holds the trunk link and office link hold magnets by releasing its D and D- relays. When check relays in the test circuit have indicated proper trunk operation the test circuit is advanced to the next test.

2.5654 Sender Request Test for Special Toll Trunks

Following completion of the release forward test with the special test key SM operated to the SMA position the sender request test is made on special toll trunks. This test checks the ability of the trunk to connect to a sender when signaled from the simulated position. When the sender request signal has been passed to the trunk and the sender is attached the trunk transmits a sender attached signal to the TTP. Registration of the sender attached signal marks the successful completion of this test permitting the test circuit to advance to the next test and causing the release of the sender and TTP.

2.57 "CH" Lead Release Test

In order to make the false overtime test, the "CH" leads to all trunks served by a recorder are interrupted at a common place in the recorder. To do this, two leads are transferred from the recorder to the trunk test circuit during the time that the two circuits are connected together. Continuity of this lead is preserved by the test circuit, except during certain critical times only while making the false overtime test itself. To check that continuity of this lead is preserved in the recorder after release from the test circuit occurs, the release takes place by a two step operation. During the first step, the "CH" leads are restored and a test made that continuity has been reestablished in the recorder circuit itself. The final step in the release

process is then completed. If after the first step of the release operation, the "CH" lead is found open, a major alarm is sounded.

This test is also initiated when the CA key is operated and when the test circuit blocks and sounds a minor alarm for other trunk trouble conditions. This is done to insure that the "CH" lead will not be held open for a long period of time due to trouble in the trunk test circuit itself or some other unusual combination of troubles.

2.58 D and D2 Relay Release Time (DST)

2.581 D Relay Shunt Test

The D relay in the CAMA trunk is slow release (a characteristic in some trunks obtained by using an external shunt resistor) so a check is made by the test circuit of the minimum release time of the D relay. A time comparison is made against a pulse generated by a condenser timed polar relay. The test will fail if the D relay releases too fast. If the timing is satisfactory, however, the test circuit advanced to the END test function after receiving a further signal that the D2 relay, a slow release relay in the trunk, has also released within a reasonable time.

When testing special toll coin or dial zero TSP trunk circuits this test is made during the normal disconnect test, therefore the test circuit is advanced to the END test function after completion of the normal disconnect test.

2.582 D2M Test (D2M)

If the D2M key is thrown, the above test is not made. Instead, a test of the minimum release time of the D2 relay is made. Here, a time comparison is made against a pulse of a condenser timed relay.

When testing special toll coin or dial zero TSP trunk circuits the D2 relay minimum release time test is made during the disconnect test regardless of the position of the D2M key.

2.59 Tone Detector

The tone detector which recognizes reorder tone during the AOD test uses a normally operated TN relay. Reorder tone is amplified, rectified, and applied to the grid of the TN electron tube to cut-off the tube and release the TN relay as an indication of tone received.

2.6 Signaling Circuits

2.61 PCI Pulse Generation

For testing trunks requiring PCI senders, the pulse generator arranged for PCI pulsing rate is connected to provide the test code or the called number for setting up the tandem connection. The PG relay is set on its back contact prior to the pulsing function and when the SP relay is operated to start pulsing the PG relay operated at the rate controlled by the condenser timed network associated with its windings and contacts.

Relay PG pulsing causes the PG1, PG2, and PG3 relays to operate in a repeated four quadrant cycle to provide the basic PCI code pattern. Conditions applied to the loop include light or heavy negative (with respect to the ring lead) potentials during the even quadrants and blank or light positive potentials during the odd quadrants. A different four quadrant cycle is assigned for each digit numerical value, and the appropriate codes are applied for the digits in turn as they are transmitted.

2.62 Dial Pulse Generation

For testing trunks requiring DP senders the pulse generator, arranged for DP pulsing rate, is connected to provide the test code or the called number for setting up the tandem connection. Prior to the pulsing function relay PG is set on its back contact and PG follower relay P is set initially on its front contact. When the SPG relay is operated to start pulsing relay P releases and thereafter follows relay PG alternately operating and releasing. Relay P forms a series of pulses at the rate controlled by the condenser timed network associated with relay PG windings.

A relay pulse counter permits a number to be dialed which corresponds to the connection or setting on the called number switches. Interdigital timing is provided as is control of the pulsing and closure of the loop.

2.63 MF Pulse Generation

For testing trunks requiring MF senders the pulse generator, arranged for MF pulsing rate, is connected to provide the test code or the called number for setting up the tandem connection. Prior to the pulsing function relay PG is set on its back contact and PG follower relay P is set initially on its front contact. When the SPG relay is operated to start

pulsing relay P releases and thereafter follows relay PG alternately operating and releasing. Each time relay P releases an MF pulse is generated in the form of a combination of two different alternating current frequencies. The rate of pulsing is controlled by the condenser timed network associated with relay PG windings.

The MF pulse generator is also used to generate and transmit the MF keypulse and X digit pulse when testing trunks arranged for automatic number identification.

2.64 Pulsing Sequence and Test Counter

The NA-MFF relay sequence chain (formerly O-10') is used as a steering circuit for outpulsing and as a test counter. Application of ground to the advance lead operates the first sequence relay, which locks independently. The next application of advance ground operates the next succeeding sequence relay. Removal of ground releases the preceding relay, etc.

For outpulsing the test code a total of 7 (MF) or (DP) or 8 (PCI) digits is pulsed, the counter being delayed after the C or TH digit and resuming after the return test line is attached.

For outpulsing the called number on a call through test 7- or 8-digits are pulsed without delay, 7-digits being provided for MF or DP calls with no stations digit and 8-digits being provided for calls with a stations digit, and for PCI calls. For a call through test with NAT CODE key operated (MF or DP calls) 3-digits are added making a total of 10-digits pulsed without delay. The stations digit switch is set at "1" for calls to numbers over 10,000.

For outpulsing the X digit of the calling number on ANI test calls, an extra steering relay XD is introduced in the pulsing sequence chain to control MF pulsing of the X digit. The outpulsing of the X digit, following the outpulsing of the called number, is delayed awaiting the reception of the start identification signal from the sender. On reception of the start identification signal by the trunk, the test circuit proceeds to reactivate the sequence circuit to outpulse the X digit information.

Tests of the trunk CS and D relays and of the disconnect function employ the condenser timed PG relay and portions of the sequence chain to provide test timing intervals.

2.7 Timing and Alarm

2.71 Busy Timing

After the ST key is operated or after the previous test and prior to the final seizure of the trunk for test, the timing counter is associated with the BY interrupter in order to time the period during which the test circuit action is suspended while the trunk selected for test or the associated reserve is busy. After approximately five minutes the time alarm will be sounded to indicate that the busy condition has lasted that long. Termination of the busy condition at any time will lead to final seizure of the trunk for test, canceling the busy timing and, if sounded, the time alarm.

2.72 Test Timing

When final seizure of the trunk for test has been made the test timing is started. An interval is timed which is long enough to permit an entire test of a trunk to be completed satisfactorily. Failure of any test function blocks the normal progress of the test, stopping the test sequence at the point trouble is encountered, and permitting the test timer to time-out to bring in the time alarm.

The length of the time-out period is predetermined by the test sequence pattern. The timing counter is associated with the TT1 interrupter to provide a 42 to 49 second test interval under control of the NML test sequence pattern, or under control of the ABR test sequence pattern during a false overtime test. The timing counter is associated with the TT2 interrupter to provide a 150 to 170 second test interval under control of the ABR test sequence pattern.

Successful completion of the test will cancel the test timing and permit busy timing to start for the next trunk. The test timing will be stopped during the transmission test, the call through test,

or the trouble indicator display test as these tests are under manual control once they are set up. The test timing will also be stopped during timing tests of the special toll coin TSP trunk.

2.73 Major and Minor Alarms

A time alarm condition is indicated by lighting the TA lamp and extending minor alarm signals to the floor alarm frame, fuse, and time alarm circuit. Operation of the ACO key will cut off the audible minor alarm, and operation of the TA key will cancel all minor alarm indications but will permit the CA function only if the REP key is operated. The time alarm starts the "CH" lead release test.

A major alarm condition, initiated by a failure of the "CH" lead release test, is indicated by flashing the TA lamp under control of the DT interrupter and extending a major alarm signal to the floor alarm frame, fuse, and time alarm circuit. A "CH" lead release test failure indicates that the charging lead of the recorder associated with the trunk under test is open and consequently no timing entries may be made for any trunk associated with that recorder. The major alarm may be canceled by operation of the CA key with the REP key operated, or by operation of the RN key.

3. SPECIAL FEATURES

3.1 Semiautomatic Tests

3.11 Transmission Test (XM)

To provide access to the trunks for transmission test purposes jacks are provided on the key and lamp panel into which a portable transmission test set may be plugged. Insertion of the test set plugs into the R and S transmission test jacks enables the ABR test pattern relay, and when the ST key is operated the trunk is connected and the test sequence, as given in 2.21 through 2.44, sets up a connection of the trunk to the return test line. The XM test function is then connected, and the transmission test jacks are connected to provide a test path from the R jack through the trunk, the trunk link and office link, and the return test line to the S jack. Upon completion of the transmission test by the portable transmission test set the CA key is operated to release the trunk.

3.12 Call Through Test (CTT)

The CTT key is operated to set up the call through test in which a call is made through the trunk to a distant point. The called number switches are preset to the desired number, the office code and line numerical switches being used when the CTT key is operated and the national code switches being used in addition when the NAT CODE key is also operated.

Operation of the "ST" key leads to the trunk connection as given in 2.11 and 2.21, and to the operation of the CTP pattern relay. An A relay operate test is made as a means of initiating the test call, and a connection is made to the sender. Connection of the PLA test function starts the pulse generator according to the pulsing type determined when the trunk was connected for test. Settings of the called number switches provide the number which leads to the connection of the trunk through the tandem office links to the distant point. All digits are pulsed out without interruption including the X digit on ANI test calls. On the call through test, the test indication from the trunk to the sender, a ground on the "SPI" lead is omitted. As a result the call goes through as a regular service call, with a position being called in by the sender and with normal sender timing in effect. Upon completion of pulsing the test sequence is advanced to the CTT test function which cuts in the TEL circuit to permit conversation with the operator and the distant party. It is necessary that a "calling number" be passed to the tandem AMA operator which will be acceptable to the transverter and billing indexer. The office code given must be one of ten assigned to the associated recorder group. When the call is completed the CA key is operated to release the trunk.

3.13 Display Trouble Indication Function (DTI)

Cross-connections are provided in the sender link and controller circuit which provide routing and charging information to the sender when a trunk is being connected to the sender. A given set of cross-connections is associated with a decade of trunks, and gives the same information for each of the 10 trunks in the decade. The trunks have been assigned as a decade because they require identical routing and charging identities. When a reserve trunk

is being connected to the sender the same information is provided from cross-connections in the trunk test circuit instead of in the sender link.

The routing and charging information, which includes recorder number, rate class, and class-of-service is extended to the transverter by the sender and is there used in preparing the initial entry. If the transverter encounters trouble it makes a bid for the transverter trouble indicator or the trouble recorder and indicates on a lamp panel or on the trouble record card the information pertaining to the call which blocked, including the routing and charging information mentioned above.

In order to check the routing and charging information, test calls are originated by the trunk test circuit with the DTI key operated to display a trouble indication. Operation of the ST key with the DTI key pre-operated will set up a connection to the trunk and start a test call in the normal manner. Ground on the "DTI" lead to the transverter will cause a simulated trouble at the transverter and result in a display on the trouble indicator. The test circuit will block in the initial entry test as a result of the transverter trouble. The desired information information appears on lighted lamps on the panel of the transverter trouble indicator. Operation of the CA key or the TRT jack at the transverter trouble indicator frame will advance the test connector to the next trunk for a trouble indication display of its routing and charging information.

The routing and charging information supplied from the trunk test frame for a reserve trunk may be checked as given above by placing a DTI test call through the reserve trunk. The information provided for a given reserve trunk on a DTI condition depends on the setting of the "decade select" switch to select an identity associated with a particular decade of trunks that the reserve trunk serves. See 3.22 and 3.23.

The cross-connection for decades of service trunks appear in duplicate at the sender link and controller frame, once each for the A and B set of cross-connections on a given call and is entirely under control of the sender link and controller.

3.14 Message Register Manual Test - MRM - Incoming Trunk From PBX, MRM, and CTT Keys Operated

Each incoming trunk from PBX is associated with a message register which records all single unit charge calls placed over the trunk. Access to the trunk for purposes of making message register operate and nonoperate current flow tests, multiple operation tests, and call through single operation tests is provided by means of this circuit. Tests are made from the message register rack where two jacks, MRT and MRM, are provided for a Dial Handset and Line Message Register Test Set (SD-25190-01). To make these tests the test circuit MRM and CTT keys are operated and the test circuit is set up to the trunk associated with the message register to be tested. When the trunk circuit is seized the trunk "MR" lead and incoming "T" and "R" leads are connected, by a relay in the test circuit, to the MRM and MRT jacks in the miscellaneous circuit for message register rack. The trunk test circuit cannot be used to test other trunks while tests of the message register are being made in the manner described above.

When the trunk has been seized by the test circuit single operation tests of the associated message register are made by plugging a dial handset into the MRT jack of the miscellaneous circuit for message register rack. When the tester receives dial tone, a test call is dialed to a single message unit charge line and the message register is observed for proper operation. Multiple operation or current flow tests are made by plugging the line message register test set into the MRM jack at the miscellaneous circuit for message register rack and initiating the tests in the approved manner.

3.2 Reserve Trunk Supplementary Circuits

Reserve trunks are provided to permit the trunk from the originating office to remain in service while the trunk circuit at the tandem point is being tested. Operation of the RT relay in the trunk by the test circuit transfers the incoming cable pair to the reserve trunk. One reserve trunk serves all the trunks of one pulsing class (PCI or MF) associated with a call

identity indexer and recorder and appears as one trunk of a decade of associated service trunks at the call identity indexer and at the test connector. The reserve trunk appears as one of a decade of reserve trunks at the trunk frame, the sender link and controller frame, and at the trunk link frame.

When a PCI or MF reserve trunk is arranged to replace trunks having the non-supervision option an NS relay may be included in the reserve trunk which, operated, changes the reserve trunk from "supervision" operation to "nonsupervision." The reserve trunk NS relay (when provided) is operated from the test circuit when the trunk under test is a nonsupervision trunk.

The MF reserve trunks arranged to replace trunks from panel offices are equipped with a PAS relay which controls the PAS (panel auxiliary sender) or NPAS (non-panel auxiliary sender) mark to the sender. The relay is operated by the test circuit when testing an MF service trunk from a panel office.

When a reserve trunk is replacing a service trunk the routing and charging information, which originates on cross-connections at the sender link for service trunks, is originated at the trunk test frame for calls through reserve trunks. Control is exercised over reserve trunk start functions to provide the appropriate information at the proper time.

3.21 Reserve Trunk Auxiliary Circuits

Each reserve trunk is provided with auxiliary relays on the trunk test frame to extend the reserve trunk busy condition for busy test and for trunk RT relay locking, and to provide control of the start signals from each of the reserve trunks to permit only one at a time to transmit its identification.

A relay BY1 is provided on the sleeve lead of the reserve trunk to indicate when the sleeve is grounded, and a relay BY is provided which responds to the reserve trunk ST signal. The ST signals from reserve trunks are sent to the reserve trunk auxiliary relays which retransmit the signal to the sender link and controller circuit. The BY relay operated in response to a ST

signal from the associated reserve operates the BA relay if no other reserve trunk is in the process of being set up to a sender by the sender link and controller circuit. Relay BA operated extends the ST signal to the appropriate sender link and controller, grounds leads in preparation for extending the associated recorder number, type of originating office, and grounds a lead which is passed through the associated trunk RT relay operated to identify the decade of that trunk, through a cross-connection field to a winding of a DI relay.

If a ST ground is received from another reserve trunk by its reserve trunk auxiliary circuit during the sender link controller operating time as described in 3.22, the second ST ground will be "locked out" of the sender link until the previous ST ground has been processed and the previous BA relay has been released. When a number of such additional requests are received simultaneously the auxiliary circuits of lower number than the previous auxiliary circuit will be served in descending numerical order until the lowest numbered circuit, when the highest numbered circuit with ST signal waiting has been served, then the highest numbered circuit with ST signal waiting is served, after which the remaining requests will be served in descending order.

If a condition appears in which an attempt has been made by the sender link and controller to attach a sender to the trunk and the "S" lead is subsequently either not grounded because a sender was not available or because of trunk trouble conditions, the ST ground to the sender link and controller will remain as a permanent signal until the controller times out. Upon controller time-out the HA or HB relay is released prior to removal of the ST ground. The release of the HX and HX1 relays, which follows at this time, leads to the operation of the BY1 relay on its secondary winding. The BY1 operated opens the "ST" lead; and locks to the ST ground from the reserve trunk and to battery from contacts on the LOT2 and LOT3 relays. With the permanent ST ground thus opened any other lower numbered circuits requesting ST are served. When the lowest numbered circuit with ST signal waiting has been served, the LOT- relays function to recycle the lock-out, permitting the highest numbered circuit with ST signal waiting to be served and releasing all BY1 relays locked to the ST

ground and LOT battery, permitting all ST grounds to enter the lock out as new requests.

3.22 Reserve Trunk Identification

Each decade of service trunks has a rate class and class-of-service identification provided for it at the sender link and controller. The same identification is provided for the reserve trunk when substituting for a trunk of the decade. Operation of a particular DIO-9 relay grounds "two-out-of-seven" leads to give a class service indication, the class number corresponding to the relay number. The DI relays are triple wound and each operate path is extended to contacts on the DI relay to ground "one-out-of-three" leads to give a rate class indication, the rate class number corresponding to the winding number.

When the sender link and controller receives the reserve trunk ST signal under control of the BA relay it assigns one of two controllers to prepare the connection to the sender. When the sender link HA or HB relay serving a decade of reserve trunks is operated, (the action which originates the routing and charging information when serving service trunks) corresponding connector HX and HX1 relays are operated to connect the rate class, class of service, and recorder number leads to the sender link and controller circuit from which they are extended further to the sender and transverter. The MF reserve trunks transmit an additional panel or nonpanel mark to the sender.

The sender link and controller selects a sender and sets up a connection between the sender and the reserve trunk. The sender operates the trunk T relay which grounds the "S" lead to operate the BY1 relay on its primary winding. Relay BY1 operated removes the ST ground from the sender link and controller and the HA or HB relay is released releasing the HX and HX1 relays to open the grounded information leads and release the operated BA relay.

3.23 Test of Reserve Trunk

A reserve trunk of itself has no routing or charging identity except recorder number. When testing, a reserve trunk identification lead through the reserve trunk RT relay is extended to operate the DIR relay to indicate a reserve under test and to provide the identification for the reserve trunk. If neither the call through test or display trouble indication call is being made, the RTI relay is normal which extends the identification lead to the DIR

terminal which is cross-connected to provide an arbitrary identification for all reserve trunks when being tested.

The identity of a particular decade associated with a reserve trunk may be preselected when either a call through test call or a display trouble indication call is being made. The identification lead is extended to operate the associated DC relay which connects the decade identity switch to the ten associated decade identification leads. The setting of the switch determines the decade lead which will be grounded through the cross-connection field to operate a DI relay.

When a given reserve trunk can function as more than one trunk option (for example, supervision and nonsupervision) it will have the functions tested as indicated by position of RS, RAN, or PAS key. The RS key operated will test the reserve trunk for non-ANI supervision features. The RAN key operated will test the reserve trunk for ANI supervision features. The PAS key operated will transmit a PAS indication to the sender and the test circuit will simulate panel operation.

3.24 Reserve Trunk Substitution (RTS or THB)

If it is desired, a reserve trunk may be substituted for a service trunk and the substitution condition may be maintained indefinitely under manual control.

Substitution can be made for any particular trunk by setting the number of the trunk on group, hold, and select switches and operating the ST key. Connection will be made to the trunk in the normal manner and a test will be made on the trunk. When the trunk RT relay is operated to make the final seizure of the trunk for test the RTO lamp is lighted. Reserve trunk substitution is locked in by operating at this time the associated RTS or THB key adjacent to the lighted group lamp. One key per group is provided to lock the associated reserve trunk to any trunk in the group. Operation of the correct RTS or THB key will extinguish the RTO lamp. The test of the replaced trunk may be terminated in any normal manner, while the RT relay will remain locked to the RTS or THB key to keep the reserve trunk circuit on the incoming trunk conductors while the service trunk circuit remains out-of-service. Once the test circuit is advanced to leave a trunk replaced by its reserve trunk no indication remains to identify the

particular trunk that is replaced. The substitution may be terminated at any time by releasing the RTS or THB key.

When a reserve trunk is locked in as a substitute it appears permanently busy to the busy test function when attempting to test other service trunks associated with the same CII or test connector even though it does not require the reserve trunk for replacement. To permit testing on an automatic basis a substitution pass busy arrangement is provided which passes as busy any trunk associated with a reserve trunk serving as a substitute.

To retest a trunk before releasing the substitution the PRT key is operated prior to the operation of the ST key when the particular circuit is set up on the group, select, and hold switches. The trunk is connected in the normal manner and the substitution pass busy is canceled. The final seizure for trunk test occurs as indicated by the RTA lamp lighted, and the test is made. If the particular replaced trunk in the group is unknown the "O" hold, and "O" select, and appropriate group settings are made on the switches and the PRT key is operated prior to the operation of the ST key to permit the connecting functions to scan all trunks in the group to locate the replaced trunk and test it. Upon operation of the ST key the connector and control operate as normally under control of the PRT key, advancing in succession over all the trunks in the group as a result of the substitution pass busy function until the particular trunk that is replaced is encountered on the connector. At that time the substitution pass busy is canceled, the final seizure for trunk test occurs as indicated by the RTA lamp lighted and the test is made.

3.3 Trunk Hold Busy (THB)

If it is desired, the "make-busy" condition can be applied to the incoming trunk conditions, and it can be "held-busy" indefinitely under manual control. Testing may be continued on any trunks whose associated make-busy circuit is not holding-busy a service trunk.

Trunk hold-busy can be applied to any particular trunk by setting the number of the trunk on group, hold, and select switches and operating the ST key. Connection will be made to the trunk in the normal manner and a test will be made of the trunk. When

the trunk RT relay is operated to make the final seizure of the trunk for test the RTO lamp is lighted. Trunk hold-busy is locked in by operating at this time the associated THB key adjacent to the lighted "group" lamp. One key per group is provided to lock the hold-busy condition on any trunk in the group. Operation of the correct THB key will extinguish the RTO lamp. The test of the hold-busy trunk may be terminated in any normal manner while the RT relay will remain locked to the THB key to keep the hold-busy condition on the incoming trunk conductors while the service trunk circuit remains out-of-service. Once the test circuit is advanced to leave a trunk held busy no indication remains to identify that particular trunk.

When a make-busy circuit is holding a trunk busy under THB key control it appears as a "busy reserve trunk" to the busy test function when attempting to test other service trunks associated with the make-busy circuit. To permit testing on an automatic basis a substitution pass busy arrangement is provided which passes as busy any trunk associated with a make-busy circuit holding-busy.

To retest a trunk before releasing the hold-busy condition the PRT key is operated prior to the operation of the ST key when the particular circuit is set up on the group, select, and hold switches. The trunk is connected in the normal manner and the substitution pass busy is canceled. The final seizure for trunk test occurs as indicated by the RTA lamp lighted, and the test is made. If the particular trunk held-busy in the group is unknown the "O" hold, and "O" select, and appropriate group settings are made on the switches and the PRT key is operated prior to the operation of the ST key to permit the connecting functions to scan all trunks in the group to locate the trunk held busy and test it. Upon operation of the ST key the connector and control operate as normally under control of the PRT key, advancing in succession over all the trunks in the group as a result of the substitution pass busy function until the particular trunk that is replaced is encountered on the connector. At that time the substitution pass busy is canceled, the final seizure for trunk test occurs as indicated by the RTA lamp lighted and the test is made.

SECTION II - DETAILED DESCRIPTION1. TRUNK CONNECTION FUNCTIONS1.1 Connector and Connector Control1.11 Test Class Identification - OS24

On Issue 4D the test connector Fig. 2 was replaced by Fig. 33 and additional connector figures were added including Figs. 37, 38, 39, and 43.

On Issue 11D, the test connector Fig. 33, was modified and additional connector Figs. 37, 38, 39, and 43 were replaced by Fig. 44, Fig. 49, and Fig. 154.

1.111 Fig. 2 Connector (A&M Only)

If Fig. 2 is provided the pulsing class (PCI) is identified by strapping on

the hold magnet off-normal springs. The "GG" (crosspoint ground) punchings may be cross-connected as follows:

"VT" punching - vacant crosspoint
"RC" punching - occupied crosspoint

Test leads through the RC relay connect only PCI trunks not having the "nonsupervision" option.

1.112 Fig. 33 Connector (A&M Only)

If Figs. 33 (Options "B" and "F"), 37, 38, 39, and 43 are provided, the pulsing class (PCI or DP) is identified by the "PC" punching cross-connected to "CI" or "DP" punching. The "CG" punchings may be cross-connected as shown below. Tests leads through the RC, RCD, VA, and VB relays connect trunks listed below:

<u>Test Class Variation</u>	<u>Connect Punching</u>	<u>PCI Trunks</u>	<u>DP Trunks</u>
(vacant crosspoint)	VT	-	-
None	RC	Returning supervision (SUP)	Bylink without loop resistors (BL) - with or without E&M lead signaling
A	VA (serv trk) VAR (rsv trk)	Nonsupervision (NS)	Wink start from sender (WS) or delay dial E&M lead signaling
B	VB	-	Bylink with loop resistors (BL)
C	3WS	-	Bylink from code selector multiple in same building

The test class (3W) indication for testing DP bylink trunk from SXS offices in the same building is obtained from the trunk during the AOD test (2.22).

If RC punching is grounded on crosspoint closure the RC relay is operated directly. If VA or VB punching is grounded the corresponding test class VA or VB relay is operated to connect test leads to the trunk, and to operate the corresponding VAA or VBA relay to set up the appropriate test conditions. Relays VA or VB operated operate the associated RC relay. Relay RCD operates in parallel with the associated RC relay. When a reserve trunk is tested grounding a VAR punching the VA or RC relay is operated depending on the setting of the VAR key operating the VARC relay. If

the 3WS punching is grounded, the RC relay is operated by ground from an off-normal spring of the connector switch hold magnet. In the following paragraphs (1.121 to 1.134) reference to the RC relay operating or releasing is considered to include, when appropriate, the relays functioning as described above.

1.113 Fig. 33 Connector (Modified) - OS24

If Figs. 33 ("A" option), 44, and 40, are provided, the pulsing class (MF, DP, AMF, or ADP) is identified by the "PC" punching cross-connected to "MF", "DP", "CI", "ADP", or "AMF" punching. The "CG" punchings may be cross-connected as shown in the table which follows. Test leads through RC and ECA relays connect trunks listed in the table:

<u>Connect "CG" to Punching</u>	<u>Trunk SD Number</u>	<u>Connect PC- to Punching</u>	<u>Trunk Use</u>
ACI	25956-01	CI	ANI Service Trunks or Reserve Trunks that serve them only
NAS	25956-01	CI	Non-ANI Service Trunks with ANI Supervision or Reserve Trunks that serve them only
NS	25956-01	CI	Nonsupervision Service Trunks or Reserve Trunks that serve them only
RAN	25956-01	CI	Reserve ANI Trunks Serving ANI Trunks or Non-ANI Trunks with ANI Supervision
RNA	25956-01	CI	Reserve ANI Trunks serving ANI Trunks, or Non-ANI Trunks with No Supervision or Non-ANI Trunks with Supervision
NS	25956-01	CI	Reserve Non-ANI Trunks Serving Non-ANI Trunks with ANI Supervision or without Supervision
RPN	25956-01	CI	Reserve Trunks Serving Non-ANI Trunks with or without Supervision
SUP	25956-01	CI	Service Trunks with Supervision or Reserve Trunks that serve them only
2W3	27010-01 27014-01 27010-01	DP (Non-ANI) ADP (ANI)	2- or 3- Wire Bylink Service Trunks without Loop Compensation
2WC	27010-01	DP (Non-ANI) ADP (ANI)	
3WS	27064-01	DP	Bylink Trunk from Code Selector Multiple in Same Building
AD3	27010-01	DP	Non-ANI Bylink Service Trunks from SXS with ANI Supervision and without Loop Compensation
ADC	27010-01	DP	Non-ANI Bylink Service Trunks from SXS with ANI Supervision and with Loop Compensation
BEM	27036-01	DP (Non-ANI) ADP (ANI)	Bylink E&M Lead Signaling Service Trunks from SXS Offices
MEM	27036-01 27044-01	DP	
WS	27015-01	DP	Wink Start Service Trunks from No. 5 Crossbar Offices
WS	27061-01	DP	Wink Start Service Trunks from No. 5 Crossbar Offices
GLD	27079-01	DP (Non-ANI) or ADP (ANI)	Special Toll ANI or Non-ANI Bylink dial Pulsing Noncoin Trunks with Loop Signaling from SXS Offices
EMD	27081-01	DP (Non-ANI) or ADP (ANI)	
PXL	27067-01	DP	Non-ANI DP from PBX
WAT	27067-01	DP	Non-ANI DP from PBX Used for Wide Area Telephone Service
WS	27015-01	MF	Wink Start Service Trunks from No. 1 and No. 5 Crossbar Offices



<u>Connect "CG" to Punching</u>	<u>Trunk SD Number</u>	<u>Connect PC- to Punching</u>	<u>Trunk Use</u>
WS	27015-01	MF	Reserve Trunk Wink Start for No. 1 Crossbar Offices Only
MEM	27044-01	MF (Non-ANI) AMF (ANI)	Wink Start E&M Lead Signaling Service ANI or Non-ANI Trunks from No. 5 Crossbar Offices
MEM	27044-01	AMF (ANI)	Wink Start E&M Lead Signaling ANI Trunks from No. 1 ESS Offices
PMS	27015-01	MF	Supervision Service Trunks from Panel Offices and Reserve Trunks that serve them only
PMN	27015-01	MF	Nonsupervision Service Trunks from Panel Offices and Reserve Trunks that serve them only
PMN	27061-01	MF	Nonsupervision Service Trunks from Panel Offices and Reserve Trunks that serve them only
RMS	27015-01	MF	Reserve Trunks for No. 1 Crossbar and Panel Supervision Trunks
RMN	27015-01	MF	Reserve Trunks for Panel Nonsupervision and Supervision Trunks, and Trunks from No. 1 Crossbar Offices
ALP	27061-01	AMF (ANI)	ANI Service Trunks from ANI No. 1 Crossbar or Panel Offices
VT	-		No Trunks Assigned
WS	27061-01	AMF (ANI)	ANI Service Trunks from ANI No. 5 Crossbar Offices or No. 1 ESS Offices
PMAS	27061-01	MF	Non-ANI Service Trunks from Panel with ANI Supervision or Reserve Trunks that serve them only
15AS	27061-01	MF	Non-ANI Service Trunks from No. 1 Crossbar Offices and Reserve Trunks which serve them only and Trunks from Non-ANI No. 5 Crossbar Offices with ANI Supervision
RIPN	27061-01	MF	Non-ANI Reserve Trunks for No. 1 Crossbar or Panel Trunks with No Supervision
RIPS	27061-01	MF	Non-ANI Reserve Trunks for No. 1 Crossbar or Panel Trunks with ANI Supervision
ZL1	27080-01	MF (Non-ANI) or AMF (ANI)	Dial Zero ANI or Non-ANI Trunks with Loop Signaling from No. 1 Crossbar or Panel Offices
ZL5	27080-01	MF (Non-ANI) or AMF (ANI)	Dial Zero ANI or Non-ANI Trunks with Loop Signaling from No. 5 Crossbar or SXS Offices
ESZN	27080-01	AMF (ANI)	Dial Zero ANI Trunks with Loop Signaling from No. 1 ESS
ZEM	27082-01	MF (Non-ANI) or AMF (ANI)	Dial Zero ANI or Non-ANI Trunks with E&M Signaling from No. 5 Crossbar Offices
LM1	27083-01	MF (Non-ANI) or AMF (ANI)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunks with Loop Signaling from No. 1 Crossbar Offices
LMP	27083-01	MF (Non-ANI) or AMF (ANI)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunks with Loop Signaling from Panel Offices
LM5	27083-01	MF (Non-ANI)	Special Toll ANI or Non-ANI Pulsing Noncoin Trunks with Loop Signaling from No. 5 Crossbar Offices

<u>Connect "CG" to Punching</u>	<u>Trunk SD Number</u>	<u>Connect PC- to Punching</u>	<u>Trunk Use</u>
ESLN	27083-01	AMF (ANI)	Special Toll ANI MF Pulsing Noncoin Trunks with Loop Signaling From No. 1 ESS Offices
EMF	27084-01	MF (Non-ANI) or AMF (ANI)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunks with E&M Signaling from No. 5 Crossbar Offices
CT1	27097-01	MF (Non-ANI) or AMF (ANI)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks with Loop Signaling from No. 1 Crossbar Offices
CTP	27097-01	MF (Non-ANI) or AMF (ANI)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks with Loop Signaling from Panel Offices
CT5	27097-01	MF (Non-ANI) or AMF (ANI)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks with Loop Signaling from No. 5 Crossbar Offices
ECF	27103-01	MF (Non-ANI) or AMF (ANI)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks with E&M Signaling from No. 5 Crossbar Offices
10LP	27092-01	DP (Non-ANI) ADP (ANI)	Dial Pulsing using Bylink to Repeat DP to 10-Digit Register from SXS with or without Common Control-Loop Supervision
10EM	27092-01	DP (Non-ANI) ADP (ANI)	Dial Pulsing using Bylink to Repeat DP to 10-Digit Register from SXS with or without Common Control E&M Supervision
CMLP	27092-01	MF (Non-ANI) AMF (ANI)	MF Pulsing from SXS with Common Control-Loop Supervision
CMEM	27092-01	MF (Non-ANI) AMF (ANI)	MF Pulsing from SXS with Common Control-E&M Supervision
CLP	27104-01	DP (Non-ANI) ADP (ANI)	Dial Pulsing using Bylink Reverse Battery Combined Special Toll and Recording Completing Service for use with TSP No. 100A
CEM	27104-01	DP (Non-ANI) ADP (ANI)	Dial Pulsing using Bylink E&M Supervision Combined Special Toll and Recording Completing Service for use with TSP No. 100A
ESZC	27802-01	AMF (ANI)	Dial Zero ANI Coin Trunk with Loop Signaling From No. 1 ESS
ESLC	27723-01	AMF (ANI)	Special Toll ANI MF Pulsing Coin with Loop Signaling from No. 1 ESS Offices

The test class (3W) indication for testing DP bylink trunks from SXS offices in the same building or from a code selector multiple in the same building is obtained from the trunk during the AOD test (2.22).

When a supervision-type test is desired on an MF or CI reserve trunk arranged to serve both supervision and nonsupervision service trunks, key RS must be operated prior to start of the test. This arranges the respective reserve trunk to function as a supervision-type service trunk. When key RS

is normal the test circuit tests this type reserve trunk for nonsupervision features only.

The ability of the MF reserve trunk to simulate a panel service trunk is checked by preoperating the PAS key.

When an ANI test is desired on a PCI-ANI reserve trunk, arranged to serve both ANI or non-ANI service trunk, the RAN key must be operated prior to the test.

When it is desired to test an ANI trunk from a panel or No. 1 crossbar office which is without originating office facilities, the ORB key (over-ride busy) must be operated. This allows the test to be made on the tandem trunk equipment when the actual line toward the originating end is in trouble.

1.12 Regular Connector Progression (PRT Normal) OS1, 24 Figs. 1, 2, or 33 and 37, 38, 39, 43, or 44 - SC2.1, 2.2, and 3

1.121 Connector Start

The purpose is to establish a connection from the test frame to a group of trunks through a crossbar switch located on the trunk test connector frame. Operation of the ST key extends a ground which operates a particular SO-9 relay according to the setting of the select switch. The S-relay operating lights an S- lamp indicating which S- relay is operated, prepares a path to operate the associated select magnet and operates the SF relay. The SF relay operating grounds a lead to operate a particular HO-9 relay according to the setting of the hold switch, prepares a path for the operation of the associated hold magnet. Operation of the H- relay lights its corresponding H- lamp and operates the HF relay. The HF relay operating operates a G- relay, depending on the setting of the group tens and group units switches, which in turn lights its G- lamp. The G- relay operating grounds a lead to operate the RS relay in the associated connector circuit. The RS relay in operating extends the S- relay ground to operate a select magnet.

The select magnet off-normal contacts now being closed permit the RH relay to operate, which in turn extends the "H" lead to operate the hold magnet closing the crosspoint which extends ground through the CG punching to the appropriate test class punching leading to the operation of the associated trunk class relays or through VT punching to operate relay CA as required (see 1.43). The operated crossbar switch hold magnet extends ground to operate connector relays RC and RCA in parallel to cut-through trunk test leads to the test circuit and also causes operation of the DP, MF, CI, ADP, or AMF relay as required to establish test conditions appropriate to the trunk under test.

The CI relay operated lights lamp PCI, relay DP operated lights lamp DP and causes operation of auxiliary relay DPA and relay MF operated lights lamp MF and causes operation of auxiliary relay MFA. Relays ADP or AMF operate relays and light lamps DP

and MF respectively and the ANI lamp. In addition, on tests of ANI-PCI trunks the CG punching cross-connection operates the ACI relay in turn operating the CI relay and lighting the PCI lamp.

The crosspoint closing formerly extended ground through the CG punching leading to the operation of the RC relay or through the CG to VT punchings cross-connected to operate the CA relay as required (see 1.43). Relay RC operated extends ground from the hold off-normal springs to operate the DP or CI relay as required to establish test conditions appropriate to the trunk under test. The CI relay operated lights the PCI lamp and operated CIA and CIB relays. The DP relay operated lights the DP lamp and operates DPA, DPB, and DPC relays.

The DP, MF, CI, ADP, or AMF relay operated operates the PST relay which prepares the connector control circuit for automatic advance by opening the leads to the group, hold and select switches. Relay PST operated operates the ST relay. The ST relay operated operates ASR relay which provides a locking path for the test sequence relays.

1.122 Group Step

When the test has been completed the CA, CAA, and CAL relays are operated (see 1.4 and 1.5). The operation of the CA and CAL relays closes a path to operate the next G- relay which locks to the HF relay ground. The next G relay operated releases the previously operated RS, select, RH, hold, RC and CI, DP or MF relays and magnets. Release of the CI, DP, or MF relays releases the CA and CAL relays. Release of the CA relay releases the previously operated G relay which operates the next RS relay. The RS relay operated extends a ground to operate in sequence the select, RH, hold, RC, CI, MF, or DP relays and magnets (see 1.121). It will be noted that the connector circuit is advanced group by group with the trunk occupying the same crosspoint on each connector switch.

1.123 Hold Step

When the test has been completed the CA and CAL relays are operated (see 1.4 and 1.5). The operation of the CA, CAA, and CAL relays, with the last G relay operated, operates the HS relay which locks and prepares a path for operating the next H- relay. Relay HS in operating releases the last G-, RS, select and RH relays and magnets. With the operation of the next H- relay the HF, hold, CI, MF, or DP, CA, CAA, and CAL, RC,

HS and H- relays and magnets release. Release of the HS relay opens the locking ground of the previous H- relay and it releases. Release of the previous H- relay extends a ground to operate in sequence the HF, G, RS, select, RH, hold, RC and CI, MF or DP relays and magnets (see 1.121).

1.124 Select Step

When the test has been completed the CA, CAA, and CA1 relays are operated (see 1.4 and 1.5). The operation of the CA, CAA, and CA1 relays with the last G- relay operated, operates the HS relay. Relay HS operating releases the G-, RS, Select, and RH relays and magnets, and with the last H9 relay operated, operates the SS relay. Relay SS operating releases H-, hold, RC, CI, MF or DP, CA and CA1 relays and magnets. The release of the G-, CA, CAA, and CA1 relays releases the HS relay. Released HS and operated SS relays provide a path to operate the next S- relay which releases SF, SS, and the previous S- relays. Release of the previous S- relay extends a ground to operate in sequence the SF, H-, HF, G-, RS, select, RH, hold, RC and CI, MF or DP relays and magnets (see 1.121).

1.125 End of Cycle

When the test is completed the CA, CAA, and CA1 relays operate releasing the H and LCT relays (see 1.4 and 1.5) operating the HS and SS relays. Relays HS and SS operated release in sequence G-, RS, select, RH, H-, HF, hold, RC, MF, CI or DP and CA and CA1 relays and magnets. Release of the HF and CA, CAA, and CA1 relays opens the locking path of the HS relay and it releases. With the last S relay operated EC relay operates and locks to the RN relay normal, lights the EC lamp and opens the locking path for the last S- relay which releases. Release of the S- relay releases SF and SS relays in sequence.

1.126 Return to Normal

At the end of the cycle with the EC relay operated and EC lamp lighted, operation of the RN key operates the RN relay which in turn releases ST, EC, and PST relays. Release of the RN key releases the RN relay leaving the test frame in normal position.

1.13 Particular Recorder Test (PRT Key) OSI - Fig. 1, 2, or 33 - SC3

1.131 Start

The operation of the nonlocking PRT key operates the PRT relay and it locks to the RN relay normal. Operation of the PRT relay lights the PRT lamp. With the PRT

relay operated and selection switches in their desired test position operate the ST key. The ST key operated starts relay operation in sequence S-, SF, H-, HF, G-, RS, select, RH, hold, RC, CI, MF or DP, PST, and ASR relays and magnets (see 1.12). With PRT key operated, PST relay operated locks the operated G- relay.

1.132 Hold Step

When the test has been completed the CA, CAA, and CA1 relays operate (see 1.4 and 1.5). Relays CA and CA1 operated provide a path to operate the next H- relay. H- relay operating releases hold magnet and HF, RC, and CI, MF or DP relays. Release of the CI, MF or DP relay releases CA, CAA, and CA1 and the previous H- relays. When the previous H- relay releases, hold magnet and HF, RC, CI, MF or DP relays operate in sequence.

1.133 Select Step

When the test has been completed the CA, CAA, and CA1 relays operate (see 1.4 and 1.5). The operation of the CA and CA1 relays with the last H relay operated releases the LCT and H relays and extends a path to operate the SS relay. Operation of the SS relay provides a path to operate the next S- relay. The operation of the SS and next S- relay releases SF, H-, HF, RC, CI, DP or MF, RH, CA, and CA1 relays and select and hold magnets. Release of the CA and CA1 relays releases the SS and previous S- relays. Release of the previous S- relay provides the operation in sequence of select, SF, H-, HF, RH, hold, RC and CI, MF, or DP magnets and relays.

1.134 End of Cycle

When the test has been completed the CA, CAA, and CA1 relays operate (see 1.4 and 1.5). The operation of the CA and CA1 relays and the last H9 relay operated releases the LCT and H relays and provides a path to operate the SS relay. The operation of the SS relay operates the EC relay through S9 operated and it lights the EC lamp. The operated SS and EC relays release the S-, SF, H-, HF, G-, RS, RH, RC, and CI, MF or DP relays and select and hold magnets. The release of the CA and CA1 relays releases the SS relay.

1.135 Return to Normal

At the completion of the test with the EC relay operated and the ST key normal, operate the RN key. Relay RN operates which releases the ST, EC, PRT, and PST relays, leaving test frame in normal position.

1.14 Stop and Start

If the test frame is stopped by releasing the ST key while a test call is in progress the test will be completed in the normal way. The CA and CA1 relays operating open the locking path of the ST relay and it releases leaving the connector associated with the trunk under test, as indicated by the group, hold and select lamps that are lighted. Reoperation of the ST key operates ST relay which permits the connector to advance to the next trunk under control of the CA and CA1 relays operated.

1.2 Trunk "Make-Busy"**1.21 Preliminary "Make-Busy" of Loop Dial Bylink Trunks OS 2.1, 2.2, 16, 21 - Figs. 4, 33, 37, 44, 49 - SC4**

To avoid simultaneous seizure of the trunk by both the test circuit and a customer call when testing bylink trunks the crosspoint associated with the trunk, when closed, applies ground to the "RV" lead to the trunk. In the 2W and BEM trunks the ground operates the trunk RV relay if the trunk is idle, applying a reversal on the trunk conductors or "M" lead of the BEM trunk, to make the trunk appear busy at the originating end. In the 3W trunk the ground is applied to the trunk "S" lead to the SXS multiple to make the trunk appear busy. This is possible for these trunks because test circuit ground on the "RV" lead will not interfere with a service call.

A delay is introduced in the operation of the H relay (1.31, 1.32 and 1.33) delaying the busy test to permit a customer call that has started to seize the trunk and establish a busy indication. The delay in the operation of the H relay is measured by the HDA, HDB, and HDF relays counting operations of the HD interrupter. The counting function is so arranged that the same nominal interval (0.63 sec) will be measured if the HD interrupter armature contact is on or approaching either its front or back contact at the starting time. This is possible because the open interval of the HD interrupter contacts is negligibly small.

When the trunk RT relay is operated later, it applies the appropriate busy condition toward the originating end and opens the "RV" lead to permit the trunk circuit to restore to normal in preparation for the start of the test. For the 2W and BEM trunks the reversed potential is applied from the test circuit.

1.22 Make-Busy, Wink Start Trunks OS 2.1, 2.2, 16 Figs. 4, 42, and 44, or 37, 38

When preparing to test MF or DP (WS) trunks originating in No. 5 crossbar offices a busy test is made (1.31 and 1.32) and the trunk RT relay is operated, applying a busy indication in the form of a reversed potential to the trunk conductors. The "T2" and "R2" leads are connected by the RCA (formerly VA) relay operated through the B repeat coil to the windings of the test circuit AT relay which apply reversed potential on circuits prior to Issue 15D. On Issue 15D the "T2" and "R2" leads are connected by the RCA relay to the OBT relay and resistance which, with the BTA relay operated on trunks from No. 5 crossbar offices, applies the reverse potential.

If a customer call is simultaneously connected to the trunk conductors the AT relay will operate to apply reorder tone to the customer. This action is for second dial tone arrangement only on test circuits prior to Issue 15D.

If the trunk is later placed under control of the THB key (see 8.1 and 8.2) and the test circuit advanced, the AT relay and tone source or the OBT relay and resistance will be disconnected from the "T2" and "R2" leads but the reversed potential will be maintained. A line termination is provided on the "T2" and "R2" leads at all times.

1.23 Make-Busy, E&M Lead Signaling Trunks OS2, 21 Figs. 4, 33, 44, and 49 - SC4

When preparing to test E&M lead signaling trunks a busy test is made (1.31 and 1.32) and the trunk RT relay is operated to apply battery to the trunk "M" lead. This "off-hook" supervision makes the trunk appearance busy at the originating office.

If the trunk is later placed under control of the THB key (see 8.1 and 8.2) and the test circuit is advanced, trunk relay RT remains locked under control of key THB maintaining the busy indication at the originating office until the key is restored to normal.

1.24 Make-Busy, Incoming Trunk From PBX OS2, 16 Figs. 4, 44, 157

When preparing to test incoming trunks from PBX a busy test is made (1.31) and, after a 1.8-second minimum delay interval, the trunk RT relay is operated, applying a busy condition in the form of a reversed

potential (off-hook) to the originating PBX. The off-hook polarity is applied to the "R2" and "T2" leads by the test circuit through operated contacts on the BTA and RCA relays, battery on lead "R2" through the OBT resistor and ground on lead "T2" through the winding of the OBT relay.

If a PBX subscriber is simultaneously connected to the trunk conductors at the time the trunk RT relay operates, relay OBT will operate on the tip and ring lead closure in the PBX. Relay OBT operates the PXSS relay which returns reorder tone to the PBX subscriber and operates the PXSl relay. When the PBX subscriber hangs up relay OBT releases, releasing relay PXSS which operates the PXST relay and releases the BTA relay. When relay BTA releases, on-hook polarity (battery on ring and ground on tip) is returned to the originating PBX to permit release of the outgoing trunk. Relay PXST operated starts a 1.8-second minimum timing interval to allow sufficient time for complete release of the outgoing trunk, after which the PXT tube fires and operates the PXT relay which locks to the PXST relay operated and extinguishes the PXT tube. Operation of the PXT relay releases the PXSl relay which releases the PXST and PXT relays in sequence and operates relay BTA. The BTA relay returns off-hook polarity (battery on tip and ground on ring) to the originating PBX to make the trunk busy.

If the trunk is later placed under control of the THB key (see 8.1 and 8.2) and the test circuit advanced, the OBT relay winding and OBT resistor will be disconnected from the "T2" and "R2" leads but the off-hook polarity will be maintained through the Tl and Rl resistors to keep the trunk busy.

1.3 Busy Test

1.31 APB Key Normal OS 2.1, 2.2 - Fig. 4, 157 - SC4, SC34

Operation of the ST key operates the BT and PB relays through the H relay normal. Operation of the BT relay provides a path to check the busy ground indications from the regular trunk and for the reserve trunks. The ST relay operated, operates the BYT relay to start busy test timing and operates the H relay.

Regular trunk being busy will ground the "S" or "A" leads, depending on the condition of the trunk and operate the B or Bl relay. Operation of the B or Bl relay will lock the BT relay, and light the BT lamp.

Reserve trunk being busy will ground the "ST" and "S" lead, operating the BY and BYl relays. Operation of the BY or BYl relays operates the BR relay, locking the BT relay and lighting the BR lamp.

Relays BT and PB are slow release relays and start to release when relay H operates. Relay BT releasing operates the STl relay which in turn operates ST2 and ST3 relays, starting the test. Operation of the ST2 relay with H relay operated will lock the PB relay operated, preventing the operation of the PB register and advance of the connector.

If the BT relay is locked the STl, ST2, ST3 relays remain normal. Operation of the H relay releases the PB relay. With the APB key normal the PB relay will not operate PB register. Busy timing will bring in a time alarm in approximately five minutes unless BT relay is released to operate STl relay to start test.

Release of the BT relay and operated H relay operates the trunk RT relay except when testing incoming trunks from a dial PBX. Relay RT extends its operating ground, operating the LCT relay. Relay LCT operating lights the RTO lamp and transfers the control of the RT relay to the locking path.

When testing incoming trunks from a PBX, release of the BT relay and operated H relay operates the PXST relay. The PXST relay operated starts a timing interval of 1.8-seconds minimum after which the PXT tube fires and operates the PXT relay. This timing interval is provided to insure complete release of relays in the outgoing trunk if the trunk was in the process of releasing on a service call at the time of busy test. When the PXT tube fires it operates the PXT relay which locks to the PXST relay operated and extinguishes the PXT tube. Operation of the PXT relay operates the PXTl relay which causes the release of the PSXT and PXT relays in sequence. Relay PXTl operated operates the RT relay in the trunk which extends its operating ground back to the test circuit to operate the LCT relay. Relay LCT operated lights the RTO lamp and transfers control of the RT relay to the locking path.

When the trunk RT relay operates the operating ground is also extended for non-supervision trunks to operate the reserve trunk NS relay which locks to the "RTL" lead. The NS relay operated sets the reserve trunk into the nonsupervision condition to correspond to the trunk which has been replaced.

1.32 Busy Test of MF Trunks From No. 1
Crossbar and Panel - OS 2.1, 2.2,
SC4.3

1.321 Originating Busy Test - First Stage
OS2, SC4.3

The busy test of the tandem incoming trunk is as previously described through the operation of the trunk RT relay. The RT, with the AIP trunk class relay, causes the LCT, LCTA, and LCTB relays to operate in that order. It also connects the OBT relay to the cable conductors of the trunk. If a low-resistance bridge is present on the conductors indicating that the originating end is busy and the sender has completed registration, the OBT relay operates and, when the LCTB is operated, BT relay operates. The BT releases the trunk RT relay to restore the trunk to service. The LCT and LCTA relays release. The slow release relay PB releases and with the APB key operated the test circuit advances to the next trunk as previously described. With APB key normal LCTA relay closes the TTL interrupter to the P relay and ground to the P relay contact. The TTL interrupter pulses the P relay and the P-counting relays count to the P4 relay which releases the LCTB. The timed interval is 14 to 20 seconds. The LCTB releases starts a new busy test cycle.

1.322 Originating Busy Test - Second Stage
OS2.1, 2.2, SC4.3

If the originating outgoing trunk is not found busy during the initial stage of busy test (before BTA operates) the operation of the LCTA relay and the nonoperation of the OBT relay closes a path to operate the BTA relay. The BTA reverses the cable conductor polarity to make the outgoing trunk busy to the local switching system. It also closes a path to operate the BTB relay but if the OBT relay operates before the BTB its operate path opens. The OBT operates the BT relay which restores the incoming trunk to service by releasing the trunk originating sender but it is too short to be accepted as a "wink start" signal. Subsequent action is as described in the first stage.

1.323 Originating Busy Test - Third Stage
OS2.1, 2.2, SC4.3

If the originating outgoing trunk is not found busy in the two preceding stages as signified by the nonoperation of the OBT

relay the BTB relay operates. The BTB grounds the armature of the HD interrupter which actuates the HDA, HDB, and HDF relays as previously described. When the HDA and HDB relays are operated and the HDF released the BTC relay operates. The delay interval for its operation is 0.5 to 0.7 second. The OBT relay operates in this period and starts the test if the originating outgoing trunk is idle at the time the test circuit gives it off-hook polarity. If the OBT does not operate in the timed interval the operation of the BTC relay operates the BT and the trunk will be passed as busy with the APB key operated or retest will be made in 14 to 20 seconds as described in originating busy test for first stage with the APB key unoperated.

1.324 Originating Busy Test - Control
Advance Fourth Stage - OS2.1, 2.2,
OS12, SC4.4

Once the test is started the OBT relay continues monitoring the originating OGT trunk for a service demand and if it releases as an indication of such a demand the BCA relay operates and locks. (This feature is canceled in offices which complete any traffic from a panel or No. 1 crossbar outgoing trunk which returns a timed low-bridged during the busy test.) The BCA releases the BTA relay which reverses the polarity on the tip and ring to the originating office to remove the make-busy signal. The BCA also operates the CAKR relay which starts the control advance sequence of operation as described previously. The BCA operated prevents the test circuit from advancing to the next trunk and the test count register does not operate. When the control advance is completed a busy test is again made of the same trunk.

1.325 Override Busy Test (ORB) OS12 and
24, SC2.1

When it is desired to test an ANI trunk from a panel or No. 1 crossbar office which is without originating office facilities, or when the actual line toward the originating office is in trouble, the ORB (override busy) key must be operated. Operation of this key allows the tandem trunk to be tested by overriding the originating busy test described above. At the conclusion of a satisfactory test of the trunk the ORB key must be restored to normal before the test circuit can advance to the next trunk to be tested. This is necessary

to prevent the possibility of inadvertently testing an ANI trunk from panel or No. 1 crossbar offices without making the originating busy test.

1.33 Automatic Pass Busy (APB) OS2.1, 2.2, and 12 - Fig. 26 - SC4.1

The APB key is operated to set the test circuit for passing all tandem office trunks when they are busy or when the associated reserve trunk is busy. When relay H operates, after the trunk is connected, it opens the operate circuit of relay PB causing it to start to release. If the ST2 relay is not operated to lock relay PB before it releases, ground from relay H operated is closed through the APB key operated to operate the PB register. Register PB operated closes ground over lead "CA" to operate the CA relay causing the connector control feature to step to the next tandem trunk circuit. As part of this function relay CA1 is operated. Relay CA operated releases relay H. Relay CA1 is locked to relay CA and H operated and relays BT and PB normal. Relay H released causes relay PB to operate and relay BT to hold, and register PB to release. Register PB released opens the "CA" lead ground to allow the CA relay of the connector control to release as soon as it has completed its functions. Relay CA releases relay CA1 and as soon as the next tandem office trunk circuit is connected relay H reoperates. The H relay operated causes the busy test feature to function again.

1.34 TSP Trunk Circuit Busy Tests - OS2.1, 2.2 - SC4.3, 100

1.341 Preliminary Busy Test

Operation of the start key operates the BT and PB relays through the H relay normal. The BT relay completes the path from the trunk "S" and "A" leads to the B and Bl relay respectively for checking busy ground indications from the trunk. The ST relay operated starts busy test timing by operating the BYT relay and also operates the H relay completing a locking circuit for relay BT through the B and Bl relays which will be operated if the trunk is found busy. On a trunk busy condition the operated B or Bl relays will light the BT lamp.

Relays BT and PB are slow release and start to release when the H relay operates if the trunk is found idle and the B and Bl

relays are not operated. Release of the BT relay operates relay GBT which starts the STO tube timer to time a minimum interval of 1.8 seconds. This timing interval is introduced to insure complete release of originating end facilities before test seizure in the event the test circuit was connected to the trunk during its release sequence.

If the trunk is seized by a subscriber at any time during the STO timing interval relay ADK will operate to ground on the trunk "A" lead and will in turn operate relay CA1 which advances the test circuit. If the trunk remains idle during this timing interval, relay STO will operate when the STO tube timer fires and in turn will operate relay ST01. When testing TSP trunks operation of the ST01 relay extends ground through the operated H relay and normal BT relay on the "RT" lead to the trunk to operate the trunk RT relay which in turn operates the test circuit LCT relay lighting the RTO lamp.

1.342 Busy Test of TSP Trunk Circuits From No. 1 Crossbar or Panel Offices

The preliminary busy test for these trunks is as described above through the operation of the test circuit LCT relay. For these trunks relay A1P is operated when the connector crosspoints close to operate either the ZL or LM relays. Relay LM operates the A1P relay and the ZL operates the DZ and A1P relays. Thereafter the busy test proceeds as described in SECTION II, 1.321, 1.322, 1.323, and 1.324.

1.343 Busy Test of TSP Trunks From No. 5 Crossbar, No. 1 ESS, or SXS Offices

1.3431 Special Toll Trunk Circuit From No. 5 Crossbar and No. 1 ESS Offices

The preliminary busy test for special toll trunks from No. 5 crossbar offices is as described about in above through the operation of the test circuit LCT relay. When testing loop signaling trunks operation of the trunk RT relay operates it applies a standing reversal toward the originating end preventing service seizures of the trunk to be tested. When testing E&M signaling trunks, operation of the trunk RT relay applies resistance battery from the test circuit to the "M" lead toward the originating end preventing service seizures of the trunk to be tested.

1.3432 Dial Zero Trunk Circuit From No. 5 Crossbar, No. 1 ESS and All TSP Trunk Circuits From SXS Offices

When testing dial zero trunks from No. 5 crossbar and any TSP trunk circuit from a SXS office the preliminary busy test is as described above through the operation of relay LCT. For these trunks relay MQA is operated from a make contact on either the ZL, ZEM, EMD, or GLD relays which operate when the connector crosspoints close. Relay ALP is then operated for these trunks by the MQA relay. With the ALP relay operated, the LCT relay operates relay LCTA and in turn relay LCTB operates. The trunk RT relay connects relay OBT to the cable conductors of the trunk in the case of dial zero loop signaling trunks. If a low bridge is detected on the conductors indicating that the originating end is busy, the OBT relay operates and ground is applied to operate relay BT through the make contacts on the MQA relay. In the case of E&M signaling dial zero trunks relay EI would detect a trunk busy condition and operate the BT relay. The BT relay releases the trunk RT relay to restore the trunk to service. The LCT and LCTA relays then release causing the test circuit to advance to the next trunk if the APB key is operated. If the APB key is normal the release of the LCTA relay connects the interrupter to the winding of the P relay. The TT1 interrupter pulses the P relay and the P counting relays count to the P4 relay which releases the LCTB. The timed interval is 14 to 20 seconds. Release of the LCTB starts a new busy test cycle.

If the outgoing trunk is not found busy during the initial stage of the busy test (before relay BTA operates) the operation of the LCTA relay and nonoperation of the OBT or EI relay closes a path to operate the BTA relay. The BTA relay reverses the cable conductor polarity to make the outgoing trunk busy to the local switching system. The OBT or EI relay will operate if a new service seizure of the trunk is detected operating relay BT which restores the incoming trunk to service. Subsequent action is as described above.

If the outgoing trunk is not found busy in the two preceding stages as

signified by the nonoperation of the OBT relay, relay BTB operates. The BTB grounds the armature of the HD interrupter which actuates the HDA, HDB, and HDF relays. When the HDA and HDB relays are operated and the HDF relay is released the BTC relay operates. The delay interval for its operation is 500 to 700 msec. If the outgoing trunk remains idle during this period the OBT or EI relays remain nonoperated and when the BTC relay operates relay ST1 operates which in turn operates the ST2, 3, and 4 relays to start the testing of the trunk. If the OBT or EI relay operates during this interval the operation of the BTC relay operates relay BT and the trunk will be passed as busy with the APB key operated or retest will be made in 14 to 20 seconds as described above with the APB key normal.

Once the test is started, signified by the operation of the ST- relays, the OBT or EI relays continue to monitor the originating end. If the OBT or EI relays operate due to a trouble condition which permits a service seizure the BCA relay operates and locks. The BCA releases the BTA relay which reverses the polarity of the tip and ring to the originating office to remove the make-busy condition for loop signaling trunks. Relay BCA also operates the CAKR relay which starts the control advance sequence as described in a separate paragraph. The BCA relay operated prevents the test circuit from advancing to the next trunk and the test count register does not operate. When the control advance is completed a busy test is again made of the same trunk.

1.344 Manual Make-Busy of TSP Trunk Circuits

If a TSP trunk is to be made busy the following procedure is to be followed. First a plug is inserted in MB jack of the trunk, then the trunk test circuit is made to seize this trunk and perform the appropriate busy test. When this is done the off-normal ST- relays will ground the "TST" lead to the trunk causing it to apply a make-busy condition to the originating end. The test circuit will block on the A relay operate test at which time it can be advanced leaving the trunk effectively busy to originating traffic.

1.4 Advance Control (END) OS 2.1, 2.2 and 12 - Fig. 26 - SC4.4, 4.5, and 5

1.41 Connector Advance

Completion of the last test in the test sequence operates the END relay, and it locks. Operation of the END relay releases the ASR relay. Release of the ASR relay releases the preceding test relay. Relay ASR being slow release allows time for the test circuit to test the trunk circuit "A" and "S" leads, to insure that the trunk has released. Operation of the ADK or SLK relays, by ground on the "A" or "S" leads respectively, will block the test and prevent the test circuit from advancing to the next trunk. With the release of the preceding test relay and the ADK and SLK relays normal, ground is extended on the "ENDK" lead, operating the CT message register scores a completed test and operates the CAA relay. The CAA relay in turn operates the CA relay directly except for tests of 2-wire bylink trunks. On tests of 2-wire bylink trunks the operation of the CAA relay grounds the "TL2" lead operating the trunk TC relay to open the start leads to the register and sender prior to releasing the RT relay so that a false pick-up of the trunk A relay on cable capacity will be ignored. The operation of the trunk TC relay will operate the RVR relay in the trunk and will release the test circuit TL1 relay as a check that the trunk TC relay has operated. On release of the TL1 relay the CA relay operates, extending ground to operate the CA1 relay, and it locks.

The CA1 relay operated, opens the path to the H relay, and it releases. In turn, the LCT and RCT relays will release. This insures releasing the RT relay before the RC- relays, and prevents recharging of the cable capacity which may cause a false operation of the trunk A relay when the RT relay releases. With the H relay released, the ST1, and in turn ST2 and ST3 relays release. Holding grounds are then removed from any operated test relays and they release. With the release of the END relay, the test sequence circuit is completely released. At this time the operated test pattern relay, namely the NML, ABR, or CTP relay, releases.

When the CA and CA1 relays operated, a path was closed to operate a G- relay, as described in section Connector Control (see 1.1). The test circuit then advances to the next trunk. During this process the hold magnet of the test connector switch releases,

releasing the CI, MF, or DP relay, which in turn releases the CA relay. The CA1 relay also releases when the PB and BT relays are operated by the release of the H relays.

On ALP calls (SC4.5) the operation of the END relay releases the BTA relay which restores the trunk to off-hook polarity enabling the OGT trunk to return to a normal nonbusy service condition. In addition the operation of the CA1 relay with subsequent release of the connector, releases the ALP, BTC, LCTA, HDA, HDB, BTB, and LCTB relays which are only involved in ALP test calls.

1.42 Repeat Test (REP) OS2.1, 2.2 and 12 - Fig. 4 - SC4.4 and 5

With the REP key operated, the release of the BT relay on an idle trunk condition causes the operation of the RP relay. Relay RP operated locks to the REP key and provides a path to operate the RST register.

From this point on circuit operation is the same as described in 1.41, up to operation of the CT message register.

At the completion of the test, with the REP key operated, ground on the "ENDK" lead operates the RST register. Register RST operated operates the CA1 relay. Relay CA1 releases the H relay to prepare for a new test.

Ground being removed from the "ENDK" lead as the test feature relays release, releases the RST register and CA1 relay. Release of the CA1 relay causes the reoperation of the H relay, starting a repeat test on the same tandem trunk circuit.

1.43 Vacant Crosspoints OS12 - Fig. 1 - SC4.2

All vacant sets of crosspoints shall have their "CG" lead connected to the "VT" lead. Under this arrangement when they are selected the closure of the "CG" crosspoints connects ground over the "VT" lead to operate the CA relay on its primary winding and the CA1 relay on its primary winding over lead "CA". With the CA and CA1 relays operated the circuit advances to the next set of crosspoints as explained for regular operation.

1.44 Trunk Type Selection OS12 - Fig. 1 - SC4.2

The trunk test circuit selects particular types of trunk circuits for test by means of setting the trunk-type switches 1 and 2 illustrated in the following table.

<u>SW1</u>	<u>SW2</u>	<u>Trunk Circuits Selected</u>
ALL	ALL	Associated Trunk Circuits
	PCI	PCI Trunk Circuits
	DP	DP Trunk Circuits
	MF	MF Trunk Circuits
CAMA	ALL	Associated CAMA Trunk Circuits
	PCI	PCI CAMA Trunk Circuits
	DP	DP CAMA Trunk Circuits
	MF	MF CAMA Trunk Circuits
PBX	ALL	Associated PBX Trunk Circuits
	DP	DP PBX Trunk Circuits
DZ	ALL	Associated Dial Zero Trunk Circuits
	MF	MF Dial Zero Trunk Circuits
SCN	ALL	Associated Special Toll Coin Trunk Circuits
	DP	DP Special Toll Coin Trunk Circuits
	MF	MF Special Toll Coin Trunk Circuits
	ALL	Associated Special Toll Noncoin Trunk Circuits
SNCN	DP	DP Special Toll Noncoin Trunk Circuits
	MF	MF Special Toll Noncoin Trunk Circuits
CMB	ALL	Associated Combined Trunks

The trunk test circuit will only select and test a trunk circuit as outlined in the table. With any other combination of settings, the operate path for the S-relays is kept open and the test frame will be inoperable.

As each trunk is selected for test the DP, MF, or CI relay is operated to ground leads to the trunk-type switch No. 2 which extends ground to the secondary winding of the CA relay if the trunk selected is not of the desired pulsing class. The CA operated operates CA1 and the circuit advances to the next set of crosspoints as explained for regular operation.

1.5 Control Advance OS12 - Fig. 26 - SC5

Operation of the control advance key will be made on encountering a test failure due to trunk trouble or if it is desired to pass a busy trunk when the automatic pass busy condition has not been established. It is also operated for the case where the trunk connection could not be completed due

to an overflow condition. Functions are incorporated in the control advance feature to hold the test circuit on a particular trunk if it recognizes that the trunk (or sender) is not restored to normal or the recorder is not restored properly.

1.51 Control Advance - REP Key Normal OS12

Manual operation of the CA key or ground on the "RC" lead from the transverter trouble indicator frame or trouble recorder frame operates the CAK relay, if the REP key and MAL relay are normal.

If the recorder "CH" lead release check was not satisfied, MAL relay would be operated. With MAL relay operated control advance cannot be made without operating the REP key. Operated CAK relay initiates the "CH" lead release test.

Relay CAK operated, operates the CAS relay, to indicate a release signal to the sender, or the CAT relay, if the trunk only is attached. The sender attached condition is indicated by the SRK relay operated. Relay CAT operated lights the CAT lamp and CAS relay operated lights the CAS lamp. The CAK is locked operated until the off-normal ST2 relay is released, providing the "CH" lead release test is completed.

Operation of the CAK and CAS or CAT relays extends ground to operate the CA relay. Circuit functions the same as in 1.41.

1.52 Control Advance - REP Key Operated OS12

Key REP operated tests the same trunk repeatedly. Operation of the CA key or ground on the "RC" lead from the transverter trouble indicator frame, trunk link, sender link, register link, call identity indexer, trunk, or recorder frames operate the CAKR relay. This allows the control advance feature to be used under control of the REP key from any one of the above locations. Operation of the CAKR relay opens the locking path of the MAL relay and it releases, if operated, provided the CAKR relay is following a second operation of the CA key. Relay CAKR operated, operates the CAK relay. With the REP key operated ground is extended to the CA1 relay and it operates. Circuit operation from this point, is the same as in 1.42.

2. TRUNK TEST FUNCTIONS - COMMUNICATION WITH THE SENDER

2.1 Test Start OS 2.1, 2.2 - Fig. 5 - SC6

When the selected tandem office trunk circuit and, if provided, its associated reserve trunks are idle, ground is extended through the H relay operated and the BT relay normal, operating the ST1 relay and locking it to the H relay operated. Operation of the ST1 relay operates the ST2 and ST3 relays.

Operation of the ST1 relay transfers the busy test timing to trouble timing, operating the TB relay.

Operation of the ST2 relay locks the PB relay and extends a ground to operate the AOP, AOD, or AO relay. Relay AO, AOP, or AOD operating lights the AOP lamp.

Operation of the ST3 relay provides a path to operate the pattern relay NML, lighting the NML lamp. Pattern relays ABR and CTP operate under control of the desired test keys operated, lighting the associated ABR or CT lamps.

Relay ST1 operated also operates the PCI pulsing class auxiliary relays CIA and CIB and formerly operated the DP auxiliary relay DPA, DPB, and DPC. The auxiliary relays operate to set up appropriate test and pulsing conditions in combination with the trunk test class relays or with former test variation relays VAA or VBA.

2.2 A Relay Operate Tests

2.21 (PCI) A Relay Operate Test (AOP) OS17 and 18 - Fig. 8 or 40 - SC7

At the time of seizure for test the LCT and ST2 relays operate, operating the AOP relay. Relay AOP operating lights the AOP and AOP1 lamps and connects TG relays across the "T" and "R" leads to the trunk A relay, operating trunk A relay and test frame TG relay in series with resistor AA. The A relay in the trunk circuit extends a ground to operate TGI relay indicating the A relay operated. Relay TGI operating operates the AK relay, lights the AOP2 lamp and locks to the AOP relay. Release of the A relay in the trunk circuit, on operation of the trunk T relay from the sender, releases the TGI relay causing ground to be applied to lead "AOPK" as an OK check of the A operate test. Ground on lead "AOPK" causes advance of the test circuit to the PLA test sequence. Formerly the release of relay TGI caused the operation of relay AR. The AR relay operating opened the loop

to the trunk and operated relay ARK in parallel with the AA resistor. Relay ARK operated gave an OK check of the A operate test and advanced the test circuit to the PLA test sequence.

2.22 (BL) A Relay Operate and Overflow Test (AOD) for Loop Dial or (AO) for E&M Lead Trunks OS17 and 18 - Figs. 40, 49 - SC22, TSP - SC111

At the time of seizure of the trunk for test, the LCT and ST2 relays operate, operating relay AO for E&M lead trunks or for loop dial trunks the AOD relay. In addition for loop dial trunks the TLI, ADKL and DLY relays are operated, operating the AODA relay. The slow release ADKL relay "YA" option, was added to absorb any false operation of the trunk A and B relays and ADK test circuit relay upon operation of the trunk RT or RV relays. The ADKL relay is slow release to insure that the A and B trunk relays and ADK relay will be given a sufficient time interval to operate if they are going to do so on a false kick-up condition and lock them in until the circuit is stabilized before proceeding with the test. Relay AO or AOD operated lights lamps AOP and AOP1, and operates relay CSX which connects the supervision monitoring relays CS1 and CS2 to contacts on the TLI relay which is connected to lead "TL1" to follow signals from the trunk CS relay. Relay AODA, a slave relay for AOD, or relay AO operated operates relay TCO through the TN relay operated as an up-check of the tone detector, to resistance battery at a point where the absence of ground indicates a trunk prebusy condition restored to normal as recognized by the CS0 or OFH relay released.

Relay TCO operated operates the trunk TC relay to open start leads to the sender and register links in preparation for the "preliminary" pulse from the test circuit. If a 2W trunk is being tested trunk TC relay operates trunk RV relay which reverses the potential on the "T" and "R" leads, operating the CS0 relay on its primary and secondary windings in series. The trunk RV relay operated also operates the trunk RVR releasing the TLI, ADKL, and DLY relays. The ADKL, DLY relays are slow release to insure that the trunk A and B relays, if falsely operated by the operation of the trunk RV relay, will operate the ADK and then fully release and in turn release ADK before the test may proceed.

If a 3W or 3WS bylink trunk is being tested the trunk TC relay operated grounds the "S1" lead to the test circuit. The 3W test class relay is operated and locked to

provide appropriate test conditions. Relay 3W operated extends the "S1" lead to operate the SBF relay and also operates the 3WA and WOT relays for later tests.

If a BEM bylink trunk is being tested trunk TC relay operates trunk RV relay which applies battery to the trunk "M" lead causing relay OFH to operate.

When testing TSP E&M signaling bylink trunks EMD the trunk RV relay operates relay EMBT and releases relay EMGT. Relay EMBT then operates the OFH relay.

The CSO, SBF, or OFH relays operated and the ADKL, DLY, and ADK relays released show that the trunk is ready for the A relay nonoperate check and for the preliminary pulse by operating RVK1 relay.

When testing Loop Signaling Bylink Trunk Circuits SD-27010-01, SD-27079-01, the RVK1 relay operates relay RVKL and shorts the 30,000-ohm winding of the CSO relay causing the nonoperate test current of approximately 6 ma to be applied to the trunk A relay through the AR2 and ANOT resistors. For Trunk Circuit SD-27044-01, the ANOT1 resistor is placed in the circuit in place of the ANOT and AR2 to give a nonoperate current of approximately 11 ma. For Trunk Circuit SD-27104-01, the ANOC resistance is placed in series with the ANOT resistance which causes the A nonoperate current to be approximately 3.6 ma. This current is maintained in the loop for the release time of the slow release relay ANTM which starts its release when relay RVKL operates. If the trunk A relay does not meet the nonoperate requirement it will operate and in turn cause operation of the test circuit ADK relay which will provide a locking path for the ANTM relay preventing its release. The test circuit will thus block with the AOP lamp lighted and AOP1 lamp extinguished to indicate nonoperate test failure. If the trunk A relay meets the nonoperate requirement it will not operate on the 6 ma current and relay ANTM will release and short the ANOT resistor thus causing the minimum operate current to be applied to the loop thereby operating the trunk A relay. When the trunk A relay operates it will operate the ADK relay in the test circuit which then starts the pulse generator by operating relay SPG in preparation for making the preliminary pulse check.

For trunk circuits other than those mentioned above the A relay nonoperate test is bypassed and the trunk A relay is operated on minimum current through the AR2 (2W) or the AR3 (3W) resistors when RVK1 relay shorts out the 30,000-ohm secondary winding of the CSO relay for loop dial trunks or through resistor EL for BEM and EMD trunks.

For 2W trunks compensating resistors are provided in the loop when the trunk under test does not have compensating resistors. Thus all current flow tests of the loop are made for the 2W trunks with a 1000-ohm compensating loop resistance either in the trunk or in the test circuit.

Trunk A relay operated operates trunk B relay which extends ground on lead "A" to operate the ADK relay which operates 27010 the SPG and SPGA relays in preparation for pulsing. These relays restore the CSO relay shunt capacitor E across the winding in preparation for receiving tone, extinguishes lamp AOP1 and lights lamp OF, and in the case of loop dial bylink trunks 2WC or 2W3, provides a simulated loop across the A relay operate resistance.

Pulse generator relay PG drives relay P (formerly relays INT and INT1, driving relays P and CKP) to open the loop or the trunk "E" lead forming one dial pulse. Relays PP1 and PP1' (formerly PP1 and PF2) count P relay operations to stop the pulse generator.

Because the pulse is received by the trunk before the register is attached (the start lead being open) the trunk OF relay is operated to connect reorder tone to the trunk which is applied toward the originating end. At the end of the preliminary pulse the tone detector is attached to "listen" for the spurts of interrupted reorder tone. Tone into the tone detector (6.3) releases the TN relay. Relays OTW and OTZ count two spurts of tone which is accepted as a check of the trunk OF function.

Relay OTZ operating operates the AK relay, which lights the AOP2 lamp, extinguishes the OF lamp, and releases the TCO and RVK1 relays to release the trunk.

As the trunk releases a check is made that it is restored to normal. Release of the trunk B relay releases the ADK relay. In the 3W and 3WS trunks release of the trunk B and TC relays releases the SBF relay. In the 2W trunk the release of the trunk B and TC relays releases the trunk RV relay. At this time the trunk RVR relay will operate and promptly release. An RVR relay contact in the "TL1" lead permits the TL1 relay to release and reoperate, the release being counted by the TL1K relay. In the BEM trunk the release of the trunk TC and B relays releases the trunk RV relay causing battery to be removed from the "M" lead to release relay OFH.

Relays SBF or OFH released or relays TL1 and TL1K operated and CSO released constitutes an OK check of the A relay operate test and advances the test circuit to the PLA test sequence.

2.23 (WS) MF or DP Loop Signaling Trunk or (PXL) Incoming Trunk From PBX A Relay Operate Test (AOD) OS17 and 18 - Fig. 40 - SC22, 35 - TSP - SC110

At the start of this test the AOD relay is operated, lighting the AOP and AOP1 lamps and operating the ADKL relay. Relay ADKL operates the DLY relay and also connects the tone detector circuit, through repeat coils, to the incoming "T" and "R" leads when testing incoming trunks from PBX. Relay DLY operates relay AODA and in turn the AODA relay operates the CSX relay connecting the supervision monitoring relays, CS1 and CS2, to signals from the trunk CS relay as indicated over the "TL1" lead to the TL1 relay. Relay AODA operates the TCO relay to resistance battery at a point where the absence of ground indicates proper trunk polarity as recognized by the CSO relay released.

Relay TCO operated operates the RVK1 relay. The trunk A relay is operated on minimum current through the AR2 resistor when RVK1 relay shorts out the 30,000-ohm secondary winding of the CSO relay. The CRT and CRR loop compensating resistors are also in the loop.

When testing MF or DP loop signaling WS trunks, A relay operated requests a sender and when the sender is attached it operates the trunk T relay, transferring the incoming "T" and "R" leads into the sender. When the trunk is attached to the sender a reversed potential is standing on the "T"

and "R" leads in the sender. The CSO relay operates on this reversal, operating the WK relay which locks. After a brief interval the sender removes the reversal, applying normal polarity to the "T" and "R" leads, releasing the CSO relay. The brief reversal is a "wink start" signal to the originating sender to start pulsing. The trunk T relay operated also grounds the "S" lead. The "S" lead ground operates the SLK relay which at this time is taken as a "sender attached" indication by operating the SDR1, SDR2, and SRK relays in succession.

Operation of the WK is also taken as an A relay up-check operating the AK relay which lights the AOP2 lamp, and extinguishes the AOP1 lamp. The AK relay operating releases, the TCO relay giving, with the sender attached indication, an OK check.

When testing incoming trunks from PBX (PXL) A relay operated requests a sender and when the sender is attached it operates the trunk R relay, transferring the incoming "T" and "R" leads into the sender. The T relay in operating operates the trunk D2 relay which grounds the "S" lead to the test circuit operating the SLK relay. The operation of the SLK relay is taken as a "sender attached" indication operating the SDR1, SDR2, and SRK relays in succession.

When the incoming "T" and "R" leads are transferred into the sender by operation of the trunk T relay, dial tone is returned to the test circuit causing release of the normally operated TN relay. The release of the TN relay is taken as an A relay operated check, operating the AK relay which lights the AOP2 lamp and extinguishes the AOP1 lamp. Operation of the AK relay releases the TCO and ADKL relays, the latter causing the operation of relay TN.

The operation of the SRK relay and release of the TCO and ADKL relays marks completion of the A relay operate test and an OK check is given.

2.24 (MEM) A Relay Operate Test (AOD) OS17, 18 and 21 - Figs. 40 and 49 - SC22 - TSP - SC110

At the start of this test the AOD relay is operated, lighting lamps AOP and AOP1 and operating relay ADKL. Relay ADKL operated operates relay DLY which in turn operates relay AODA. Relay AODA operated operates relay CSX to connect supervision monitoring relays CS1 and CS2 to signals

from the trunk CS relay as indicated over lead "TL1" to relay TL1. Relay AODA also operates relay TCO to resistance battery at a point where the absence of ground indicates a proper trunk supervision as recognized by relay OFH released.

Relay TCO operated causes relay RVK1 to operate. The trunk A relay is operated on minimum current through resistor EL and causes a sender to be requested.

In the case of "delay dial" operation, relay A causes operation of trunk relay CS and in turn relay RV, causing an "off-hook" signal to be transmitted over lead "M". This signal, in the form of battery on lead "M", operates relay OFH which causes operation of relays WK and AK. When the sender becomes attached trunk T relay operates but "off-hook" or delay dial supervision is maintained on the tip and ring leads by the sender until the sender is ready to receive pulses.

In the case of "wink-start" operation, trunk relay A operated causes trunk T relay to operate which in turn operates trunk relays CS and RV and also relays SLK, SDR1, SDR2, and SRK as a sender attached signal. Relay OFH operates to mark the beginning of the "wink" when battery is applied to lead "M" by trunk relay RV. Relay OFH operated causes relays WK and AK to operate.

Operation of relay WK indicates a trunk A relay up-check and relay AK operated lights lamp AOP2 and extinguishes lamp AOP1.

When testing TSP E&M signaling trunks ZEM, EMF, or ECF the battery on the "M" lead operates relay EMBT and releases relay EMGT in the test circuit. Relay EMBT then operates relay OFH which causes operation of relays WK and SUPR. Relay WK operated operates relay AK. Further, when testing noncoin trunks, relay T of the trunk operated operates trunk relay SA which in turn operates relay SLK in the test circuit by grounding the "S" lead. When testing coin trunks the "S" lead is grounded by operation of the T relay thereby operating relay SLK. The remainder of the "sender attached" indication is the same as described above for "wink start" operation.

In any event when the sender is ready to receive pulses, trunk relay CS is released by reversal of the loop by the sender which causes trunk RV relay to release.

Relay OFH follows relay RV release giving an OK check for the A relay operate test and advances the test circuit to the PLA test sequence. When testing TSP trunks relay OFH follows relay EMBT which follows relay RV.

2.25 A Relay Operate Test - TSP Dial Zero Trunk Circuits

The A relay operate test for TSP dial zero non-ANI trunks is as described above in 2.23 or 2.24 up to operation of the trunk A relay.

2.251 Non-ANI Trunk Circuits - Loop or E&M Signaling SC110

When the trunk A relay operates it operates the trunk PR relay which grounds the "TT" lead to the test circuit to operate relay PRQ. Operation of relay PRQ is taken as an A relay operate check and relay PLA is then operated to advance the test circuit to the pulsing test.

2.252 ANI Trunks - Loop or E&M Signaling

When the trunk A relay operates, the trunk requests connection to a sender. When the sender becomes attached, the trunk T relay operates which releases relay TL1 in the trunk test circuit. Relay TL1 releasing operates relays CS1 and CS2.

In loop signaling trunks, operation of the T relay causes in turn operation of the TL and RV relays in the trunk circuit and causes operation of relays SLK and CS0 in the trunk test circuit. Operation of the SLK relay causes successive operation of relays SDR1, SDR2, and SRK. Relay SRK operated indicates that the sender is attached. Relay CS0 operated operates relay WK.

Operation of the WK relay is taken as an A relay up-check, operating the AK relay which lights the AOP2 lamp and extinguishes the AOP1 lamp. The AK relay operating releases the TCO relay giving, with the sender attached, an indication of a satisfactory check for the A relay operate test. Relay PLA is then operated to advance the test circuit to the pulsing test.

In E&M signaling trunks, operation of the T relay causes in turn operation of the CS and RV relays. The operation of the trunk RV relay gives a "sender attached"

indication as described above for loop signaling dial zero trunks. Further, operation of the RV relay applies battery to the "M" lead thereby operating relay EMBT and releasing relay EMGT in the test circuit. Relay EMBT then operates relay OFH which causes operation of relays WK and SUPR.

Operation of the WK relay is taken as an A relay up-check and the test circuit proceeds to complete the test as described above for loop signaling dial zero trunks.

2.3 Office Code Outpulsing - (PLA)

2.31 (PCI) Office Code Outpulsing - (PLA) Fig. 9 ("Mfr Disc.")

While the A relay is releasing, the SKR operates in series with the sender TTF relay. The SRK and ARK relays operated, operate the PLA relay. Relay PLA operated, operates the SP relay and connects the trunk "T" and "R" leads to the pulsing circuit. When the office code has been pulsed the 5' counter relay operates. The 5' counter relay operating stops the pulse generator and gives an OK check.

2.32 (PCI) Office Code Outpulsing - (PLA) OS5, 6 and 15 - Figs. 45, 46, 47, and 50 - SC7 and 15

When relay PLA operates after the OK check of the A relay operate test, relay SP operates and the trunk tip and ring leads are connected to the pulsing circuit. When the office code has been pulsed steering relay TT operates and CDA releases to stop the pulse generator and gives an OK check.

2.33 (BL) Office Code Outpulsing (PLA) OS6, 7, 14, and 15 - Figs. 45, 46, 47 48, and 49 - SC16.1, 16.2 and 23 (Formerly Fig. 9 and 41)

After the AOD test has released, relay RVKI is reoperated to operate trunk A relay by shorting out the 30,000-ohm winding of the CSO relay for loop dial trunks or by applying ground to the trunk "E" lead for E&M lead trunks. Trunk A relay operated causes trunk relays B and RV to operate in turn causing relays ADK and CSO to operate and when a sender is attached to the trunk the SLK and RVK2 relays operate to start the pulse generator. For loop dial pulsing relay RVK2 or SPG shorts out the repeating coil and CSO relay and the SPG relay connects a simulated loop across the pulsing contact during pulsing.

When the office code has been pulsed, counter relay TH operates (formerly 5' counter relay operated). The operation of relay TH or 5' stops the pulse generator. In offices arranged for foreign area translation where the DP Senders SD-25999-01 are equipped with option "WF" (A&M Only) the office code and the TH digit are transmitted before the generator is stopped. Trunk relay A operated leads to a sender being attached which operates the trunk T relay grounding the "S" lead ground operates the SLK relay which at this time is taken as a "sender attached" indication by successively operating the SDR1, SDR2, and SRK relays.

When the sender grounds the "CO" lead to operate the trunk T relay, the marginal trunk TMG relay should not operate. A trunk TMG relay back contact in the "TL1" lead gives a down-check by holding the TLL relay operated.

The counter relay operation together with "sender attached" and trunk TMG relay down-check indications provides an OK check.

2.331 Pulsing Test for Dial Pulsing Bylink Trunks Using the 10-Digit Register SD-27101-01

On completion of the A relay operate test of Trunk Circuit SD-27092-01, relay PLA is operated and relays OAD, AODA, and AK are released. Release of relay AK operates the RVK1 relay which causes operation of the trunk A and D relays. Operation of the trunk A relay causes the trunk to connect to a register. When the register is attached the trunk RA relay is operated grounding the "RA" lead to the test circuit to operate the RGA relay which then operates relay RVK2. When the trunk D relay operated it grounded the "A" lead to the test circuit to operate the ADK relay.

Relays AKD and RVK2 operated cause operation of the SPG and SPGA relays in sequence. Relay SPG starts the pulse generator and the test code plus the digit one for each of the four numerals is pulsed into the register. When the test number pulsing is completed relay STP is operated and in turn operates relay EP. With registration completed in the register it bids for connection to the sender and when the sender becomes attached the trunk T and D2 relays operate which causes the operation of the test circuit SLK, SDR1, SDR2, and SRK relays in sequence.

When the sender is ready to receive the test number from the register it grounds the "FR" lead to the trunk which extends the signal to the register on the "SA" lead. The register then seizes the data transfer circuit which establishes a data channel to the sender and the test number is passed from register to sender. For ANI trunks relays STP and EP are operated after the KP signal and X digit are pulsed into the sender as described in SECTION II, 2.82. Relays SRK and EP operated as described above complete the path for operating relay RTL which advances the test circuit to the next test.

2.34 (WS) Office Code Outpulsing (PLA) - Figs. 9 and 41 - ("Mfr's Disc.")

On loop dial wink-start trunks after the AOD test has released the RVK2 relay is operated to start pulsing by operating the SPG and SPGA relays and to short cut the repeat coil and CSO relay winding during pulsing. The RVK2 locks and CSO releases. The SPG also connects a simulated loop across the pulsing contact when the office code has been pulsed; the 5' counter relay operates, stopping the pulse generator and giving an OK check.

2.35 (WS) (PXL), Office Code Outpulsing (PLA) OS6, 7, and 15 - Figs. 45, 46, 47, 48, 49, and 154 - SC16.1, 16.2, 23, 28, and 35.

On loop signaling MF or DP trunks or on E&M lead MF trunks, after the AOD test has released, the RVK2 relay is operated in turn operating relays SPG and SPGA to start the pulse generator and, for DP trunks, to short out the repeat coil and CSO relay winding during pulsing.

When the office code has been pulsed, (a) relay PLB is operated for line number outpulsing and relay RTL for return test line test, or (b) counter relay TH will operate to stop the pulse generator and give an OK check ("Mfr Disc.").

When testing incoming trunks from PBX with the POT-PMR key operated to the POT position (operator class) relay POT will be operated to permit the proper test code cross-connected to the OA, OB and OC punchings to be transmitted. This code simulates a call to a service or assistance operator thus causing the marker to operate the trunk OT relay which enables the operator class features of the trunk. When testing incoming trunks from PBX with the POT-PMR key operated

to the PMR position (message register class) relay PMR will be operated to permit the proper test code cross-connected to the MA, MB and MC punchings to be transmitted.

The marker informs the sender to cancel AMA treatment for both the operator and message register classes.

2.36 PLA Pulsing Test - TSP Trunk Circuits - OS14, 15, and 22 - SC120

2.361 Pulsing Test for MF Pulsing Trunk Circuits

On completion of the A relay operate test relay PLA is operated and relays AOD, ADKL, DLY, AODA, and AK are released. When testing any TSP MF pulsing trunk except dial zero non-ANI, release of the AK relay operates the RVK2 relay which releases the RVK1 relay and operates relay SPG to start the pulse generator. The test code plus the digit one for each of the four numerals is then outpulsed to the sender. For ANI trunks the X digit is also outpulsed as described in SECTION II, 2.83, after the test circuit receives the start identification signal from the sender which causes the operation of the CSO and AST relays in sequence. When outpulsing has been completed relay STP operates and in turn operates relay EP. The sender then operates the trunk PR relay which grounds the "TT" lead to the test circuit to operate the PRQ relay. Relays PRQ and EP operated complete the path to operate the PDTT relay which releases the PLA relay and starts the next test in the sequence.

2.362 Pulsing Test for Dial Zero Trunk Circuits

When testing dial zero ANI trunk circuits the pulse generator outpulses the KP signal plus the OI X digit and test circuit operation is the same as if it were outpulsing the first two digits of the test code. On completion the steering relay BD1 will be operated and will operate relay STP from ground on relay PLA through the DZ relay operated and AD relay normal. The STP relay then operates relay EP which completes the path for operating relay PDTT to start the next test.

When testing dial zero non-ANI trunks no outpulsing takes place and relay STP is operated after the PLA relay operates. Relays EP and PDTT are then operated to advance the test circuit to the next test.

2.363 Pulsing Test for Dial Pulsing Bylink Trunks

On completion of the A relay operate test, relay PLA is operated and relays AOD, ADKL, DLY, AODA, and AK are released. Release of relay AK operates the RVK1 relay which causes operation of the trunk A, A1, A2 relays in sequence and the trunk B relay. Operation of the trunk A relay causes the trunk to connect to a register. When the register is attached the trunk RA relay is operated grounding the "RA" lead to the test circuit to operate the RGA relay which then operates relay RVK2. When the trunk B relay operated it grounded the "A" lead to the test circuit to operate the ADK relay. Relays ADK and RVK2 operated cause operation of the SPG and SPGA relays in sequence. Relay SPG starts the pulse generator and the test code plus the digit one for each of the four numerals is pulsed into the register. When the test number pulsing is completed relay STP is operated and in turn operates relay EP. With registration completed in the register it bids for connection to a sender and when the sender becomes attached the trunk T relay operates which causes the operation of the test circuit SLK, SDR1, SDR2, and SRK relays in sequence. Operation of the trunk T relay also operates the trunk RV and SA relays and releases the trunk A and A1 relays. The test circuit ADK relay operates on release of the trunk A relay and operation of the trunk SA relay releases relay TLL which in turn operates the CS1 and CS2 relays.

When the sender is ready to receive the test number from the register it grounds the "FR" lead to the trunk which extends the signal to the register on the "SA" lead. The register then seizes the data transfer circuit which establishes a data channel to the sender and the test number is passed from register to sender. For ANI trunks relays STP and EP are operated after the KP signal and X digit are pulsed into the sender as described in SECTION II, 2.82. When the sender is satisfied it grounds the "FT" lead to the trunk to operate the trunk PR relay which grounds the "TT" lead to the test circuit to operate relay PRQ. Relays PRQ and EP operated as described above complete the path for operating relay PDTT which advances the test circuit to the next test.

2.4 PDTT Position and Data Transfer Test - TSP Trunk Circuits

Relay PDTT is operated on completion of the PLA pulsing test. Operation of relay PRQ completes the path for grounding the

"TT" lead to the trunk which extends the ground on lead "TT" to the traffic service position No. 100A link and connector circuit. Ground on lead "TT" signals the controller circuit to establish a link through the connector between the trunk under test and TTP.

The controller circuit first applies battery to the "PCT" lead to operate relay PLC which then returns ground to the controller on lead "NBT". The data group number is passed from the controller to the TTP and is registered on the DGN- relays. The controller then proceeds to establish the link and grounds the "S" lead to operate relay SSP. When the link hold magnets have been operated the controller circuit grounds lead "OKT" to operate the OKSP relay which closes ground on the "S" lead to lock the link hold magnets and also applies ground on the "PA" lead to the trunk through the link crosspoints to operate the trunk PA relay. When the trunk PA relay operates it causes release of the test circuit PRQ relay which removes ground from the "TT" lead to the link connector. After completing its checks the controller releases thereby releasing relay PLC. Release of relay PLC operates relay DTST which seizes the data transfer circuit by applying battery to leads "STDT", "STDT1", and "STOP" and also connects lead "PC" to the "KPR" lead to operate the trunk TP relay. The data transfer circuit also receives the data group number registered on the DGN- relays and then proceeds to establish a data channel between the trunk under test, TTP and sender, if attached. (The sender is not attached at this time when testing dial zero non-ANI trunks.) The data listed in the table below is then passed between the above mentioned circuits and when registration is completed the data transfer circuit grounds the "DTOK" lead to operate relay DTOK. When the DTOK relay operates it removes battery from the "STDT" and "STDT1" leads to release the data transfer circuit and relay DTST.

When testing any TSP trunk circuit other than dial zero non-ANI the sender is attached and for TSP special toll trunks has registered the test number which includes the test code plus the digit "one" for each of the four numerals during the PLA pulsing test. When the data channel is established the sender grounds the A (0, 1, 2, 4, 7), B (0, 1, 2, 4, 7), C (0, 1, 2, 4, 7) on a two-out-of-five basis and leads "DO", "1", "EO", "1", "FO", "1", and "GO", "1" corresponding to the test number, along with the other information listed in the table below, into the TTP.

Sender to TTP

Recorder Number
 Rate Class ("Mfr Disc.")
 Class of Service
 Call Identification*

TTP Register Relays

RO,1,2,4,7,13 (3-out-of-6)
 RCO,1,2 (1-out-of-3)
 {CLSO,1,2,3,4 (1-out-of-5)
 {CSOO,5 (1-out-of-2)
 OMA, OI, NIT (1-out-of-3)

Trunk to TTP

Originating Area
 Trunk Type Special toll noncoin trunk -
 Dial Zero noncoin trunk -
 Dial Zero coin trunk -
 Office Index Special toll coin trunk
 Time Period Special toll coin trunk

OA0,1,2 (1-out-of-3)
 SPT
 ZNC
 ZCN
 {OI00,10,20 (1-out-of-3)
 {OITO, 1,2,4,7, (2-out-of-5)
 IP

TTP to Special Toll Coin TrunkTrunk Register Relays

Free Call Indication Key SM, normal
 Rate Treatment Key SM operated to SMA or
 SMB position
 Initial Period Key SM operated to SMA or
 Time Interval SMB position

CTT
 RTUO,RTUL,RTTO,RTTL,RTHL
 M1,2,3,4,5 (1-out-of-5)

*When testing dial zero non-ANI trunks the call identification mark is passed to the TTP from the trunk - OI or OMA for ANI or non-ANI trunks respectively.

Ground on lead "G1" from the sender via the data channel operates relay TCR which applies ground to the corresponding test number leads thereby simulating test number registration in the TTP to satisfy the registration check in the data transfer circuit.

When testing any TSP special toll trunk circuit release of relay DTST with relay DTOK operated operates the PDK1 relay which advances the test circuit to the RTL test by operating the RTL relay. For dial zero trunks operation of the PDK1 relay with key SM operated to the SMA position initiates the "transfer to cord switchboard test" as described in 2.41. When testing dial zero ANI trunks the operation of relay PDK1 opens the "TTG" lead to the sender thereby permitting it to release. When the sender releases, relays SA, SLK, SDR1, SDR2, and SRK will be released. On completion of the "transfer to cord switchboard test" or if the special test key SM is not operated to the SMA position, relay TCR is operated through a normal contact on the SDR2 relay

in preparation for transmitting the test number into the sender via the data transfer circuit. When relay TCR operates it grounds the leads mentioned above corresponding to the test number and also operates relay STF which grounds the "RF" lead to the trunk via the connector link to operate the trunk SR relay. Operation of the SR relay in the trunk initiates a request for connection to a sender. When the sender becomes attached the trunk T and TL relays are operated and ground lead "SA" to the test circuit via the connector link to operate the SAF relay. The SAF relay releases relay STF which operates relay DTST. Relay DTST then functions as described above to seize the data transfer circuit which establishes a data channel between trunk, TTP and sender. For this operation of the DTST battery is applied to lead "PTOS" through an operated contact on relay SAF instead of the "STOP" lead as an indication to the data transfer circuit that information is being passed from the TTP to the sender so that the appropriate variation or registration checks

are made in the data transfer circuit. The test number is passed to the sender and when registration has been successfully completed in the sender the data transfer circuit grounds lead "DTOK" to operate the DTOK relay. Operation of relay DTOK releases the data transfer circuit and relay DTST and advances the test circuit to the RTL test by operating relay RTL.

2.41 Transfer to Cord Switchboard Test for Dial Zero Trunks

When key SM is operated to the SMA position operation of the PDK1 relay, as described in the position and data transfer test, grounds lead "RLF" to the dial zero trunk. Ground on the "RLF" lead operates the trunk CBST relay which then returns ground on leads "CBST" and "CBA" to the test circuit. Ground on lead "CBST" operates relay CBSK which completes the path for operating relay CBAK to ground on lead "CBA". When the CBAK relay operates it grounds lead "CBS" to the trunk to operate the trunk CB relay which in turn releases the trunk CBST relay. Release of the trunk CBST relay removes ground from leads "CBST" and "CBA" to release the slow release CBSK relay. Release of the CBSK relay removes ground from the CBS and RLF relays to restore the trunk to the condition before the start of the test. When the CBSK relay releases it also operates the TCR relay to prepare the test circuit for transmitting the test number to the sender as described in the position and data transfer test.

2.5 Seizure of Return Test Line - (RTL) OS4 - Fig. 12 - SCB

2.51 Regular Seizure

The OK check lead from previous test operates the RTL relay and it lights the RTL lamp. Relay RTL operating operates the TLB relay and it locks, transferring the first test line "S1" lead from a busy ground to the winding of the FTL relay. The marker receiving the test call, tests all "S1" leads. All "S1" leads will test busy except the one to be picked and the marker will ground this lead operating the FTL relay which locks giving an OK check.

2.52 "TRL" Lead Test (TRL)

The preoperation of the TRL key operated operates the TRL relay (after RTL relay operates if A wiring is provided), lighting TLL. The TLB relay operating opens

the "S1" lead of the first test line, enabling the marker to pick it in the usual manner. Since the TRL relay is operated the "S1" lead is connected to the winding of the FTLA relay, which operates when picked by the marker. Operation of the FTLA relay grounds the first test line, "S1" lead, removes the ground from the second test line "S1" lead, and extinguishes the TL1 lamp. Recognizing ground on the first test line "S1" lead the marker makes a second trial. On the second trial the marker makes the second "S1" lead busy and the STL relay operates grounding the second test line "S1", extinguishing TL2 lamp, and connecting FTL to the first test line "S1" lead. Recognizing ground on the second test line "S1" lead the marker signals the sender on the "TRL" lead to try again. The first trial by the new marker grounds the first test "S1" lead to operate FTL and complete the test connection. The FTL operated gives an OK check.

2.6 Test of Fundamental Tip and Ring (FTR) OS7 - Fig. 13 - SCB

The OK check lead from the previous test operates FTR relay. If the marker encounters an all channels busy condition, preventing the return test connection the FTL relay will release after the RTL relay released and the COF lamp will light.

The FTR relay operating connects the "FT" and "FR" leads from the sender to the trunk test circuit. A low-resistance battery from the sender on the "FT" lead operates the marginal TGM relay and TGS relay in series. Operated TGS relay operates the TGS1 relay which in turn operates the slow release SR relay. With the operation of the SR relay, TGK1 relay operates, indicating a satisfactory "FT" lead test. Relay TGK1 operated opens the "FT" lead, releases the TGM, TGS, TGS1, and SR relays. Release of the TGS1 relay operates the TGR relay which extends the "FR" lead from a high-resistance battery from the sender operating relay TGS. Relay TGM does not operate due to its being a marginal relay.

When the slow release SR relay releases, and TGR and TGS relays operate, indicating a satisfactory "FR" lead test, TGK relay operates, giving an OK check.

Lighted lamps of this test indicate the nature of this test as follows:

FT lamp: Tip lead open or grounded.
 FRV lamp: Fundamental reversed.
 FR lamp: Ring lead open or grounded.
 FTFR lamp: Tip and ring crossed.

2.7 Line Number Outpulsing (PLB)

2 71 Figs. 3, 9, and 41 ("Mfr Disc")

The OK check by the previous test operates the PLB relay. The PLB relay operating removes the ground from the PG relay or the INT relay to resume pulsing. The remaining digits are pulsed and at the end of pulsing the STP relay operates through the operated pulse sequence relays.

The DP trunks respond when the sender is ready for originating line identification. In the BL trunk the trunk TMG relay is operated, releasing the TLL relay as an up-check. For the WS trunk the sender takes the initial action by reversing the potential on the "T" and "R" leads, operating the CSO relay, which in turn operates the WK relay as an up-check.

Relay STP operated for PCI transfers the "T" and "R" leads to the originating supervisory loop, for DP shorts out the CSO relay 30,000-ohm winding, and, together with an appropriate up-check indication, gives an OK check.

2.72 OS5, 6, 14 and 15 - Figs. 45, 46, 47, 48, 49, 50, and 154 - SC15, SC16, and SC28

Relay PLB operates as a result of completion of PLA pulsing ("WT" option) or as the result of an OK check from the previous test ("WS" option, "Mfr Disc.") and causes the P relay to release and allow outpulsing to continue. The remaining digits are pulsed and at the end of pulsing relay STP is operated through the steering sequence relays. Relay STP operated causes operation of relays EP and STP1 and transfers the PCI trunk "T" and "R" leads to the originating supervisory loop and for loop signaling MF or DP trunks, shorts out the CSO relay high-resistance winding.

When testing MF trunks from panel the PAS2 relay is operated in parallel with the STP. The PAS2 removes ground from the slow release relay PAS1 winding and opens the T and R loop to the sender. The loop remains open until the PAS1 releases; this action is to simulate the open interval received from a panel district selector and is required by the sender to complete its functions.

When the sender is ready for originating line identification, the trunk relay TMG of a bylink DP trunk will operate thus releasing relay TLL as an up-check. In the case of E&M lead bylink trunks a further check is made for presence of "off-hook" signal on the trunk "M" lead.

An OK check is obtained to advance to the next test sequence when relay EP operates and when the up-check is completed by bylink trunks.

When testing incoming trunks from PBX with the POT-PMR key operated to either the POT or PMR position, relay NAMA will be operated causing the operation of relay DFT when the EP relay operates at the end of line number outpulsing. Operation of the DFT relay bypasses the initial entry test.

2.8 Identification Index (X) Digit Outpulsing - 15, 16.2, 16.3, 28

2.81 PCI Trunk Class - SC15

The PCI ANI trunk class relay ACI closes a circuit to operate the PXD relay when the PLA relay operates to start pulsing of the called directory number. The PXD operates the XD when the final pulse is transmitted and at the completion of this pulse the SXD operates. The SXD disconnects the PCI pulse generator from the trunk and closes the transmission circuit to it. The next operation of the pulse generator P relay releases the STA relay which operates the MFP relay. The MFP closes the MF generator to the trunk. The CSO relay operates when the sender is ready to receive the X digit. The CSO operates the AST relay which releases the P relay to start a pulse cycle during which the KP signal is sent to the sender. The P released also operates the PPI relay. At the end of the pulse cycle the P relay reoperates and operates the PPI' relay and disconnects the KP signal. The PPI' steers control of the next digit to the XD relay. The next release of the P relay closes the X digit signal (value one) to the trunk and operates the MFF relay. The P relay reoperates and disconnects the X digit signal and releases the XD relay. The XD releases the STP relay which operates the EP relay to release PXD, SXD, MFF, and MFP relays. Subsequent action is the same as for non-ANI operation.

2.82 DP Trunk Class - SC16.2, 16.3

The trunk class ADP relays primes the test circuit for X digit pulsing. When the P relay operates at the end of the stream

of dial pulses for the last digit the CF, W, and SXD relays operate in that order. The SXD releases the U relay which operates the STS on the next release of the P. The P relay continues pulsing releasing the STA, operating the XD and releasing the STS which releases the PPl and PPl' relays. The PPl' operates the MFP relay which connects the MF generator circuit to the trunk. The pulse generator P relay is held operated until the AST relay operates from an operated CSO relay which is an indication that the sender is ready to register the X digit. The P relay released transmits the KP signal and operates the PPl relay. The next operation of the P disconnects the KP signal and operates PPl' relay which places the MF output under control of the XD steering relay. On release of the P the X digit is transmitted and the MFF relay operates. The final operation of the P relay releases XD which operates STP: it in turn operates the EP ending the test sequence.

When testing DP combined trunks the release of the XD relay does not operate the STP relay until an ANI ST pulse signal has been transmitted. Therefore, after the XD relay has released the generator continues to pulse and when the PG and P relays release, the SPCT (Start Pulse Combined Trunks) relay operates transmitting the ANI ST signal. The next operation of PG and P relays cause release of the MFF relay and operation of relay STP which in turn operates the EP ending the test sequence.

2.83 MF Trunk Class - SC28

The AMF trunk class relay primes the test circuit for the transmittal of an X digit after called line number pulsing. The FXD is operated by the PLA as previously described and while the ST signal is transmitted the XD steering relay operates. The P relay operates to end the ST signal and releases the STS relay which releases the PPl and PPl' relays. The PPl' operates the SXD relay and when the AST relay operates, as a signal that the sender is prepared to receive the X digit, the P relay releases to send the KP signal and reoperate the PPl. The next operation of the P relay operates the PPl' which advances the steering circuit to the X digit. The X digit is transmitted on the release of the P relay which also operates the MFF relay. The following operation of the P relay releases the XD relay which operates the STP to end pulsing.

2.9 Initial Entry Test (IET) OS8 - Fig. 16 - SC8.2, 35

At the completion of the previous test, the IET relay operates to the check lead made available by the previous test. The IET relay operating lights the "IE" lamp. The CII relay operates through the operated check relays UK2, UK1, TK2, and TK1 which operated to the recorder circuit as an indication that the initial entry on a two-out-of-five basis has been made satisfactorily. The operation of the CII relay operates the IE relay. The IE relay locks through the winding of the IEK relay. Release of the CII relay on completion of initial entry removes the shunt path to the IEK relay and it operates. Operated IEK relay gives an OK check by extending the ground to operate in sequence the next test "DFT".

The OK check will not be made while the transverter is having trouble, as indicated by operation of the TTT relay, lighting the TT lamp. Operations of the TTT relay are counted by the TV1 and TV2 relays and block the test if two transverter trouble indications are received on one test call as follows:

- (a) Operation of the TTT relay on the first attempt operates the TV1 relay, releasing the IE relay and holding the check lead open. Release of the TTT relay, and CII relay, if operated, at the end of the first attempt removes the shunt path to the TV2 relay and it operates.
- (b) A second attempt to make the initial entry follows failure on the first attempt. If no trouble is encountered on the second attempt an OK check is obtained as given above. If trouble is encountered the TTT relay is operated for a second time during the test call and it locks to TV2 relay operated, holding open the check lead and blocking the test.

When testing TSP trunk circuits relay IET is operated to start the initial entry test when the fundamental tip and ring test is completed. Relay IET operates the STM relay which applies battery on leads "STV" and "CBS" to the transverter connector. The transverter connector then functions to seize the transverter and the initial entry is made as described above. All information required by the recorder for recording the

initial entry is passed to the transverter from the TTP. When the initial entry has been successfully entered on the AMA tape the transverter grounds the "TVR" lead to operate the TVR relay which releases relay STM. When testing dial zero or special toll coin trunks with key SM operated to the SMB position operation of relay TVR operates the SPD relay which releases the TTP in preparation for making position recall tests of these trunks. Operation of relay SPD releases the connector link hold magnets and relay SSP which in turn releases the OKSP relay. Release of these two relays releases all information registered in the TTP thereby restoring it to normal.

If the transverter encounters initial entry trouble a second trial is made as described above.

3. D RELAY FUNCTION TEST - (DFT) OS7 - FIG. 17 - SC8.3, 35

The OK check ground given by the previous test operates the DFT relay. The DLT relay was previously operated during the "RTL" test and the SRK relay is operated indicating the sender is attached.

With relay SRK operated and the "D" lead grounded by the sender, relay DFT operating operates the DO relay which locks. Relay DO operated lights the DO lamp. The DFT relay operating also lights the DFT and DCL lamps. When testing TSP trunks or LOBL class trunks the sender release is started with the opening of the "TTG" lead by the DFT relay. When testing non-TSP trunks sender release is initiated when the D-relays of the trunk operate, thereby grounding the "DC" lead to the sender.

For PCI trunks the SRK relay releases when the sender releases and opens the "TST" lead. For all other trunks the release of the sender causes operation of the TLL relay or ADK relay which then releases relay SDR1. For TSP trunks, release of the sender also releases the SA relay. The SDR1 relay releases relay SDR2 which in turn releases relay SRK. Relay DLT releases after the release of the SRK relay and lights the DLP lamp. The release of the SRK and DLT relays extends the "D" lead ground from the trunk circuit to operate the DLK relay. Operation of the DLK relay gives an OK check by extending the ground to operate the next test function relay.

Relays SDR1, SDR2, and DLT are made slow release to insure that the ground from the sender which operates the trunk D relay has been removed before relay DLK is connected to the "D" lead to check the D relay lock path.

The OK check for this test depends on:

- (a) The release of the sender, releasing the SRK relay. If the "DC" lead is not grounded by the trunk circuit to the sender circuit the SRK relay remains operated. The SRK relay operated holds the DLT relay locked. The DLT relay locked lights the DCL lamp and the test is blocked.
- (b) The continuity of the "D" lead after the DO relay has operated and locked and the release of the SRK relay by the sender. With the release of the sender the "D" lead is checked to insure that the A or A1 relay operating locks slow release D relay. If a failure occurs the DLT relay releases lighting the DLP lamp. A "D" lead ground check failure fails to operate the DLK relay blocking the test. If the test fails at this time the DH key, if provided, and the REP key may be operated to make a further test on the D relay when the test has been advanced to the "DST" test. (See 5.8)

4. TANDEM OPERATOR HOLD AND SIGNALING TESTS - TSP TRUNK CIRCUITS

4.1 Ring Back Test OS7.2, 17 - SC141, 142

Following the completion of the D function test, with the special test key SM operated to the SMA position, the trunk is signaled from the TTP to apply the ring-back signal towards the originating end. Relay DLK operates at the end of the D function test and in turn operates relay RBT which grounds the "RB" lead to the trunk through the connector link crosspoints to operate the trunk RB relay. The operation of the RBT relay also inserts the marginal relay MG in series with relay CSO.

4.11 Loop Signaling Coin Trunks

For loop signaling coin trunks the ringback signal consists of a continuous on-hook, off-hook flash. When the trunk applies the first on-hook flash to the

incoming tip and ring leads relay CSO releases in turn releasing relay SUPR which completes the circuit for operating relay FL1. The on-hook potential is maintained for a period of 50 to 95 msec after which the trunk applies off-hook potential for the same time duration, operating relay CSO which in turn operates relay SUPR. When relay SUPR operates it causes operation of relay FL2. At the end of the 50 to 95 msec interval the off-hook potential is removed and on-hook potential is again supplied as the trunk continues flashing. The on-hook potential releases relays CSO and SUPR in sequence and relay RBTK is operated through make contacts on relays FL1 and FL2 to ground on a break contact of relay SUPR. When relay RBTK operates it removes ground from the "RB" lead to the trunk. At the end of the on-hook interval the trunk applies the off-hook potential to the incoming tip and ring leads and thereafter stops flashing due to removal of ground from lead "RB". The off-hook potential operates relay CSO and SUPR in sequence. For dial zero trunks, operation of relays RBTK and SUPR provide the check path for the ringback test, operating the next relay in the test sequence.

For special toll trunks, operation of the RBTK relay initiates release of the simulated position which proceeds as described at the end of 4.2. Release of relay OKSP in addition to operation of relays RBTK and SUPR provides the check path for the ringback test, operating the next relay in the test sequence.

4.111 ESS Loop Signaling Coin Trunks

When testing ESS loop signaling coin trunks the ringback signal consists of a timed "Wink" of 104 to 130 msec, a "Quiet" period of 96 to 130 msec followed by a 700- and 1700-cycle MF tone of 918 to 1070 msec duration.

With the SM key operated to the SMA position, the operation of relay RBT grounds lead "RB" to the trunk under test causing operation of its RB and CRB relays. The CRB in operating releases the RV which starts the trunk timer circuit and also sends an on-hook signal to the test circuit resulting in the release of the CSO, SUPR, CS1, and CS2 relays. The release of the SUPR causes operation of relay FL1.

Operation of the FL1 relay causes release of the EMBT and operation of relay EMGT. The EMBT released operates the WKS relay which locks to the WKOK normal and also starts the release of the slow release WKT (55 to 65 msec) relay which had been operated early in the sequence through the ESSL and EMBT operated.

Release of the WKT relay before reoperation of relay EMBT indicates that the trunk has met the minimum "Wink" signal requirement.

Reoperation of the EMBT before the WKT has released will cause operation of relay TBL and in turn the EMT lamp as an indication that the trunk failed to meet the minimum "Wink" signal requirement.

With relay WKT released, relay WKOK is operated and locked through EMPL normal. Slow release relay WKF (95 to 105 msec) starts to release and when the trunk timer ends its timing cycle the trunk RV relay is operated. The on-hook signal is now removed and the off-hook signal reapplied to the tip and ring operating the CSO, SUPR, and FL2 relays. The FL2 relay operated releases the EMGT and operates relay EMBT which restores the operate path for the WKF relay preventing its release.

If the WKF relay releases, relay TBL and lamp EMT will be operated as an indication that the trunk maintained the "Wink" signal in excess of its maximum requirement.

Relay EMBT in operating also causes the operation of the OFH relay and in turn the RCT through make contacts of the OFH and WKOK. The RCT relay connects the "T1" and "R1" leads from the MF receiver through a pad to the secondary winding of the A repeat coil. The primary winding of the A repeat coil is connected to the incoming tip and ring leads of the trunk.

The trunk RV relay having operated also caused the trunk W relay to operate restarting the trunk timer which applies a "Quiet" period of 96 to 130 msec after which the trunk W1 relay will be operated and apply a ringback 700 and 1700 cycle MF tone to the incoming tip and ring leads. Relay W1 operated also starts the trunk 918 to 1070 msec timing stage. The MF receiver on detecting the proper tones grounds the "P1" lead to operate the test circuit EMPL relay which

releases relay WKOK and operates relay GBT to start the 600 to 900 msec STO tube timer. When the STO timing interval expires the STO tube fires and operates the STO relay.

If the trunk maintains the 700 and 1700-MF cycle tones on the tip and ring leads for the timing interval of the STO timer as signified by relay EMPI remaining operated, relay RBTK operates. Operation of relay RBTK indicates that the trunk has functioned properly on ringback test.

Should the trunk fail to maintain tone for the timing interval of the STO timer, relay EMPI will release, in turn releasing relays RCT and GBT preventing operation of relay RBTK thus blocking the test.

When the trunk timing interval expires relay RB releases, tone is removed and test circuit EMPI relay will release. Relay EMPI released releases relay RCT and GBT which in turn releases relay STO. Relay STO released and RBTK operated completes the check path for the ringback test and advances the test circuit to answer test.

4.12 Loop Signaling Noncoin Trunks

For loop signaling noncoin trunks the ringback signal is a high potential of on-hook polarity, +130 volts on the tip lead and -48 volts on the ring lead. When lead "RB" to the trunk is grounded as described above the trunk returns this potential on the incoming tip and ring leads thereby operating the marginal relay MG and releasing relay CSO. Release of the CSO relay releases relay SUPR and operation of relay MG operates relay MGI. With relay MGI operated and SUPR released relay RBTK is operated indicating that the trunk has applied the proper signal to the incoming tip and ring leads. When relay RBTK operates it removes ground from lead "RB" causing the trunk to open the tip and ring leads for a duration of 20 to 40 msec after which normal off-hook potential is restored. The normal off-hook potential operates relays CSO and SUPR in sequence and with relays MG and MGI released the ringback check is given to operate the next relay in the test sequence.

For loop signaling noncoin TSP trunks arranged for completion from No. 1 ESS offices the ringback signal is a timed on-hook, -48 volt battery and ground signal on the tip and ring.

When relay RBT operates it applies ground on the "RB" lead to the trunk operating the trunk RB and RBl relays. Relay RBT also starts the release of the slow release MHB relay which was operated early in the test sequence to insure its slow release property. When the MHB releases after 250 to 500 msec it operates relay RFK which opens the "RB" lead in turn releasing the trunk RB relay. The trunk RB relay releasing applies an on-hook potential to the tip and ring causing release of the CSO and SUPR and operation of relay FL1 in the test circuit.

Operation of the FL1 relay causes release of the EMBT and operation of relay EMGT. The EMBT released operates the WKS relay which locks to the WKOK normal and also starts the release of the slow release WKT (55 to 65 msec) relay which had been operated early in the sequence through the ESSL and EMBT operated.

Release of the WKT relay before reoperation of relay EMBT indicates that the trunk has met the minimum ringback signal requirement.

Reoperation of the EMBT before the WKT has released will cause operation of relay TBL and in turn the EMT lamp as an indication the trunk failed to meet the minimum ringback signal requirement.

With relay WKT released, relay WKOK is operated and locked to relay RBTK normal. Slow release relay WKF starts to release and when the RBl in the trunk releases the on-hook signal is removed and the off-hook signal reapplied to the tip and ring operating the CSO, SUPR, and FL2 relays. The FL2 relay operated releases the EMGT and operates relay EMBT which restores the operate path for the WKF relay preventing its release.

If the WKF relay releases relay TBL and lamp EMT will be operated as an indication that the trunk maintained the ringback signal in excess of its maximum requirement.

Relay EMBT in operating also causes the operation of the OFH relay and in turn the RCT through make contacts of the OFH and WFOK. The RCT in operating closes a path to operate the RBTK indicating end of ringback test and advances test circuit to next test.

4.13 E&M Signaling Noncoin Trunks

For E&M signaling noncoin trunks the ringback signal is an on-hook, off-hook wink on the "M" lead. When relay RBT operates it applies ground on the "RB" lead to the trunk RB relay. Relay RBT also starts the release of the slow release relay RHB which was operated early in the test sequence to ensure its slow release property. When relay MHB is released after 200 to 500 msec it operates relay RFK which opens the "RB" lead to the trunk thereby releasing the trunk RB relay. At this time the trunk will apply ground to the "M" lead to operate relay EMGT and release relay EMBT which had been operated to the off-hook (battery) condition on the "M" lead. Relay EMBT releases relay OFH and operates the WKS relay which locks to the WKOK relay normal. Release of the EMBT relay starts the release of the slow release WKT relay which had operated early in the test sequence through EMPP and EMBT relays operated. When the WKT relay releases it operates relay WKOK which locks to the RBTK relay normal and starts the release of the slow release relay WKF. If the wink on the "M" lead is of proper duration, 70 to 150 msec, ground is removed from the "M" lead and battery is applied by the trunk thereby releasing relay EMGT and operating relay EMBT which restores the operate path for the WKF relay preventing its release. If the wink on the "M" lead was too long relay WKF would release and operate relay TBL to block the test and light the EMT lamp indicating the cause of failure. Relay WKOK operated releases relay WKS. When relay EMBT operates it causes operation of relay OFH to battery on the "M" lead and if the wink is of proper duration relay RCT is operated to operate relay RBTK. Operation of relay RBTK marks the successful completion of the ringback test and the test circuit is advanced to the next test in the sequence.

4.14 E&M Signaling Coin Trunks

When testing E&M signaling coin trunks relay EMCN is operated at the beginning of the test sequence. Relay EMCN operated enables the MF receiver by closing the receiver "A" and "B" leads and prepares the test circuit for checking the E&M coin ringback signal. Relay RBT is operated to start the test and grounds lead "RB" to the trunk to operate the trunk RB relay. The trunk RB relay then operates the W, W1, and W2 trunk relays in sequence. When the W2 relay operates it starts the release of the slow release W relay and also grounds the "M" lead to operate the EMGT relay and releases the EMBT relay which has been operated to the off-hook potential (battery) on the "M" lead. Relay EMBT releases relay OFH and

starts the release of the slow release WKT relay. If the trunk maintains ground on the "M" lead for a minimum of 70 msec relay WKT releases and operates the WKOK relay which locks to the EMPl and EMP2 relays normal. When relay WKT releases it also starts the release of the slow release WKF relay. When the trunk W relay releases battery is applied to the "M" lead releasing relay EMGT and operating relay EMBT which restores the operate path for the WKT relay preventing its release. If the ground wink on the "M" lead was too long relay WKF would release and operate relay TBL to block the test and light the EMT lamp to indicate wink failure.

Relay EMBT operated causes operation of the OFH relay to battery on the "M" lead and in turn relay RCT is operated through make contacts on relays OFH and WKOK. The RCT relay connects the "T1" and "R1" leads from the MF receiver through a pad to the secondary winding of the A repeat coil. The primary winding of the A repeat coil is connected to the incoming tip and ring leads of the trunk. Release of the trunk W relay releases the trunk slow release relay ON which applies the ringback 700- and 1700-cycle MF tones to the incoming tip and ring leads. Relay ON released also starts the trunk 900 to 1500 msec TM tube timer. The MF receiver on detecting the proper tones grounds the "P1" lead to operate the test circuit EMPl relay which releases relay WKOK and operates relay GBT to start the 600 to 900 msec STO tube timer. When the STO timing interval expires the STO tube fires and operates the STO relay. If the trunk maintains the 700- and 1700-cycle tones on the tip and ring leads for the timing interval of the STO timer as signified by relay EMPl remaining operated, relay EBTK operates, indicating that the trunk has functioned properly for the ringback test. Relay RBTK operated removes ground from lead "RB" to the trunk. If the trunk does not maintain the 700- and 1700-cycle MF tones on the tip and ring leads for the timing interval of the STO tube timer relay EMPl releases, and will in turn release relays RCT, GBT, and STO preventing operation of relay RBTK thus blocking the test.

When the trunk TM tube timing interval expires the TM tube fires and releases the W1 and RB relays in sequence. Release of relay RB removes the 700- and 1700-cycle MF tones from the tip and ring leads thereby causing the MF receiver to release relay EMPl. Relay EMPl then releases the RCT relay and relay GBT which in turn releases relay STO. Release of the STO relay with relay RBTK operated completes the check path for the ringback test and advances the test circuit to the next test in the sequence.

4.2 Position Recall Test OS7.2, 17 - SC143

This test is performed on all dial zero trunks and on special toll coin trunk circuits, following completion of the D function test when the SM key is operated to the SMB position. Relay RBT is operated and inserts the high-resistance winding of the CSO relay in series with the incoming tip and ring leads to the trunk. It also starts the release of the slow release relay MHB which was operated early in the test sequence to ensure its slow release property. For the duration of time that the MHB remains operated the high bridge is maintained on the incoming tip and ring leads causing the trunk A and Al relays to release. When the MHB relay releases after 250 to 500 msec the low bridge off-hook condition is restored to the incoming tip and ring leads causing operation of the trunk A relay which in turn operates the trunk PR relay before the slow operate trunk Al relay reoperates. When the PR relay operates it requests connection to the TTP by grounding the "TT" lead to the test circuit. The test circuit and the TSP No. 100A link controller circuit then function as described in the position and data transfer test to establish a link through the link connector between the trunk and TTP. The data transfer circuit then functions to establish a data channel between trunk and TTP in the same manner as described for the position and data transfer test. Information from the trunk is passed to the TTP via the data channel and registered in the TTP. The trunk also passes the position recall indication to the TTP via the data channel by grounding lead "RCL" which operates the RCLK relay. When the data transfer functions are complete the DTOK relay is operated to complete the path through a make contact on relay RCLK for operating the RBTk relay which is the check indicating proper trunk operation for this test.

When testing special toll coin trunk circuits relay RBTk operates relay SPD which functions to release the TTP by releasing the connector link hold magnets and relays SSP and OKSP in sequence. When the TTP is released as indicated by release of the OKSP relay it marks the completion of the position recall test and the test circuit is advanced to the next test in the sequence.

4.3 Tandem Operator Hold Test OS7.2, 17 - SC140

Following the D relay function test, with the SM key normal, the tandem operator hold test of TSP trunks is initiated, relay

RBT is operated on completion of the D relay function test and operates relay TOHT. Relay RBT also inserts the high-resistance winding of the CSO relay in series with the incoming tip and ring leads thereby causing release of the trunk A and Al relays. The trunk Al relay in releasing applies ground to lead "OS" to operate the test circuit OS relay which in turn operates relay GBT to start the STO tube timer. During the one-second minimum timing interval of the STO tube timer the TOHF relay monitors a break contact on the SK relay which is held operated through a make contact on the trunk D1 relay. If the tandem operator hold feature of the trunk is functioning properly the trunk D and D- relays will remain operated during the time that the trunk A and Al relays are released thus maintaining the test circuit SK relay operated preventing operation of relay TOFH. If, due to a trouble condition in the trunk, the D and D- relays release, relay SK will release and operate the TOHF relay which blocks the test and lights the TOHF lamp to indicate the failure. To prevent release of the trunk and office link hold magnets in case of tandem hold failure, ground is maintained on the "S" lead to the office link frame through a make contact on the TOHT relay which was operated at the start of the test.

On completion of the STO tube timing interval the STO tube fires to operate relay STO which in turn operates relay STO2. If the TOHF relay has not operated, indicating proper trunk operation, the STO2 relay shunts the high-resistance winding of the CSO relay through a break contact on relay TOHF thereby causing the trunk A and Al relays to operate. Operation of the trunk Al relays releases relay OS. The STO2 relay will also release relays TOHT, GBT, and STO in sequence. Following successful completion of this test the test circuit advances to the coin collect test when testing coin trunks by grounding lead "CC" to the trunk through the position link connector crosspoints. When testing noncoin trunks relay RBTk is operated to advance the test circuit to the CS relay test.

4.4 Coin Collect Test for TSP Coin Trunks OS2.2, 21 - SC140

When relay OS releases on completion of the tandem hold test the "CC" lead to the trunk is grounded through the position link connector crosspoints to start the coin collect test.

For loop signaling trunks, except those from electronic switching offices, ground on

lead "CC" operates the trunk CC relay which in turn operates the trunk MO relay. Relay MO applies the high-voltage on-hook potential to the incoming tip and ring leads (+130 volts tip, -48 volts ring). When the coin collect potential is applied by the trunk it causes operation of relay MG and releases relay CSO which had been operated to the normal off-hook potential on the tip and ring leads. Release of relay CSO releases relay SUPR and operation of relay MG operates the MGI relay. Release of the SUPR relay and operation of the MGI relay complete the path for operating relay RBTK indicating that the trunk has functioned properly in applying the coin collect potential to the incoming tip and ring leads. Relay RBTK operated removes ground from the "CC" lead thereby releasing the trunk CC relay which in turn restores normal off-hook potential to the incoming tip and ring leads. The off-hook potential operates relays CSO and SUPR in sequence and causes release of relays MG and MGI. For dial zero trunks, relay RBTK operated initiates release of the simulated position which proceeds as described in 4.2. Release of relays MGI and OKSP and relay SUPR operated complete the check path for the coin collect test through relay RBTK operated to advance the test circuit to the CS relay test. For special toll coin trunks operation of the RBTK relay advances the test circuit to the diode verification test.

For loop signaling trunks associated with electronic switching offices the coin collect signal consists of an on-hook off-hook "Wink", a "Quiet" period and a 700- and 1100-cycle MF tone on the tip and ring. Trunk operation and test circuit detection of these signals is as described in 4.111 except that operation of relays EMP1, EMP2, and STO with SM key normal, operates relay RBTK. When the trunk has completed its tone period tone is removed and relays EMP1, EMP2, RCT, GBT, and STO release. Release of the STO relay with relay RBTK operated and relay OKSP released completes the check path for the coin collect test and relay CST is operated to advance the test circuit to the CS relay test.

When testing E&M signaling coin trunks relay EMCN is operated at the beginning of the test sequence and relay EMPP is operated when the TTP is requested as signified by operation of relay PRQ. Relay EMCN enables the MF receiver by closing the receiver "A"

and "B" leads and prepares the test circuit for checking the E&M coin collect signal. When relay OS releases at the end of the tandem hold test it grounds the "CC" lead to the trunk through the position link connector crosspoints to operate the trunk CC and W relays in sequence. Relay W operates the trunk W1 and W2 relays. When relay W2 operates it starts the release of the slow release W relay and also grounds the "M" lead to operate the EMGT relay and releases the EMBT relay which had been operated to the off-hook potential (battery) on the "M" lead. Relay EMGT operated and relay EMBT released operates relay WKS which locks to a normal contact of relay WKOK. Relay EMBT releases relay OFH and starts the release of the slow release WKT relay. If the trunk maintains ground on the "M" lead for a minimum of 70 msec relay WKT releases and operates the WKOK relay which locks to the EMP1 and EMP2 relays normal. Relay WKOK operated releases relay WKS. When relay WKT releases it also starts release of the slow release WKF relay. When the trunk W relay releases battery is applied to the "M" lead releasing relay EMGT and operating relay EMBT which restores the operate path for the WKF relay preventing its release. If the ground wink on the "M" lead was too long relay WKF would release and operate TBL to block the test and light the EMT lamp to indicate wink failure. If the ground wink is of too short duration as indicated by relays WKS, WKT, and EMBT operated and relay EMGT released, relay TBL will operate thereby blocking the test and lighting the EMT lamp to indicate wink failure.

Relay EMBT operated causes operation of the OFH relay to battery on the "M" lead and in turn relay RCT is operated through make contacts on relay OFH and WKOK. The RCT relay connects the "T1" and "R1" leads from the MF receiver through a pad to the secondary winding of the A repeat coil. The primary winding of the A repeat coil is connected to the incoming tip and ring leads of the trunk. Release of the trunk W relay releases the trunk slow release relay ON which applies the coin collect 700- and 1100-cycle MF tones to the incoming tip and ring leads. Relay W released also starts the trunk 900 to 1600 msec TM tube timer. The MF receiver on detecting the proper tones grounds leads "P1" and "P2" to operate the test circuit EMP1 and EMP2 relays which then release relay WKOK and operate relay GBT to start the 600 to 900 msec STO tube timer. When

the STO timing interval expires the STO tube fires and operates the STO relay. If the trunk maintains the 700- and 1100-cycle tones on the tip and ring leads for the timing interval of the STO timer as signified by relays EMP1 and EMP2 remaining operated, relay RBTk operates and removes ground from the "CC" lead. Operation of relay RBTk indicates that the trunk has functioned properly for the coin collect test. If the trunk does not maintain the 700- and 1100-cycle MF tones on the tip and ring leads for the timing interval of the STO tube timer relays EMP1 and EMP2 release and will in turn release relays RCT, GBT, and STO preventing operation of relay RBTk thus blocking the test.

Operation of the RBTk relay initiates release of the simulated position which proceeds as described in 4.2.

When the trunk TM tube timing interval expires the TM tube fires and releases the W1 and CC relays in sequence. Release of relay CC removes the 700- and 1100-cycle MF tones from the tip and ring leads thereby causing the MF receiver to release relays EMP1 and EMP2. Relays EMP1 and EMP2 then release the RCT relay which in turn releases relays GBT and STO. Release of the STO relay with relay RBTk operated and relay OKSP released completes the check path for the coin collect test and relay CST is operated to advance the test circuit to the CS relay test.

4.5 Diode Verification Test - TSP Special Toll Coin Trunks

When relay RBT operates, relay DTM is operated to insure its slow release characteristic. Operation of the RBT relay also establishes the reverse test potential of 88.6-volts positive. Operation of relay DTM applies the test potential to the trunk "TL" lead via the TSP No. 100A link and connector circuit.

When relay RBTk operates upon completion of the Coin Collect Test, the reverse test potential is examined by the trunk test circuit by applying the test potential to the firing anode of the DK tube. If the combined back resistance of the two trunk diodes is greater than approximately 0.2 meg ohm the test potential will be sufficiently high to fire the DK tube. The DK tube firing will operate relay RDK which locks to relay RBT or DTM operated.

When relay RDK operates, the forward test potential is applied to the "TL" lead. Only the TL diode is tested for forward current since, if the TLL diode were open, the data transfer circuit would not be able to function and an indication of trouble will be displayed by the trouble recorder circuit. The TL diode is checked for a minimum forward current of 43.5 ma. Satisfactory forward current will operate relay FDK which locks. Relays RDK and FDK operated initiate release of the simulated position which proceeds as described in 4.2. Release of relays OKSP and MGI and relay SUPR operated complete the check path for advancing the test circuit to the next test in the sequence.

Satisfactory completion of the reverse and forward diode tests is required prior to the release of slow release relay DTM. If relay DTM releases prior to completion of the forward or reverse diode checks, the simulated position will not release and the test circuit will block. Relay DTM releasing with either relay RDK or FDK released will light the DTF lamp indicating failure of the diode verification test.

5. TRUNK TEST FUNCTIONS - SUPERVISION FROM THE CALLED PARTY

The conditions of the terminating subscribers line are indicated to the tandem trunk by polarity changes which operate and release the trunk CS relay. In trunks without tone appliers the test circuit checks operations of the CS relay either by a lead from a CS contact or by a check of the repeated supervision. A trunk may have a tone applier which includes a CS relay follower. In the following paragraphs reference is made to the trunk CS relay which may be assumed to include the CS relay follower relay if a tone applier is used. For PCI trunks the CS relay follower is the tone applier CS1 relay and for DP and MF loop signaling trunks it is the tone applier SV relay.

5.1 CS Relay Test (CST) Figs. 9 and 19 ("Mfr Disc.")

Operation of the CST relay extends the start lead ground to operate the CSS relay. Operation of the CST relay operates the NAT relay. Operated NAT and CST relays partially complete a circuit to operate the O-counter relay in preparation for counting pulses. The CST and CSS relays operated open the connection between the 5 and 6 counting stages.

In effect the chain of 0 to 10 counters is broken into two chains. One consists of six stages and the other of five stages.

The six stages consists of counter pairs 0-5 and reflect the test frame preparation for counting the CS relay operations of the trunk circuit. The closures of the BB interrupter control the operations of the 0' to 5' counter relays. The closures from the BB interrupter are of 1.3-seconds duration. This is less than the minimum trunk delay interval of 2 seconds, so that the trunk should not initiate an answer entry on the tape. If the trunk is functioning improperly, so that an answer entry is initiated at this time, the FC relay operates from the CII relay and the test blocks with the FC lamp lighted.

Since the BB interrupter cycle requires a total of 1.5 seconds, a total of four cycles or 6 seconds remain after the first complete interval of off-hook supervision. Sufficient time is allowed for the trunk charge interrupter to complete its maximum cycle of 5 seconds and record a false charge condition on the tape.

The five stages consist of counter pairs 6 to 10 which indicate to the test frame satisfactory operations of the trunk relay by the operate and release of the CS1 relay operating the 6" to 10' counting relays.

The CSS relay operated extends ground from the BB interrupter operating the BB relay. Open period of the BB interrupter releases the BB relay. Release of the BB relay removes the shunt from the winding of the 0'- counter relay and it operates. Operated 0'- counter relay operates the CSA relay. Operation of the CSA relay occurs at the end of the closed cycle of the BB interrupter so that the next closure of the BB interrupter is certain to last for the complete closed interrupter interval. On this closure, BB relay operated, will operate the RV relay under control of the CSA relay. Operated RV relay reverses the polarity of the potential applied to the trunk CS relay and it operates. In SUP trunks the operation of the trunk CS relay operates the trunk T which reverses the polarity to the test circuit CS0 relay and it operates operating relays CS1 and CS2. In NS trunks the operation of the trunk CS relay operates the CSF relay which operates relays CS1 and CS2. In DP trunks the CS relay releases the TLI relay which operates relays CS1 and CS2. Operated CS1 relay operates CSB relay and it locks. The CSB relay operated provides alternate paths to operate the 0 and 6 counter relays. When the BB interrupter opens at the end of the first full closure, the CR resistance remains in the circuit to apply a release condition to the trunk CS relay and it releases. Open period of the BB interrupter releases the BB relay. Release of the BB relay removes the shunt from

the 1'- counter relay and it operates. Release of the CS1 relay due to the CS relay in the trunk circuit releasing, removes the shunt from the 6' counter and it operates.

The BB interrupter continues to close and open its contacts for a total of five pulses after which the 5' relay operates to shunt-down the CSA relay. The CSA relay released opens the path to the BB relay, stopping further closures and releasing the RV relay. This reapplies a negative soak to the trunk CS relay, which then remains in a released condition. If the trunk CS relay released properly on each of the five counted closures the 10' counter relay will be operated. Operation of the 10'- counter relay gives an OK check by extending the ground to operate in sequence the next test function.

5.2 CS Relay Test OS6, 9.1 - Figs. 19 and 46 - SC9.1

Operation of relay CST as the result of an OK check from the previous test, operates relays CSS and CSS1. Relays CSS and CSS1 operated convert the NA-MFF counting and steering relay chain into two independent counting chains. Relays NA-TH comprise a counting chain to count the closures of interrupter BB. Relays HU-MFF comprise a counting chain to follow the action of the trunk CS relay.

The closures of the BB interrupter are of 1.3-seconds duration. This is less than the minimum trunk delay of 2 seconds, so that the trunk should not initiate an answer entry on the tape. If the trunk is functioning improperly, so that an answer entry is initiated at this time, relay FC operates from relay CII and the test circuit blocks with lamp FC lighted.

Since the BB interrupter cycle requires a total of 1.5 seconds, a total of four cycles or 6 seconds remain after the first complete interval of off-hook supervision. This is sufficient time to allow the trunk charge interrupter to complete its maximum cycle of 5 seconds and record a false charge on the tape if required.

The CSS relay operated causes operation of relay BB as soon as interrupter BB back contact closes. Open periods of BB interrupter contact release relay BB. The first operation of relay BB conditions both counting chains for use by causing relays NA and HU to operate and lock. Relay NA operated operates relay NTA which locks and opens the original operate paths of relays NA and HU. Relay NA operated also causes relay NB to operate and lock. Relay NB operated transfers the locking path of relay NA to the ground from the closed interrupter contact. When the interrupter contacts

open to release relay BB, relay NA releases causing relay CSA to operate. The next closure of the interrupter contact is certain to last for the complete closed interval. On this closure, relay BB operated, will operate relay RV under control of relay CSA. Relay RV operated reverses the polarity of the potential applied to the trunk CS relay causing it to operate. Trunk CS relay operated in PCI trunks causes operation of trunk T relay in turn causing operation of relay CSO for SUP trunks or relay CSF for NS, NAS, and ACI trunks. In MF or DP trunks operation of trunk CS relay releases relay TL1. In any case operation of relay CSF or CSO or the release of relay TL1 causes operation of relays CS1 and CS2. Relay CS1 operated causes relay CSB to operate and lock. Relay CSB provides means to permit the NA-TH relay chain to count the BB interrupter contact closures and opens and for HU-MFF relay chain to follow the trunk CS relay action independently.

When the BB interrupter opens to release relay BB, resistor CR remains in the circuit to apply a release condition to trunk relay CS and it releases. Relay BB released also releases counting relay NB. The DP or MF trunk CS relay released operates relay TL1 which in turn releases relays CS1 and CS2 to release CS relay counting relay HU. The PCI trunk CS relay is monitored by the CSO or CSF relay.

The BB interrupter continues to alternately close and open its contacts for a total of five pulses after which counting relay TH operated and CDA released shunt-down relay CSA. Relay CSA released opens the operate path for relay BB and releases relay RV. This applies a negative soak to trunk relay CS, which then remains in a released condition. If the trunk CS relay released properly on each of the five counted BB closures, relay MFF will be operated with relay STS released. This provides an OK check for the CS relay test and advances the test circuit to the next test sequence. If trunk CS relay does not respond properly during this test by operating more or less than five times, the test circuit will block and display an alarm.

5.21 Joint Hold Test - Incoming Trunk From PBX, POT-PMR Key Operated to the POT Position (Operator Class Call) OS 3, 6, 9, 10, 17, 19 and 24 Figs. 14, 19, 20, 46 and 157 SC-36

When testing incoming trunks from PBX with the POT-PMR key operated to the POT position (operator class) relay POT is operated when the connector crosspoint closes

and applies ground to the "PXL" punching. Relay POT operates relays POT1 and NAMA, the NAMA relay in turn applies ground to the armature of the "DS" interrupter. When the CST relay operates as a result of an OK check of the D relay function test it operates relays CSS and CSS1 in sequence. The following closure of the "DS" interrupter front contact causes the operation of relay BB through operated contacts on the CSS1 and POT relays from ground on the operated NAMA relay. Relay BB in operating operates the NA relay which then operates the NB and NTA relays in sequence. Approximately 0.5 seconds after the first closure of the "DS" interrupter the front contact is opened releasing relay BB which then releases the NA relay. Release of relay NA causes the operation of the HU and CSA relays, the latter relay lighting the CSA lamp. When the "DS" interrupter again closes its front contact approximately 2.5-seconds later, the BB relay operates causing the operation of relay RV which applied a positive soak to the CS relay in the trunk, via the return test line, causing it to operate. When the CS relay in the trunk operates it operates the trunk RV relay and removes ground from the "TL1" lead causing release of the test circuit TL1 relay. The trunk RV relay in operating applies an off-hook signal to the incoming "T" and "R" leads causing operation of the test circuit CSO relay. Release of relay TL1 operates the CS1 and CS2 relays, the CS1 in turn lighting the SUPV lamp and operating relays NC and TND. When the "DS" interrupter opens its front contact approximately 0.5 seconds after the last closure it releases the BB relay. Release of relay BB releases relay NB and inserts the 30,000-ohm winding of relay CSO into the incoming loop to the trunk, simulating a PBX extension on-hook signal, thereby releasing the trunk A relay. The release of the trunk A relay inserts the 30,000-ohm winding of the trunk CS relay into the outgoing loop, which is the high-resistance flash to the operator, thereby causing release of the test circuit SK relay. Release of the SK relay causes release of relays SK1 and SK2 and the SK2 in turn releases the HU relay. If the trunk CS relay fails to hold on its 30,000-ohm winding or if the trunk D relay fails to hold, when the trunk A relay releases, to a ground provided through operated contacts on the trunk OT and RV relays a joint hold failure is indicated to the test circuit by ground on the "TL1" lead which operates the test circuit TL1 relay or by removal of ground from the "D" lead which releases the test circuit DLK relay. In either case the NTA and CSA relays will release in sequence immediately blocking the test circuit and lighting the JHF lamp.

The "DS" interrupter closes its front contact approximately 2.5 seconds after the start of the previous open interval and operates relay BB which then operates relay AD and simulates a PBX extension off-hook signal by shunting the 30,000-ohm winding of the test circuit CSO relay causing the trunk A relay to operate. When the trunk A relay operates it shunts the 30,000-ohm winding of the trunk CS relay thereby operating the test circuit SK relay which in turn operates the SK1, 2 relays and relay SK2 then operates the U relay.

The "DS" interrupter continues to pulse relay BB which transmits 0.5-second off-hook and 2.5-second on-hook signals to the trunk on the incoming "T" and "R" leads causing the trunk A relay to operate and release. The operation and release of the trunk A relay causes high-resistance flashes to be returned to the test circuit via the return test line thereby operating and releasing the SK and SK1, 2 relays. Succeeding pulses of the BB relay release relay NC, operate relay BD, release relay AD, operate relays CD, CD1, and CDA, release relay BD, operate relays TH and TH1 and release relays CD, CD1, and CDA all in the given sequential order. The corresponding high-resistance flashes returned to the test circuit pulse the SK and SK1, 2 relays which release relay TND, operate relay STA, release relay U, operate relays STS and STS1, release relay STA, operate relay MFF and release relays STS, STS1, all in the given sequential order. When the fifth on-hook signal has been transmitted to the trunk, as indicated by release of relays CD, CD1, and CDA, the test circuit CSA relay releases extinguishing the CSS lamp and lighting the FFF lamp. When the fifth high-resistance flash has been returned to the test circuit, as indicated by the release of relay STS1, the trunk A relay operates shunting the 30,000-ohm winding of the trunk CS relay thereby causing the test circuit SK relay to operate. Relay SK in operating operates the SK1 and SK2 relays, the SK2 relay in turn releases the test circuit RV relay. Relay RV in releasing applies a negative soak to the trunk CS relay, thereby causing its release. Release of the trunk CS relay releases the RV relay in the trunk which in turn applies an off-hook signal to the incoming "T" and "R" leads to operate the test circuit CSO relay. Release of the trunk CS relay also applies ground to

the "TLL" lead to the test circuit operating the TLL relay. In turn relay TLL releases relays CS1, CS2, and NTA. Relay CS1 in releasing extinguishes the SUPV lamp and grounds the "CSKT" lead to operate the ANS relay which marks the successful completion of the joint hold test. When relay ANS operates the FFF lamp is extinguished and the relays operated for the joint hold test are released.

5.3 ANI Supervision - SC33

5.31 Non-ANI Operation

If the PCI, MF, or DP trunks to be tested are arranged to return off-hook supervision immediately after sender release (PCI) or when the called number has been registered (DP or MF) the associated CG terminal is cross-connected as covered under the cross-connection data table for terminals NAS, ADC, AD3, 15A3, PMAS, and RIPS. On the NAS, 15A3, PMAS, and RIPS conditions the trunk class relay NAS closes the trunk "CSF" lead to the CSF relay and operates the SUP relay and lights the NAS lamp.

At the end of D relay function test the sender releases the trunk which then presents reversed supervision to the test circuit. The reversal operates the CSO relay and with the NAS operated the AST relay operates. The AST places the FS relay locking circuit under control of the CSO front contacts. Should the CSO relay release at any time before disconnect test the FS relay releases and blocks the circuit. The AST also advances the circuit from the D function test to the next test sequence. During CS relay test the CSF relay follows the trunk CS operations. When the DISA relay operates for disconnect test it opens the lock path for the AST relay which releases. Subsequent operation is the same as SUP class trunks.

On the ADC and AD3 conditions, the NAD trunk class relay which is operated from the ADC or AD3 terminal lights the NAD lamp and operates the 2WC or the 2W3 class relays. At the completion of the PLB pulsing the sender causes the trunk to reverse the supervision to the circuit. The reversal operates the CSO or OFH relay either of which operates the AST relay. The AST closes the path to operate the IET test sequence relay. The subsequent operations are the same as described for PCI trunk with ANI type supervision.

5.4 Answer Test (ANS) OS9.1 - Fig. 20 - SC9, 37

The ANS relay operates to initiate the answer test. This test is made for all calls completed to the return test line, except for the transmission test. At the time the ANS operates the RV relay should be normal. Negative soak will then be applied to the trunk CS relay. The trunk will in turn return on-hook supervision to the test circuit so that the CS0, CS1, and CS2 relays will be normal. The soak current to the trunk CS relay will operate the SK and in turn the SK1 and SK2 relays. The ANS and SK2 operated, operates CS3 relay and it locks. The CS3 operated operates RV which reverses the current to the trunk CS relay and closes a path through the CC and CB resistors in series with the SK winding. When testing incoming trunks from PBX, relay PXL1 will be operated placing the CG and CF resistances in series with the SK relay winding when relay CS3 operates. The combined value of the circuit resistance is such that a test operate condition is applied to the trunk CS relay and it operates. The current flow through the SK winding should be reduced by these resistances sufficiently so that it releases, in turn releasing SK1 and SK2.

In PCI-SUP trunks the operation of trunk CS relay operates trunk T relay which reverses the polarity on the tip and ring leads to the test circuit and operates relay CS0 in turn operating relays CS1 and CS2. In PCI-NS and NAS-ACI trunks the operation of trunk CS relay causes relay CSP to operate which in turn operates relays CS1 and CS2. Should supervision be falsely returned relay FS releases to block the test.

In all DP and MF trunks relay CS releases the TL1 relay which operates relays CS1 and CS2. Relay CS1 operated causes relay CSX to release and transfer control of supervision monitoring relays CS1 and CS2 in preparation for disconnect tests. Control of relays CS1 and CS2 is transferred to relay CS0 for supervision-type PCI and MF loop signaling trunks and DP-2W trunks, to relay SBF for DP-3W trunks, to relay OFH for E&M lead signaling trunks, or to CSF for PCI nonsupervisory, NAS or ACI trunks. This provides a check that proper supervision is being returned toward the originating office when required. The CS1 operated closes a contact shunting the test resistance which gives a full soak to the CS relay to make

the contact closure more reliable. Relay SK will reoperate and operate SK1. The path to the SK2 is now open because both the ANS and RV relays have operated, so that it will remain normal.

Two to five seconds after the trunk CS relay operates, the charge delay interval of the trunk should expire and an answer entry be placed on the AMA tape by the recorder. When the call identity indexer identifies the trunk, 2-out-of-5 of the "T0" to "T7" leads and 2-out-of-5 "U0" to "U7" leads are grounded from the recorder to the trunk test circuit. If the call identity index coincides with that previously encountered on the initial entry, paths from these leads will be closed through the operated T0 to T7 and U0 to U7 relays to operate the TK1, TK2, UK1 and UK2 relays. If these relays operate, the path to the CII relay is closed and it operates. The CII operated in turn closes a path to the "TER" lead from the recorder. If the recorder satisfactorily perforates the answer entry, a check signal is received on this lead in the form of a ground to operate the AE1 relay which then locks to the ANS relay. The release of the call identity indexer will remove the operating grounds for the TK1, TK2, UK1, and UK2 relays which will then release, in turn restoring the CII relay. With the AE1 operated the check path closure should be complete and the test sequence will then advance. The release of ANS after the test sequence circuit has functioned will allow SK2 to operate and the CS3 and AE1 relays to release.

If the trunk CS relay did not operate on the test condition, the test circuit will block and the CS0 lamp will light as an indication of trouble. If the CS relay does operate but the answer entry is not completed by the recorder, the AE1 relay will not operate. The test set then blocks with the AEF lamp lighted as an indication of this failure.

The 3WS class trunks return answer supervision on the loop at the end of the charge delay interval, in addition to maintaining supervision on the "S" lead to the code selector multiple. In order to check this feature, the WOK relay is operated by the operation of AE1. The WOK operated opens the ground applied by the SBF relay to supervision monitoring relays CS1 and CS2, thus transferring control of CS1 and CS2 to the CS0 relay. If the CS0 relay is

operated, indicating that proper supervision is being returned on the loop toward the originating office, the circuit will advance to the DIS test. However, if the CSO relay is not operated, the CS1 and CS2 relays will release. The release of CS2 will cause the CSO lamp to light as an indication of failure to receive answer supervision. The CS2 released will, in addition, prevent the test frame from advancing to the next test function.

When testing incoming trunks from PBX with POT-PMR key normal (CAMA class) the answer test is made as described above for DP-2W trunks. If the test is made with the POT-PMR key operated to the PMR position (message register class) the trunk does not initiate an answer entry to be perforated on the AMA tape, therefore, the AMA functions of this test are bypassed. With the POT-PMR key operated to the PMR position the test circuit checks the operation of the trunk CH relay over the "TL1" lead. When the trunk CS relay operates and removes ground from the "TL1" lead the test circuit TL1 relay releases. Release of the TL1 relay operates the TLT relay through operated contacts on the ANS and PMR relays. Relay TLT in operating transfers the "TL1" lead from the winding of the TL1 relay to the grounded winding of the CHO relay. When the trunk CH relay operates after the 2- to 5-seconds charge delay interval which is timed in the trunk, resistance battery is applied to the "TL1" lead causing operation of the test circuit CHO relay. The CHO relay locks through an operated contact on the TLT relay to battery supplied through the 1000-ohm CHO resistance. When relay CHO operates it marks the successful completion of the answer test for a message register class call and the "ANSK" lead is grounded to operate the DIS relay which advances the test circuit to the "disconnect test."

When testing incoming trunks from a dial PBX with the POT-PMR key operated to the POT position (operator class) the answer test is made as described above for DP-2W trunks however, the AMA functions of the test are bypassed since the trunk does not initiate an answer entry to be perforated on the AMA tape. Upon completion of the answer test relay SDT is operated through an operated contact on the POT1 relay to advance the test circuit to the "ringback test" which is made only on an operator class call.

When testing TSP trunks a timing test is performed during the ANS sequence. See 5.5

5.41 Ringback Test - Incoming Trunk From PBX, POT-PMR Key Operated to the POT Position (Operator Class Call) OS-3, 9, 17, 19 and 24 Figs. 14, 19, 20 and 157, SC-37

When testing incoming trunks from PBX with the POT-PMR key operated to the POT position (operator class) relay POT is operated when the connector crosspoint closes and applies ground to the "PXL" punching. Relay POT operated operates relays POT1 and NAMA. Relay SDT operates through the operated contacts on the POT1 relay as a result of an OK check of the "answer test" and applies ground to the armature of the "DT" interrupter. On the following closure of the "DT" interrupter back contacts, relay DT2 is operated and locks to ground on the operated contacts of the SDT relay. Operation of the DT2 relay releases relay RV which applies a reversal (on-hook) to the outgoing loop thereby releasing the trunk CS relay. When the CS relay releases it releases the trunk RV relay which repeats the reversal on the incoming "T" and "R" leads causing the test circuit CSO relay to release. Release of the CSO relay releases relays CS1 and CS2. In turn the CS1 relay extinguishes the SUPV lamp and the CS2 relay operates relay SDF. The "DT" interrupter opens its back contact 0.15 seconds after the last closure and operates its front contacts 0.98 seconds later. On this closure relay DT3 operates and operates relay RV which applies an off-hook signal to the outgoing loop thereby operating the trunk CS relay. When the CS relay operates it operates the trunk RV relay which repeats the off-hook signal on the incoming "T" and "R" leads causing operation of the test circuit CSO relay. The CSO relay in operating operates relays CS1 and CS2. In turn the CS1 relay lights the SUPV lamp and operates relay DIS. Operation of the DIS relay releases the SDT relay which then releases relays DT2, DT3, and extinguishes the SDT lamp. Operation of relay DIS marks successful completion of the "ringback" test and the DISA relay is operated lighting the DIS lamp.

5.42 Timing Tests for TSP Special Toll Coin Trunks - OS31, 32.1, 32.2

5.421 Accelerated Timing Test

5.4211 Initial Period Timing - SC151

On completion of the previous test function, with the SM key operated to the

SMA position, relay ANS is operated and in turn operates relay TMT to prepare the test circuit for the accelerated timing test. Relay TMT operated connects ground to the armature of the GT interrupter and operates the trunk RTB relay by grounding the "RTB" lead to the trunk. The RTB relay in operating connects the "M6", "M60", "CC", and "OK" leads, required for making the accelerated timing test, into the test circuit. The initial period time IPT selector switch and overtime period time OPT selector switch permit selection of any combination of initial and overtime periods. The following description of operation is for the initial period time IPT selector switch set to five minutes. For any other initial period time setting one, two, three, or four the operation of the trunk and trunk test circuits is similar except that the sequence of operation described for the fifth minute occurs in the first, second, third, or fourth minutes depending on the setting of the IPT selector switch. The IPT selector switch may also be set to the NM position to make the "no minutes" timing test.

Note: CTM key must be normal when making the NM test.

When the GT interrupter makes its front contact relay GTF operates and in turn causes relay GTL to operate to ground on the "HMG" lead from the trunk. Ground is applied to the "HMG" lead from the trunk when the trunk STT relay operates during the answer sequence. Operation of the trunk CH relay initiates perforation of the answer entry as described in 5.4. Operation of relay AEL indicating completion of the answer entry causes operation of relay TMTA. Relay TMTA operated lights the TMT lamp indicating start of the timing test and releases relay TK1, TK2, UK1, and UK2. Release of any one of the four relays mentioned releases relay CII. Relay GTF releases when the GT interrupter moves off its front contact, and when the GT interrupter makes its back contact relay GW operate. The GW relay operates relay SIX which operates the TOK relay and also grounds the "M6" lead to the trunk. Relay TOK operates relay TMC1 and the trunk OK relay by applying ground to the "OK" lead. At this time, with the IPT selector switch in the NM position, relay TETP will operate which in turn will

operate relay TRCY when relay TOK releases. Operation of the TRCY relay will release the TMC1 relay.

When the trunk OK relay operates it causes the trunk MC1 relay to operate to ground on the "M6" lead. The GT interrupter continues to pulse and breaks its back contact causing operation of relay GZ which in turn releases relay TOK and the slow release SIX relay. Release of the TOK relay releases the trunk OK relay. The GT interrupter then makes its front contact to operate relay GTF which operates relay CC. Relay CC applies ground to the "CC" lead to the trunk and operates relay TOK which grounds the "OK" lead to the trunk operating the trunk OK relay. The trunk CH1 relay is then operated through a make contact on relay OK to ground on the "CO" lead. If the IPT selector switch is set to the NM position the operation of the trunk CH1 relay will operate the trunk relay CTT through a make contact of the trunk NM relay. Relay CTT in operating removes ground from the "HMG" lead releasing relay GTL which prevents any further timing pulses from being transmitted to the trunk. Relay GTL in releasing also operates the IPCK relay at this time which prepares the check path to advance the test circuit to the normal disconnect test (See 5.614) when relay CC releases.

If the IPT selector switch is set to any position other than NM, or if the trunk fails to remove ground from the "HMG" lead to stop timing with the IPT selector switch set to the NM position, in approximately 500 msec the GT interrupter moves off its front contact thereby releasing relay GTF which releases relay TOK and the trunk OK relay in sequence. Relay GTF also releases the slow release CC relay. When the GT interrupter makes its front contact relay GW releases and operates the SXTY relay which in turn operates the TOK relay. The TOK relay operates the TMC2 relay and the trunk OK relay.

At this time if the IPT switch is set in the NM position the TOK relay operates relay ETM. Relay M60 in the trunk then operates to ground on the "M60" lead through a make contact on the OK relay. The trunk MC2 relay is also operated by relay OK

through make contacts on the trunk MC1 and M60 relays. When the GT interrupter breaks its back contact relay GZ is released and in turn releases the SXTY and TOK relays.

When relay SXTY releases with IPT switch in the NM position the FTM relay operates to block the test frame and indicate NM failure by lighting the FTM lamp. On all other settings of IPT switch, release of the SXTY relay causes release of relay TMC1 and the release of relay TOK releases the trunk OK, M60, and MC1 relays in sequence, signifying the end of the first minute of initial period timing. As the GT interrupter continues pulsing the test circuit and trunk relays are operated and released as described above. Succeeding operations of the test circuit TOK and SXTY relays operate relays TMC3 and TMC1. Similarly, succeeding operations of the trunk OK and M60 relays, operate the trunk MC3 and MC1 relays signifying the end of the second and third minutes of the initial period. When the test circuit TOK and SXTY relays operate at the end of the fourth minute of the initial period the test circuit TETP and trunk ETP relays operate. Following the operation of relay TETP, relay TRCY operates when the TOK relay releases on termination of the same timing pulse that had operated relay TETP. Similarly, the trunk RGY relay operates when the trunk OK relay releases as a result of the release of relay TOK. Operation of the TRCY relay releases relays TMC1, TMC3, and TETP. Operation of the trunk RGY relay releases the trunk MC1, MC3, and ETP relays. The next operation of the test circuit CC and TOK relays, due to the continued pulsing of the GT interrupter, operate the trunk OK and CC relays causing the trunk to return the coin collect signal to the test circuit on the incoming tip and ring leads.

For loop signaling trunks except from ESS offices, operation of the trunk CC relay causes the trunk M0 relay to operate which applies the high voltage on-hook potential to the incoming tip and ring leads (+130 volts on the tip lead, -48 volts on the ring lead). The collect potential operates the test circuit MG relay and releases relay CSO which had been operated to the normal off-hook potential on the incoming tip and ring leads. Release of relay CSO releases relay SUPR and operation of relay MG operates the MGI relay. Relay CCK is then operated through a break contact on relay SUPR and a make contact on relay MGI.

For loop signaling trunks from ESS offices the coin collect signal consists of an on-hook, off-hook "Wink", a "Quiet" period and a 700- to 1100-cycle MF tone. Trunk operation and test circuit detection of these signals is as described in 4.111 except that operation of relays EMP1, EMP2, and STO operate relay CCK indicating that the trunk has functioned properly in transmitting the collect signal.

The coin collect signal for E&M signaling trunks consist of an on-hook, off-hook wink on the "M" lead followed by 700- and 1100-cycle tones on the incoming tip and ring leads. Trunk operation and test circuit detection of these signals is as described in the coin collect test. When the EMP1, EMP2 and STO relays operate as described in the coin collect test, relay CCK operates indicating that the trunk has functioned properly in transmitting the collect signal.

Relays CC and TOK in the test circuit release at the end of the timing pulse and in turn release the trunk OK and CC relays. The following timing pulse of the GT interrupter releases relay GW which operates relay SXTY. The SXTY relay operates the TOK relay and grounds the "M60" lead to the trunk. Relay TOK operates relay ETM and the trunk OK relay which in turn operates relay M60 in the trunk to ground on the "M60" lead. Relay ETM releases the TRCY relay and when the trunk M60 relay operates it operates the PR relay in the trunk which grounds the "TT" lead to the test circuit operating relay PRQ. When the trunk PR relay operates it removes ground from the "HMG" lead releasing the GTL relay which in turn releases relays M60, GZ, and the trunk OK relay. Relay GZ in turn releases relays TOK and SXTY. Relay PRQ in operating applies ground to lead "NTT" to the trunk which extends the ground on lead "TT" to the traffic service position No. 100A link connector circuit. Ground on lead "TT" signals the controller circuit to establish a link through the line connector between the trunk and TTP as described in the position and data transfer test.

If the PRQ relay has not been operated by the time the GT interrupter breaks its back contact, in approximately 500 msec to release relay SXTY, relay FTM operates and blocks the test. Relay FTM then lights the FTM lamp which indicates a trunk timing failure.

Relay FTM will also operate and block the test if a trunk timing failure causes the trunk PR relay to operate prematurely, that is, before the initial timing period, set on the IPT selector switch has been completed. In this case the operation of the trunk PR relay operates relay PRQ completing the operate path for relay FTM through the "end of timing" relay ETM normal and any one of the TMC1, TMC2, or TMC3 relays operated. To detect premature operation of the trunk PR relay during the final minute of the initial period, when relays TMC1, TMC2, and TMC3 are released due to operation of relay TRCY as described above, the operate path for relay FTM is completed through relay PRQ operated and relay ETM and SXTY normal.

Relays SSP and OKSP are operated when the trunk and TTP are attached causing operation of the trunk PA and PA1 relays which in turn release the RCY and PR relays in the trunk. Release of the trunk PR relay releases the test circuit PRQ relay. Relay DTST then operates and applies battery to leads "STDT", "STDT1" to start the data transfer circuit which establishes a data channel between the TTP and trunk. The TTP passes the overtime period time set on the overtime period time OPT selector switch to the trunk which registers this information on the M- relays. The TTP also passes the ET signal to the trunk to instruct it to register ten overtime periods before requesting connection to the TTP. On completion of data transfer, relay DTOK is operated and the data transfer circuit releases. When the DTOK relay operates it completes the path for operating relay IPCK which signifies that the trunk has functioned properly in timing the initial period. Relay IPCK also operates relay SPD which releases the TTP by releasing the link connector hold magnets and relays SSP and OKSP.

5.4212 Overtime Period Timing - SC152

When the TTP is released on completion of the initial timing period relays SSP and OKSP release and in turn release the trunk PA and PA1 relays. The PA1 relay in releasing grounds the "HMG" lead to the test circuit. When the GT interrupter makes its front contact it operates relay GTF which completes the path for operating the GTL relay to ground on the "HMG" lead. As the GT interrupter continues pulsing it breaks its front contact and releases relay

GTF. When the GT interrupter makes its back contact relay GW operates, operating relay SIX. Relay TOK then operates causing operation of relay TMC1 and the trunk OK relay. The trunk MCL relay operates to ground on the "M6" lead from the test circuit SIX relay operated. When the trunk MCL relay operates it operates the trunk EFO and CH2 relays in sequence. Test circuit and trunk operation thereafter, is as described for initial period timing. However, during overtime timing the coin collect signal is not transmitted by the trunk, therefore the test circuit CCK relay does not operate. The operate path for the trunk CC relay, which causes the coin collect signal to be transmitted is opened when the trunk CH2 relay operated as described above. The test circuit counts the number of overtime periods being pulsed by registering the number of times the TETP relay is operated and released. Each time relay TETP is operated and released it signifies completion of an overtime period which, depending on the setting of the overtime period OPT selector switch, may be one to five minutes. The overtime period count is registered on the P- relays and when the P3 and P5 relays are operated with relays P1 and P4 normal, it signifies that the tenth overtime period has been pulsed. The trunk registers the overtime period count on the IC rotary switch, advancing one position for each overtime period. The switch is driven by operation and release of the trunk ETP relay. The test circuit and trunk register the tenth overtime period simultaneously at the start of which the trunk EC relay is operated through the tenth position on the IC rotary switch. At the end of the tenth overtime period when relays SXTY and TOK are operated, the test circuit ETM relay operates through relays P3, P5, TRCY, SXTY, and IPCK operated and relays P1, P2 normal. The trunk PR relay operates at this time through the EC relay operated and grounds the "TT" lead to the test circuit operating relay PRQ. Operation of the trunk PR relay also removes ground from lead "HMG", releasing relay GTL thereby preventing further timing pulses. Relay PRQ applies ground to the "NTT" lead to the trunk. Ground on the "NTT" lead is passed through the trunk to the traffic service position No. 100A link connector circuit on the "TT" lead. Ground on lead "TT" signals the controller circuit to establish a link through the link connector between the trunk and TTP as described in the position and data transfer

test. If, due to a trouble condition in the trunk, the TTP and trunk are not attached by the time the GT interrupter moves to release relay SXTY, the FTM relay operates to block the test. Premature operation of the trunk PR relay during overtime period timing would also cause operation of the FTM relay as described above for initial period timing.

Relays SSP and OKSP are operated when the trunk and TTP are attached causing the trunk PA and PAL relays to operate. Relay PAL releases relay PR and completes the path for operating the trunk IC rotary switch release magnet which restores the switch to normal. When relay OKSP operates it operates relay DTST which applies battery to the "STDT", "STDT1" leads to start the data transfer circuit which establishes a data channel between the trunk and TTP. When the data channel has been established, ground on lead "EC" from the trunk EC relay operates the test circuit TEC relay, indicating that it has successfully registered ten overtime periods. The data transfer circuit then operates relay DTOK and releases. Operation of relay DTOK completes the check path for the accelerated timing test advancing the test circuit to the disconnect test.

5.422 Normal Timing Test

5.4221 Initial Period Timing - SC153

The initial period time is set on the IPT selector switch and is passed to the trunk via the data transfer circuit during the position and data transfer test. The following description of operation is for the initial period time IPT selector switch set to five minutes. For any other initial period time setting one, two, three, or four the operation of the trunk and trunk test circuits is similar, except that the sequence of operation described for the fifth minute occurs in the first, second, third, or fourth minutes depending on the setting of the IPT selector switch.

On completion of the CS relay test, with the SM key operated to the SMB position, relay TMT operates to start the normal timing test. When the trunk CH relay operates during the answer test it completes the

path for grounding the "HMG" and "TTS" leads to the timer link. Operation of the trunk CH relay initiates perforation of the answer entry as described in 5.4. Operation of relay AEL indicating completion of the answer entry causes operation of relay TMTA. Relay TMTA operated lights the TMT lamp indicating start of the timing test and releases relays TK1, TK2, UK1, and UK2. Release of any one of the four relays mentioned releases relay CII. The timer link will simultaneously transmit timing pulses to the trunk and trunk test circuit on leads "M6", "M60", "CC", and "OK" when signaled from the test circuit by operation of relay TMT, which grounds lead "TTF" to the timer link. At the start of the first minute the timer link applies a 400-msec ground pulse to the "M60" lead of the trunk and test circuit causing the test circuit SXTY relay to operate for the duration of the pulse. During the interval in which the SXTY relay is operated by the ground pulse on the "M60" lead, the timer link applies a 300-msec pulse to the "OK" lead of the trunk and test circuit thus pulsing the trunk OK and test circuit TOK relays. Six seconds later the "M6" and "OK" leads are pulsed in the same manner described above thereby pulsing the trunk OK and test circuit SIX and TOK relays. When the trunk OK relay operates it operates the trunk MCL relay and operation of the test circuit TOK relay operates the TMCL relay. The timer link next pulses the "CC" and "OK" leads of the test circuit thereby pulsing the test circuit CC and TOK relays. The pulse on the "CC" and "OK" leads of the trunk cause the trunk CH1 relay to operate. Sixty seconds after the start of the initial period the timer link pulses the "M60" and "OK" leads thus pulsing relays SXTY, TOK in the test circuit and OK, M60 relays in the trunk circuit. The pulsing of the test circuit SXTY, TOK relays operates the TMC2 relay and releases the TMCL relay. In the trunk, the pulsing of the M60 and OK relays operates relay MC2 and releases relay MCL signifying the end of the first minute of initial period timing. As the timer link continues to transmit timing pulses to the test circuit, succeeding pulses of the SXTY, TOK relays operate relays TMC3 and TMCL. Similarly succeeding pulses of the trunk M60, OK relays operate the trunk MC3 and MCL relays signifying the end of the second and third minutes of the initial period. When the test circuit TOK, SXTY relays and

trunk M60, OK relays are pulsed at the end of the fourth minute of the initial period the test circuit TETP and trunk ETP relays are operated. Following the operation of relay TETP, relay TRCY operates when relay TOK releases on termination of the same timing pulse that had caused operation of relay TETP. Similarly, the trunk RCY relay operates when the trunk OK relay operates. Operation of the TRCY relay releases relays TMCl, TMC3 and TETP. Operation of the trunk RCY relay releases the trunk MC1, MC3, and ETP relays. The next operation of the test circuit CC, TOK relays and trunk CC, OK relays, due to continued pulsing by the timer link, causes the trunk to return the coin collect signal to the test circuit on the incoming tip and ring leads.

Trunk operating in transmitting the coin collect signal and test circuit detection is as described in the initial period of the accelerated timing test. The following pulse of the test circuit SXTY, TOK relays and trunk M60, OK relays causes operation of the ETM relay in the test circuit and PR relay in the trunk. When the trunk PR relay operates it removes ground from the "HMG" lead which signals the timer link to cease pulsing. The PR relay also grounds the "TT" lead to the test circuit operating relay PRQ which returns ground to the trunk on lead "NTT". Ground on the "NTT" lead is passed through the trunk to the No. 100A link connector circuit on lead "TT". Ground on the "TT" lead signals the controller circuit to establish a link through the link connector between the trunk and TTP as described in the position and data transfer test.

If the PRQ relay has not been operated by the time the final timing pulse is terminated, in approximately 400 msec to release relay SXTY, relay FTM operates and blocks the test. Relay FTM then lights the FTM lamp which indicates a trunk timing failure.

Relay FTM will also operate and block the test if a trunk timing failure causes the trunk PR relay to operate prematurely, that is, before the initial timing period, set on the IPT selector switch, has been completed. In this case the operation of the trunk PR relay operates relay PRQ completing the path for operating relay FTM

through the "end of timing" relay ETM normal and any one of the TMCl, TMC2, or TMC3 relays operated. To detect premature operation of the trunk PR relay during the final minute of the initial period, when relays TMCl, TMC2, and TMC3 are released due to operation of relay TRCY as described above, the operate path for relay FTM is completed through relay PRQ operated and relay ETM and SXTY normal.

Relays SSP and OKSP are operated when the trunk and TTP are attached causing operation of the trunk PA and PA1 relays which in turn release the RCY and PR relays in the trunk. Release of the trunk PR relay releases the test circuit PRQ relay. Relay DTST then operates and applies battery to leads "STDT", "STDT1" to start the data transfer circuit which establishes a data channel between the TTP and trunk. The TTP grounds the "MO" and "ET" leads to the trunk, via the data channel, causing these signals to be registered on the trunk M1 and ET relays respectively. On completion of data transfer, relay DTOK is operated and the data transfer circuit releases. When the DTOK relay operates it completes the path for operating relay IPCK which signifies that the trunk has functioned properly in timing the initial period. Relay IPCK also operates relay SPD which releases the TTP by releasing the link connector hold magnets and relays SSP and OKSP.

5.4222 Overtime Recall Test - SC154

When the TTP is released on completion of the initial period relays SSP and OKSP release and in turn release the trunk PA and PA1 relays. The PA1 relay in releasing grounds the "HMG" and "TTS" leads to the timer link, thus signaling the timer link to start overtime period timing. The timing pulses, as in the initial period, are transmitted simultaneously to the trunk and test circuit.

At the start of the first minute of the overtime period, the timer link applies a 400-msec ground pulse to the "M60" lead of the trunk and test circuit causing the test circuit SXTY relay to operate for the duration of the pulse. During the interval in which the SXTY relay is operated by the ground pulse on the "M60" lead, the timer link applies a 300-msec pulse to

the "OK" lead of the trunk and test circuit thus pulsing the trunk OK and test circuit TOK relays. Six seconds later the "M6" and "OK" leads are pulsed in the same manner described above thereby pulsing the trunk OK and test circuit SIX and TOK relays. When the trunk OK relay operates it operates the trunk MCL relay and operation of the test circuit TOK relay operates the TMCL relay. The trunk MCL relay operates relay EFO which in turn operates the CH2 relay in the trunk. The test circuit TOK relay in operating causes operation of relays TMCL and TETP in sequence. On termination of the timing pulse the trunk OK and test circuit SIX and TOK relays release. When relay TOK releases it operates relay TRCY which completes the path for operating relay HBO. Relay HBO inserts the high-resistance winding of relay CSO in series with the incoming tip and ring leads releasing the A and Al relays in loop signaling trunks. When testing E&M signaling trunks, operation of the HBO relay removes ground from the "E" lead to release the trunk A and Al relays. Release of the Al relay removes the locking ground of the trunk D relay thereby causing relay HLD to operate to battery in series with the trunk D relay winding. The trunk D relay is thus maintained operated from the test circuit by ground on the HLD relay winding. Release of the trunk Al relay also operates the trunk PR relay which grounds the "TT" lead to the test circuit operating relay PRQ. The PRQ relay returns ground to the trunk on lead "NTT". Ground on the "NTT" lead is passed through the trunk to the No. 100A link connector circuit on lead "TT" thereby signaling the controller to establish a link through the connector between the trunk and TTP as described in the position and data transfer test. When the TTP and trunk are attached the trunk PA, PAL relays and test circuit SSP, OKSP relays are operated. The PAL relay in operating releases the trunk PR relay and in turn relay PRQ releases and removes ground from lead "NTT". Relay PRKO then operates through make contacts on the OKSP, HLD1 and OS relays. Relay HLD1 operated as a result of operation of relay HLD and the OS relay operates to ground on the "OS" lead from a break contact on the trunk Al relay after the trunk and TTP are attached. When the PRKO relay operates it releases the HBO relay which restores the originating end off-hook condition thereby causing operation of the trunk

A and Al relays. The Al relay operated causes release of relays HLD, HLD1 and OS in the test circuit.

A start signal is passed to the data transfer circuit on the "STDT", "STDT1" leads when the trunk and TTP are attached. When the data transfer circuit functions are completed relay DTOK is operated and the data transfer circuit is released. Relay DTOK operates the SPD relay which functions to release the connector link hold magnets by opening the "S" lead and also releases relays SSP and OKSP. Release of the OKSP relay completes the path for operating relay RRV which releases relay RV. Release of the RV relay causes release of the trunk CS and CS1 relays by transmitting a terminating end on-hook signal to the trunk on the tip and ring leads. Release of the trunk CS1 relay operates the trunk thermal relay CSR after a two-to-five-second time delay and in turn relay PR operates. Relay PR then operates the test circuit PRQ relay which applies ground to the "NTT" lead causing the link controller to establish a link through the connector between trunk and TTP. Operation of the trunk CSR relay operates the trunk RLF relay which removes the locking ground of the trunk D relay thereby causing relay HLD1 to operate in series with the trunk D relay winding. The trunk D relay is thus maintained operated from the test circuit by ground on the HLD relay winding. Relay HLD operates relay HLD1 which completes the path for operating relay PRKT through make contacts on relays OKSP and TS which operate when the trunk and TTP are attached. The operate ground for relay TS is passed to the test circuit through the position link connector from a ground on a break contact on the trunk CS1 relay. When relay PRKT operates relay RRV releases and in turn operates relay RV which restores the terminating end off-hook condition on the tip and ring leads causing the trunk CS and CS1 relays to operate. The operation of the trunk CS1 relay removes ground from the "TS" lead thereby releasing relay TS in the test circuit.

When the TTP and trunk are attached the start signal is passed to the data transfer circuit on the "STDT", "STDT1" leads and when the data transfer circuit functions are completed relay DTOK operates and the data transfer circuit releases. Relay

DTOK operated completes the check path for the overtime recall test and the DIS relay is operated to advance the test circuit to the cancel timing test. When the DIS relay operates it initiates the release of relays ANS, TMT, IPCK, PRKO and PRKT. Ground on the "D" lead from the winding of relay HLD is maintained, through make contacts on relays HLD, OKSP and relay CTK normal, when the IPCK relay releases on completion of the overtime recall test. This is done to prevent release of the trunk D relays due to the trunk RLF relay remaining locked operated after its operation during the terminating end recall check described above.

5.5 PCI Supervision Delay Test SDT OS9.2 - Fig. 21 - SC9.2

This test is applied after the answer entry has been made on the AMA tape, since the trunk does not lock in the supervision until after that time. This test is omitted on the "abbreviated" test sequence. The ANS test previously operated the RV relay. The SDT relay operates and holds RV relay. This path is closed prior to the release of ANS, so that RV holds over the transfer from ANS to SDT. The SDT operated applies ground to the "SDTS" lead through the MAL relay contacts to the DT interrupter. When the interrupter back contact closes the DT2 relay operates and locks. The interrupter back contact then opens and neither contact is closed for 0.98 second after which the front contact closes and the DT3 operates and locks. During the interval between the operation of DT2 and DT3 relays, the path to the RV is opened, allowing it to release. This passes on-hook supervision back to the trunk for this interval, releasing the trunk CS relay. In SUP trunks if the charging condition lock fails the trunk T relay will release, repeating supervision to release the CSO relay and, in turn the CS1 and CS2 relays. With NS, NAS, and ACI trunks, if the charging condition lock fails the CSF relay will be released, releasing the CS1 and CS2 relays. The CS2 relay released operates the SDF relay, which locks. The SDF operated blocks the test, indicating a trunk charging condition lock failure. In SUP trunks supervision should not be repeated until after a timed-disconnect entry.

The SDF relay, unoperated when the charging condition lock holds, forms a check path when the DT3 relay operates. On the advance of the test sequence, SDT releases, in turn releasing the DT2 and DT3 relays.

5.6 Disconnect Test (DIS)

5.61 Normal Disconnect

5.611 PCI or MF OS9.2 - Figs. 33 and 152 - SC10

This test is applied unless either the DTR or FDTR keys are operated or the FOT condition has been established. The DIS relay is operated by the OK check from the previous test, operating the DIT relay. The DIS relay holds the RV relay operated. The DIT relay operates DTS and DTT relays through a check path that makes an up-check of the full soak off-hook condition applied to the trunk and a down-check of the sleeve monitoring SL relay, which is shunted down by sleeve ground in the trunk.

The DTT relay operated starts the pulse generator and transfers the locking path of the STP relay to the PG relay back contact. When PG operates for the first time STP relay is released opening the low-resistance loop through the CSO relay leaving the R resistor and RL1 relay winding in the trunk A relay loop. This applies a release test to the trunk A relay, which releases, in turn releasing the trunk D relay. The RL1 relay operates in series with the releasing trunk A relay to indicate a loop rather than an open circuit release of the A relay. The RL2 relay is an up-check of the RL1 relay as the loop is momentarily opened during the release of the trunk D relay. The trunk D relay releases the trunk DL relay which opens the terminating loop, releasing relays SK and SK1.

On the second release of the PG relay DTE operates. Thus three pulses of 0.070-second duration are counted from the time the trunk A relay release condition is applied until DTE relay operates. The release of SK1 relay before DTE relay operates, operates the fast operate DRK relays as a check that the A and D relays do not exceed

the .210-second allowed time. If the release time of the A and D relays exceeds the maximum the test will block with the ADR lamp lighted.

At SK1 relay release, ground is extended to the DT interrupter operating relay DT2 when the interrupter back contact makes. After an interval of 0.98 second the front contact of the interrupter closes to operate DT3 relay. Prior to the operation of the DT3 relay, the trunk D2 relay should have released opening the sleeve ground shunting the SL relay. The hold magnets holding the test connection are now grounded through the SL relay, operating it, and in turn operating SL1 relay, which opens the path to the D2H relay. If the release time of the trunk D2 relay is excessive the DT3 relay operates to operate the D2H relay, blocking the test with the D2H lamp lighted.

The trunk will now function with the AMA recorder to place the disconnect entry on the tape. When this occurs the operated two-out-of-five of the T0 to T7 and U0 to U7 relays extend ground on the associated leads, corresponding to the trunk number. Again the path to operate TK1, TK2, UK1, and UK2 is closed and the CII relay operates. When CII operates the "TER" lead from the recorder is closed. When the recorder completes the disconnect entry a check signal is received on this lead, operating the DEK relay which locks to the DIT relay. If this signal is not received the DE lamp remains lighted as an indication that the disconnect entry was probably not received.

Operation of the DEK relay operates the TTL relay which initiates the "CH" lead release test. (See 5.7). When this test is completed satisfactorily the advance signal to the next stage is given. This advance releases the DIS relay. In turn, the path of the DIT, DTS, and DTT relays is opened. When these relays are released the locked in test relays and the pulse generator and counter relays restore to normal.

5.612 DP Normal Disconnect OS9 and 10, Figs. 23 and 152 - SC24

This test is applied unless either the DTR or FDTR keys are operated or the FOT condition has been established. The DIS relay is operated by the OK check from

the previous test, operating the DIT relay. The DIS relay holds the RV relay operated. The DIT relay operates DTS and DTT relays through a check path that makes an up-check of the full soak off-hook condition applied to the trunk and a down-check of the sleeve monitoring SL relay, which is shunted down by sleeve ground in the trunk.

The DTT relay operated starts the pulse generator and transfers the locking path of the STP relay to the PG relay back contact. When PG operates for the first time STP relay is released opening the shunt path around the CS0 relay 30,000-ohm winding in parallel with appropriate resistors to impose the trunk A relay release current flow conditions for loop signaling trunks or opens the trunk "E" lead for E&M lead trunks. The trunk A relay releases, releasing in 2W and WS trunks the A1 relay, in BL trunks the B relay, and in all trunks the D relay. The trunk D relay releases the trunk D1 relay which opens the terminating loop, releasing relays SK and SK1.

On completion of three cycles (DP-WS) or three and one-half cycles (DP-BL) of the PG relay the counting relays operate relay DTE. Thus six pulses of 0.050-second duration are counted for the DP-WS or seven pulses for the DP-BL trunk from the time the trunk A relay release condition is applied until the DTE relay operates. The release of SK1 relay, before DTE relay operates, operates the fast operate DRK relay as a check that the A and D relays do not exceed the 0.300- or 0.350-second allowed time. If the release time of the A and D relay exceeds the maximum the test will block with the ADR lamp lighted.

In BL trunks the slow release B relay releases from the trunk A relay released. The release of the trunk B relay, before DTE relay operates, releases the ADK relay as a check that the trunk B relay does not exceed 0.350-second release time. If the release time of the B relay exceeds the maximum the test will block with the BRL lamp lighted.

In the 3W trunk the release of the trunk D1 relay causes the trunk to perform its wink-off function which releases and reoperates the SBF, CS1, and CS2 relays and releases the WOT relay.

In the 3WS trunk the release of the B relay causes the trunk to perform its wink-off function which releases and reoperates the SBF relay. On the release of the SBF relay, the WOT relay releases and remains released after the SBF reoperates. With SBF operated and WOT released the WOK relay is released as a check that the wink-off function has been performed satisfactorily.

At SK1 relay release, ground is extended to the DT interrupter operating relay DT2. After an interval of 0.98 second the front contact of the interrupter closes to operate DT3 relay. Prior to the operation of the DT3 relay, the trunk D2 relay should have released, opening the sleeve ground shunting the SL relay. The hold magnets holding the test connection are now grounded through the SL relay, operating it, and in turn, operating SL1 relay, which opens the path to the D2H relay. If the release time of the trunk D2 relay is excessive the DT3 relay operates to operate the D2H relay, locking the test with the D2H lamp lighted.

The trunk will now function with the AMA recorder to place the disconnect entry on the tape. When this occurs the operated two-out-of-five of the T0 to T7 and U0 to U7 relays extend ground on the associated leads, corresponding to the trunk number. Again the path to operate TK1, TK2, UK1, and UK2 is closed and the CII relay operates. When CII operates the "TER" lead from the recorder is closed. When the recorder completes the disconnect entry a check signal is received on this lead, operating the DEK relay which locks to the DIT relay. If this signal is not received the DE lamp remains lighted as an indication that the disconnect entry was probably not received.

When the recorder has completed its entry it grounds the "RC" lead to release the trunk by releasing the trunk CH relay and in turn the trunk TC relay. In WS supervision trunks the CH relay releases the trunk RV relay to release relay CS0. In nonsupervision WS trunks relay DEK operated simulates relay CS0 releasing by releasing relays CS1 and CS2. In 2W or EM trunks the TC relay releases the trunk RV relay which in turn releases relays CS0 or

OFH respectively. In 3W trunks the TC relay releases relay SBF. In any case relay CS0, SBF, or OFH released causes relays CS1 and CS2 to release.

When the above tests have been successfully completed the TTL relay operates which initiates the "CH" lead release test. (See 5.8). When this test is completed satisfactorily the advance signal to the next stage is given. This advance releases the DIS relay. In turn, the path of the DIT, DTS, and DTT relays is opened. When these relays are released and locked in test relays and the pulse generator and counter relays restore to normal.

5.613 Normal Disconnect - Incoming Trunks From PBX - OS9 and 10, Figs. 23, 152 and 157 - SC-37

This test is applied unless either the DTR-FDTR key is operated to either position or the FOT condition has been established. The DIS relay is operated by the OK check of the previous test operating the DIT and DISA relays. The DISA relay lights the DIS lamp and also lights lamp MRF through operated contacts on the PMR relay if the disconnected test is made with the POT-PMR key operated to the PMR position (message register class). Relay DIT operates the DTS and DTT relays through a check path that makes an up-check of the full soak off-hook condition applied to the trunk and a down-check of the sleeve monitoring SL relay, which is shunted down by sleeve ground in the trunk. The DIS relay operated holds the test circuit RV relay operated except when making the disconnect test with the POT-PMR key operated to the POT position (operator class) in which case the RV relay releases when relay DTS operates.

The DTT relay operated starts the pulse generator and transfers the locking path of the STP relay to the PG relay back contact. When relay PG operates for the first time the STP relay is released opening the shunt path around the CS0 relay 30,000-ohm winding placing it in parallel with appropriate resistors to impose the trunk A relay release current. Release of the trunk A relay releases the slow release D relay in the trunk.

When making the disconnect test with the POT-PMR key operated to the POT position (operator class) the test circuit RV relay is released when relay DTS operates as described above causing release of the trunk CS and RV relays in sequence. For operator class calls both the trunk RV and A relays must release to permit release of the trunk D relay.

Release of the D relay in the trunk releases the trunk D1 relay which opens the terminating loop thereby releasing the test circuit SK and SK1, 2 relays.

When making the disconnect test with the POT-PMR key normal or operated to the PMR position (CAMA or message register class) the release of the D1 relay in the trunk releases the trunk RV and CS relays. When the RV relay in the trunk releases it will release the test circuit CSO relay for any of the PBX classes (operator, message register or CAMA). In turn the release of the CSO relay releases the CS1, 2 relays and the CS1 relay extinguishes the SUPV lamp.

When the PG relay has timed 450-msec (four and one-half cycles) from the time the STP relay released to impose the release current condition on the trunk A relay, the TND counting relay operates relay DTE. The release of the SK1 relay, before the operation of the relay DTE, operates the fast operate DRK relay as a check that the trunk A and D relays do not exceed the 450-msec allowed time. If the release time of the A and D relays exceed the maximum allowed time the DRK relay will be prevented from operating, blocking the test circuit and lighting the ADR lamp.

When making the disconnect test with the POT-PMR key operated to the PMR position (message register or flat rate class) release of the trunk RV relay causes resistance battery to be applied to the winding of the message register in the trunk. The message register, however, is shunted by the 3.7-ohm winding of the test circuit MRK relay, which is connected to the winding of the message register over the "MR" lead, thus the message register is prevented from operating. Battery on the "MR" lead operates the MRK relay which in turn operates the MRW relay. When the trunk slow release D2 relay releases, after release of relay D1, the trunk CH relay will release removing battery from

the "MF" lead thereby causing the MRK relay to release. Release of relay MRK operates the MRZ relay which then operates relay DEK. When relay DEK operates it extinguishes the MRF lamp to indicate that the trunk circuit is functioning properly to score the message register. If more than one pulse of battery is detected on the "MR" lead relay MRK will reoperate and release the MRW relay which lights the MDO lamp and operates the FC relay. The FC relay operated blocks the test circuit by opening the "DISK" check path to prevent operation of the DST relay and lights the false charge FC lamp.

If the PBX trunk circuits in the office are arranged for flat rate service the message registers are not provided. The above sequence, in such a case, will test the flat rate functions of the trunk circuits. When making the disconnect test with the POT-PMR key normal (CAMA class) release of the D1 relay in the trunk initiates the disconnect entry to be perforated on the AMA tape. When this occurs the operated two-out-of-five of the T0 to T7 and U0 to U7 relays extend ground on the associated leads, corresponding to the trunk number. Again the path to operate TK1, TK2, UK1, and UK2 is closed and the CII relay operates. When relay CII operates the "TER" lead from the recorder is closed. When the recorder completes the disconnect entry a check signal is received on this lead, operating the DEK relay which locks to the DIT relay. If this signal is not received the DE lamp remains lighted as an indication that the disconnect entry was probably not received. When the recorder has completed the disconnect entry it grounds the "RC" lead to the trunk causing release of the CH relay which then releases the trunk TC relay. On successful completion of this test relay TTI will operate to initiate the "CH" lead release test. (See 5.8). When the "CH" lead release test is completed satisfactorily the advance signal is given to the next stage.

When the advance signal is given for any class (operator, message register or CAMA) the DIS relay releases. In turn the paths of relays DIT, DTS, and DTT are opened causing their release. When these relays are released the locked in test relays and pulse generator and counter relays restore to normal.

5.614 Normal Disconnect Test - TSP Trunk Circuits - OS9.2, 9.3, 11 - SC160

This test is applied unless either the DTR, FDTR, or SM key is operated or the FOT condition has been established. The DIS relay is operated by the OK check from the previous test. Relay DIS operates the DIT, DISA, DISB, AD relays and releases relay ANS. The DIT relay operates the DTS and DTT relays through a check path that makes an up-check of the full soak off-hook condition applied to the trunk and a down-check of the sleeve monitoring SL relay, which is shunted down by sleeve ground in the trunk. Operation of relay DTT starts the pulse generator and transfers the locking path of the STP relay to the PG relay back contact. When testing dial zero or special toll coin trunks relay DTT also operates the D2T relay in preparation for making the D2 relay minimum release time check.

When the PG operates for the first time the STP relay is released, inserting the high-resistance winding of the CSO relay in the loop to release the trunk A relay in loop signaling trunk. For E&M signaling trunks the ARL relay is operated to release the trunk A relay.

The pulse generator will pulse 70-msec intervals for all TSP trunks except bylink, noncoin in which case the intervals will be 50 msec. When the trunk A relay releases, the trunk D and DL relays release. For dial zero and special toll coin trunks the minimum release time of the trunk D relay is checked by relay DER which monitors a break contact of the SK relay. If the SK relay releases, indicating release of the trunk DL relay, before the pulse generator has pulsed seven intervals of 70 msec (490 msec) to operate the SDET relay, relay DER operates and blocks the test. The DER relay lights the DS lamp to indicate that the trunk D relay released in less than its minimum release requirement. If the SK relay remains operated until after operation of relay SDET by the HUI relay, the DER relay operate path is opened preventing its operation.

When the SK and SK1 relays are released after release of the trunk DL relay, relay SK1 starts the release of the slow

release, 95 to 105 msec, D2T relay which times the minimum release time of the trunk D2 relay. If the trunk D2 relay releases in less than its minimum release requirement, the SL, SL1 relays operate and in turn operate the D2ER relay through a make contact on relay D2T. Relay D2ER blocks the test and lights the D2M lamp to indicate the D2 relay minimum release time failure. If the SL, SL1 relays are held operated by the trunk D2 relay until after the D2T relay has released the D2ER relay operate path is opened preventing its operation.

The test circuit also checks that the release time of the trunk D and D2 relays does not exceed the maximum release requirements. The maximum release time of the trunk D relay is timed by the pulse generator. For MF special toll noncoin trunks, three pulses of the pulse generator (210 msec) cause operation of the CDA relay which in turn operates relay DTE. If the SK, SK1 relays have not released by the time the DTE relay operates, relay DRK remains nonoperated and the test circuit blocks with the ADR operated to indicate that the trunk D relay has exceeded its maximum release time requirement. For dial zero or special toll coin trunks the pulse generator pulses 15 intervals or approximately one second before operating the DTE relay through a make contact or relay STS. If the SK, SK1 relays have not released before operation of the DTE relay the test circuit blocks with the ADR lamp lighted. When testing bylink trunks the same check is made for the trunk B relay. In this case relay DTE is operated through a break contact of the CDA relay after the pulse generator has pulsed six intervals, approximately 300 msec. Failure of the trunk B relay to release before operation of the DTE relays, causes the ADK relay to remain locked, thus blocking the test with the BRL lamp lighted.

When the SK1 relay releases, ground is applied to the DT interrupter operating relay DT2. After an interval of 0.98 second the front contact of the interrupter closes to operate the DT3 relay. Prior to operation of the DT3, the trunk D2 relay should have released, opening the sleeve ground shunting the SL relay. The hold magnets holding the test connection are now grounded through the SL relay, operating it, and in turn operating the SL1 relay,

which opens the path to the D2H relay. If the release time of the trunk D2 relay is excessive the DT3 relay operates the D2H relay blocking the test circuit with the D2H lamp lighted.

When the trunk D-relays release the trunk functions with the recorder to place the disconnect entry on the tape. On completion of the disconnect entry the recorder grounds the "RC" lead releasing the trunk CH, TC, and RV relays. When testing coin trunks, release of the RV relay operates the trunk CR relay causing the trunk to transmit the coin return signal to the originating end, as described in 5.619, thereby operating relay ACS.

Coin trunks return on-hook supervision to the test circuit on completion of the coin return signal and noncoin trunks return the on-hook supervision on release of the trunk RV relay. Loop signaling trunks release relay CSO and E&M signaling trunks release the OFH relay in the test circuit. Release of relay CSO or OFH initiates the release of relays SUPR and CSL, thereby operating relay TTL which starts the "CH" lead test as described in 5.7.

5.615 Cancel Timing Test - TSP Trunk Circuits

When the special test key SM is operated to the SMB position, battery is applied on the "RF" lead to the trunk when the DISB relay is operated on completion of the previous test function. Battery on lead "RF" operates the trunk CTM relay which causes the trunk, except special toll coin trunks, to function to apply battery on the "OT" lead to the call identity indexer as a signal to the recorder for perforating a cancel timing entry. The recorder then proceeds to perforate the cancel timing entry and operates the test circuit NR, TR and CR relays which light the CR lamp. When the entry is completed the trunk receives ground on the "RC" lead from the call identity indexer initiating release of the trunk TC relay which applies ground to the "SA" lead to the TTP as a signal that the entry has been successfully completed.

For testing special toll coin trunks, with the SMB and CTM keys operated, at the end of the calling end recall test the DIS relay will be operated through make contact of the CTM key. This will result in the making of a cancel timing entry test of these trunks. With the key not operated at the end of the calling end recall test the test frame will proceed with a called end recall test and bypass the cancel timing entry test.

When testing dial zero trunks operation of relay CTK1 initiates the ring forward test as described in 5.616. For special toll trunks operation of the CTK1 relay operates relay SPD which releases the TTP and trunk PA relay by releasing the connector link hold magnets and relays SSP and OKSP. When relay SPD operates it releases relay STP which in turn releases the trunk A and A1 relays. These in turn release the trunk RV relay which returns on-hook supervision to the test frame releasing relays CSO or OFH which release relays CS1 and CS2. When testing noncoin trunks, release of these relays initiates the "CH" lead release test as described in 5.8. On completion of this test the check path for advancing the test circuit to the D relay shunt test, noncoin trunks, is through the NR, TR, CR and SL relays operated. When testing coin trunks release of the RV relay causes the transmission of the automatic coin signal. A satisfactory check as indicated by relay ACS operated advances the test frame to the next test of the sequence as described in 5.619.

5.616 Ring Forward Test - TSP Dial Zero Trunk Circuits - SC163

When the CTK1 relay operated on completion of the cancel timing test it opened the operating path for the slow release relay MHB. Relay MHB had been operated early in the test sequence to ensure its slow release property. During the time, 250 to 500 msec, that the MHB relay remains operated ground is applied on the "RF" lead to the trunk operating the RF relay through make contacts on relays CTK1 and SMB. When the trunk RF relay operates it causes the trunk to function to apply a simplex pulse of +130 volts on the outgoing tip and ring leads. The +130 volt pulse operates the test circuit RF relay through the return test line which then operates relay RFK. When the RFK relay operates it operates relay SPD which releases the TTP and trunk PA relay by releasing the connector link hold magnets and relays SSP and OKSP. When the SPD relay operates it also opens the lock path for relay STP thus permitting it to release. When relay STP releases it releases the trunk A and A1 relays which in turn initiate the release of trunk RV relay. When the trunk RV relay releases it causes the trunk to return on-hook supervision to the test frame releasing relays CSO or OFH which then release relays CS1 and CS2. When testing noncoin trunks, release of these relays initiate the "CH" lead release test described in 5.7. On completion of this test the check path for advancing the test circuit to the D relay shunt test, for noncoin trunks, is completed through the NR,

TR, CR and SL relays operated. When testing coin trunks release of the RV relay causes the transmission of the automatic coin signal. A satisfactory check as indicated by relay ACS operated advances the test frame to the next test of the sequence as described in 5.619.

5.617 Release Forward Test - TSP Trunk Circuits - SC162

When key SM is operated to the SMA position battery is applied to the "RLF" lead to the trunk when the DISB relay operates on completion of the previous test function. Battery on the "RLF" lead operates the trunk RLF relay which causes release of the trunk D- relays. Release of the trunk D- relays operates the test circuit SL relay and also close the trunk "CH-DJ" leads thereby signaling the recorder to perforate a normal disconnect entry. When the disconnect entry is completed trunk TC relay is released and test circuit NR and DEK relays are operated. Operation of relay NR lights the NR lamp as an indication that the recorder has perforated the normal disconnect entry and removes battery from the "RLF" lead.

When testing special toll trunks operation of relay DEK initiates the sender request test as described in 5.618. For dial zero trunks operation of the SL relay operates relay SPD which releases the TTP and trunk PA relay by releasing the connector link hold magnets and relays SSP and OKSP. When relay SPD operates it releases relay STP which in turn releases the trunk A and A1 relays. These in turn release the trunk RV relay which returns on-hook supervision to the test frame releasing relays CS0 or OFH which release relays CS1 and CS2. For dial zero noncoin trunks release of these relays initiates the "CH" lead release test described in 5.7. On completion of this test the check path for advancing the test circuit to the D relay shunt test, is completed through the NR, SL relays operated. When testing dial zero coin trunks the automatic coin signal check is made as described in 5.619, in order to complete the check path for advancing the test circuit to the END test.

5.618 Sender Request Test - TSP Special Toll Trunk Circuits - SC162

When the DEK relay operated on completion of the disconnect entry it completed the operate path for relay STF through the SPTL relay operated. The STF relay in operating grounds the "RF" lead to the trunk to operate the trunk SR relay which causes the trunk to bid for connection to a sender by grounding the "ST" lead to the sender link. When the sender becomes attached lead "SA" to the test circuit is grounded to operate relay SAF indicating that the trunk functioned properly to attach to a sender. Operation of the SAF relay releases the STF relay which then removes ground from the "RF" lead to release the trunk SR relay. The SAF relay also opens lead "TTG" to the sender causing its release. The sender releasing releases relay SA. Relay SA released and relay SAF operated operate relay SPD which releases the TTP and trunk PA relay by releasing the connector link hold magnets and relays SSP and OKSP. When relay SPD operates it also releases relay STP causing release of the trunk A and A1 relays which in turn release the trunk RV relay. The trunk RV relay in releasing causes the trunk to return on-hook supervision to the test frame, releasing relays CS0 or OFH which then release relays CS1 and CS2. For noncoin trunks release of these relays initiates the "CH" lead release test described in 5.7. On completion of this test the check path for advancing the test circuit to the D relay shunt test, for special toll noncoin trunks, is completed through the NR, SL relays operated. When testing special toll coin trunks the automatic coin signal check is made as described in 5.619 in order to complete the check path for advancing the test circuit.

5.619 Automatic Coin Signal Check - TSP Coin Trunk Circuits - OS21 - SC151.2

When the TTP is released causing release of the trunk PA relay and the disconnect entry has been perforated indicated by release of the trunk TC relay, the trunk RV relay is released. Release of the RV relay causes coin trunks to transmit either the coin return or coin collect signal toward the originating end. Dial zero coin trunks

will transmit the coin return signal regardless of the position of key SM. Special toll coin trunks transmit the coin return signal when key SM is normal and the coin collect signal when this key is operated to either the SMA or SMB position.

The coin return signal for loop signaling coin trunks, except from electronic switching offices consists of a high potential off-hook condition, -48 volts on the tip lead and +130 volts on the ring lead. For loop signaling coin trunks from electronic switching offices the coin return signal consists of an on-hook off-hook "Wink", a "Quiet" period and a 1100- and 1700-cycle MF tone period. E&M signaling coin trunks transmit an on-hook, off-hook wink on the "M" lead followed by 1100- and 1700-cycle MF tones on the tip and ring leads. The high potential off-hook coin return signal causes the test circuit MG and MGL relays to operate and hold the CSO and SUPR relays operated. The CSO and SUPR relays were operated to the normal off-hook potential on the tip and ring leads before the coin return signal was applied. When the MGL relay operates it operates relay ACS through a make contact on relay SUPR thereby indicating that the loop signaling coin trunk functioned to apply the proper signal to the tip and ring leads. Loop signaling trunks for ESS transmit the on-hook off-hook wink on the tip and ring followed by a "Quiet" period in turn followed by 1100- and 1700-cycle MF tone on the tip and ring leads causing the test circuit to function as described in 4.111 except in this case relay EMP2 is operated and relay EMP1 remains released. When the test circuit STO timer relay operates with the EMP2 operated, relay ACS operates as an indication that the trunk functioned properly. E&M signaling coin trunks transmit the on-hook, off-hook wink on the "M" lead followed by the 1100- and 1700-cycle MF tone on the tip and ring leads causing the test circuit to function as described in the coin collect test, except in this case relay EMP2 is operated and relay EMP1 is released due to the different MF tone transmitted by the trunk for the coin return signal. Relay EMP2 operated and relay EMP1 released operates the ACS relay when the STO timer relay operates as described in the coin collect test.

When testing special toll coin trunks with key SM operated to either position the trunk applies the coin collect signal towards the originating end. The coin collect signal and its detection by the test circuit is as described in the coin collect test. When the coin collect signal is detected relay ACS is operated indicating that the trunk functioned to apply the proper signal.

Relay ACS operated completes the check path to initiate the "CH" lead release test as described in 5.7. When testing E&M signaling coin trunks the check path is completed through the ACS relay operated and relay STO normal. Relay STO is released when the trunk removes the MF tones on completion of the coin collect signal.

5.62 Disconnect Timed Release (DTR) OS10 - Fig. 23 - SC11 and 25

This test is applied during DIS test sequence in place of the normal disconnect test when the DTR key and DTR relay are operated. The DIS operated operates DIT relay.

The DIT operated connects the DL interrupter to the DL1 and DL2 counter relays to measure, with the DS interrupter and DS1, DS2, and DS3 counter relays the maximum allowable time for the trunk RL relay operate. Operation of the DL1 relay from the interrupter front contact starts the test function in synchronism with the DL interrupter. The DL1 relay operated connects the DR interrupter to the DR1, DR2, and DR3 counter relays to measure the minimum allowable time for the trunk RL relay operate.

The DL1 relay operated releases the RV relay which releases the trunk CS relay simulating a called subscribed disconnect. If tone appliers are associated with the trunks tone applier relays CS1 or SV follow the trunk CS relay. Trunk CS relay releasing starts the trunk slow operate RL relay. After the heating interval, trunk RL relay operates releasing in turn the trunk D1 and D2 relays. The D1 released opens the terminating loop to release SK, SK1, and SK2. In PCI trunks D1 relay releases the trunk T relay releasing the CSO and in turn the CS1 and CS2 relays. The CS2 relay releases the

STP relay. In the 3W trunks the DL relay releasing starts the wink-off function. Trunk DL relay released removes ground from the "S1" lead and releases the slow release trunk W relay. When trunk W relay goes down ground is restored to the "S1" lead, the intervening open interval being the "wink". During the wink the SBF relay releases WOT relay and CS1 and CS2 relays. After the wink SBF relay reoperates the CS1 and CS2 relays. The WO lamp lights to indicate a successful wink-off test. The CS2 relay operating releases the STP relay. In the 3WS trunks the release of the B relay initiates the wink-off function. The release of B removes ground from the "S1" lead and starts the release of the trunk W relay which is a slow release relay. When the W relay releases, ground is restored to the "S1" lead completing the "wink". At the start of the "wink", the SBF relay is released in turn releasing the WOT relay. At the conclusion of the "wink", SBF reoperates, but WOT remains down thus lighting the WO lamp as a visual indication of the successful completion of the wink-off function. With SBF operated and WOT released the WOK relay is released. If the WOK relay fails to release, the test frame will block.

In all trunks, except incoming trunks from PBX, the release of the trunk D2 relay initiates a disconnect entry in the recorder. The DL relay initiates the disconnect entry in incoming trunks from PBX. When the recorder perforates an entry having an index matching the one registered in the test circuit the check relays operate the CII relay and then the DEK relays extinguishing the DE lamp, completion of the entry also releases the trunk CH and TC relays. In the supervision WS trunks relay CH releases trunk relay RV which in turn releases relay CSO. In nonsupervisory WS trunks relay DEK operated simulates release of CSO. In 2W or EM trunks relay TC releases trunk relay RV which in turn releases relay CSO or OFH respectively. In incoming trunks from PBX with the POT-PMR key normal (CAMA class) the release of the trunk DL relay initiates the disconnect entry and releases the trunk RV relay. When the trunk RV relay releases it causes release of the test circuit CSO relay. Relay CSO released releases relays CS1 and CS2. Relays CS2 or OFH released opens the locking path for relay STP releasing it.

Relay STP released starts the release of the trunk by releasing the trunk A relay.

If the disconnect entry occurs to operate the CII relay prior to the end of the 6.2- to 9.5-second DR timing interval it indicates premature operation of the trunk RL relay, and the FTE relay is operated to block the test and light the FTE and E lamps. If the trunk RL relay does not operate to release the SK1 relay prior to the end of the 34.25- to 37-second DL and DS timing interval, the FTE relay is operated to block the test and light the FTE and L lamps.

When the above tests have been successfully completed the TTL relay operates which initiates the "CH" lead release test. (See 3.7). When this test has been completed satisfactorily the test sequence will be advanced to END.

Note: If the test frame fails while making a disconnect timed release test, minimum time of two minutes shall elapse before a repeat test may be made on the same trunk. This is due to the thermal-type RL relay in the trunk circuit, which requires approximately two minutes to release and leave the trunk available for retesting.

5.63 **FDTR** False Disconnect Timed Release Test (FDTR) OS10 - Fig. 23 - SC12 and 26

This test is applied in the test sequence in place of the normal disconnect when the FDTR key is operated. False over-time test, if being made, is replaced by the disconnect timed release test.

At the time the ST3 relay operates, FTC relay operates under control of the FDTR key. Operated FTC relay operates DTR relay. The test sequence then proceeds to the point where the disconnect test is made, by the operation of the DIS relay.

The DIS relay operated, operates the DIT relay. With the DTR and DIT relays operated a ground path to the DL interrupter is closed which causes it to function, starting the DR timer and releasing the RV relay as described for the disconnect timed release test (See 3.62). Release of the RV relay reverses the battery and ground applied to the trunk supervisory CS relay, simulating

a called party on-hook signal. The DR timer measures an interval of 6.2 to 9.5 seconds after which the DR3 relay operates, reoperating the RV relay. The RV relay re-operated applies off-hook supervision to the trunk, which should allow the timed release function of the trunk to restore without operating. The DL interrupter closes its back contact 29 seconds after the operation of the DL1 relay to close a path to operate the DL2 relay. If a disconnect entry is received from the trunk prior to the operation of the DL2 relay, FTE relay will operate. The FTE relay operated, indicates that the timed release function has not properly restored and removes the operate ground from the DL timer. The test circuit then blocks with the FTE lamp lighted. When the DL2 relay operates it opens the path to the FTE relay and releases the STP relay.

When relay STP releases, for loop signaling trunks, the trunk A relay is offered a high-resistance bridge and it releases. For E&M lead signaling trunks relay STP operates relay ARL which opens the trunk "E" lead. The trunk should now release as for a normal disconnect (See 5.612) with a disconnect entry placed on the tape. This action should result in the operation of the DEK relay. The DEK relay operated, together with a trunk down-check initiates the "CH" lead release test and permits the test to advance to the END condition. Release of the DIS relay will in turn release the associated test relays.

FOT

5.64 False Overtime Test (FOT) OS10 - Fig. 23 - SCL3 and 27

At the conclusion of a normal call the trunk TC and CH relays remain operated and control the placing of the disconnect entry on the recorder tape. If the recorder is not available, the CH interrupter in the trunk controls a delay of two to five seconds, after which these relays should be released. The trunk will then no longer initiate a request for a recorder, so that the disconnect entry will not be made, even after the recorder becomes available. This feature of the trunk is tested by the trunk test circuit and has been called here the "False Overtime Test." If this trunk feature is inoperative, the disconnect entry

will be made whenever the recorder becomes available. This will result in a false overtime charge due to the delay in seizing the recorder.

This test is made when the DIS stage is reached, if the proper preparation has been made. Both the FOT and FOT1 nonlocking keys must be simultaneously operated for this preparation. These keys close a path to operate relay FOTT. The FOTT controls the path to operate FOT and lights the FOTT lamp. These precautions were adopted to prevent accidentally setting up this condition, because of the possibility of losing some overtime revenue when this test is made. Since the recorder is made unavailable for an interval some service disconnect entries may be lost. (Initial entries are not affected, and answer entries are delayed by this test.) Hence it is recommended that this test be performed only during light load periods, unless a particular trunk is being given maintenance attention or other special conditions apply. By performing this test during light load periods, the number of disconnect entries which will have to be handled will be small, thus reducing the number affected. In addition to this, if a recorder is immediately available, such as would be the case for a light load period, a considerable number of the service disconnect entries placed when the recorder is unavailable may be recorded. This is because the trunk requires an average interval of 3.5 seconds to time out. Thus a disconnect entry will be made when the recorder becomes available at the end of the test interval for calls which terminated too late in the test interval to have timed out, provided that the recorder is not seized by a transverter or other high preference traffic. The FOT test can be canceled by operating the FOTR, DTR, FDTR, or RN keys.

When DIS operates, DIT in turn operates. Ground is applied to the DS interrupter contact. The DS1 relay operates under control of the interrupter. Operated DS1 releases the STP relay. The STP in releasing initiates a trunk disconnect. At the time the transverter seized the recorder to place the initial entry for the trunk test call on the tape, the recorder TTK and TTA relays were operated. The signal for operating

these relays was given by the sender which in turn received a signal from the trunk that a test call was in progress. The operation of the TTA relay opens the "CH" lead to all trunks served by the recorder and connects the opened lead to the trunk test circuit over the "CHT" and "CHG" leads. Continuity of these leads is maintained in the test circuit except for the interval to be described later. (See 5.8). This path is through "doubled" back contacts of the FOT relay which are shunted by "doubled" back contacts of the CHG relay. When DS1 relay operated it operates CHG relay so that this lead is now open, since the contacts of FOT relay are opened for this test. This open prevents the recorder from placing timing entries on the tape, since no ground is available on any "CH" lead to trunks served by the recorder. The DS interrupter will close its front contact after a two-second interval which operates DS2 relay through a closed contact of DS1 relay. After the front contact closure and a 0.238-second open interval of the DS interrupter has occurred, the back contact recloses. The DS2 operated shunts the DS1 winding and it releases. Operated DS2 relay and released DS1 relay operates the DS3 relay. When the DS interrupter back contact makes, with the DS3 relay operated, it shunts the DS2 relay and it releases. Opening of the back contact of the DS interrupter removes the shunt from the winding of the DS1 relay and it operates. The operation of DS1 relay opens the shunt path to the DS3 relay. The path to the DS2 relay is opened by DS3 relay so that subsequent closures of the DS interrupter are ineffective. The DS1 and DS3 relays remain operated at the end of this cycle. The time required to complete the cycle is nominally 6.3 seconds. The DS1 and DS3 relays operated release the CHG relay, which restores the "CHT" to "CHG" lead continuity. This allows the recorder again to handle timing entries.

If the trunk were functioning properly, the CH and TC relays of the trunk should have restored prior to the operation of DS1 and DS3, since the action requires two to five seconds. If, due to a trunk trouble, this action has not occurred and these relays have not released, a disconnect entry

will be placed on the tape, which will cause the FTE relay to operate under control of the CII relay. The CII relay will operate in response to the timing entry as described for the normal disconnect test. (See 5.612). The test circuit will block with the FOT lamp lighted as an indication of the trouble. If no entry is received, the path to the DR interrupter is closed at the end of the DS1-DS3 relay cycle initiating the DR1, DR2, and DR3 relay cycle of operation described for the disconnect timed release test. (See 5.62). The DR3 relay operation six to nine seconds later together with a down-check for DP trunks, initiates the "CH" lead release test. The test will advance if a check is received. When advance occurs, relays DIS and DIT release allowing the test relays DS1, DS3, DR1, and DR3 to release.

5.7. "CH" Lead Release Test OS8.2 - Fig. 24

As described in preceding paragraphs, this test follows all disconnect tests or is made if the call advance key is operated or if a test circuit blockage occurs with the trunk test circuit attached to the recorder. At the start of the test sequence, ST1 relay operates, operating TT3 relay. At the time of the initial entry test, the recorder TTK and TTA relays are operated from the transverter. The RA relay in the trunk test circuit operates in series with the recorder TTA relay. The RA relay operated, operates the TT4. The TT3 and TT4 relays remain operated through subsequent test stages until the "CH" lead release test is made.

This test is started by operation of the TT1 relay. Operation of the AL relay, which occurs on a blockage condition or CAK which occurs when the call advance key is operated, extends ground to operate TT1. The TT1 relay is also operated at the end of a disconnect test, through CS1 relay released as a trunk down-check if "S" option is provided, as follows. When the disconnect timed release test is made the DTR relay contact is opened but the path is closed by the paralleling contact of the SK2 relay, which closes when the trunk loop is opened by the timed release of the trunk. In addition a check is made during the DTR test for 3W and 3WS trunks that the wink-off test

was successful. The false timed release test shunts the DTR relay contact with a contact on a FTC relay. For the false over-time release test operation of DR3 relay operates TT1 relay. When TT1 operates, the path through the RA relay to the recorder TTA relay is opened, allowing these relays to release. The TT1 operated also opens the path to the slow release TT3 relay, starting its release. The recorder TTA relay should be released by the time TT3 releases, since TTA is a normal speed relay. The release of TT3 opens the path to the slow release relay TT4. During this interval, the primary winding of the TT2 relay is closed through to the "CHK" lead to the recorder. If the TTA had released and restored ground to the trunk "CH" leads, a ground will be placed on the "CHK" lead which will operate TT2. If TT2 operates, signifying a satisfactory check, the path for advancing out of the disconnect stage is closed when TT4 releases. The TTK recorder relay is released by the operation of TT2, so that the test circuit to recorder connection is completely broken.

If no ground is found on the "CHK" lead, TT2 will not operate and the test circuit will block. The MAL relay operates when TT4 relay releases for this case. With MAL operated, a ground is applied to the major alarm lead as an indication that the recorder is not available for timing entries. The "CHL" lamp is lighted in the test circuit to indicate the trouble.

If for some reason, the recorder TTA relay failed to release, it would be possible to get a check condition by the connection through the test circuit, if the network consisting of double-back contacts of TT1, back contact of TT4 and a front contact of TT3 in parallel were not placed in the "CHT" lead path. This network is open only during the time that the TT2 should operate and is closed at all other times. Hence a false check is prevented should the TTA closure be maintained under trouble conditions. In this particular case, TT4 released will allow the recorder to function on timing entries even though an alarm has been indicated. However, it is not expected that this "false alarm" situation will occur frequently.

When TT1 operated, it locked to its operating path, which will be maintained for trouble blockage or to TT2, which in turn

is locked to ST3. Hence, TT1 and TT2 will remain operated until the test sequence is completed independently of the release of the associated disconnect test relays.

5.8 D and D2 Relay Release Time (DST) **DST**

The minimum release time of the trunk D relay is checked on this test unless the D2M key is thrown. For the latter case the minimum release time of the trunk D2 relay is tested. Because of the AMA charge features of the trunk, neither test can be applied earlier in the test sequence.

6. D RELAY SHUNT TEST

6.1 D Relay Shunt Test OS11 - Fig. 153 (SC 14 and 23, 38)

This test is made when the DST relay operates after the disconnect test for the normal test sequence. Since the trunk relays are normal the test trunk connection through the office would release were it not held through the SL relay winding connected to the sleeve of the office frame appearance. The circuit to the SL relay is closed through DST operated. This path is closed before the release of DIS occurs, thus maintaining its continuity. The DST relay operated operates the trunk D relay.

Relay DSL operates from DSS. During the SDT or DIS test, relay DT2 operated, operating the slow release DSS relay to allow it ample time to soak. When DSL operates the locking circuit for DSS opens and it starts to release. The trunk D relay receives its soak during the release time of DSS. When DSS releases, a path to operate the DT1 relay is closed. This path is through the SK1 operated, which checks that the supervisory trunk loop closed when the trunk D relay operated the trunk D1 relay. It is also carried through the SL1 back contact since the SL relay should be shunted down by the operation of the trunk D1 relay. When DST operated it transferred the primary winding of the PG relay to a voltage divider providing an approximate 0.050-second operate and release time of the PG relay for PCI and MF and 0.065 second for DP. With DT1 relay operated the pulse generator is started.

When DT1 operated, it also released the trunk D relay and transferred the control of the DSL relay from direct ground to

one controlled by the back contact of the PG relay for DP test or the front contact of the P relay for MF and PCI tests. Hence, when PG operates or the P releases, the DSL relay is released.

Released DSL connects the back contact of the PG relay or the front contact of the P relay to the TE winding. When PG releases or P operates TE relay operates. The trunk D relay released in turn releases the DL relay, which opens the terminating loop. The SK, SK1, and SK2 relays in the test circuit then release. If SK2 releases before TE operates, a path is closed to the DFR relay which operates and locks the DT1. The DFR relay is fast operate because of its low time-constant effected through the use of a low-resistance winding and series resistance. This reduces to a minimum the variation caused by its operating time. If DFR operates, the trunk D relay release time was too short. This is probably caused by an open shunt resistor in the trunk. If DRF did not operate the test advances when the SL1 relay reoperates, which occurs when the trunk D2 opens the shunting ground on the SL relay. The TE and DT1 and other associated test relays release when DST becomes normal on test advance.

This test is bypassed when testing incoming trunks from PBX with the POT-PMR key operated to the POT position (operator class).

This test is bypassed when testing TSP trunk circuits with the special test key operated to the SMA or SMB position. This test is also bypassed when testing TSP special toll coin or dial zero trunk circuits regardless of the position of the SM key.

6.11 D Relay Shunt Test - Fig. 25 ("Mfr Disc.")

This test is made when the DST relay operates after the disconnect test for the normal test sequence. Since the trunk relays are normal the test trunk connection through the office would release were it not held through the SL relay winding connected to the sleeve of the office frame appearance. The circuit to the SL relay is closed through DST operated. This path is closed

before the release of DIS occurs, thus maintaining its continuity. For PCI trunks DST relay operated operates the trunk D relay in series with the DSK relay. For DP trunks DST relay operates the trunk D relay from direct ground, the DSK relay having been operated earlier from off-normal ground.

Relay DSL operates from DSK. During the SDT or DIS test, relay DT2 operated, operating the slow release DSS relay to allow it ample time to soak. When DSL operates the locking circuit for DSS opens and it starts to release. The trunk D relay receives its soak during the release time of DSS. When DSS releases, a path to operate the DT1 relay is closed. This path is through the SK1 operated, which checks that the supervisory trunk loop closed when the trunk D relay operated the trunk DL relay. It is also carried through the SL1 back contact since the SL relay should be shunted down by the operation of the trunk DL relay. When DST operated it transferred the primary winding of the PG relay to a voltage divider providing an approximate 0.050-second operate and release time of the PG relay for PCI and 0.065 second for DP. With DT1 relay operated a ground to the PA resistance is opened, allowing the PG condenser to charge from battery through the PA resistance and secondary winding of PG. The charging current holds PG nonoperated for the changing interval, after which the steady current flow through the primary from the PA resistance to the potential at the junction of the voltage divider assumes control and operates it. The PG in operating applies ground to the PA resistance which reverses the direction of the current in the primary since the flow is now from the midpoint of the voltage divider to ground. However, the relay does not release until the surge caused by the discharge of the energy stored in the PG condenser has subsided. The relay is thus held operated for the timing interval before it releases.

When DT1 operated during PCI test it also transferred the ground to the trunk D relay from the ST3 ground which was originally applied, to one controlled by the back contact of the PG relay. Hence, when PG operates, this path opens, releasing the trunk D relay and also the DSK.

When DT1 operated during DP test, it also released the trunk D relay and transferred the control of the DSK relay from direct ground to one controlled by the back contact of the PG relay. Hence, when PG operates, the DSK relay is released.

The DSK released releases DSL which connects the back contact of the PG relay to the TE winding. When PG releases TE relay operates. The trunk D relay released in turn releases the D1 relay, which opens the terminating loop. The SK, SK1, and SK2 relays in the test circuit then release. If SK2 releases before TE operates, a path is closed to the DFR relay which operates and locks to DT1. The DFR relay is fast operate because of its low-time constant effected through the use of a low-resistance winding and series resistance. This reduces to a minimum the variation caused by its operating time. If DFR operates, the trunk D relay release time was too short. In PCI trunks this is probably caused by an open shunt resistor. If DFR did not operate the test advances when the SL1 relay reoperates, which occurs when the trunk D2 opens the shunting ground on the SL relay. The TE and DT1 and other associated test relays release when DST becomes normal on test advance.

6.2 D2M Test (D2M)

6.21 D2M Test (D2M) OS11 - Fig. 153 - SC14

With the D2M key operated a timing test is applied to the D2 relay in the trunk to check its minimum release time. The D2M relay operates from the ST3 relay. The DSS relay operates during the SDT test and operates the DSL relay. (See 3.5).

When the DST relay operates to start the D2M test, ground is applied to the trunk "D" lead, under control of the DSS relay. Ground on the "D" lead reoperates the trunk D relay in turn operating the D1 relay to close the loop through the SK relay which operates, in turn operating the SK1 and SK2 relays. The trunk D1 and D2 relays apply ground to the sleeve lead which shunts the SL relay down, in turn releasing the SL1 relay. The DST relay operated extends ground on the "DSTS" lead to operate the D2N relay, which determines the pulsing rate of the pulse generator for this test. The DST relay operated also releases the slow release

DSS relay which allows the trunk relays to soak during its release time. With the release of the DSS relay the path to the trunk D relay is opened, and it releases. Release of the D relay, releases the D1 relay, opening the loop through the SK relay winding releasing it and opens the path to the D2 relay. Hence, a signal to start timing the D2 relay release is given by the release of the SK relay. The SK relay released releases the SK1 relay. The SK1 relay released operates relay DT1 to start the pulse generator.

The SK1 relay released also operates the DT1 relay which transfers control of the DSL relay to the PG relay. The PG relay operated releases the DSL relay.

After a 50-msec interval relay PG releases and extends ground to operate the TE relay and provides a shunt path to the DFR preventing it from operating until the TE relay operates. The TE relay operated removes the shunt to the DFR relay and holds open the operate path, indicating the end of the timed interval.

The trunk D1 relay released, releases the slow release D2 relay. The D2 relay released removes ground from the sleeve permitting the SL relay to operate from battery on the link hold magnets, holding the test connection. The SL relay operated, operates SL1 relay to indicate that the slow release D2 relay in the trunk circuit has released.

If the D2 relay release time exceeds the minimum, the timed interval will have ended to shunt the DFR relay and to operate the TE relay. In this case the SL1 relay will ground the check lead to advance the test sequence.

If the D2 relay release time is less than the minimum, SL1 relay operating will operate the DFR relay prior to the grounding of the shunt path by the PG relay. The DFR relay operated blocks the test with the D2M lamp lighted.

Successful completion of the test will advance the test sequence to END, releasing the DST relay and associated lamp.

The D2 minimum release time test is made during the normal disconnect test when

testing TSP special toll coin or dial zero trunk circuits, therefore this test is bypassed for these trunks.

6.22 D2M Test (D2M) - Fig. 25 ("Mfr Disc.")

With the D2M key operated a timing test is applied to the D2 relay in the trunk to check its minimum release time. The D2M relay operates from the ST3 relay. The D2M relay operated, operates DSK relay which operates the DSL relay. The DSS relay operates during the SDT test (see 3.4).

When the DST relay operates to start the D2M test, ground is applied to the trunk "D" lead, under control of the DSS relay. Ground on the "D" lead reoperates the trunk D relay in turn operating the D1 relay to close the loop through the SK relay which operates, in turn operating the SK1 and SK2 relays. The trunk D1 and D2 relays apply ground to the sleeve lead which shunts the SL relay down, in turn releasing the SL1 relay. The DST relay operated extends ground on the "DSTS" lead to operate the D2M relay, which transfers the control of the PG relay to the DSS and SK1 relays. The DST relay operated also releases the slow release DSS relay which allows the trunk relays to soak during its release time. With the release of the DSS relay the path to the trunk D relay is opened, and it releases. Release of the D relay, releases the D1 relay, opening the loop through the SK relay winding releasing it and opens the path to the D2 relay. Hence, a signal to start timing the D2 relay release is given by the release of the SK relay. The SK relay released releases the SK1 relay.

The SK1 relay released removes ground from the PA resistance, allowing the PG condenser to charge from battery through the PA resistance and secondary winding of the PG relay. The charging current holds the PG relay nonoperated for 65 msec, after which the steady current flow through the primary from battery through the PA resistance to the potentials at the junction of the voltage divider assumes control and operates the PG relay.

The SK1 relay released also releases the DT1 relay which transfers control of the DSK relay to the PG relay. The PG relay operated releases the DSK relay which in

turn releases the DSL relay. The PG relay in operating also applies ground to the PA resistance which reverses the direction of the current in its primary from the potential at the junction of the voltage divider to ground at the PA resistance. The PG condenser discharges through the secondary winding of the PG relay, holding the PG relay operated for 65 msec, after which the current in the primary assumes control to release the PG relay.

Release of the PG relay extends ground to operate the TE relay and provides a shunt path to the DFR preventing it from operating until the TE relay operates. The TE relay operated removes the shunt to the DFR relay and holds open the operate path, indicating the end of the timed interval.

The trunk D1 relay released, releases the slow release D2 relay. The D2 relay released removes ground from the sleeve permitting the SL relay to operate from battery on the link hold magnets, holding the test connection. The SL relay operated, operates SL1 relay to indicate that the slow release D2 relay in the trunk circuit has released.

If the D2 relay release time exceeds the minimum, the timed interval will have ended to shunt the DFR relay and to operate the TE relay. In this case the SL1 relay will ground the check lead to advance the test sequence.

If the D2 relay release time is less than the minimum, SL1 relay operating will operate the DFR relay prior to the grounding of the shunt path by the PG relay. The DFR relay operated blocks the test with the D2M lamp lighted and grounds the PA resistor to stop the PG relay pulsing.

Successful completion of the test will advance the test sequence to END, releasing the DST relay and associated lamp.

6.3 Tone Detector OS16 - Fig. 35 - SC22

The TN relay is normally operated through section (6, 7, 8) of the TN tube. Reorder tone is fed to the grid of section (2, 3, 4) of the TN through the TN transformer. The TF load resistor and TE1 capacitor serve as a low pass filter. The TE

capacitor and TE resistor serve as a high pass filter. Together the filters pass frequencies in the range of the applied tone. Varistor V2, capacitor TH, and resistor TH form a negative pulse rectifier with a relatively short time constant which does not accumulate charge at the low frequencies where the trunk repeat coil may ring. The higher reorder tone frequency negative pulses accumulate on the TH capacitor, cutting off section (6, 7, 8) of the TN tube, releasing the TN relay. The TE2 capacitor serves to make the TN relay less sensitive to "clicks."

7. SIGNALING CIRCUITS

7.1 Pulse Generator OS15 - Fig. 47

For MF, DP, and PCI pulsing and for timing certain test features, the timing of the pulses is controlled by the pulse generator circuit consisting of the pulse generator relay PG, the pulsing relay P, timing capacitor PG and resistor networks for three types of pulsing.

Relay PG is a double-wound mercury-contact polar relay. The single armature spring closes with two separate break contacts and with two separate make contacts. The two break contacts and the two make contacts are used in parallel in this circuit.

When the circuit is completed for pulsing, the P and PG relays constitute a self-interrupting pulsing circuit, the timing being controlled by capacitor PG and various combinations of resistors PG1 - 13.

The secondary winding of PG is connected at both ends to battery through the network resistors. The negative terminal of the primary winding is connected to the positive terminal of the secondary winding, the positive terminal of the primary winding is connected to the PG capacitor. The primary and secondary windings are wound in opposition to each other. Thus with ground on the armature of the P relay control contact, with P normal, current is applied to the PG secondary winding in the direction to operate PG, but the current in the primary winding to charge the PG capacitor opposes the operation of PG. As the charging current reduces toward zero the secondary

ampere-turns exceed the primary ampere-turns in the opposing direction, and PG operates. Operation of PG operates P which in turn transposes the battery and ground connections to both primary and secondary circuit. The current in the secondary winding is now in a direction to cause the relay armature to return to its break contact, but since the PG capacitor will charge in the reverse direction, which in this case is in the direction to hold PG relay operated, the relay armature action is delayed until the secondary current dissipates and PG releases in turn releasing P. When this occurs the closure of ground through the break contact of P restores the initial condition in which the current in the PG secondary is again in the direction to operate PG to close its make contact, and the pulsing continues. The duration of closure of the PG contact in either direction depends upon the values of the resistances used, which determines the speed of pulsing.

7.2 PCI Pulsing OS5 - Figs. 47 and 50 - SC15

The CI pulsing circuit consists of start pulse relay SP, pulse generator relays P, PG, PG1, PG2, and PG3, grounding relay GR, pulse tip and ring relays PT and PR, relays 12 and 34 which supplement the contacts of the called number switches and final pulse relay FP.

Operation of the CI pulsing class relays arranges the timing resistors to set the speed of the pulse generator to approximately 7.3 pps by short-circuiting resistors PG2 and PG3 and inserting resistors PG7, 8, and 9 into the network. This sets the operate and release times of PG relay to approximately 0.068 second per operation.

When relay SP operates to start the pulsing by releasing relay P, CI pulses are transmitted as controlled by the cross-connected test call code or by the setting of the call through code selector switches in conjunction with counting and steering relays - SD- MFF. Relay PG1 follows the closures of the back contacts of relay PG, operating each time PG returns to normal. Relay PG2 previously operated and locked, and relay PG3 is normal before pulsing begins. The first release of PG1 removes

the short circuit from PG3 and it operates. The next operation of PG1 shunts down PG2. The next release of PG1 releases PG3. The following operation of PG1 operates PG2 and so the cycle repeats. Each complete cycle, which generates four pulses to transmit one digit, proceeds as follows:

Pulse	PG1	PG2	PG3
1	up	up	down
2	down	up	up
3	up	down	up
4	down	down	down

The CI pulses consist of light and heavy, positive and negative pulses, each pulse having a duration of about 65 msecs. The second and fourth intervals or "quadrants" are always negative pulses, either heavy or light, and are used as steering pulses at the receiving circuit, two such pulses advancing the receiving circuit to the next digit register. The heavy negative pulses also convey code information. The first and third quadrants may be positive pulses, or non (blank pulses). The positive pulses are always light pulses for transmitting the number, but most receiving circuits require a heavy positive pulse as a terminating signal.

Three different codes of pulse combinations are used, the regular one for office code and all numerals except thousands, the thousands code, and the stations code. These codes are given in the following table where n represents a light negative pulse, N heavy negative, P light positive, and - a blank pulse. The four letters J, M, R, and W corresponding to numerals 5, 6, 7, and 9 are the only stations digits provided. If no station is dialed or if any other numeral is dialed in error a zero will be transmitted. The stations code for 1 is not used in sending a stations digit, but is used in sending the first digit of a 10,000 number.

Regular	Thousands	Stations
0 - n - n	0 - n - n	0 - n - n
1 p n - n	1 - n - N	1 p n - n
2 - N - n	2 p n - n	
3 p N - n	3 p n - N	
4 - n p n	4 - N - n	
5 - n - N	5 - N - N	5 (J)-npn
6 p n - N	6 p N - n	6 (M)-n-N
7 - N - N	7 p N - N	7 (R)pN-n
8 p N - N	8 - n p n	
9 - n p N	9 - n p N	9 (W)-N-n

Relay PG1 operated grounds lead "R" for a positive or blank add pulse and grounds lead "T" for negative even pulses when released. The GR operates and locks when relay PG1 operates the first time. Relay PT is connected so as to be operated when a positive odd pulse is required or normal when a blank odd pulse is required. Operated it connects 6500-ohms battery to lead "T" giving a light positive pulse. Normal it connects ground through a back contact of GR to lead "T" to discharge trunk cable capacity prior to start of pulsing. Relay PR is connected so as to be operated when a heavy negative even pulse is required or normal when a light negative even pulse is required. Operated it connects 115-ohm battery to lead "R" to give the heavy negative pulse. Normal it applies 6500-ohm battery to lead "R" to give a light negative pulse.

After the entire number has been pulsed, relay FP operates to reverse the "tip" and "ring" leads so as to send out a blank pulse and then a heavy positive pulse.

7.21 Connection of Pulsing Circuit to Called Number Switches OS5

On the first and fourth pulses of each digit relay PT is connected through a back contact of PG3 to certain contacts on the called number switches or to test call code cross-connection terminals and on the second and third pulses through a front contact of PG3 to other switch or cross-connection terminals. These points are grounded or not according to the setting of the test code or switches and the progression through the digits. As the PT relay action is significant only in the first and third quadrants, it has the preceding quadrant time in each case to get ready.

Similarly relay PR is controlled on the first and second quadrant through a front contact of PG2 and on the third and fourth quadrants, through a back contact of PG2.

Since there are a limited number of contacts on the called number switches and cross-connection terminals, relays 12 and 34 are provided to further control relays PT and PR. If a certain digit requires PT operated for the first pulse and PR for the second, 12 operates and in turn operates PT and PR for the quadrants in which they should

be operated. Relay 34 performs a similar function for digits which require PT operated for the third pulse and PR for the fourth.

7.22 Transmission of Called Number OS5 - Figs. 45 and 50 - SC15

The release of relay AOP operates relay SP to start pulsing. Relay PLA operated connects the pulsing circuit to the "T" and "R" leads. The terminals on level 1 of switch A or the "A" digit test code cross-connection have been previously closed through by operation of steering relay AD. Connection from ground on relay SP to the contacts of relays PG2 and PG3 to operate PR or PT as requires for the first two quadrants of digit "A" has already been set up. Operation of PG3 at the end of the first quadrant operates steering relay BD which prepares the operating paths for PT and PR for use during the last two quadrants of the "A" digit. Release of PG2 at the end of the second quadrant transfers control of PR for use during the last two quadrants to level 2 of switch A. Release of PG3 at the end of the third quadrant releases steering relay AD which prepares the control path for PR and PT for use during the first two quadrants of digit "B".

So the pulsing proceeds, transferring the operating ground for PT and PR two pulses at a time through the A, B, C, STA, TH, HU, T, and U switches as controlled by steering relays AD-MFF.

On a test code call, pulsing continues until digit "C" has been outpulsed when steering relays TT operated and CD released stops the pulse generator until the PLB test, at which time the pulsing continues until all eight digits have been pulsed. At this point the steering circuit causes relay FP to operate and transmit the final pulse signal.

When FP is connected, a blank pulse is sent after the fourth quadrant of the unit digit followed by a heavy positive pulse. When relay PG2 releases after the final pulse, relay EP operates to stop the pulse generator and to operate relays STP and STP1. The STP disconnects the pulsing circuit from the "T" and "R" leads and re-connects relay CSO across the trunk.

7.3 PCI Generator ("Mfr Disc.")

7.31 Generation of PCI Pulses Fig. 3

The CI pulsing circuit consists of start pulse relay SP, pulse generating relays PG, PG1, PG2, and PG3, grounding relay GR, pulse tip and ring relays PT and PR, relays 12 and 34 which supplement the contacts of the called number switches and final pulse relay FP.

The PG relay is a nonbiased condenser-timed polarized relay. It closes its front contact when energized in one direction by its primary winding, closes its back contact when energized in the other direction by its primary winding, and remains on either contact or between the contacts when not energized. When current is first closed through the primary in either direction, its force is more than neutralized by an opposing current in the secondary winding, the source of which is the charge or discharge of the timing condenser. When the condenser has been charged or discharges, current ceases to flow in the secondary, and the primary causes the armature to move over from one contact to the other. The actual time of operation varies somewhat with variations in voltage, resistance and relay adjustment. It averages about 0.068 second per operation. Jack PG affords a means to patch the windings of relay PG separately to a relay test set.

When PG relay closes its front contact, CI and SP relays being operated, it grounds out the 300-ohm battery and so starts opposing currents in the two windings. At first the effect of the secondary winding is stronger and the front contact is held closed, but as the condenser discharges the current in the secondary dies down until the primary winding becomes the stronger when the relay breaks its front contact and closes its back contact. Now the battery through 300 ohms is not grounded out and currents in the two windings are reversed. As the condenser charges the primary becomes effective, when the relay breaks its back and closes its front contact. Then the cycle repeats.

In sending out CI pulses the PG relay pulses as just described with PG1 operating

every time PG closes its back contact. The pulsing must start with the timing condenser discharged and the PG- relays in a definite condition (the PG on its back contact, the PG1 and PG2 operated and PG3 normal). The condenser is discharged and PG set on its back contact when ST1 operates operating SB which with SP normal grounds out the 300-ohm resistance. The SB operating operates PG1 and PG1 operates PG2, but PG3 cannot operate because its winding is short-circuited.

The PLA relay operating extends "PLAS" ground through CI operated to the winding of the SP relay. The SP operates and then PG and PG1 start continuous pulsing. The PG2 being operated and locked and PG3 normal before the pulsing begins, the first release of PG1 removes the short circuit from PG3 and that operates. The next operation of PG1 short-circuits PG2 and that releases, leaving PG3 still up. The next release of PG1 releases PG3. The following operation of PG1 operates PG2 and so the cycle repeats. Each complete cycle, which generates four pulses to transmit one digit, proceeds as follows:

Pulse	PG1	PG2	PG3
1	Up	Up	Down
2	Down	Up	Up
3	Up	Down	Up
4	Down	Down	Down

When operated PG1 grounds the "R" lead for a positive or blank odd pulse, and when normal it grounds the "T" lead for a negative even pulse. The GR operates with PG1 but slightly later.

The winding of PT is connected to the called number switch so as to be ready in the operated position when a positive odd pulse is required or normal when a blank odd pulse is required. Operated it connects 6500-ohms battery to the "T" lead, giving the light positive pulse. Normal it connects ground through back contact of GR to the "T" lead, so that both sides of the trunk are grounded momentarily to discharge the trunk capacity, until GR operates immediately after PG1, after which the "T" lead is open to give the blank pulse. Prior to outpulsing the PG1 relay is operated but the GR will not be operated until the SP (start pulse) relay operates.

The winding of PR is connected to the called number switch so as to be ready in the operated position when a heavy negative even pulse is required, or normal when a light negative even pulse is required. Operated it connects 115-ohm battery to the "R" lead, giving the heavy negative pulse. Normal it leaves only 6500-ohm battery connected to the "R" lead, giving the light.

After the entire number has been transmitted relay FP is operated if its winding is connected. It breaks the operating circuit of PG1 when PG3 is also operated, reverses the "T" and "R" leads, and makes such connections as to send out a blank pulse and then a heavy positive pulse, as will be described in detail later.

7.32 Connection of Pulsing Circuit to Called Number Switches Fig. 10

On the first and fourth pulses of each digit the winding of PT is connected through a back contact of PG3 to certain contacts on the called number switches, and on the second and third pulses through a front contact of PG3 to other contacts on the called number switches. These points are grounded or not according to the setting of the switches and the progress of the operations through the digits. As the operation or nonoperation of PT is significant only in the first and third pulses, it has in every case the whole preceding pulse to get ready.

Similarly the winding of PR is connected on the first and second pulses through a front contact of PG2 to certain of the switch contacts, and on the third and fourth pulses through a back contact on PG2 to other switch contacts.

Since there are not enough contacts on the called number switches to give all the combinations required, relays 12 and 34 are furnished, with their windings connected to the switch contacts, and their contacts connected through the front and back contacts of PG2 and PG3 to the windings of PT and PR. Then if a certain digit requires PT operated for the first pulse and PR for the second, 12 operates from a contact and in turn operates PT and PR for the periods during which they should be operated. The 34 performs a similar function for digits which require PT operated for the third pulse and PR for the fourth.

The pulses are transmitted in a continuous stream, four pulses to each digit. The first and third pulses of each digit are either blank or light positive, the second and fourth either light or heavy negative. The different combinations of four pulses determine the numeral transmitted for each digit. In addition each negative pulse, whether light or heavy, serves to advance the distant control circuit which receives the pulses and registers the numbers transmitted.

Three different codes of pulse combinations are used, the regular one for office code and all numerals except thousands, the thousands code, and the stations code. These codes are given in the following table where n represents a light negative pulse, N heavy negative, p light positive, and - a blank pulse. The four letters J, M, R, and W corresponding to numerals 5, 6, 7, and 9 are the only station designations provided for. If no station is dialed or if any other numeral is dialed in error a zero will be transmitted. The stations code for 1 is not used in sending a stations digit, but is used in sending the first digit of a 10,000 number.

Regular	Thousands	Stations
0 - n - n	0 - n - n	0 - n - n
1 p n - n	1 - n - N	1 p n - n
2 - N - n	2 p n - n	
3 p N - n	3 p n - N	
4 - n p n	4 - N - n	
5 - n - N	5 - N - N	5 (J)-npn
6 p n - N	6 p N - n	6 (M)-n-N
7 - N - N	7 p N - N	7 (R)pN-n
8 p N - N	8 - n p n	
9 - n p N	9 - n p N	9 (W)-N-n

7.33 Transmission of Called Number

The release of AOP connects the pulsing circuit to the "T" and "R" leads through front contacts of CI and operates SP to start the pulsing. The terminals of the NA or the A switch, are already grounded through back contacts of relays 3 and 3' so some connections are already set up from ground to the contacts of PG2 and PG3 to operate PR and PT as required for the four pulses of the "NA" or "A" digit.

The release of PG2 at the end of the second pulse operates relay 3, which transfers the ground operating PT and PR on the

first and second pulses of a digit from the A switch to the B switch. The next operation of PG2, at the end of the fourth, allows relay 3' to operate in series with 3. The 3' operating transfers the ground for operating PT and PR on the third and fourth pulses of a digit from the A switch to the B switch.

So the pulsing proceeds, transferring the grounds for operating PT and PR two pulses at a time through the A, B, C, ST, TH, H, T, and U switches in turn, by operating the progress relays 3, 3', 4, 4', 5, 5', 6, 6', 7, 7', 8, 8', 9, 9', 10, and 10'.

Each pair of progress relays locks up either to the pair operating it or to off-normal ground. When 5' operates it places a ground on the secondary winding of PG stopping the pulsing until PLB operates at which time PG continues its pulsing to operate 6.

The 10' operates at the end of the fourth pulse at the units digit, which is the last digit. The 10' operates FP.

When FP is connected, a blank pulse is sent after the fourth pulse of the unit digit with PG on its back contact, PG1, PG2, and FP operated and PG3 normal. Then PG breaks its back contact, releasing PG1 which lets PG3 operate. The FP operated reverses the connections between the "T" and "R" leads and the contacts of PG1, and also connects the 115-ohm resistance battery to the "T" lead, so the release of PG1 starts a heavy positive pulse.

After the heavy positive pulse has lasted for the usual time of a pulse, PG closes its back contact. Usually that would operate PG1 terminating the pulse and releasing PG2; but this time, since FP and PG3 are both operated, the back contact of PG is cutoff from the winding of PG1 and connected instead to release PG2 directly. The STP operates upon the release of PG2. The operating circuit for STP is wired through a front contact of SP so that it cannot be operated falsely while station delay is being measured.

The operation of STP and STP1 after the final pulse marks the completion of the pulsing functions on the call. The STP disconnects the "T" and "R" leads from the pulsing circuit to terminate the heavy positive pulse and connects them to the CSO relay through the K coil.

7.4 Dial Pulsing OS6, 14, 15, and 23 - Figs. 46, 47 and 48 - SC16.1, 16.2

The dial pulsing circuit consists of start pulse relay SPG, pulse generator relays P and PG and counting relays W, Z, CF, and Pl-5.

Operation of the DP pulsing class relays arranges the timing network resistors to set the speed of the pulse generator for approximately 10 pps. This involves insertion of resistors PG1, 10, 11, 12, and 13 into the network. The operate and release times for PG relay is approximately 0.050 second per operation.

Early in the test sequence the pulse generator is conditioned for operation by operation of P relay and setting of PG on its back contact. The pulse generator is started by relay SPG operated which releases relay P. Dial pulses in the form of opens and closures of the "T" and "R" loop for loop signaling trunks or the "E" lead for composite signaling trunks are transmitted. The dial pulse code consists of a 3-digit test line code and four digits "1" for test line calls or 7 to 11 digits for call through tests.

The number of pulses transmitted for each digit is determined by the setting of the called number switches or by a cross-connected test code. Counting relays Pl-5 follow the progress of the pulses and when the number counted coincides with the selected number for a particular digit, relay CF operates to terminate the pulsing and to prepare the counting relays for counting the interdigital interval. The W-Z combination controls the advance of the steering relays AD-MFF and also controls the beginning and end of pulsing for each digit and for interdigital intervals.

When the last digit has been pulsed relay EP operates through a steering relay contact network to stop the pulse generator and to advance the test circuit to the next test sequence.

7.5 Counting Relays OS14 - Fig. 48 - SC16

The pulse counting relays Pl-5 are used to count the number of dial pulses generated and are then recycled and used to

count the interdigital interval pulses. The Pl and P2 function as a pulse divider and P3, 4, and 5 are used to differentiate between the different pairs of pulses.

The following table gives the sequence of the counting relay operations.

Pulse	P	Pl	P2	P3	P4	P5	Counting Relays Remaining Operated
1	RLS OPR	0	0				P1, P2
2	RLS OPR	R	R	0			P3
3	RLS OPR	0	0		0		P1, P2, P3, P4
4	RLS OPR	R	R				P3, P4
5	RLS OPR	0	0	R			P1, P2, P4
6	RLS OPR	R	R			0	P4, P5
7	RLS OPR	0	0				P1, P2, P4, P5
8	RLS OPR	R	R	0			P3, P4, P5
9	RLS OPR	0	0		R		P1, P2, P3, P5
10	RLS OPR	R	R				P3, P5

7.51 Interdigital Interval - OS14 and 15 - Fig. 48 - SC16

When relay CF operates at the end of pulsing for a particular digit, relay W operates. Relay W release the digit steering chain relay corresponding to the digit just transmitted in preparation for controlling the next digit and also short-circuits the P pulsing contact to prevent pulsing the trunk A relay during interdigital timing. In addition when P relay releases following the last pulse closure for the digit, all counting relays Pl-5 restore to normal so as to be available to count the interdigital interval.

The PG and P relays continuously function and when P operates at completion of the first interdigital timing pulse, relay CF releases and causes relay Z to operate. Relay Z transfers the CF operate path from the selector switch or test code cross-connection terminal to a contact network which marks the end of the 1/2-second interdigital interval. When five 100 msec pulse cycles have elapsed relay CF reoperates and releases W causing the next digit steering chain relay to operate. This chain relay, however, is ineffective until the preceding chain relay releases. Relay Z operated also short-circuits the P pulsing contact to prevent falsely pulsing the trunk A relay after W releases.

The last closure of P relay during the interdigital interval releases CF in turn releasing Z to transfer control of the pulsing back to the digit steering relay chain and so on.

7.6 Dial Pulse Generator - Fig. 41 "Mr Disc."

7.6.1 Pulse Generator

The pulse generator circuit consists of timing relays INT and INT1, the pulsing relay P, the checking relay CKP, the pulse limit switch, and the associated networks. Presetting the pulse limit switch determines the pulse rate and the percent break of the dial pulses as follows:

Setting	Rate	% Break
Avg	10	63.5
8 pps Min Bk	8	40
8 pps Max Bk	8	80
12 pps Min Bk	12	40
12 pps Max Bk	12	80

Potentiometers included in the pulsing networks permit adjustments to be made in the percent break and pulsing rate.

In the following description the pulse limit switch is considered to be set to "AVG". The INT and INT1 relays interact to generate pulses, and the front contact on the INT1 controls the P and CKP relays which are connected in series to the PN and PM voltage divider resistors. The positive terminal of the CKP relay secondary is connected to battery through PL resistor and to ground through INT1 relay front contact.

The positive terminal of the INT relay secondary is connected to battery through PH resistor and to ground through INT1 relay back contact and through a network of start and stop control contacts. The primary winding of the INT relay is connected to battery through the AVG2 biasing resistor. The secondary winding of the INT1 is connected through the XBK resistor to the XBK capacitor which is connected to ground through the INT relay front contact and to the INT shorting resistor through the INT relay back contact.

After the DP and DPC relays have operated to establish the pulsing class and provide grounds to energize the DP generator the INT, INT1, P, and CKP relays are operated. The INT and INT1 relays are operated through the biasing windings, capacitor SBK is charged up, and capacitor B is discharged.

The generator starts when ground is removed from the PH resistor on the positive terminal (3+) of the INT secondary winding. During outpulsing SPG relay operated removes this ground. Removal of control ground from 3+ of the INT relay permits B capacitor charging current to flow in the reverse direction through INT relay secondary winding. During the peak of the charging surge the reverse current in the secondary winding causes the INT relay to release, discharging the XBK capacitor. When the B capacitor is sufficiently charged the reverse current becomes reduced to permit the biasing winding to reoperate the INT relay. When the INT relay reoperates the XBK capacitor will charge, the charging current flowing in the reverse direction through the INT1 relay secondary winding. During the peak of the charging surge the reverse current in the secondary winding causes the INT1 relay to release. The INT1 relay released removes ground from the PL resistor, reversing the current through the windings of the P and CKP relays, releasing them to start the dial pulse. The INT1 relay released also applies ground to 3+ of the INT relay, discharging the B capacitor in the forward direction through the INT relay secondary winding. When the XBK capacitor is sufficiently charged the reversed current in the INT1 secondary becomes reduced to permit the biasing winding to reoperate the INT1 relay. The INT1 relay reoperates the P and CKP relays to end the dial pulse and removes ground from 3+ of the INT relay, charging the B capacitor to release the INT relays as the pulse generator starts to recycle. The P and CKP relays, following the INT1 relay,

generate dial and check pulses, respectively. The pulse generator is stopped as required by applying direct ground to 3+ of the INT relay through the network of control contacts.

7.62 Counting Relays OS6 - Fig. 9 - SC16

Associated with the pulse generator are the pulse counting relays LC, LD, LE, and P1 to P6. The LC, LD, and LE relays comprise a three relay pulse dividing circuit with the counting relays P1 to P6 being operated alternately by the LE relay operating or releasing.

The digits are counted on the P-relays as follows:

Digit	Relays Operated
1	P1
2	P2
3	P3
4	P4
5	P5
6	P5 P6
7	P6 P1
8	P6 P2
9	P6 P3
10	P6 P4

7.63 Pulsing Even and Odd Pulses

The preliminary operation of the CKP and P relays operate the LC relay. Operation of the SPG relay removes ground from the 3+ terminal of the INT relay starting pulsing (See 4.61). When INT1 relay subsequently releases INT1, 14, and 15 contacts open reversing the current in the P and CKP relay windings allowing these relays to open their 14 and 15 contacts. The P relay contact opens the loop for the first open period of the digit.

With the release of the CKP relay, the shunt ground is removed from the winding of the LE relay, LE relay operates. Operation of the LE relay operates the P1 relay and it locks to the succeeding relay, P2. The next operation of the CKP relay operates the LD relay. Operation of the LD relay releases the LC relay, LC relay releases LE relay. The LE relay releasing operates the P2 relay which releases the P1 relay.

The INT-INT1 interrupter will continue to pulse until the combination of P- relays is reached which connects the ground through

the Z relay, sequence relays, switch keys, pulsing relays to the winding of the SP1 relay. Both the SP1 and W relays close a short around the contacts of the P relay to prevent further interruptions of this relay from being effective on the loop. The SP1 relay initially closes this short at the beginning of the interdigital interval and opens it at the end of the interdigital interval, while the W relay maintains the closure when the SP1 relay releases during the interdigital interval. At this time ground from the CKP13 contact will be connected to the outer end of the SP1 relay winding to prevent its operation. When the CKP relay operates to its 15 contact this ground will be removed and the SP1 relay will operate. The SP1 relay causes the operation of the W relay.

The P relay operates to its 15 contact with the CKP relay and recloses the loop for the last pulse of the digit. The interrupter will continue to pulse and when relay CKP again closes its 13 contact, relay SP2 operates through the operated contacts of relay SP1. Relay SP2 closes a circuit for holding relay SP1 and releases any of the L- and P- relays which may have been operated. When the CKP relay again operates to the 15 contact both the SP1 and SP2 relays release. The SP2 relay in releasing recloses the operating and locking circuits to the L- and P- relays. The SP1 relay in releasing allows the Z relay to operate.

7.64 Interdigital Interval - Fig. 11

The Z relay in operating releases the pulsing sequence relay corresponding to the digit just transmitted and transfers the digit control lead from the steering chain to the "3" lead for timing the interdigital interval.

The PG interrupter will continue to pulse and the number of pulse cycles will again be counted on the L- and P- relays except that, due to the delay in recycling the counting relays after counting the digit pulses the P1 relay will operate only after 1-1/2 pulse cycles of the interdigital interval have been completed. When 2 additional cycles have elapsed the P3 relay will be operated connecting the digit control lead through the operated contacts of the P3 relay to the inner end of the winding of relay SP1. At this time the CKP relay will be closing its 13 contact to connect ground to the outer end of the SP1 winding thus, preventing its operation. When relay CKP again breaks its 13 contact, it removes the

shunt from relay SP1 allowing it to operate. Relay SP1 operated, operates WR relay. Operated WR relay releases the W relay. When relay CKP again closes its 13 contact, relay SP2 reoperates via relay SP1 operated to release the L- and P-relays again. The subsequent operation of relay CKP to its 15 contact breaks the holding path through its 13 contact of relays SP1 and SP2 to release them. Relay SP2 in releasing recloses the circuit for operating and locking the counting relays and partially closes the combined operating path for relay LE and locking path for relay LC. Relay SP1 in releasing:

(a) Opens make contacts bridged around the contacts of relay P to return control of the loop closures to relay P.

(b) Releases relay WR and Z.

7.65 Completion of Dialing

At the completion of dialing with the operation of the 10' pulsing sequence relay, (9' relay for calls with no stations digit), STP relay operates. Operation of the STP relay operates the EP relay. The EP relay operated releases the SPG relay.

The EP relay operated places shunt ground on the 3+ terminal of the INT relay to stop the pulse generator, indicating the end of pulsing.

7.7 Multifrequency Pulsing - OS6, 15, 17, 22 - Fig. 46, 47 - SC28, 30, 31, and 32

Numbers are transmitted by multifrequency pulsing by transmitting for each digit a pulse consisting of two alternating current frequencies. The duration of each pulse is approximately 65 msec with an open interval between pulses of 65 msec. Each number, comprising seven to eleven digits, is preceded by a KP (gate-opener) pulse, and is followed by a start (ST) pulse. The KP pulse is of longer duration than the digit pulses, and is used to activate the receiving circuit to the condition for registration of the digit pulses which follow.

Each pulse is transmitted as a combination of two different frequencies, selected as required from six supply leads designated 0, 1, 2, 4, 7, and 10.

The MF pulses are transmitted to the trunk tip and ring leads through coil A. The frequencies used are as follows:

Digit	Frequencies Transmitted	MF Supply Leads Connected
1	700,900	0,1
2	700,1100	0,2
3	900,1100	1,2
4	700,1300	0,4
5	900,1300	1,4
6	1100,1300	2,4
7	700,1500	0,7
8	900,1500	1,7
9	1100,1500	2,7
0	1300,1500	4,7
ST	1500,1700	7,10
KP	1100,1700	2,10

The code to be outpulsed is determined by the setting of the called number switches, the XD relay or by a cross-connected test code. Since each digit consists of only one pulse, the digit steering relays AD-MFF, along with pulsing relay P, function as the sole control of the outpulsing.

Early in the test the pulse generator is conditioned for operation by operation of P and setting PG on its back contact. The pulsing is started by operation of relay SPG which releases P. The first release of P closes the KP frequencies 1100 and 1700 to the tip and ring leads. The first pulse is lengthened to 100 msec under control of relay PPI. Release of P also operates PPI in preparation for changing the pulsing speed to 65 msec operations of the KP pulse. During the KP pulse cycle relay P reoperates and PPI operates to short-circuit timing network resistors PG2 and PG3 so as to set all following digits at the 7.3 pps rate. The next time P releases causes the first digit pulse to be transmitted and also operates the digit steering relay next in order to the one corresponding to the digit being set. When P next operates the previous digit steering relay releases, its locking contact having been transferred to control of the P relay by the operation of the succeeding steering relay. The circuit operation continues in this fashion with one digit being outpulsed each time P releases until the last digit has been outpulsed at which time relay EP operates to stop pulsing, and to advance to the next test sequence as described previously.

7.8 Pulsing Sequence

The digits to be pulsed are under control of the called number switches, XD relay or test code cross-connection terminals. The pulsing sequence relays steer the pulse control to the called number switches, XD relay or cross-connection terminals as required. On DP or MF calls if the STA switch is not set to "1", "W", "R", "J", relay NSD operates to omit pulsing a stations of "ten thousands" digit. On all calls if the stations switch is set to "1" for calls to numbers over ten thousand the digit "1" is outputted following the office code "C" digit.

Pulsing sequence for PCI calls:

Pulsing Sequence Relays	Called No. Switch	Digits
AD-BD	A)	Office
BD-CD	B)	Code
CD-TT	C)	
TT-TH	STA	Station or Ten Thousands
TH-HU	TH	Thousands
HU-TND	HU	Hundreds
TND-U	T	Tens
U-STA	U	Units
STA-XD**	XD Relay	"X"

Pulsing sequence for MF or DP calls:

Pulsing Sequence Relays	Called No. Switch	Digits
NA	NA)	National
NB	NB)	Area
NC	NC)	Code
AD	A)	Office
BD	B)	Code
CD	D)	
TT*	STA	Ten Thousands
TH	TH	Thousands

Pulsing Sequence Relays	Called No. Switch	Digits
HU	HU	Hundreds
TND	T	Tens
U	U	Units
STA*	STA	Stations
XD**	XD Relay	"X"

*If a ten thousands or a stations digit is not required relays TT or STA respectively are bypassed in the pulsing sequence chain.

**Only on ANI test calls.

7.9 Pulsing Sequence and Test Counter
("Mfr Disc.")

The digits to be pulsed are under control of the called number switches. The pulsing sequence relays steer the pulse control to the called number switches as required. On DP test calls the STA switch, if not set to "1", "W", "R", "J", or "M", will preoperate the 10 and 10' pulsing sequence relays to omit the STA digit. On DP call through test the STA switch set to "1" for calls to numbers over ten thousand operates the TTH relay which changes the steering pattern so the STA switch will break by the pulse control before the TH switch.

Pulsing sequence for PCI calls:

Pulsing Sequence Relays	Called No. Switch	Digits
0-0'	NA)	National
1-1'	NB)	Area Code
2-2'	NC)	(future)
3-3'	A)	Office
4-4'	B)	Code
5-5'	C)	
6-6'	STA	Station or Ten Thousands
7-7'	TH	Thousands

Pulsing Sequence Relays	Called No. Switch	Digits
8-8'	H	Hundreds
9-9'	T	Tens
10-10'	U	Units

Pulsing sequence for DP calls to line numbers under 10,000:

Pulsing Sequence Relays	Called No. Switch	Digits
0-0'	NA)	National
1-1'	NB)	Area
2-2'	NC)	Code
3-3'	A)	Office
4-4'	B)	Code
5-5'	C)	
6-6'	TH	Thousands
7-7'	H	Hundreds
8-8'	T	Tens
9-9'	U	Units
10-10'	STA	Stations

The 10-10' relays are preoperated when stations digit is omitted.

Pulse sequence for DP calls to line number 10,000 and over, TTH operated:

Pulsing Sequence Relays	Called No. Switch	Digits
0-0'	NA)	National
1-1'	NB)	Area
2-2'	NC)	Code
3-3'	A)	Office
4-4'	B)	Code
5-5'	C)	
6-6'	STA	Ten Thousands
7-7'	TH	Thousands
8-8'	H	Hundreds
9-9'	T	Tens
10-10'	U	Units

The operation of the sequence relays in chain style, is controlled by the operate and release of the PG2 relay for PCI and Z relay for DP. Sequence relay 0 counter operates and locks with NAT code relay operated. Counting starts with 3 counter relay operated with NAT code relay released. At the completion of the desired pulses, the PG2 or Z relay operates removing the shunt from the 0' counter relay and it operates. Operation of the 0' counter relay extends the path to operate the next counter relay 1 when PG2 or Z releases. Next operation of the PG2 or Z relay removes the shunt from the 1' counter relay and it operates.

This operation is repeated until the 9' or 10' counter relay operates. At this time pulsing is stopped.

8. TIMING AND ALARMS

8.1 Counter Operation

8.1.1 Timing Counter - (TW and TZ) OS11 - Fig. 32

The first closed period of a timing interrupter operates the TW relay. The first open period of the interrupter removes the shunt from the winding of the TZ relay and it operates. The second closed period with the TZ relay operated shunts the TW relay, and it releases. The second open period and the released TW relay, releases the TZ relay.

8.1.2 Timing Counter - (TW1 and TZ1) OS11

The second closed period with the TZ relay operated and the TW relay normal, TW1 relay operates, TZ1 relay being shunted at this time. The second open period and the TW relay released releases the TZ relay removing the shunt from the winding of the TZ1 relay and it operates. The third closed period operates the TW relay. The third open period removes the shunt from the winding of the TZ relay, and it operates. The fourth closed period with the TZ relay operated, shunts the TW relay and it releases. The operated TZ relay and released TW relay shunts the TW1 relay winding and it releases. The fourth open period releases the TZ relay and in turn the TZ1 relay.

8.1.3 Time Alarm OS11

During the first cycle of the TW1 and TZ1 relays, release of the TW1 relay with

the TZ1 relay operated, operates the TA relay. During the second cycle, TW1, TZ1, and TA relays operated, operate the TAl relay or the AL relay. Operation of the TAl relay provides a path to operate the AL relay. Relay AL operating lights the AL lamp and grounds the "TA" lead to the alarm frame sounding the minor audible alarm.

8.2 Busy Timing OS11 - Fig. 32

With the ST1 relay normal a path is provided to operate the BYT relay and it locks. Operation of the BYT relay and the first closure of the BY interrupter, relay TW operates. Operated TW relay starts busy timing. The BYT relay remains locked, permitting the timing counter circuit to function (See 8.11). The BYT relay operated times for the operation of the ST1 relay for a period of 4-1/2 to 5 minutes.

8.3 Test Timing OS11

- (a) NML, CTP, or ABR operated with FOTT operated:

Relay ST1 operating releases the BYT relay and busy timing stops. Release of the BYT releases all operated timing counter relays TW, TZ, TW1, TZ1, and alarm relays TA, TAl.

Operation of the ST1 relay and released timing counter and alarm relays, operates the TB relay starting test timing.

With the NML, CTP, or ABR and FOTT operated, TW relay operates to the closed contact of the TT1 interrupter. First operation of the TW relay starts timing counter to function (See 8.11). The timing period is 42 to 49 seconds.

- (b) ABR operated with FOTT normal.

Relay TB operates, operating the TW relay to the closed contacts of the TT2 interrupter. Timing starts as in paragraph on Counter Operation (See 8.11). Timing period is 150 to 170 seconds.

The operation of the Display Trouble Indication, Call Through Test or Transmission Test stops timing counter relays TW and TZ by placing a ground on the interrupter lead holding one of them operated.

8.4 Major and Minor Alarms

8.41 Time Alarm OS11 - Fig. 32

Operation of the AL relay as a result of time-out grounds the "TA" lead to the floor alarm frame fuse and time alarm circuit, which lights the aisle pilot lamps and sounds the minor audible alarm. The TA lamp is lighted on the lamp panel, and when required, TA lamps associated with this test circuit are lighted on other test circuits.

If the AL relay is operated during the Return Test Line function (RTL) the AL1 relay is operated to ground the "S1" leads of the return test lines. Ground on the "S1" leads of the return test lines will prohibit false seizure.

The AL operated also initiates the "CH" lead release test by operating the TT1 relay (See 5.7) restoring the "CH" lead to the recorder to avoid holding it open as a result of any trouble condition.

The TA key is operated to cut off the time alarm. The test circuit is prevented from advancing to the next tandem trunk circuit if the TA key is left operated. Repeat tests can, however, be made even if the TA key is operated.

The ACO key is operated to cut off the alarm bell. The use of this key does not block the test circuit and is designed for use in silencing the alarm during a repeat test of a tandem trunk circuit which is in trouble.

8.42 Major Alarm OS8.2, 11 - Fig. 32

A failure of the "CH" lead release test (See 5.7) is indicated by the release of TT4 relay prior to the operation of the TT2 relay. The "CH" lead release test is made to release the "CH" lead from the custody of the test frame and check that it has been properly restored to the recorder. Failure of this check indicates that the lead has not been properly restored upon release of the TT4 relay and that the "CH" lead appears open to all the trunks served by the recorder, canceling some timing entries and delaying all others. Because a failure of this nature is a hazard

to the AMA timing entries of many calls, the major alarm is sounded when a "CH" lead release failure occurs.

Lead "CH" release failure operates the MAL relay through the TT1 relay operated and TT4 and TT2 relays released. The MAL operated, locks and grounds the "MA" lead to the floor alarm frame fuse and time alarm circuit to sound the major alarm, transfers the operate path of the TA lamp to a back contact on the FL relay, and transfers the contacts of the DT interrupter to operate the slow release FL relay. Operated MAL relay, operates MAK relay.

Relay FL is operated every 1.3 seconds from the DT interrupter by a ground pulse lasting 0.15 second. At the end of each pulse the slow release FL relay remains operated for approximately 0.45 second before releasing. The FL relay in pulsing flashes the TA lamp as a visual indication that a major alarm is originating at the test frame.

The MAL relay may be released by operation of the RN relay or by operation of the CAKR relay from the CA key operated with the REP key operated. (See 1.52).

9. SEMIAUTOMATIC TESTS

9.1 Transmission Tests (XM) OS9.1 - Fig. 18 - SC8

Patch cords to connect the transmission measuring set to the trunk test circuit are plugged into the R and S jacks on the lamp and key panel. The R jack contact closes a circuit to the ABR winding. When the test is started, ST3 operates, and closes the circuit to operate the ABR relay, in turn lighting the ABR lamp. The test circuit then advances through the AOP or AOD, FLA, RTL, PLB, IET, and AFT test stages (See 2.1) since the ABR relay closes the "RTLK" lead to the PLB relay of the test sequence, instead of to the FTR relay, as for a normal test. When the D functions test is completed, ground on the "DFTK" lead operates the XM relay. Operation of the XM relay in turn lights the XM lamp, and applies ground to the "XMS" lead, which operates the TRM relay.

The TRM relay operated transfers the tip and ring leads from the trunk to the R jack. A holding bridge is applied by the test set to the trunk during the time that

the reading is being made. By sending 1 milliwatt at 1,000 cycles into the S jack from the sending sources, the loss through the trunk is noted by reading the power received by the transmission measuring set. After completing the reading, the CA key is operated to release the trunk, the circuit operation being the same as described in the section on "control advance with trunk attached" (See 1.5), except that STP releasing opens the trunk loop through the transmission test set, instead of through the CSO relay. Relays XM and TRM restore under control of the ASR relay.

9.2 Call Through Test (CTT) - OS4, - Fig. 14 - SC17

Operation of the CTT key prepares the test frame for this test. The number to be reached is set up on the called number switches, A through UNITS (or STATION). If the number to be reached requires the use of an "XOX" or an "XLX" code, the NAT CODE key is also operated, and the proper area code set on the NA, NB, and NC switches. If the call through test is to be made on a reserve trunk, the DECADE IDENTITY switch should be set to give the identity of the trunks for which maintenance is necessary, or one which gives the proper class indication to the marker to reach the desired terminating area. For Call Through tests made on other than a reserve trunk, the setting of this switch is immaterial.

Initiation of the Call Through test is made by either operating the ST key after setting the GROUP TENS, GROUP UNITS, HOLD, and SELECT switches to the desired trunk or by control advance from the preceding test. The test circuit functions as described in the section on Connector Control (See 1.1) until the ST1, ST2, and ST3 relays operate. Operation of the ST2 causes a ground through the operated CTT key to operate the CTP relay and a similar ground operates the RTL relay. Relay CTP operated causes paths to operate the ABR, MNP, and MND relays ("B" option) or MNP and CTPA relays ("A" option). Relay RTL operated, operates the NAT relay if the NAT key has been operated.

When the ST2 relay operated it operates the AOP, AOD, or AO relay resulting in the activation of the "A operate test" as described (See 2.2). If this check is satisfactorily completed, ground on the "AOPK" lead operates the FLA relay. When

the sender is attached the trunk T relay is operated which grounds the "S" lead. Lead "S" ground operates the SLK relay which operates the SRK relay as a "sender attached" indication. The "TST" lead to the trunk remains open and a trunk test indication is not given to the sender. Thus the sender will function as on a regular call, with the CMA operator position attached. During the process of seizing the sender at the time of the A operate test, a decade identity is given to the sender from cross-connections in the sender link and controller circuit.

When the trunk being tested is a reserve trunk this identity is supplied from the test circuit. Operation of the RTI relay opens the lead to the "DIR" terminal which supplies an arbitrary decade identity for the purpose of applying routine test line calls to the reserve trunk and closes a path to operate the corresponding DC relay. The DC relay operated then closes a path from the DECADE IDENTITY switch, depending on its setting; to ground the terminal giving the desired identity for the test call. From this point on the decade identification takes place as covered in the section (See 10.2) on Reserve Trunk Features. This arrangement allows the reserve trunk first, to reach any point which can be reached by a service trunk (since sometimes routing information is derived from the decade identity), and second, to duplicate the exact condition of any service trunk.

The PLA relay operated then causes the called number to be outpulsed. If the NAT Key is operated, the "XOX" or "XIX" code of the desired area will be transmitted preceding the office code and called number digits. If key NAT is normal, the national area code digits are omitted and outpulsing starts with the office code digits. The called number digit control is transferred from the test call code straps or cross-connections to the called number switches by operation of relay MNP for PCI trunks or by operation of CTPA for MF or DP trunks (formerly relay MND for DP trunks). The entire called number is transmitted without the pause which accompanies a test call code following the office code C digit since the CTT key operated prevents stopping the pulse generator until all digits have been pulsed.

At this time the "PLAK" check lead is completed to advance the test sequence. For PCI trunks STP relay closes the trunk tip and ring leads through the A repeat coil and CSO relay windings. The STP also shorts out the 30,000-ohm winding of the CSO relay if option "S" is provided. These functions prepare to hold the trunk when the sender releases. Ground on the "PLAK" lead is extended to the CTT relay, which operates and locks.

The operation of CTT grounds a winding of the A retard coil, which closes talking battery to the transmitter of the telephone set plugged in at the TEL jack. With option "T" the CTT relay opens the CG resistance termination on the A repeat coil and replaces it by a connection to the T induction coil. With option "S" CTT relay removes the TN transformer from the A repeat coil and replaces it by a connection to the T induction coil. The receiver of the telephone set is connected across a winding of the T induction coil. A varistor is connected in parallel with this receiver for the purpose of click suppression. The A retard and A repeat coils and the T induction coil in conjunction with the telephone set thus provide a talking set. (By use of the FRAME LINE KEY the set can also be connected to the frame line circuit to facilitate maintenance.) When the sender connects to the operator position, the calling number, which should include an office code meeting the recorder group check in the transverter, can be passed by use of the talking connection to the operator. The operator then keys up the calling number and the tandem office connection is established as for a regular service call. When the called number is reached, the trunk CS relay will operate, leading to the operation of the CSI relay from contacts on CSO relay for PCI SUP trunks, on CSF relay for PCI NS, NAS and ACI trunks, and on TLI relay for DP and MF trunks. Relay CSI lights the SUPV lamp.

The test circuit maintains this connection until a new call is originated by the use of the control advance key, which functions to release the STP relay and allows the trunk to restore. This operation is described in the section on Control Advance with Trunk Attached (See 1.5).

On call through tests of TSP trunk circuits, operation of relay PRQ with the CTPA relay operated closes ground on the "CTT" lead to the trunk. The trunk then extends the "CTT" lead ground to the TSP No. 100A position link and connector on the regular start lead "ST". The controller in this case functions to connect the trunk under test to a regular traffic service position.

9.3 Display Trouble Indication Function (DTI) OS13 - Fig. 4 - SC8

Operation of the DTI key grounds the "DTI" lead, which is multiplied to all transverters. It also closes a path to the ABR and RTI relays, which operate when the test is started. Key DTI formerly opened the path to the NAT relay, to prevent it from operating, should the NAT key be operated.

The test is started by either the operation of the ST key (See 1.121) or by control advance (See 1.5) from the preceding test. With the ABR relay operated, the FTR test stage is omitted. Otherwise the test proceeds as for a normal test until the initial entry test is reached. At this time, the sender and transverter are connected, and the transverter receives a signal that a trunk test call is in progress. The transverter then receives ground on the "DTI" lead, which causes it to simulate a trouble condition and forces a display on the transverter trouble indicator panel. Then the transverter will time out and release, giving a signal to the sender. The sender will then call in a second transverter, which will also encounter a simulated trouble. At the time the first transverter functioned, a ground was sent to the test circuit on the "TTT" lead, to the primary of the TTT relay, which operates. Operation of TTT closes the circuit to the TV1 relay winding. Relays TV1 and TV2 form a "prime counter" type of circuit, so that when both the TTT and CII relays have released (CII releases when the recorder releases), TV2 operated in series with TV1. On the second trial, ground on the "TTT" lead reoperates TTT which locks to the operated TV2 contact on its secondary winding. This blocks the test circuit with the TT lamp lighted. The desired readings may be then taken from the transverter trouble indicator panel, and the next trunk tested by operating the CA key.

The RTI relay operated during this test permits the reserve trunk to assume the decade identity of any trunk served by a given recorder and this permits this information to be displayed on the trouble indicator panel. Circuit functions performed by this relay are basically the same as described in the section Call Through Test (See 9.2) and the Reserve Trunk Features (See 10.3).

9.4 Manual Message Register Test - Incoming Trunk From a Dial PBX - OS3 and 17, Fig. 157

To gain access to the trunk circuit for purposes of making operate and current flow tests of the message register the MRM and CTT keys are operated and the test circuit is set up to the trunk associated with the message register to be tested. When relay ST3 operates during the test start function it operates relay CTPA through make contacts on the CTT key. Relay CTPA then operates relay CTP which lights the CTP lamp. During the test start function relays ST2 and LCT will also operate and in turn cause operation of the MRM relay through make contacts on the MRM key and PXL1 and CTP relays. The MRM relay operated lights the red MRM lamp and connects the trunk "MR" lead and incoming "T" and "R" leads to the MRM and MRT jacks respectively in the miscellaneous circuit for message register rack. The message register tests are then made from the message register rack by plugging a dial handset into the MRT jack for single message register operation tests or by plugging the line message register test set into the MRM jack for multiple operation and current flow tests.

The trunk test circuit cannot be used to test other trunks while tests of the message register are being made as described above. During these tests the CA key is also rendered ineffective by a break contact on the operated MRM relay which opens the operate path of the CA relay thereby preventing circuit advance.

10. RESERVE TRUNK SUPPLEMENTARY CIRCUITS

- 10.1 Reserve Trunk Auxiliary Circuits -
RM3, OS13 - FIG. D, E, F - SC10 and 19
- 10.11 Normal Operation - Only One Reserve
Trunk Initiating "ST" Request

When the A relay in a reserve trunk operates, ground is extended to the

associated reserve trunk auxiliary circuit through the "ST" lead to operate the BY relay. The BY or the BY1 relay operated provides ground to operate the BR relay as a busy reserve indication during the busy test when connecting for test trunks associated with this reserve trunk. This same ground serves as a locking ground for the trunk RT relay.

The BY relay operates the BA relay. The BA relay extends the "ST" lead to the sender link and controller circuit which leads to the operation of either the associated HA or HB relay in the sender link. The HA or HB relay operates the associated HX and HX1 relays. The HX1 relay operates the HXA and LOT1 relays in cascade. The sender link and controller selects the sender and connects the sender to the reserve trunk, operating the T relay. The T relay grounds the sleeve lead to the associated reserve trunk auxiliary circuit operating the primary winding of the BY1 relay. The T relay operating releases the A relay thereby removing the "ST" ground. The BY1 relay operating or the A relay releasing removes the "ST" ground from the winding of the BY relay releasing it. When the BY relay releases, the "ST" lead to the sender link is opened and relay HA or HB is released. The HA or HB releasing releases the associated HX and HX1 relays. The HX1 relay releasing releases the HXA relay. When the HXA relay releases supplementary ground is applied to the secondary winding of BY1, ground is applied to operate LOT2 which in turn operates LOT3, and ground is removed from the slow release LOT1 relay. The LOT1 releasing, releases the BA relay, the secondary winding of the BY1 relay, and the slow release LOT2 relay. The LOT2 relay releases the slow release LOT3 relay. When the call is completed, ground is removed from the sleeve lead and it releases the BY1 relay on its primary winding.

10.12 Normal Operation - A Second Reserve Trunk Initiating "ST" Request in a Lower Numbered Auxiliary Circuit While Preceding "ST" request is Being Served

A reserve trunk is being served as for a single request (See 10.11) up to the release of the HXA relay. While this trunk

is being served the A relay in a lower numbered reserve trunk is operated, operating the BY relay in its associated reserve trunk auxiliary circuit. The lower numbered BA relay cannot operate until the HXA relay is released. When the first trunk releases the HXA relay, the second BA relay is operated, supplementary ground is applied to the secondary winding of the first BY1 relay, the slow release LOT1 relay is released. When the LOT1 relay releases, the supplementary ground is removed from the secondary winding of the first BY1 relay and the LOT1 relay releases the first BA relay. At this time, the "ST" lead from the second BA relay is extended to the sender link which operates the associated HA or HB relay in the sender link. The HA or HB relay operates the associated HX and HX1 relays. The HX1 relay operates the HXA and LOT1 relays in cascade. The serving of the second trunk is completed as the first trunk under appropriate conditions (See 10.11 to 10.16).

10.13 Normal Operation - A Second Reserve Trunk Initiating "ST" Request in a Higher Numbered Auxiliary Circuit While a Prior "ST" Request is Being Served

A reserve trunk is being served as for a single request (See 10.11). While the first trunk is being served, the A relay in a higher numbered reserve trunk is operated operating the BY relay in its associated reserve trunk auxiliary circuit. The second BA relay cannot operate until the first BA relay is released. When the LOT1 relay is released, it releases the secondary winding of the first BY1 relay, the first BA relay, and the slow release LOT2 relay which in turn releases the slow release LOT3 relay. The first BA relay releasing enables the second BA relay to operate. The LOT2 relay released with the second BA relay operated extends the second "ST" lead to the sender link and controller circuit which leads to the operation of either the associated HA or HB relay. The serving of the second trunk is completed as the first trunk under appropriate conditions (See 7.11 to 7.16).

10.14 Sender Link and Controller Time-Out - Only One Reserve Trunk Initiating "ST" Request

A reserve trunk is being served as for a single request (See 10.11) up to the point

where the LOT1 relay is operated. After the LOT1 relay is operated the sender link and controller times out awaiting normal removal of the "ST" ground which it is serving. The time-out releases the HA or HB relay which in turn releases the associated HX and HX1 relay. The HX1 relay releases the HXA relay. When the HXA relay releases, ground is applied to the secondary winding of the BY1 relay to operate it and ground is removed from the slow release LOT1 relay. The BY1 relay operating releases the BY relay which in turn operates the LOT2 relay. The BY relay releasing opens the "ST" lead to the sender link. The release time of the LOT1 relay is such that the LOT2 relay becomes operated before the LOT1 relay releases. The LOT2 operating, operates the LOT3 relay. The LOT1 releasing, releases the BA relay, and the slow release LOT2 relay. The LOT2 relay releasing, removes battery from the secondary winding to release the BY1 relay, and also releases the slow release LOT3 relay. The release of the BY1 extends the "ST" ground to operate the BY relay again, permitting the "ST" ground to reappear as a new request which is served as the first trunk under appropriate conditions (See 10.11 to 10.16).

10.15 Sender Link and Controller Time-Out - Second Reserve Trunk Initiating "ST" Request in a Lower Numbered Auxiliary Circuit While Prior "ST" Request is Being Served

A reserve trunk is being served as for a single request (See 10.11), up to the point where the LOT1 relay is operated. After the LOT1 relay is operated the sender link and controller times out awaiting normal removal of the "ST" ground which it is serving. The time-out releases the HA or HB relay which in turn, releases the associated HX and HX1 relays. The HX1 relay releases the HXA relay. While the first trunk is being served, the A relay in a lower numbered reserve trunk is operated operating the BY relay in its associated reserve trunk auxiliary circuit. The second BA relay cannot operate until the first BY relay is released. When the HXA relay is released it applies ground to the first BY1 relay on its secondary winding and releases the slow release LOT1 relay. The first BY1 relay operating releases the first BY relay. When

the first BY relay releases the second BA relay may operate and the "ST" lead to the sender link from the first trunk is opened. The LOT1 relay releasing releases the first BA relay. The first BA relay released in conjunction with the second BA relay operated enables the second trunk to connect the "ST" lead to the sender link and controller which leads to the operation of the associated HA or HB relay. From this point on the second trunk is served as the first trunk under the appropriate condition. (See 10.13). When the LOT2 relay releases it removes battery from the secondary winding to release the first BY1 relay. The release of the first BY1 relay extends the "ST" ground to operate the BY relay again, permitting the "ST" ground to reappear as a new request.

10.16 Sender Link and Controller Time-Out - Second Reserve Trunks Initiating "ST" Request in a Higher Numbered Auxiliary Circuit While a Prior "ST" Request is Being Served

A reserve trunk is being served as for a single request (See 10.11), up to the point where the LOT1 relay is operated. After the LOT1 relay is operated, the sender link and controller times out awaiting normal removal of the "ST" ground which it is serving. The time-out releases the HA or HB relay which in turn releases the associated HX and HX1 relays. The HX1 relay releasing, releases the HXA relay. While the first trunk is being served the A relay in a higher numbered reserve trunk is operated operating the second BY relay. The second BA relay, however, cannot operate until the first BA relay is released. When the HXA relay is released it applies supplementary ground to the secondary winding of the first BY1 relay and releases the slow release LOT1 relay. The first BY1 relay operating releases the first BY relay. The first BY relay releasing operates the LOT2 relay and opens the "ST" lead to the sender link. The release time of the LOT1 relay is such that the LOT2 relay becomes operated before the LOT1 relay releases. The LOT2 relay operates the LOT3 relay. The LOT1 relay releasing releases the first BA relay and the slow release LOT2 relay. The first BA relay releasing enables the second BA relay to operate. The LOT2 relay releasing

enables the second BA relay to connect the "ST" lead to the sender link and controller circuit which leads to the operation of the HA or HB relay. From this point on the second trunk is served as the first trunk under the appropriate condition. (See 10.12). The LOT2 relay releasing removes battery from the secondary winding to release the first BY1 relay. The release of the first BY1 relay extends the "ST" ground to operate the BY relay again permitting the "ST" ground to reappear as a new request.

10.2 Reserve Trunk Identification

Because of the Lockout nature of the reserve trunk auxiliary circuits only one BA relay is operated at a time. (See 10.1). Relay BA operated closes the "ST" lead to the sender link and controller circuit serving the reserve trunk and grounds certain information leads. Information which is determined on a group basis includes the recorder number and, if option "N" is provided, the "AMA" or "NAMA" indication or if option "ZG" is provided a "PAS" or "NPAS" indication, and with "ZR" option an "ANI" or "NANI" indication is provided via the "DIB", "DIC", and "DID" leads from the reserve trunks. Relay BA operated grounds one-out-of-two leads for "AMA"- "NAMA" or "PAS"- "NPAS" or "ANI"- "NANI" and three-out-of-six leads for recorder number as given in the following table: "RNA, -B, -C" leads are connected to "RNO, -1, -2, -4, -7, -13" leads to give recorder number as shown.

RECORDER NUMBER	RNA	RNB	RNC
00	RNO	RN7	RN13
01	1	7	13
02	2	7	13
03	0	1	2
04	4	7	13
05	0	1	4
06	0	2	4
07	1	2	4
08	0	1	7
09	0	2	7
10	1	2	7
11	0	4	7
12	1	4	7
13	2	4	7
14	0	1	13
15	0	2	13
16	1	2	13
17	0	4	13
18	1	4	13
19	2	4	13

Relay BA operated also extends a ground on the "DIA" lead to all trunks in the group

associated with the call identity indexer serving the reserve trunk. The ground is extended through the single operated trunk RT relay to the "DI" lead which is multiplied to all trunks in the same decade to provide a "decade identification." Leads "DI" are cross-connected to one of thirty "DR" leads numbered "DROO" to "DR29" which are associated with the windings of triple wound DI relays. These cross-connections determine the rate class and class of service indications. The units digit of the "DR" lead number indicates the number of the DI relay which corresponds to the class of service, and the tens digit of the "DR" lead number indicates the DI relay winding which corresponds to the rate class.

A ground appearing on any winding of a DI relay will operate the DI relay. The DI relay operated grounds two-out-of-seven "CS" leads to give the class of service according to the following table:

CLASS OF SERVICE	DI RELAY	"CS" LEADS
0	0	"CS0", "CS5"
1	1	"1", "5"
2	2	"2", "5"
3	3	"3", "5"
4	4	"4", "5"
5	5	"0", "6"
6	6	"1", "6"
7	7	"2", "6"
8	8	"3", "6"
9	9	"4", "6"
10	10	"3", "4"
11	11	"0", "1"
12	12	"0", "2"
13	13	"1", "2"
14	14	"0", "4"
15	15	"1", "4"
16	16	"2", "4"
17	17	"0", "3"
18	18	"1", "3"
19	19	"2", "3"
20	20	"5", "6"

The DI relay operated also extends the operate path to ground one-out-of-three "RC" leads to give rate class according to the following table:

RATE CLASS	DI RELAY WINDING	"RC" LEADS
0	1	"RCO"
1	2	"1"
2	3	"2"

Acting in response to the "ST" lead ground the sender link and controller will provide a path from the controller HA or HB relay operated through a C relay to the sender to provide grounds on various information leads when serving service trunks. When serving reserve trunks a portion of that information, including recorder number, rate class, class of service, and, with option "N" or "ZG" or "ZR", "AMA", "NAMA", "PAS" or "NPAS", "ANI" or "NANI" is extended from the BA and DI relays operated as described above. The HA or HB relay serving a decade of reserve trunks does not provide grounds on the above information leads, except "AMA", "NAMA", "PAS" and "NPAS", "ANI" or "NANI" when not provided from the test circuit, but operates instead the associated HX and HX1 relays on the test frame. The HX and HX1 relays operated extend the "RN-", "RC-", "CS-", and, with option "N" or "ZG", or "ZR", "AMA", "NAMA", "PAS" and "NPAS", "ANI" or "NANI" leads from the BA and DI relays operated through a sender link C relay to the sender to provide grounds on these information leads.

10.3 Test of Reserve Trunk - RM3

A reserve trunk is connected for test in the same manner as a service trunk. The test call placed through the reserve trunk is the same as that for a service trunk with additional functions being provided for the reserve trunk to test each of the possible variations that the reserve trunk can assume and to check certain functions of the reserve trunk auxiliary relays.

As described earlier a reserve trunk capable of acting as both a supervision-type trunk and a nonsupervision-type trunk or as an ANI and non-ANI trunk has a special class cross-connection on the test connector frame. These class punchings are covered in 1.113 on the connector. Formerly for PCI reserve trunks the class punching was "VAR". Key RS (formerly VAR) is provided to arrange the MF or PCI reserve trunk to function as a nonsupervision trunk with the key normal or as a supervision trunk with the key operated. Key PAS is provided to arrange the MF reserve trunk to transmit a "NPAS" indication to the sender with the key normal or "PAS" with the key operated. When the reserve trunk RT relay operates it locks to ground on lead "RTL". The trunk NS or PAS relay operated under control of the NS or PAS class relay via lead "NS" or "PAS" sets the trunk for the nonsupervisory or panel auxiliary sender features as required. The RAN key is provided to arrange the PCI trunk to function as a non-ANI trunk with the RAN key normal and an ANI trunk with the RAN key operated by operating the trunk ANI relay.

When the reserve trunk A relay is operated during the "A" operate test the reserve trunk auxiliary relays BY and, subsequently BA operate. The "DIA" lead extends ground through the reserve trunk RT relay operated to operate the DIR relay which locks to STL relay operated and lights lamp RT indicating a reserve trunk being tested. Relay DIR operated extends the operate ground either (a) through RTL relay normal to the "DIR" terminal which is cross-connected to give an arbitrary rate class and class-of-service indication on all except the "CTT" or "DTI" tests; or (b) through RTL relay operated to operate the DC relay to connect ground from the Decade Identity switch to provide a particular decade rate class and class-of-service indication on "CTT" and "DTI" tests.

Ground from the BY relay operated under control of the A relay during start and from the BY1 relay under control of the "S" lead for the duration of the call is extended to the "RTL" lead to hold operated whatever RT relay is operated at the time a call is being placed in the reserve trunk.

A check is made of the locking ground provided by the BY and BY1 relays by opening the reserve trunk RT relay locking ground provided through the LCT relay operated when DIR relay operates with AOP or AOD relay operated. At this time, the ground from the BY or BY1 relay operated placed on the "RTL" lead maintains the reserve trunk RT relay lock. Failure of the BY or BY1 relay locking ground will permit the reserve trunk RT relay to release, dropping the test connection. It should be noted that a failure will result in blocking the test progress in the "AOP" test for PCI trunks, but on MF trunks the test progress is not blocked until the "RTL" test on failure to operate the RTL relay with the TLI relay released.

10.4 Reserve Trunk Substitution (RTS or THB)

10.41 Substitution of a Reserve Trunk for a Particular Service Trunk OS2.1, 2.2 and 13 - Fig. 4 - SC4

Connection to a particular trunk may be made in the normal manner by setting the number of the trunk on the group, hold and select switches and operating the ST key. This will lead to a busy test of the trunk and when both the service trunk and the associated reserve trunk are idle as indicated by B, B1, and BR relays normal, the BT relay will be released. Release of the BT relay extends ground from H operated, through the LCT relay normal, and the connector to operate the trunk RT relay. Relay RT operated extends its operate path through its locking

contacts to operate the LCT relay as a check that the locking path is good. Relay LCT in operating transfers the operate ground to the locking path of the trunk RT relay, and lights the RTO lamp to indicate that the trunk RT relay has been operated. The RT relay operated transfers the incoming trunk conductors to the reserve trunk in order to maintain service on the incoming trunk and makes the final connection of the trunk for test.

When the connection was made to the trunk in the normal manner, a "Group" lamp was lighted. Associated with each "Group" lamp is an RTS or THB key which locks in the reserve trunk as a substitute. Operation of the RTS or THB key associated with the lighted "Group" lamp will extend ground from the operated connector RC relay to operate the SPB relay which will extinguish the RTO lamp to indicate that the proper RTS or THB key has been operated. The RTS or THB key operated also grounds the "RBL" lead to the locking contact of the trunk RT relay to hold it operated to the RTS or THB key. Test circuit advance from this point is accomplished in any normal manner, either automatically or under manual control.

10.42 Substitution of a Reserve Trunk for a Service Trunk Which Blocks the Test Circuit

If the test circuit blocks during the test of a trunk and it is desired to maintain the reserve trunk substitution, it will be found that the RTO lamp is lighted as a result of the test connection. Locking of the trunk RT relay and subsequent action follows the operation of the RTS or THB key as given in the above paragraph.

10.43 Substitution Pass Busy OS2.1, 2.2

Ground placed on the "RBL" lead by the RTS or THB key appears as a "Busy Reserve" indication anytime the affected reserve trunk is sought during the busy test. When the RC relay is operated in the connector associated with a reserve trunk having its RTS and THB key operated the slow operate SPB relay is operated to initiate a substitute pass busy function. If the APB key is normal ground is extended from the SPB relay operated through the CPB relay normal to operate the PB register to score a "pass busy". The PB register in turn operates the CA and CAL relays to advance

the connector to the next trunk. If the APB key is operated the ground on the busy reserve lead results in a normal automatic pass busy function.

10.44 Reseizure of Replaced Trunk

The replaced trunk may be reseized for test to check it before releasing the substitution or to identify it out of the group associated with the RTS or THB key. If the replaced number is known it may be set on the group, hold and select switches, but if it is not known the proper group setting, as identified by the operated RTS or THB key, and "0" hold and "0" select settings may be made. In either case the APB key is normal and the PRT key is operated prior to the operation of the ST key to prepare the cancel pass busy path. Operation of the PRT key limits test connector action to the trunks of one group, only one trunk of which may be locked into the substitution condition at a time.

Upon operation of the ST key the crosspoint corresponding to the settings of the group, hold, and select switches will be operated. If the replaced trunk is not associated with a crosspoint operated during the PRT test the substitution pass busy function will occur (See 1.13) under control of the slow operate SPB relay. If the replaced trunk is associated with a crosspoint when it is operated during the PRT test, ground will be extended from the operated RTS or THB key through the locking contact of the operated RT relay, the crosspoint on the "RT" lead, the operated RTS or THB key, and the operated PRT relay to operate the CPB relay to cancel the substitution pass busy. Relay CPB in operating opens the lead to the "PB" register before the slow operate SPB relay operates to ground the lead. Relay CPB operated also opens the operate path of the BR relay to cancel the reserve busy indication, and lights the RTA lamp to indicate that the replaced trunk is attached.

When reseizing a replaced trunk the REP key may be operated before the ST key. Connector operation following operation of the ST key is as given above and when the replaced trunk is attached and seized for test and BT relay is released initiating the test and operating and locking the RP relay through the REP key operated. Repeat tests are then performed in the normal manner.

11. TRUNK HOLD BUSY (THB)11.1 Hold Busy of a Particular Service Trunk OS2.1, 2.2 - Fig. 4 - SC4

Connection to a particular trunk may be made in the normal manner by setting the number of the trunk or the group, hold and select switches and operating the ST key. This will lead to a busy test of the trunk and when it is idle as indicated by B, BI and BR relay normal, the BT relay will be released. Release of the BT relay extends ground from H operated, through the LCT relay normal, and the connector to operate the trunk RT relay. Relay RT operated extends its operate path through its locking contacts to operate the LCT relay as a check that the locking path is good. Relay LCT in operating transfers the operate ground to the locking path of the trunk RT relay, and lights the RTO lamp to indicate that the trunk RT relay has been operated. The RT relay operated transfers the incoming trunk conductors to the make-busy circuit to take the trunk out of service and makes the final connection of the trunk for test.

When the connection was made to the trunk in the normal manner, a "Group" lamp was lighted. Associated with each "Group" lamp is a THB key which locks in the make-busy circuit to hold the trunk busy. Operation of the THB key associated with a lighted "Group" indicates that the proper THB key has been operated. The THB key operated also grounds the "RTL" lead to the locking contact of the trunk RT relay to hold it operated. Test circuit advance from this point is accomplished in any normal manner, either automatically or under manual control.

11.2 Hold Busy of a Service Trunk Which Blocks the Test Circuit

If the test circuit blocks during the test of a trunk and it is desired to maintain the hold-busy condition, it will be

found that the RTO lamp is lighted as a result of the test connection. Locking of the trunk RT relay and subsequent action follows the operation of the THB key as given in the above paragraph.

11.3 Substitution Pass Busy OS2.1, 2.2

Ground placed on the "RBL" lead by the THB key appears as a "Busy Reserve" indication anytime the associated make-busy circuit is sought during the busy test. When the RC relay is operated in the connector associated with a make-busy circuit having its THB key operated the slow operate SPB relay is operated to initiate a substitute pass busy function. If the APB key is normal ground is extended from the SPB relay operated through the CPB relay normal to operate the PB register to score a "pass busy". The PB register in turn operates the CA and CA1 relays to advance the connector to the next trunk. If the APB key is operated the ground on the busy reserve lead results in a normal automatic pass busy function.

11.4 Reseizure of a Trunk Held Busy

The held-busy trunk may be reseized for test to check it before releasing the hold-busy or to identify it out of the group associated with the THB key. If the replaced number is known it may be set on the group, hold and select switches, but if it is not known the proper group setting, as identified by the operated THB key, and "0" hold and "0" select settings may be made. In either case the APB key is normal and the PRT key is operated prior to the operation of the ST key to prepare the cancel pass busy path. Operation of the PRT key limits test connector action to the trunks of one group, only one trunk of which may be held busy at a time.

Upon operation of the ST key the crosspoint corresponding to the settings of the group, hold, and select switches will be

operated. If the held-busy trunk is not associated with a crosspoint operated during the PRT test the substitution pass busy function will occur (See 11.3) under control of the slow operate SPB relay. If the held-busy trunk is associated with a crosspoint when it is operated during the PRT test, ground will be extended from the operated THB key through the locking contact of the operated RT relay, the crosspoint on the "RT" lead, the operated THB key, and the operated PRT relay to operate the CPB relay to cancel the substitution pass busy. Relay CPB in operating opens the lead to the PB register before the slow operate SPB relay operates to ground the lead.

Relay CPB operated also opens the operate path of the BR relay to cancel the reserve busy indication, and lights the RTA lamp to indicate that the held-busy trunk is attached.

When reseizing a held-busy trunk the REP key may be operated before the ST key. Connector operation following operation of the ST key is as given above and when the held-busy trunk is attached and seized for test the BT relay is released initiating the test and operating and locking the RP relay through the REP key operated. Repeat tests are then performed in the normal manner.

SECTION III - REFERENCE DATA1. WORKING LIMITS

None

2. FUNCTIONSTrunks Tested

2.001 This circuit is capable of testing CAMA tandem incoming trunk circuits listed below:

<u>Trunk SD Number</u>	<u>Type of Pulsing</u>	<u>Trunk Use</u>	<u>Trunk Test Class Feature</u>
25956-01	PCI	ANI Service or Reserve Trunk	ACI
		Non-ANI Service or Reserve Trunk with ANI Supervision	NAS
		Nonsupervisory Service or Reserve Trunk	NS
		Reserve ANI Trunk Service ANI Trunks or Non-ANI Trunk with ANI Supervision	RAN
		Reserve ANI Trunk Serving ANI Trunks or Non-ANI Trunks With No Supervision or Non-ANI Trunks With ANI Supervision	RNA
		Reserve Non-ANI Trunk Serving Non- ANI Trunks With ANI Supervision or Without Supervision	NS
		Reserve Trunk Serving Non-ANI Trunks With or Without Supervision	RPN
		Supervisory Reserve or Service Trunk	SUP
27010-01	DP	Non-ANI 2- or 3-Wire Bylink Serv- ice Trunk Without Loop Compensation	2W3
27014-01	DP		
27010-01	DP (ADP)	ANI 2- or 3-Wire Bylink Service Trunk Without Loop Compensation	2W3
	DP	Non-ANI 2- or 3-Wire Service Trunk With Loop Compensation	2WC
	DP (ADP)	ANI 2- or 3-Wire Service Trunk With Loop Compensation	2WC
	DP	Non-ANI Bylink Service Trunk From SXS With ANI Supervision and Without Loop Compensation	AD3
	DP	Non-ANI Bylink Service Trunk From SXS With ANI Supervision and With Loop Compensation	ADC
27064-01	DP	Non-ANI 3-Wire Bylink Service Trunk From Code Selector Multiple in Same Building	3WS
27036-01	DP	Non-ANI Bylink "E&M" Lead Signaling Service Trunk From SXS Offices	BEM

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<u>Trunk SD Number</u>	<u>Type of Pulsing</u>	<u>Trunk Use</u>	<u>Trunk Test Class Feature</u>
27036-01	DP-(ADP)	ANI Bylink "E&M" Lead Signaling Service Trunk From SXS Offices	BEM
27036-01	DP	Wink Start "E&M" Lead Signaling Service	MEM
27044-01	DP	Trunk From No. 5 Crossbar Offices	
27015-01	DP	Wink Start Service Trunk From No. 5 Crossbar Office	WS
27061-01	DP	Wink Start Service Trunk From No. 5 Crossbar Offices	WS
27067-01	DP	Service Trunk From Dial PBXs Not Arranged For ANI	PXL
27067-01	DP	Used for Wide Area TEL. Service	WAT
27015-01	MF	Wink Start Service Trunk From No. 1 and No. 5 Crossbar Offices	WS
		Reserve Trunk Wink Start From No. 1 and No. 5 Crossbar Offices Only	WS
27044-01	MF	Wink Start "E&M" Lead Signaling Service Trunk From No. 5 Crossbar Offices	MEM
27044-01	MF(AMF)	ANI Wink Start "E&M" Lead Signaling Service Trunk From No. 1 ESS Offices	MEM
27015-01	MF	Supervisory Service Trunk From Panel Offices and Reserve Trunks That Serve Them Only	PMS
27015-01	MF	Nonsupervisory Service Trunk From Panel Offices and Reserve Trunks That Serve Them Only	
27061-01	MF		
27015-01	MF	Reserve Trunk for No. 1 Crossbar and Panel Supervisory Trunk	RMS
		Reserve Trunk for Panel Non- supervisory Trunk	RMN
27061-01	MF(AMF)	ANI Service Trunk From No. 1 Crossbar or Panel Offices Also From No. 5 Crossbar WS	ALP
27061-01	MF(AMF)	ANI Wink Start Service Trunk From No. 1 ESS Offices	WS
27061-01	MF	Non-ANI Service Trunk From Panel Offices With ANI Supervision	PMAS
		Non-ANI Service Trunk From No. 1 or No. 5 Crossbar Offices With ANI Super- vision	15AS
27061-01	MF	Non-ANI Reserve Trunk From No. 1 Crossbar or Panel Offices With No Supervision	RIPN
		Non-ANI Reserve Trunk From No. 1 Crossbar or Panel Offices With ANI Supervision	RIPS
27079-01	DP(ADP)	Special Toll ANI or Non-ANI Bylink Dial Pulsing Noncoin Trunk With Loop Signaling From SXS Offices	GLD

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<u>Trunk SD Number</u>	<u>Type of Pulsing</u>	<u>Trunk Use</u>	<u>Trunk Test Class Feature</u>
27081-01	DP(ADP)	Special Toll ANI or Non-ANI Bylink Dial Pulsing Noncoin Trunk With "E&M" Lead Signaling From SXS Offices	EMD
27080-01	MF(AMF)	Dial Zero ANI or Non-ANI Trunk With Loop Signaling From No. 1 Crossbar Panel Offices	ZL1
27080-01	MF(AMF)	Dial Zero ANI or Non-ANI Trunk With Loop Signaling From No. 5 Crossbar or SXS Offices	ZL5
27080-01	MF(AMF)	Dial Zero ANI Trunk With Loop Signaling From No. 1 ESS	ESZN
27082-01	MF(AMF)	Dial Zero ANI or Non-ANI Trunk With "E&M" Lead Signaling From No. 5 Crossbar or SXS Offices	ZEM
27083-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunk With Loop Signaling From No. 1 Crossbar Offices	LM1
27083-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunk With Loop Signaling From Panel Offices	LMP
27083-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunk With Loop Signaling From No. 5 Crossbar Offices	LM5
27083-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunk With Loop Signaling From ESS Offices	ESLN
27084-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Noncoin Trunk With "E&M" Lead Signaling From No. 5 Crossbar Offices	EMF
27092-01	DP(ADP)	Dial Pulsing Using Bylink to Repeat DP to 10-Digit Register From SXS With or Without Common Control - Loop Supervision	10LP
27092-01	DP(ADP)	Dial Pulsing Using Bylink to Repeat DP to 10-Digit Register From SXS With or Without Common Control - E&M Supervision	10EM
27092-01	MF(AMF)	MF Pulsing From SXS With Common Control- Loop Supervision	CMLP
27092-01	MF(AMF)	MF Pulsing From SXS With Common Control- E&M Supervision	CMEM
27097-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks With Loop Signaling From No. 1 Crossbar Offices	CT1
27097-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks With Loop Signaling From Panel Offices	CTP
27097-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks With Loop Signaling From No. 5 Crossbar Offices	CT5

<u>Trunk SD Number</u>	<u>Type of Pulsing</u>	<u>Trunk Use</u>	<u>Trunk Test Class Feature</u>
27103-01	MF(AMF)	Special Toll ANI or Non-ANI MF Pulsing Coin Trunks With "E&M" Lead Signaling From No. 5 Crossbar Offices	ECF
27104-01	DP(ADP)	Dial Pulsing Using Bylink Reverse Battery Combined Special Toll and Re- cording Completing Service for Use With TSP No. 100A	CLP
27104-01	DP(ADP)	Dial Pulsing Using Bylink E&M Supervision Combined Special Toll and Recording Com- pleting Service for Use With TSP No. 100A	CEM
27802-01	MF(AMF)	Dial Zero ANI Coin Trunk With Loop Sig- naling From No. 1 ESS	ESZC
27723-01	MF(AMF)	Special Toll ANI Coin Trunk With Loop Signaling From No. 1 ESS	ESLC

2.002 When test features and functions apply to more than one type of trunk the following abbreviations apply:

- All Bylink Trunks - (BL)
- All E&M Signaling Trunks - (EM)
- All Dial Pulse Trunks - (DP)
- All PCI Trunks - (PCI)
- All MF Trunks - (MF)
- All Trunks - None

Connector and Connector Control

2.003 Selects the particular trunk circuit on which the first test shall be made according to the setting of the "group", "select", and "hold" switches.

2.004 Starts and stops under control of the ST key.

2.005 Indicates by lighting the EC lamp that the end of the cycle of trunks to be tested has been reached.

2.006 Returns to normal under control of the RN key when not testing a trunk.

2.007 Progresses automatically from one trunk circuit to another for test purposes.

2.008 Limits the automatic progression under control of the PRT key in order to test the trunks associated with a particular AMA recorder.

2.009 Gains access to each of the trunk circuits to be tested by means of a test connector composed of crossbar switches.

2.010 Indicates from the test connector the pulsing class and test features required of the trunk under test.

2.011 Selects for test under control of the "trunk type" switch, the trunks of just one pulsing class, or all trunks.

2.012 Provides a vacant terminal indication when the connector position selected for test has no trunk circuit associated with it. This VT indication will advance the connector to the next connector position.

2.013 (A&M Only) provides a test "variation" indication (VA or VB) when the trunk at the connector position selected for test requires a variation in the testing class. When testing PCI trunks the VA indication is associated with nonsupervision trunks (NS). For DP trunks VA is associated with wink start trunks (WS) to distinguish them from bylink trunks (BL), and VB is associated with bylink trunks having loop compensating resistors. The 3WS variation is associated with DP bylink trunks from code selector multiple in the same building.

2.014 The 2WC or 2W3 makes the originating office end of the trunk "prebusy" from the tandem trunk by connecting ground which (for 2W) operates the trunk RV relay or (for 3W and 3WS) grounds "S" lead.

2.015 The 2WC, 2W3 or BEM connects the HD interrupter to time a busy test delay to guard interval of simultaneous test circuit and customer seizure.

2.016 Provides test variation indications by means of trunk class relays to set the test circuit for test of features inherent with each trunk type.

Busy Test

2.017 Indicates by means of a BT lamp when the trunk selected for a test is busy.

2.018 Indicates by means of a BR lamp when the reserve trunk associated with the trunk selected for test is busy.

2.019 Advances the connector under control of the APB key to the next position in the progression when either the trunk or its reserve are busy.

2.020 Operates the trunk RT relay to complete the test connection and transfers control of the RT relay to the locking path to check the lock contact of the RT relay.

2.021 Indicates by means of the RTO lamp that the trunk RT relay has been operated.

2.022 The NS or PMN sets the reserve trunk into the "nonsupervisory" condition when testing "nonsupervisory" regular trunks (A&M Only).

2.023 The 2WC, 2W3, WS and PXL provides "reversed" battery and ground to make originating office end of trunk busy from tandem trunk with trunk RT relay operated.

2.024 The WS (A&M Only), PXL applies reorder tone to customer in event of "simultaneous" test circuit seizure, if second dial tone operation is used.

2.025 Scores on the PB register the number of circuits passed as busy.

2.026 Provides for setting the reserve trunk to function as a trunk from a panel office when testing trunks from panel offices.

2.027 Provides for setting the PCI reserve trunk for ANI operation when testing PCI-ANI trunks.

2.028 Provides means to test MF-ANI trunks from No. 1 crossbar and panel offices without reserve trunk substitution.

2.029 Makes a busy test on the cable conductors toward the originating end offices.

2.030 Recognizes a busy signal from the originating end of an ANI trunk from No. 1 crossbar or panel offices.

2.031 Reverses the polarity of the cable conductors toward the originating end of an ANI trunk from No. 1 crossbar or panel offices as an outgoing trunk make-busy signal.

2.032 Recognizes simultaneous make-busy and originating seizure signals on tests of ANI trunks from No. 1 crossbar or panel offices.

2.033 Delays start of tests for 0.5 second to permit markers or selectors to establish a busy signal on simultaneous seizures, maintaining the backward make-busy signal during this interval on tests of ANI trunks from No. 1 crossbar or panel offices.

2.034 Withdraws the test and restores the ANI trunk from No. 1 crossbar or panel offices to service whenever a seizure by the originating office is detected.

2.035 Times for 14 to 21 seconds for a busy retest on busy ANI trunks from No. 1 crossbar or panel offices when the APB key is not operated.

2.036 Provides means by the operation of the ORB key to override the apparent busy condition on ANI trunks from No. 1 crossbar or panel offices resulting from trouble conditions on the cable pair or originating end so as to enable the testman to seize and test these trunks. The operation of the ORB key prevents any further test progress to the next trunk until the key is restored to normal.

2.037 Provides a lamp indication of the originating office busy test period on test of ANI trunks from No. 1 crossbar or panel offices.

Advance Control

2.038 Makes repeat tests on a trunk circuit under control of the REP key. Operation of the REP key is necessary to enable the "D Hold" feature, the remote control feature, and the major alarm release feature.

2.039 Prevents a false start when the RT relay is released on Bylink DP Trunk, SD-27010-01.

2.040 Scores on the CT register the number of circuits tested successfully.

2.041 Scores on the RST register the number of successful repeat tests on the same trunk.

Control Advances

2.042 Performs the control advance function under control of the CA key.

2.043 Responds to any remote control signal when the REP key is operated.

2.044 Responds to remote control signals from the transverter trouble indicator independently of the REP key.

2.045 Recognizes that the sender is attached at the time control advance is initiated, lights the CAS lamp, removes the test call indication to the sender, permitting it to time-out, and releases the trunk.

2.046 Recognizes that the sender is not attached at the time control advance is initiated, lights the CAT lamp, and releases the trunk.

2.047 Makes a down-check of the trunk before extending the advance signal.

2.048 Extends a signal to advance the connector control.

2.049 Initiates the "CH" lead release check when the recorder is attached.

2.050 Cancels the major alarm under control of the REP key.

2.051 PXL - Renders the CA key ineffective when making manual message register tests on message registers associated with incoming trunks from a dial PBX.

Test Start

2.052 PCI - Connects the PCI pulsing control and appropriate test features and lights the PCI lamp when a PCI pulse class indication is obtained.

2.053 NS - Connects appropriate test features and lights lamp NST when a nonsupervision trunk class is obtained.

- 2.054 SUP - Connects appropriate test features and lights lamp SVT when a supervision trunk class is obtained.
- 2.055 DP - Connects the DP pulsing control and appropriate test features and lights lamp DP when a DP trunk class indication is obtained.
- 2.056 WS - Connects appropriate test features and lights lamp WS when a wink-start trunk class indication is obtained.
- 2.057 BEM - Connects appropriate test features and lights lamps BL and EM when a bylink "E" and "M" lead trunk class indication is obtained.
- 2.058 2WC - Connects appropriate test features and lights lamps BL and 2WC when a DP 2-wire bylink trunk with loop compensating resistors class indication is obtained.
- 2.059 2W3 - Connects appropriate test features and lights lamps BL and 2W3 when a PDP 2- or 3-wire trunk without loop compensating resistors class indication is obtained.
- 2.060 MF - Connects the MF pulsing control and appropriate test features and lights lamp MF when a multifrequency pulse trunk class indication is obtained.
- 2.061 MEM - Connects appropriate test features and lights lamps EM and WS when an MF or DP "E" and "M" signaling lead, wink-start or delay dial trunk class indication is obtained.
- 2.062 PMS - Connects appropriate test features and lights lamps WS and PAS when an MF wink-start supervision trunk from panel class indication is obtained.
- 2.063 PMN - Connects appropriate test features and lights lamps WS, PAS, and NST when an MF wink-start nonsupervision trunk from panel class indication is obtained.
- 2.064 Provides a source of ground and battery on an off-normal basis which is maintained only for the duration of the test on a trunk circuit.
- 2.065 Connects the actual test functions in the sequence of application.
- 2.066 Indicates by means of lamps AOP to END the progress of the test function sequence.
- 2.067 PMAS - Connects appropriate test features and lights lamps PAS, NAS, and WS when a non-ANI trunk, from panel offices with ANI supervision, indication is obtained.
- 2.068 15AS - Connects appropriate test features and lights lamps NAS and WS when a non-ANI trunk, from No. 1 or No. 5 crossbar offices with ANI supervision, indication is obtained.
- 2.069 ACI - Connects appropriate test features and lights the "ANI" lamp when an ANI-PCI trunk indication is obtained.
- 2.070 NAS - Connects appropriate test features and lights the NAS lamp when a non-ANI trunk with an ANI supervision, indication is obtained.
- 2.071 ADC - Connects appropriate test features and lights the 2WC, BL, and NAD lamps when a non-ANI bylink trunk, from step-by-step offices with ANI supervision and loop compensation, indication is obtained.
- 2.072 AD3 - Connects appropriate test features and lights the 2W3, BL, and NAD lamps when a non-ANI bylink trunk, from step-by-step offices with ANI supervision and without loop compensation, indication is obtained.
- 2.073 AlP - Connects appropriate test features and lights the AlP and WS lamps when an ANI trunk, from No. 1 crossbar or panel offices, indication is obtained.
- 2.074 ADP - Connects appropriate test features and lights the ANI lamp when a DP-ANI trunk indication is obtained.
- 2.075 AMF - Connects appropriate test features and lights the ANI lamp when an MF-ANI trunk indication is obtained.
- 2.076 Provides means for testing ANI type trunk supervision on either ANI or non-ANI trunks.
- PCI A Relay Operate Test
- 2.077 Applies a resistance loop to the trunk A relay to operate it on minimum current, and checks that the loop is closed.

2.078 Recognizes by an open loop condition that the sender has seized the trunk.

2.079 Checks that the applied A relay operate loop resistance is not shorted-out. ("Mfr Disc.")

2.080 Indicates the nature of the failure by lamps lighted when the test blocks, the AOP1 being lighted before sender seizure and AOP2 being lighted after.

BL A Relay Operate Test - Loop Dial Trunks

2.081 Tests, at AOD of test sequence, the ability of the trunk A relay to operate on minimum current and the ability of the trunk to return reorder tone on preliminary pulses. For Bylink Trunk Circuits, SD-27010-01, SD-27079-01 the test circuit applies a nonoperate test current to the trunk A relay, before applying the test operate current, to check the nonoperate requirements of the trunk A relay.

2.082 Makes a down check of trunk "prebusy" condition.

2.083 Removes loop capacitor prior to closing loop to avoid trunk A relay kick.

2.084 Operates trunk TC relay to open start leads to sender and register links.

2.085 (3W) Establishes, when ground appears on "S1" lead, the 3-wire trunk test class lighting 3W or 3WS lamp.

2.086 Applies a resistance loop to the trunk A relay to operate it on minimum current.

2.087 Shorts out trunk A relay operate resistance loop during pulsing.

2.088 Causes dial pulse generator to apply a single "preliminary" pulse.

2.089 Connects tone detector to listen for reorder tone, and counts two spurts of tone.

2.090 Checks that the applied A relay operate loop resistance is not shorted-out.

2.091 Opens loop and releases trunk TC relay.

2.092 Makes down-check of trunk RVR relay as a trunk normal indication.

2.093 Blocks the test when a failure occurs and indicates the nature of the failure by lighting lamps as follows:

AOP1 lamp: A relay operate failure

OF lamp: Recorder tone failure

AOP2 lamp: Loop resistance check failure

BL A Relay Operate Test - E&M Lead Trunks

2.094 Tests, at AO of test sequence for E and M signaling trunks, the ability of the trunk A relay to operate on minimum current (worst circuit "E" lead resistance) and to return reorder tone on preliminary pulses.

2.095 Operates trunk TC relay to open start leads to sender and register links.

2.096 Causes the dial pulse generator to apply a single "preliminary" pulse.

2.097 Connects tone detector to listen for reorder tone, and counts two spurts of tone.

2.098 Opens lead "E" to trunk and also releases trunk relay TC.

2.099 Makes a down-check of trunk RV relay as a trunk normal indication.

2.100 Blocks the test when a failure occurs and indicates the nature of the failure by lighting lamps as follows:

AOP1 lamp: A relay operate failure

OF lamp: Reorder tone failure

AOP2 lamp: Trunk normal check failure

WS, PXL A Relay Operate Test

2.101 Tests, at AOD of test sequence, the ability of the trunk A relay to operate on minimum current.

2.102 Applies a resistance loop to the trunk A relay to operate it on minimum current.

2.103 WS - Recognizes by a reversed loop condition that the sender is attached.

2.104 WS - Recognizes by removal of the reversed loop condition that sender is ready to receive pulsing.

2.105 PXL - Recognizes by a ground on the "S" lead that the sender is attached.

2.106 PXL - Recognizes by dial tone from the sender indicating the sender is ready to receive pulsing.

2.107 WS - Checks that the applied A relay operate loop resistance is not shorted-out. ("Mfr Disc.").

2.108 Blocks the test when a failure occurs and indicates the nature of the failure by lighting lamps as follows:

AOP1 lamp: A relay operate failure
AOP2 lamp: A relay operate test check failure

PCI Office Code Outpulsing

2.109 Provides at PLA of test sequence, for pulsing of office code digits on automatic test calls.

DP Office Code Outpulsing - Loop Dial Trunks

2.110 Provides, at PLA of test sequence (a) outpulse of the office code digits in all offices, or (b) in offices arranged for foreign area translation to outpulse the office code and the line number TH digit ("Mfr Disc.") on automatic test calls.

2.111 BL - Initiates a call by closing loop to operate trunk A relay.

2.112 Places a network simulating the cable conductors across the loop before starting dial pulsing.

2.113 BL - Checks that sender has attached without operating trunk TMG relay.

DP Office Code Outpulsing - "E" and "M" Lead Trunks

2.114 Provides, at PLA of test sequence (a) outpulse of the office code digits in all offices, or (b) in offices arranged for foreign area translation to outpulse the office code and the line number TH digit ("Mfr Disc.") on automatic test calls.

2.115 BEM - Initiates a call by closing the "E" lead to operate trunk A relay.

2.116 BEM - Checks that sender has attached without operating trunk TMG relay.

MF Office Code Outpulsing

2.117 Provides, at PLA of test sequence, for pulsing of office code digits on automatic test calls.

Return Test Line

2.118 Maintains a busy condition on the return test line except at RTL of test sequence when making a test call to that point.

2.119 Makes a test of the trunk "TRL" lead under control of the TRL key by manipulating the busy condition of the return test line at the time the marker attempts to establish the connection. This causes the marker to signal the sender over the "TRL" lead. Failure of the test circuit to respond properly to marker seizure attempts is indicated by lamps TLL and TL2 remaining lighted.

Fundamental Tip and Ring Test

2.120 Makes at FTR of test sequence a test of the fundamental tip and ring from the terminating end to the tandem sender. Lighted lamps indicate the nature of a test failure as follows:

FT lamp: Tip lead open or grounded.
FRV lamp: Fundamental reversed.
FR lamp: Ring lead open or grounded.
FTR lamp: Tip and ring crossed.

Line Number Outpulsing

2.121 Provides, at PLB of test sequence, for pulsing of line number digits on automatic test calls.

2.122 Removes the network simulating the cable conductors after pulsing is completed.

2.123 BL - Checks operation of the trunk TMG relay when the sender simulates operator position connection.

2.124 PAS - Opens the loop momentarily to the MF sender after line number outpulsing to simulate panel operation.

X Digit, MF Outpulsing on ANI Calls

2.125 Provides at the end of PLB test sequence for the MF pulsing of the KP pulse and X digit on ACI, ADP, and AMF-ANI test calls when a start identification signal is received from the sender.

Initial Entry Test

2.126 Applies at time of sender release a supervisory operate current to the trunk A relay.

2.127 Registers at IET of test sequence the call identity index of the test call at the time of the initial entry as received on a two-out-of-five basis from the recorder.

2.128 Indicates by lamps T0 to T7 and U0 to U7 the registered call identity index on a two-out-of-five basis.

2.129 Receives an indication on the "TTY" lead from the transverter that it has encountered trouble on a trunk test call and is attempting to connect to the transverter trouble indicator.

2.130 Counts the successive TTT indications on a trunk test call and blocks the test if two of them appear on the same call.

D Relay Function Test

2.131 Tests at DFT of test sequence the operation and control of the trunk D relay.

2.132 Tests the "D" lead of the trunk by checking the trunk D relay operated as indicated by the DO lamp lighted, if provided.

2.133 Tests the "DC" lead of the trunk by looking for a sender release indication from the sender. A failure of this test will block the test with the DCL lamp lighted.

2.134 Monitors the trunk D relay winding and blocks the test if the trunk A relay fails to lock the slow release D relay. Test failure is indicated by DLP lamp.

2.135 Provides a trunk D relay holding ground under control of the DH key and REP key to bypass the D lock at DFT of test sequence in order to make a test of D relay minimum release time at DST of test sequence. ("Mfr Disc.")

2.136 Provides for false charge indication during DFT of test sequence.

CS Relay Test

2.137 Tests at CST of test sequence the ability of the trunk CS relay to release after soak and of the trunk to provide charge delay time.

2.138 SUP - On PCI trunks recognizes supervisory signals extended to the originating end by means of the polar CSO relay.

2.139 NS, NAS or ACI - Recognizes supervisory signals received by the PCI trunk from the terminating end by means of the CSF relay operated by the trunk CS relay.

2.140 DP or MF - Recognizes supervisory signals received by the DP or MF trunk from the terminating end by means of the TLL relay operated by the trunk CS relay.

2.141 Causes the SUPV lamp to follow the trunk CS relay operations.

2.142 Connects the busy back (BB) interrupter to the NA to TH chain of counting relays.

2.143 Applies a negative soak to the trunk CS relay prior to applying a positive operate current for 1.2 seconds. Failure of the CS to operate following the negative soak will block the test with CSS lamp lighted.

2.144 Checks the minimum charge delay time and the ability of the trunk CS relay to release on maximum release current by repeatedly operating the CS for 1.2 seconds and releasing it on maximum release current resistance loop under control of the busy back interrupter.

2.145 Connects the supervisory relay of the originating end to the HU to MFF chain of counting relays to check operations of the supervisory relay against operations of the busy-back interrupter and lights the BBC lamp, if provided, when busy back is completed.

2.146 Provides for the false charge indication during CST of test sequence.

PXL Joint Hold Test

2.147 Tests the joint holding feature of the trunk on an operator class call by checking that the trunk D relay remains operated when the trunk A relay is released. During this test the trunk A relay is operated and released for five complete cycles (.5 second operate and 2.5 second release). If the trunk D relay releases at any time during the pulsing of the A relay the test circuit will block and the JHF lamp will be lighted.

2.148 Checks the ability of the trunk CS relay to hold on its 30,000 ohm winding on an operator class call. During the joint hold test the trunk A relay is operated and released for five complete cycles

(.5 second operate and 2.5 second release). If the trunk CS relay releases any time during the pulsing of the A relay the test circuit will block and the JHF lamp will be lighted.

2.149 Tests the ability of the trunk to permit the PBX extension to flash the operator on an operator class call. During the joint hold test the trunk A relay is operated and released for five complete cycles (.5 second operate and 2.5 second release). At the end of the five pulses of the A relay the test circuit checks that five high resistance flashes have been returned, via the return test line, as indicated by the state of the steering circuit. If five high resistance flashes have not been returned the test circuit will block and the FFF lamp will be lighted.

Answer Test

2.150 Answers the test call at ANS of test sequence by applying an off-hook condition to the terminating end over the maximum loop resistance after a negative soak.

2.151 Checks that the resistance applied to the terminating loop as an answer signal is not shorted-out.

2.152 SUP - Recognizes the answer supervisory signal repeated by the PCI trunk.

2.153 MF, DP, NS, NAS and PCI - Recognizes directly from the trunk CS relay the answer supervisory signal received by the trunk.

2.154 Shorts the terminating loop resistance to hold the trunk supervisory relay.

2.155 MF or DP - Transfers control of supervision check from trunk CS relay to the originating end.

2.156 Recognizes the call identity index indication from the recorder as being the one registered at the time of the initial entry, and accepts a timing entry recorded indication from the recorder.

2.157 Indicates the nature of a failure by lighting the CSO lamp when the trunk fails to recognize answer supervision, the AEF lamp when the recorder fails to indicate a timing entry, and the FS lamp if the NS or PMN trunk returns false supervision.

PXL - Ringback Test

2.158 Tests the ability of the trunk to permit an operator to ring back a PBX extension on an operator class call. During the test, the test circuit applies an on-hook pulse to the trunk CS relay via the return test line and checks that the trunk circuit transmits this pulse on the incoming tip and ring leads.

PCI - Supervision Delay Test

2.159 Applies at SDT of test sequence an on-hook indication for an interval which is too brief to extend supervision back to the originating end. A supervisory signal received at the originating end at this time will block the test with the SDT lamp lighted.

2.160 Provides for the false charge indication during SDT of test sequence.

Normal Disconnect

2.161 Simulates at DIS of test sequence a calling party disconnect condition.

2.162 Connects the pulse generator and the pulsing sequence relays to time the release of the trunk A, D and (for BL) B relays.

2.163 Loop Signaling Trunks - Releases the A relay on a resistance loop which applies the release current to the A relay, and checks that the release loop is not open.

2.164 (E and M Signaling Trunks) - Releases the trunk A relay to start simulated disconnect test.

2.165 Recognizes that D and D1 relays have released by an open in the terminating loop.

2.166 Connects the DT interrupter and counter to check the D2 relay maximum release time.

2.167 Maintains the test connection through the links by means of ground applied to the sleeve at the return test line.

2.168 Determines when the trunk D2 relay removes ground from the sleeve by means of the connection to the sleeve at the return test line.

2.169 Records the appearance of the call identity index and a timing entry signal from the recorder at the time of the disconnect entry.

2.170 3W - Checks to see that the sleeve lead is removed.

2.171 Initiates the "CH" lead release check.

2.172 Blocks the test when a failure occurs and indicates the nature of a failure by lighting lamps as follows:

BL BRL lamp: B relay release time exceeding the maximum.

ADR lamp: A and D relay release time exceeding the maximum.

D2H lamp: D2 relay release time exceeding the maximum.

DE lamp: Disconnect entry failure.

2.173 PXL - Checks that the trunk message register operate path is functioning properly on an operator class call by checking for battery on the "MR" lead. If battery is not detected on the "MR" lead the test circuit will block and the MRF lamp will be lighted.

2.174 PXL - Checks that the trunk message register operate path does not apply more than one pulse of battery on the "MR" lead on operator class calls. If more than one pulse of battery is detected on the "MR" lead the test circuit will block and the MDO lamp will be lighted.

Disconnect Timed Release

2.175 Simulates, at DIS of test sequence under control of the DTR key, a timed release disconnect.

2.176 Connects the DR interrupter and counter to measure the minimum timed release interval.

2.177 Connects the DL and DS interrupter and counters to measure the maximum timed release interval.

2.178 Applies an on-hook reversal to the terminating end to initiate timed release disconnect.

2.179 Recognizes that the trunk D1 relay has released by an open in the terminating loop.

2.180 PCI - Recognizes on-hook reversal extended to the originating end and releases trunk A relay.

2.181 Maintains the test connection through the links by means of ground applied to the sleeve at the return test line.

2.182 Determines when the trunk D2 relay removes ground from the sleeve by means of the connection to the sleeve at the return test line.

2.183 Records the appearance of the call identity index and a timing entry signal from the recorder at the time of the disconnect entry.

2.184 3W - Checks the ability of the trunk to provide a wink-off interval when the trunk D1 relay releases.

2.185 3WS - Checks the ability of the trunk to provide a wink-off interval when the trunk B relay releases.

2.186 MF or DP - Checks that trunk dismisses originating end after the disconnect entry is completed.

2.187 Initiates the "CH" lead release check.

2.188 Blocks the test when a failure occurs and indicates the nature of a failure by lighting lamps as follows:

FTE lamp: False timing entry.

E lamp: Timing entry early.

L lamp: Timing entry late.

DE lamp: Disconnect entry failure.

WO lamp dark: Wink-off failure.

False Disconnect Timed Release

2.189 Simulates, at DIS of test sequence, under control of the FDTR key, a false timed release disconnect.

2.190 Applies an on-hook reversal to the terminating end for a short interval.

2.191 Connects the DR interrupter and counter to time the on-hook reversal.

2.192 Connects the DL interrupter and counter to measure an interval in which the disconnect entry will appear when the trunk has initiated a false disconnect indication.

2.193 Recognizes a premature disconnect entry as a failure and blocks the test.

2.194 Releases the trunk A relay when false disconnect entry waiting period has expired.

2.195 Recognizes that trunk D and D1 relays have released by an open in the terminating loop.

2.196 Maintains the test connection through the links by means of ground applied to the sleeve at the return test line.

2.197 Records the appearance of the call identity index and a timing entry

signal from the recorder at the time of the disconnect entry.

2.198 DP or MF - Checks that trunk dismisses originating end after the disconnect entry is completed.

2.199 Initiates the "CH" lead release test.

2.200 Blocks the test when a failure occurs and indicates the nature of a failure by lighting lamps as follows:

FTE lamp: False timed release disconnect entry.

DE lamp: Regular disconnect entry failure.

False Overtime Test

2.201 Makes a busy recorder trunk time-out test at DIS of test sequence under control of the FOT and FOT1 keys and indicated by the FOTT lamp lighted.

2.202 Connects DS interrupted and counter to provide 6.3 second "CH" lead open interval.

2.203 Releases trunk A relay in synchronism with DS interrupter.

2.204 Enables DR interrupter and counter to provide interval in which false overtime entry will appear if trunk fails to time out.

2.205 DP or MF - Checks that trunk dismisses originating end after the disconnect entry is completed.

2.206 Initiates the "CH" lead release check.

2.207 Blocks the test when a failure occurs and indicates by means of the FOT lamp lighted that a false overtime entry has been made.

"CH" Lead Release Test

2.208 Releases the recorder TTA relay to restore the "CH" lead to the recorder.

2.209 Times two successive intervals, the first to permit TTA to release, and the second to permit the restored "CH" lead ground to be registered in the test circuit.

2.210 Release recorder TTK relay upon receipt of "CH" lead ground.

2.211 Operates the major alarm when the "CH" lead ground fails to be registered in the test circuit.

D Relay Shunt Test

2.212 Checks, at DST of test sequence, the minimum release time of the trunk D relay.

2.213 Operates the trunk D relay which in turn operates trunk D1 and D2 relays.

2.214 Recognizes the reoperation of the D1 relay be a grounded sleeve and a re-closed terminating loop, when D1 reoperates during the delay interval provided.

2.215 PCI and MF - Connects the pulse generator, which synchronizes the test by releasing the trunk D relay at the beginning of the first pulse.

2.216 DP - Connects the pulse generator, which synchronizes the test by releasing the trunk D relay at the beginning of the first pulse.

2.217 Times an interval to measure the trunk D relay minimum release time.

2.218 Recognizes the release of the trunk D and D1 relays by an open in the terminating loop.

2.219 Blocks the test with the DS lamp lighted when the trunk D relay releases in less than the minimum acceptable release time.

2.220 Determines when the trunk D2 relay removes ground from the sleeve by means of the connection to the sleeve at the return test line.

D2M Test

2.221 Checks, at DST of test sequence under control of the D2M key, the minimum release time of the trunk D2 relay.

2.222 Operates the trunk D relay which in turn operates trunk D1 and D2 relays while providing a test delay interval for these operations.

2.223 Connects the pulse generator to time the minimum release time of the trunk D2 relay.

- 2.224 Releases the trunk D relay which in turn releases the trunk D1 and slow release D2 relays.
- 2.225 Starts timing when D1 releases as indicated by an open in the terminating loop.
- 2.226 Determines when the trunk D2 relay in releasing has removed ground from the sleeve by means of the connection to the sleeve at the return test line.
- 2.227 Blocks the test with the D2M lamp lighted when the trunk D2 relay releases in less than the minimum acceptable release time.

BL Tone Detector

- 2.228 Energizes a normally operated TN relay through the TN vacuum tube.
- 2.229 Amplifies and rectifies reorder tone, cutting off the TN tube to release the TN relay.

Signaling Circuits

- 2.230 PCI - Provides high and low, positive and negative loop conditions for signaling the sender in PCI code.
- 2.231 DP - Provides open and closed loop conditions for signaling the sender in DP code.
- 2.232 MF - Provides multifrequency pulses for signaling the sender in MF code.
- 2.233 DP - Provides, under control of the "pulse limit" switch, limiting dial pulse rates and percent break values ("Mfr Disc.").
- 2.234 Counts digits on a 14 step counting chain whose functions are included in the following 5 enumerated functions.
- 2.235 Counts a total of 7- or 8-digits on automatic progression, extending a signal to delay pulsing, after the C or TH digit, and a signal to stop pulsing after the final digit.
- 2.236 Provides during a call through a test a count of 7- or 8-digits without delay.
- 2.237 DP or MF - Increases the total number of digits counted to 10 or 11 under control of the NAT CODE key and the CTT key to include the national code.

- 2.238 DP or MF - Omits the STA digit from the line number when the STA switch is not set to a stations letter. (Results in 7- or 10-digits in above 3 functions.)

- 2.239 DP or MF - Pulses the stations digit after the line number except when the STA switch is set to "one" for numbers over 10,000.

- 2.240 Generates pulses by means of a condenser-timed polar relay which is used both for pulsing and for test counting. Tests of the trunk CS and D relays and of the disconnect function employ this pulsing.

- 2.241 Translates the preset number into forms appropriate to PCI, DP, or MF signaling by means of connections on the called number switches. On Call Through tests the switch setting determine the called number. On all other tests cross-connections determine the test code.

Busy Timing

- 2.242 Releases the BY, TT1, or TT2 interrupter and counter when the control advance function is performed.
- 2.243 Recognizes that final seizure of the trunk for test has not been made.
- 2.244 Connects the BY interrupter and the counter to time a 4.5 to 5.5 minute interval, after which the time alarm is sounded.
- 2.245 Releases the BY interrupter and the counter and, if sounded, the time alarm when the trunk and reserve become idle and the trunk is seized for test.

Test Timing

- 2.246 Recognizes that final seizure of the trunk for test has been made.
- 2.247 Connects the TT1 interrupter and the counter under control of the NML test sequence pattern to time a 42 to 49 second trunk test interval.
- 2.248 Connects the TT2 interrupter and the counter under control of the ABR test sequence pattern to time a 150 to 170 second trunk test interval.
- 2.249 Connects the TT1 interrupter and the counter under control of the ABR test sequence pattern and the FOT keys to time a 42 to 49 second trunk test interval.

2.250 Sounds the time alarm at the end of any trunk test interval.

2.251 Releases the TT1 or TT2 interrupter and counter when trunk test is completed prior to the end of the trunk test interval.

2.252 Stops the timing counter when the transmission test, the call through test or the trouble indicator display test is made.

Major and Minor Alarms

2.253 Indicates a time alarm by lighting the TA lamp and extending minor alarm signals to the floor alarm frame, fuse and time alarm circuit.

2.254 Cancels, under control of the ACO key, the audible minor alarm indication to the floor alarm frame, fuse, and time alarm circuit.

2.255 Cancels, under control of the TA key, all minor alarm indications to the floor alarm frame, fuse, and time alarm circuit.

2.256 Disables the control advance function under control of the TA key unless the REP key is operated.

2.257 Indicates a major alarm by flashing the TA lamp under control of the DT interrupter, and extending a major alarm signal to the floor alarm frame, fuse, and time alarm circuit.

2.258 Initiates the "CH" lead release test under control of the time alarm.

Transmission Test

2.259 Extends at XM of test sequence trunk tip and ring and test line tip and ring to transmission test jacks on the test panel when the transmission test set is plugged into those jacks.

Call Through Test

2.260 Provides at CTT of test sequence a telephone circuit to permit talking on a call through test. The telephone circuit is connected to the frame line multiple under control of the "frame line" key.

2.261 Applies talking ground to the TEL circuit under control of the CTT key or the "frame line" key.

Display Trouble Indication

2.262 Signals the transverter under control of the DT1 key to simulate a trouble and display a trouble indication on the transverter trouble indicator.

PXL Manual Message Register Test

2.263 Checks of the message register associated with the trunk can be made with the aid of the test circuit. With the MRM and CTT keys operated the test circuit is set up on the trunk associated with the message register under test. The test circuit functions to connect the message register winding and trunk incoming tip and ring leads to jacks in the miscellaneous circuit for message register rack from where current flow and operate tests of the message register are made.

Reserve Trunk Auxiliary Circuits

2.264 Extends a reserve busy trunk indication to the connector control circuit.

2.265 Recognizes a start signal from the reserve trunk, and grounds appropriate identification leads, including the recorder number, while extending the start signal to the sender link circuit.

2.266 Performs a lock-out function when simultaneous start signals are received from reserve trunks, extending the start leads and their appropriate identification grounds one at a time.

2.267 Recognizes conditions which indicate that the sender link controller is attached and subsequently released.

2.268 Opens the start lead to the sender link when the sleeve is grounded at the reserve trunk.

2.269 Opens the start lead from the reserve trunk when the sender link controller times out and releases prior to the sleeve being grounded at the reserve trunk.

2.270 Holds open the start lead from the reserve trunk until other waiting start signals have been served, when the start lead has been opened by the sender link controller timeout.

Reserve Trunk Identification

2.271 Translates the associated service trunk information from a single lead

per decade to biquinary class of service and one-of-three rate class indications and indicates one-out-of-two PAS or NPAS, or ANAI or ANI.

2.272 Connects the information leads to the appropriate sender link controller as indicated by a ground from that controller.

Test of Reserve Trunk

2.273 Connects the decade selector under control of the DTI key or the CTT key when testing a reserve trunk.

2.274 Selects, by means of the "decade identity" switch, one of ten decade identification leads when testing reserve trunks.

2.275 Provides a test "variation" indication (VAR or VBR) when the reserve trunk at the connector position selected for test requires a variation in the testing class. When testing PCI trunks the VAR indication is associated with nonsupervision trunks (NS), (A&M Only).

2.276 PCI - Tests, under control of the VAR key, the nonsupervisory option of the reserve trunk (A&M Only).

2.277 Provides means under control of RS and PAS and RAN keys to test a reserve trunk as a supervision trunk or as a non-supervision trunk and as a panel or non-panel MF trunk and as an ANI or nonsupervisory trunk.

2.278 When a test of a reserve trunk is in progress lamp RT is lighted.

Reserve Trunk Substitution

2.279 Recognizes that a reserve trunk is serving as a substitute trunk under control of an RTS or THB key and initiates the automatic pass busy function under this condition.

2.280 Provides for the reconnection of a replaced trunk when the PRT key is operated.

2.281 Indicates by means of the RTA lamp that the replaced trunk is reattached.

2.282 Locks the trunk RT relay under control of the RTS or THB key associated with the reserve trunk serving the trunk.

2.283 Identifies reserve trunks which are substituting for service trunks under control of the RTS or THB keys.

Trunk Hold Busy

2.284 (Loop Signaling Trunks) - Recognizes that a reversal circuit is holding a trunk busy under control of a THB key and initiates the automatic pass busy function under this condition.

2.285 ("E" and "M" Lead Signaling Trunks) - Recognizes a trunk is being held busy under control of a THB key and initiates the automatic pass busy function under this condition.

2.286 Provides for the reconnection of a trunk held busy when the PRT key is operated.

2.287 Indicates by means of the RTA lamp that the trunk held busy is reattached.

2.288 Locks the trunk RT relay under control of the THB key associated with the connector serving the trunk.

2.289 Identifies connectors in which trunks are held busy under control of the THB keys.

TSP Trunk Circuit - Additional Test Features and Functions

2.290 Position and Data Transfer Test

This test checks the ability of the TSP trunk circuit to connect to the TTP and checks that the required information is passed by means of the data transfer circuit between the trunk, TTP and sender, if attached.

2.291 Transfer to Cord Switchboard Test for Dial Zero Trunk

This test checks the ability of the dial zero trunk to transfer a call to a cord switchboard when signaled from the TTP. Actions of the trunk in transferring the call are checked by means of leads that are connected to the trunk finder circuit on service calls.

2.292 Ringback Test

This test checks the ability of the trunk to transmit a ringback signal towards

the originating end when signaled from the TTP.

2.293 Tandem Operator Hold Test

This test checks the ability of the trunk to be held from the traffic service position when the originating subscriber goes on-hook during the time that the position is attached. The test circuit simulates an originating end on-hook and checks that the trunk D relays do not release while the trunk is attached to the TTP.

2.294 Position Recall Test of Dial Zero and Special Toll Coin Trunks

Special toll coin trunks, up to 18 or 35 seconds before the end of the initial period, and dial zero trunks will recall the TTP when a 200 to 500 msec on-hook flash is received from the originating end. During this test the test circuit simulates an originating on-hook flash of 250 to 500 msec to check the ability of these trunks to recall the TTP.

2.295 Coin Collect Test

This test checks the ability of the coin trunk to transmit the coin collect signal towards the originating end when signaled from the TTP.

2.296 Timing Tests - TSP Special Toll Coin Trunk Circuits

- (a) Checks the coin timing functions of the special toll coin trunk.
- (b) accelerated timing test.

Timing pulses are generated by the test circuit and transmitted to the trunk to check the ability of the trunk to time the initial period and 10 over-time periods.

(c) Normal Timing Test

Timing pulses are generated in the timer link and transmitted simultaneously to the trunk and test circuit to check the ability of the trunk to time the initial period. The ability of the trunk to recall the TTP in the overtime period is also checked during the normal timing test. The trunk is allowed to time six seconds into the first overtime period and the test circuit first simulates an originating end on-hook, then a terminating end on-hook and checks that the trunk connects to the TTP in both cases.

2.297 Release Forward Test

This test checks the ability of the trunk to release the connection forward when signaled from the TTP.

2.298 Sender Request Test - Special Toll Trunks

This test checks the ability of the trunk to attach to a sender when signaled from the TTP.

2.299 Cancel Timing Test

The ability of the trunk to initiate a cancel timing entry is checked during this test. The test circuit checks by means of leads directly to the recorder that the entry has been successfully entered. On special toll coin trunks the entry check is bypassed for the cancel timing entry is not made. However, for these trunks the test circuit checks that the cancel timing signal from the TTP causes the trunk to release its TC relay.

2.300 Ring Forward Test

This test checks the ability of the trunk to apply the ring forward signal towards the originating end when signaled from the TTP.

3. CONNECTING CIRCUITS

- 3.01 Tandem Incoming Trunks (PCI) - SD-25956-01.
- 3.02 Tandem Incoming Trunks - (MF) - SD-27061-01.
- 3.03 Tandem Incoming Trunks - (DP-BL-E&M) - SD-27036-01.
- 3.04 Tandem Incoming Trunks (DP-BL-2W) - SD-27010-01.
- 3.05 Tandem Incoming Trunks (MF-DP-E&M) - SD-27044-01.
- 3.06 Tandem Incoming Trunks (DP-BL-3W) - SD-27014-01.
- 3.07 Tandem Incoming Trunks (DP-BL-3WS) - SD-27064-01.
- 3.08 Tandem Incoming Trunks (DP or MF-WS) - SD-27015-01.
- 3.09 Tandem Incoming Trunks (MF-PMS-PMN) - SD-27015-01.

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|---|--|
| 3.10 Tandem Incoming Trunks (DP-PXL) - SD-27067-01. | 3.28 Sender Link and Controller Circuit - SD-25358-01. |
| 3.11 Tandem Incoming Trunks (DP-BL) - SD-27079-01. | 3.29 Floor Alarm Frame Fuse and Time Alarm Circuit - SD-25046-01. |
| 3.12 Tandem Incoming Trunks (MF-Loop Sig) - SD-27080-01. | 3.30 Interrupter Frame Circuit - SD-25062-01. |
| 3.13 Tandem Incoming Trunks (DP-BL-E&M) - SD-27081-01. | 3.31 Office Link and Connector Circuit - SD-25033-01. |
| 3.14 Tandem Incoming Trunks (MF-E&M) - SD-27083-01. | 3.32 Miscellaneous Circuit for Trunk Test Frame - SD-25378-01. |
| 3.15 Tandem Incoming Trunks (MF-Noncoin - Loop Sig) - SD-27083-01. | 3.33 Miscellaneous Circuit for Incoming Register and Link Frame - SD-25593-01. |
| 3.16 Tandem Incoming Trunks (MF-Noncoin - E&M) - SD-27084-01. | 3.34 Trouble Recorder Frame Miscellaneous Circuit - SD-27049-01. |
| 3.17 Tandem Incoming Trunks (MF-Coin-Loop Sig) - SD-27097-01. | 3.35 Auxiliary Trunk Test Circuit - SD-27065-01. |
| 3.18 Tandem Incoming Trunks (MF-Coin-E&M) - SD-27103-01. | 3.36 Miscellaneous Circuit for Message Register Rack - SD-27075-01. |
| 3.19 Recorder and Recorder Connector Circuit - SD-25872-01. | 3.37 Traffic Service Position Link Controller Circuit - SD-95910-01. |
| 3.20 Miscellaneous Circuit for Transverter Trouble Indicator - SD-25983-01. | 3.38 Traffic Service Position No. 100A Link and Connector Circuit - SD-95912-01. |
| 3.21 Miscellaneous Circuit for Trunk Frame - SD-25370-01. | 3.39 Timer Link and Controller Circuit - SD-27098-01. |
| 3.22 Miscellaneous Circuit for Trunk Link Frame - SD-25375-01. | 3.40 Dual Channel Receiver Circuit - SD-95956-01. |
| 3.23 Miscellaneous Circuit for Sender Link Frame - SD-25371-01. | 3.41 MF Sender Circuit - SD-27024-01. |
| 3.24 Miscellaneous Circuit for Call Identity Indexer - SD-25637-01. | 3.42 Transverter Connector Circuit - SD-25967-01. |
| 3.25 Miscellaneous Circuit for Recorder and Recorder Connector - SD-25884-01. | 3.43 Data Transfer Circuit - SD-27100-01. |
| 3.26 Transverter Circuit - SD-25968-01. | 3.44 Tandem Incoming Trunks (MF-DP-BL-E&M-Loop) SD-27092-01. |
| 3.27 Frame Line Circuit - SD-96379-01. | 3.45 Tandem Incoming Trunks (DP-BL-Loop E&M) SD-27104-01. |

4. FUNCTIONAL DESIGNATIONSRelays4.1 Index of Relays

<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
0-10	Counter Relays	-	9	01008	BL
12	1 & 2 Leads	01307	3 50	01005 01032	BQ
0'-10'	Counter Primed Relays	-	9	01008	BM
2W3	2- or 3-Wire Bylink Class	01329	49	01031	BM
2WC	2-Wire with Loop Com- pensation	01329	49	01031	BM
3W	3-Wire Trunk Class	01325	34	01016	M
3WA	3-Wire Auxiliary	01325	34	01016	M
3WS	3-Wire Code Selector Class	01329	156	01035	E
7D	7-Digit Called Number	-	9	01008	BM
10BL	10-Digit Register Bylink	01329	171	01066	BU
34	3 & 4 Leads	01307	3 50	01005 01032	BQ
A1P	ANI #1 Crossbar & Panel	01329	49	01031	BM
ABR	Abbreviated Pattern	01305	7	01007	N
ACI	ANI PCI Pulsing Class	01329	154	01040	BK
ACS	Automatic Coin Sig Check	01315	162	01048	DE
AD	A Digit	01308	46	01029	BT
ADK	A Relay Time Check	01303	26	01006	BH
ADKL	A Relay Time Check	01324	40	01016	L
ADP	ANI DP Pulsing Class	01330	154	01040	BK
AE1	Answer Entry 1	01313	20	01011	E
AK	Trunk A Relay Check	01324	8 Q,R	01004 01016	L
AL	Alarm	01317	32	01011	BG
ALL	Alarm Auxiliary	01306	12	01011	L

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
AMAE	AMA Information Error	01331	161	01046	EC
AMF	ANI MF Pulsing Class	01330	154	01040	BK
ANI	Auto Number Iden	01330	164	01049	BU
ANS	Answer Test Function	01304	6 151	01007 01033	M
ANTM	A Relay Nonoperate Timing	01324	40	01016	BN
AO	A Relay Operate Test, BEM	01304	151	01033	M
AOD	A Relay Operate Test, MF or DP	01304	6 151	01007 01033	N
AODA	A Relay Operate Test, Auxiliary	01304	40	01016	L
AOP	A Relay Operate Test, PCI	01304	6 151	01007 01033	N
AR	A Resistance	-	8 40	01004 01016	L
ARK	A Resistance Check	-	8 40	01004 01016	L
ARL	A Relay Release	01326	49	01031	BL
ASR	Advance Slow Release	01318	26	01006	BH
AST	ANI Supervision Test	01324	46	01029	BT
AT	Apply Tone	01322	42	01017	A
B	Busy Trunk, Sleeve Indication	01303	4	01006	BJ
B1	Busy Trunk, A Relay Indication	01303	4	01006	BJ
BA(00-24)	Bush Reserve Trunk Auxiliary	01319	D,E,F	01014	BA(00-15)-CH
BB	Busy-Back	01313	19	01011	F
BCA	Busy Circuit Advance	01302	4	01006	BK
BD	B Digit	01308	46	01029	BT
BD1	B Digit Auxiliary	01308	164	01049	BU
BEM	Bylink E&M Trunk Class	01329	49	01031	BL
BL	Bylink Trunk Class	01330	41 49	01017 01031	BL

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
BLA	Bylink Trunk Class Auxiliary	01330	49	01031	BL
BR	Busy Reserve Trunk	01303	4	01006	BJ
BRK	B Relay Release Check	-	22	01012	E
BT	Busy Test	01302	4	01006	BJ
BTA	Busy Test - 1st Aux	01302	4	01006	BK
BTB	Busy Test - 2nd Aux	01302	4	01006	BK
BTC	Busy Test - 3rd Aux	01303	4	01006	BK
BTE	B Relay, Time End	-	22	01012	E
BY(00-24)	Busy Reserve, A Relay Indication	01319	D,E,F	01014	BY(00-15)-CG BY(16-34)-CD
BY1(00-24)	Busy Reserve, Sleeve Indication	01319	D,E,F	01014	BY1(00-15)-CF BY1(16-24)-CC
BYT	Busy Timing	01317	32	01011	BG
CA	Control Advance	01318	1	01003	CN
CAA	Control Advance Auxiliary	01318	4	01006	BJ
CA1	Control Advance 1	01318	4	01006	BJ
CAK	Control Advance Key Auxiliary	01318	26	01006	BH
CAKR	Control Advance Key Auxiliary	01318	26	01006	BH
CAS	Control Advance Sender Attached	01318	26	01006	BH
CAT	Control Advance Trunk Only	01318	26	01006	BH
CBAK	Cord Board Trans Check #1	01335	162	01048	DF
CBSK	Cord Board Trans Check #2	01335	162	01048	DF
CC	Coin Collect	01338	167	01051	DC
CCK	Coin Collect Check	01338	167	01051	DA
CD	C Digit	01308	46	01029	BT
CD1	C Digit Auxiliary	01308	158	01042	BU
CDA	C Digit Auxiliary	01308	46	01029	BT
CEM	Combined E&M Supervision	01329	170	01065	EC

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
CEM1	Combined E&M Supervision Auxiliary	01329	170	01065	EB
CF	Counting Finished	01328	48	01030	BS
CHG	"CH" Lead Ground Control	01312	24	01013	B
CHO	Trunk CH Relay Operate Check	01325	20	01011	BU
CI	PCI Pulsing Class	01330	3 50	01005 01032	BP
CIA	PCI 1st Auxiliary	01302	3 50	01005 01032	BP
CIB	PCI 2nd Auxiliary	01302	3 50	01005 01032	BP
CII	Call Identify Index	01311	15	01010	G
CIF	Coin Information Error	01331	161	01047	EC
CKP	Check Pulse	-	11	01005 01017	BU
CLP	Combined Loop Supervision	01329	170	01065	EC
CLP1	CLP Auxiliary	01329	170	01065	EB
CLS(0-4)	Class of Service (0-4)	01332	161	01047	EA
CMB	Combined Trunks	01330	170	01065	EC
CMF	Convertible MF Pulsing	01329	171	01066	BU
CPB	Cancel Substitute Pass Busy	01303	4	01006	BJ
CR	Cancel Release Entry	01315	165	01049	E
CS0	CS Relay (Trunk) Test	01323	14	01040	J
CS1	CS Relay (Trunk) Test Relay	01325	19	01011	F
CS2	CS Relay (Trunk) Test Relay	01325	20	01011	E
CS3	CS Relay (Trunk) Test Relay	01313	20	01011	E
CS(00,5)	Class of Service (00,5)	01332	161	01047	EA
CSA	CS Relay (Trunk) Test Relay	01321	19	01011	F
CSB	CS Relay (Trunk) Test Relay	01313	19	01011	F

<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
CSF	CS Relay Follower	01325	36	01016	BR
CSS	CS Relay (Trunk) Test Relay	01313	L,M L,M	01011	F
CSS1	CS Relay (Trunk) Test Relay	01313	M	01011	F
CST	CS Relay Test Function	01304	6 151	01007 01033	N
CSX	CS1 Control Transfer	01325	20	01011	M
CT	Circuits Tested	01318	4	01006	Message Register
CTKL	Cancel Timing Check	01335	161	01046	EB
CTL	Coin Toll Trunk (Loop)	01329	160	01045	EF
CTP	Call Through Pattern	01305	7	01007	N
CTPA	Call Through Pattern Auxiliary	01305	U,V	01049	BT
CTT	Call Through Test	01304	6 151	01007 01033	N
D2ER	D2 Relay Early Release	01317	162	01048	DF
D2H	D2 Hold	01314	22 152	01012 01034	D
D2M	D2 Minimum Release Test	01317	25 153	01012 01035	B
D2N	D2 Minimum Release Test Auxiliary	01317	25 153	01012 01035	B
D2T	D2 Minimum Release Timer	01317	162	01048	DC
DC(00-19)	Decade Selector Connector	01319	31	01014	DC(00-03)-CK DC(04-19)-CJ
DEK	Disconnect Entry Check	01314	22 152	01012 01034	D
DER	D Relay Early Release	01317	162	01048	DE
DFR	D Relay Fast Release	01317	25 153	01012 01035	B
DFT	D Relay Functions Test	01304	6 151	01007 01033	N
DGN(0,1, 2,4,7)	Data Group Number	01332	161	01047	EA

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
DI(0-9)	Decade Identity	01319	28	01014	CK
DI(10-20)	Decade Identity	01319	159	01042	CC,CE,CD
DIR	Decade Identity Reserve Trunk	01319	4	01006	BJ
DIS	Disconnect Test Function	01304	6 151	01007 01033	M
DISA	Disconnect Test Function Auxiliary	01304	151	01033	L
DISB	Disconnect Test Function Auxiliary	01304	164	01049	BU
DIT	Disconnect Test Auxiliary	01314	22 152	01012 01034	D
DL(1-2)	Delay (Long) 1,2	01316	23	01013	C
DLK	D Lock Check	01309	17	01011	F
DLT	D Lock Test	01309	17	01011	F
DLY	Delay Pulsing	01324	40	01016	L
DO	D Operate	01309	17	01011	F
DP	DP Pulsing Class	01330	11 41 49	01005 01017 01031	BL
DPA	DP 1st Auxiliary	01330	11 41 49	01005 01017 01031	BL
DPB	DP 2nd Auxiliary	-	11 41	01005 01017	BS
DPC	DP 3rd Auxiliary	-	41	01017	BR
DPG	Dial Pulse Generator	-	11	01005	BT
DR(1-3)	Delay (Recorder) 1,2,3	01316	23	01013	C
DRK	D Release Check	01314	22 152	01012 01034	D
DS(1-3)	Delay (Short) 1,2,3	01316	23	01013	C
DSK	D Soak Check	-	25 153	01012 01035	B
DSL	D Soak Check Auxiliary	01317	25 153	01012 01035	B

<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
DSS	D Soak Start	01317	25 153	01012 01035	B
DST	D Shunt Test Function	01304	6 151	01007 01033	M
DT1	Disconnect Time 1	01317	25 153	01012 01035	B
DT(2-3)	Delay Timer (Supervi- sion) 2,3	01314	22 152	01012 01034	D
DTBL	Data Trans Trouble	01331	161	01046	EC
DTCB	Data Trans Conn Busy	01331	161	01046	EC
DTE	Disconnect Time End	01321	22 152	01012 01034	D
DTM	Diode TEST Timing	01310	162	01048	DB
DTOK	Data Trans Check	01331	161	01046	EC
DTR	Disconnect Timed Release	01316	O P	01013 01013	C
DTS	Disconnect Time Start	01314	22 152	01012 01034	D
DTST	Data Trans Start	01331	161	01046	EB
DTT	Disconnect Time Start Auxiliary	01314	22 152	01012 01034	D
DZ	Dial Zero Trunk	01330	160	01044	EE
DZ1	Dial Zero Trunk Auxiliary	01330	160	01044	EE
DZ2	Dial Zero Trunk Auxiliary	01330	160	01045	EE
DZCN	Dial Zero Coin Trunk	01330	160	01044	EE
E1	E Lead Ground	01326	166	01050	DA
EC	End of Cycle	01301	1	01003	CN
ECF	Coin Toll Trunk (E&M)	01329	160	01045	EF
EM	E&M Signaling Trunk Class	01330	49	01031	BL
EMBT	E&M Battery Test	01326	166	01050	DC
EMCN	E&M Coin Trunk	01330	160	01045	EE
EMD	E&M DP Trunk	01329	160	01044	EF
EMER	Emergency	01333	177	01065	EA

<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
EMF	E&M MF Trunk	01329	160	01045	EF
EMGT	E&M Ground Test	01326	166	01050	DC
EMP1	E&M Inband Sig Reg	01326	166	01050	DA
EMP2	E&M Inband Sig Reg	01326	166	01050	DB
EMPP	E&M TSP Trunk	01330	160	01045	EE
END	End of Test Function	01304	6 151	01007 01033	M
EP	End of Pulsing	01320	11 41 49	01005 01017 01031	BM
ESDZ	ESS Dial Zero Trunk	01329	176	01067	EF
ESLC	ESS Loop Trunk, Coin	01329	175	01067	EE
ESLN	ESS Loop Trunk, Noncoin	01329	173	01066	EF
ESSL	Loop-EM Converter	01329	174	01066	EF
ETM	End of Timing	01338	167	01051	DA
FC	False Charge	01312	16	01010	K
FDK	Forward Diode Check	01310	162	-	DB
FL	Flash Time Alarm Lamp	01314	32	01011	BG
FL(1,2)	Flash Count 1 & 2	01310	162	01048	DF
FOT	False Overtime	01316	23	01013	C
FOTT	False Overtime Test	01316	23	01013	C
FP	Final Pulse	01307	3 50	01005 01032	BQ
FS	False Supervision	01325	36	01016	BR
FTC	False Timed Disconnect Check	01316	23	01013	C
FTE	False Timing Entry	01316	23	01013	C
FTL	First Line Test	01306	12	01011	L
FTLA	First Line Test Auxiliary	01306	12	01011	LR BR-1
FTM	False Timing	01338	167	01051	DA
FTR	Fundamental Tip and Ring Test	01304	6 151	01007 01033	N

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
G(00-19)	Group (00-19)	01301	A,B,C	01004	G{00-03}-CN G{04-19}-CM
GBT	TSP Busy Tst Auxiliary	01303	166	01050	DC
GLD	TSP DP Trunk (Loop)	01329	160	01044	EF
GR	Grounding Relay	01307	3 50	01005 01032	BQ
GTF	GT Int Front Cont	01337	167	01051	DC
GTL	Simulated Timer Lk	01337	167	01051	DC
GW	Coin Toll Timing Gen	01337	167	01051	DC
GZ	Coin Toll Timing Gen	01337	167	01051	DC
H	BT and PB Hold	01303	4	01006	BJ
H(0-9)	Hold Chain Relays (0-9)	01301	1	01003	CP
HBO	High Bridge Orig End	01336	162	01048	DE
HDA	HD Interrupter Auxiliary	01303	4	01006	BH
HDB	HD Interrupter B Contact	01303	4	01006	BH
HDF	HD Interrupter F Contact	01303	4	01006	BH
HF	Hold Chain Forward	01301	1	01003	CP
HLD	D Relay Hold	01336	162	01048	DE
HLD1	D Relay Hold Aux	01336	162	01048	DE
HS	Hold Chain Stop	01301	1	01003	CP
HU	Hundreds Digit	01308	46	01029	BT
HU1	Hundreds Digit Auxiliary	01308	164	01049	BU
HX, HX1 (0A, 0B, 1A, 1B, 2A, 2B, 3A, 3B)	H Relay Connectors	01319	29	01014	CB
HXA	H Relay Connector Auxiliary	01319	D	01014	CE
IE	Initial Entry	01312	16	01010	K
IEK	Initial Entry Check	01312	16	01010	K
IET	Initial Entry Test Function	01304	6 151	01007 01033	N
INT	Interrupter Relay	-	41	01017	BU
INT1	Interrupter T Relay 1	-	41	01017	BU

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
IP	Initial Period	01332	161	01047	EA
IPCK	Initial Period Timing Check	01338	167	01051	DA
LC	Pulse Divider C	-	11 41	01005 01017	BS
LCT	Lock Contact Test	01303	4	01006	BJ
LCTA	Lock Contact Test 1st Auxiliary	01302	4	01006	BK
LCTB	Lock Contact Test 2nd Auxiliary	01302	4	01006	BK
LD	Pulse Divider D	-	11 41	01005 01017	BS
LE	Pulse Divider E	-	11 41	01005 01017	BS
LOT(1-3)	Lock-Out Timing (1,2,3)	01319	D	01014	LOT(1,2)-CD LOT 3 - CC
LM	TSP MF Trunk (Loop)	01329	160	01045	EF
MAK	Major Alarm Check	01317	32	01011	BG
MAL	Major Alarm	01317	32	01011	BG
MAS	MF Trunk ANI Supervision	01329	154	01040	BL
MEM	MF E&M Class Trunk	01329	49	01031	BL
MF	MF Pulsing Class	01330	49	01031	BL
MFA	MF Pulsing Class Auxiliary	01330	49	01031	BL
MFF	MF Pulse Steering Finished	01308	46	01029	BT
MFP	MF Pulsing Function	01327	49	01031	BM
MG	Marginal Relay	01323	162	01048	DD
MGl	Marginal Relay Auxiliary	01323	162	01048	DF
MHB	Momentary High Bridge	01323	162	01048	DF
MND	Manual DP Call	-	11 41	01005 01017	BS
MNP	Manual PCI Call	01307	3 50	01005 01032	BP
MQA	Modified Busy Test	01329	160	01045	ED

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
MRK	Message Register Check	01314	157	01041	BW
MRM	Message Register Manual Test	01304	157	01041	BW
MRW	Message Register Counting	01314	157	01041	BW
MRZ	Message Register Counting	01314	157	01041	BW
NA	National Code A Digit	01308	46	01029	BT
NAD	Non-ANI DP with Supervision	01329	154	01040	BL
NAMA	PBX-NON-AMA Trunk	01329	157	01041	BW
NAS	Non-ANI with ANI Supervision	01329	154	01040	BL
NAT	National Dialing Code	-	9	01008	BM
NB	National Code B Digit	01308	46	01029	BT
NC	National Code C Digit	01308	46	01029	BT
NIT	Number Iden Trouble	01332	161	01047	EA
NM	No Minutes Test	01333	167	01051	DA
NML	Normal Test Pattern	01305	7	01007	N
NR	Normal Release Entry	01315	165	01049	E
NS	No Supervision Class	01329	49	01031	BM
NSD	No Stations Digit	01328	49	01031	BM
NST	Nonsupervisory Test	01325	36	01016	BR
NTA	Not A Digit Steering	01308	46	01029	BT
OA(0,1,2)	Orig Area (0,1,2)	01332	161	01047	EA
OBT	Originating Busy Test	01322	4	01006	BK
OFH	Off-Hook Supervision	01326	49	01031	BL
OI	Oper Iden - ANI	01332	161	01047	EA
OI(00,10,20)	Office Index Tens	01332	161	01047	EA
OIT(0,1,2 4,7)	Office Index Units	01332	161	01047	EA
OKSP	Sim Pos Attached	01331	161	01046	EC

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
OMA	Oper Iden - Non-ANI	01332	161	01047	EA
OP	Overtime Period	01332	161	01047	EA
OPST	Overtime Period Start	01333	161	01047	EB
OS	Orig Supervision	01335	161	01046	EC
OTW	Overflow Tone WZ	01324	40	01016	BP
OTZ	Overflow Tone WZ	01324	40	01016	BP
P	Pulsing Relay	01321	11 41 47	01005 01017 01030	BS
P1	Pulse Counter 1	01320	11 41 48	01005 01017 01030	BS
P2	Pulse Counter 2	01320	11 41 48	01005 01017 01030	BS
P3	Pulse Counter 3	01320	11 41 48	01005 01017 01030	BS
P4	Pulse Counter 4	01320	11 41 48	01005 01017 01030	BS
P5	Pulse Counter 5	01320	11 41 48	01005 01017 01030	BS
P6	Pulse Counter 6	-	11 41	01005 01017	BR
PAN	TSP Trunk from Panel	01329	160	01045	EF
PAS	Panel Auxiliary Sender	01329	154	01040	BL
PAS1	Panel Auxiliary Sender 1	01330	154	01040	BL
PAS2	Panel Auxiliary Sender 2	01320	154	01040	BL
PB	Pass Busy	01302	4	01006	BJ
PB(M.R.)	Busy Trunks Passed	01302	4	01006	Message Register
PCL	Pulsing Class	01303	168	01052	BU
PCRD	Pulse Class Reg Delay	01330	170	01065	ED
PDK1	Pos Data Trans Ck	01335	161	01046	EB
PDTT	Pos & Data Trans Test	01304	162	01048	DF

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
PG	Pulse Generator	01321	9 47	01008 01030	BS
PG1	Pulse Generator 1	01307	3 50	01005 01032	BQ
PG2	Pulse Generator 2	01307	3 50	01005 01032	BQ
PG3	Pulse Generator 3	01307	3 50	01005 01032	BQ
PLA	Outpulsing Function, (A) Office Code	01304	6 151	01007 01033	N
PLB	Outpulsing Function, (B) Line Number	01304	6 151	01007 01033	N
PLC	Position Link Cont	01331	161	01046	EC
PMR	PBX - Message Register Trunk	01329	157	01041	BW
POT	PBX - Operator Trunk	01329	157	01041	BW
POT1	PBX - Operator Trunk Auxiliary	01329	157	01041	BU
PP	Preliminary Pulse Relay	-	40	01016	BP
PP1	Preliminary Pulse Relay 1	01308	40 49	01016 01031	BM
PP1'	Preliminary Pulse Prime Counter	01308	49	01031	BM
PP2	Preliminary Pulse Relay 2	-	40	01016	BP
PPC	Person Class	01333	177	01065	EA
PPT	TSP Trunk	01330	160	01044	EE
PPT1	TSP Trunk Auxiliary	01330	160	01044	EE
PR	Pulse Ring	01307	3 50	01005 01032	BQ
PRKO	Pos Recall Ck Orig End	01336	162	01048	DE
PRKT	Pos Recall Ck Term End	01336	162	01048	DE
PRQ	Position Request	01331	162	01048	DF
PRT	Particular Recorder Test	01301	1	01003	CN
PST	Particular Circuit Start	01303	1	01003	CN

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
PT	Pulse Tip	01307	3 50	01005 01032	BQ
PXD	Pulse X Digit	01320	155	01035	BU
PXL	PBX Trunk	01329	157	01041	BW
PXL1	PBX Trunk Aux.	01329	157	01041	BW
PXSI	PBX Trunk Simultaneous Seizure Memory	01302	157	01041	BW
PXSS	PBX Trunk Simultaneous Seizure	01302	157	01041	BW
PXST	PBX Timing Start	01303	157	01041	BW
PXT	PBX Timing	01303	157	01041	BW
PXT1	PBX Timing Memory	01303	157	01041	BW
R1P	Reserve Trunk #1 Crossbar & Panel	01329	154	01040	BL
R(0,1,2,4, 7,13)	Recorder Number	01332	161	01047	EA
RA	Recorder Attached	01312	24	01013	B
RBT	Ring Back Test	01304	162	01048	DF
RBTk	Ring Back Test Ck	01310	162	01048	DE
RC	RT Relay Connector	01330	2 33	01004 01015	Test Conn
RC(0,1,2)	Rate Class	01332	161	01047	EA
RCA	RT Relay Connector Auxiliary	01330	44	01015	Test Conn
RCB	Conn Auxiliary	01330	163	01049	Test Conn
RCD	RC DP Auxiliary	-	37	01016	Test Conn
RCLK	Pos Recall Ck	01332	161	01046	EC
RCT	Receiver Cut-Through	01326	166	01050	DB
RDK	Reverse Diode Check	01310	162	01048	DB
RF	Ring Forward	01313	162	01048	DE
RFK	Ring Forward Ck	01315	162	01048	DF

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<u>Relay Desig</u>	<u>Functional Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
RGA	Register Attached	01324	162 172	01048 01066	DF
RH(00-19)	Group Hold	01301	2 33	01004 01015	Test Conn
RL1	Release (Check) 1	01323	22 152	01012 01034	J
RL2	Release (Check) 2	01314	22 152	01012 01034	D
RN	Restore to Normal	01303	1	01003	CN
ROM	Recorder Marker	01334	161	01046	EB
RP	Repeat Test	01302	4	01006	BJ
RRV	Release RV Relay	01336	162	01048	DE
RS(00-19)	Group Select	01301	2 33	01004 01015	Test Conn
RST	Repeat Same Trunk	01318	4	01006	Message Register
RTI	Reserve Trunk Identification	01319	4	01006	BJ
RTL	Return Test Line Function	01304	6 151	01007 01033	N
RV	Reverse (Polarity)	01313	19	01011	F
RVK1	Reversal Check Relay 1	01324	40	01016	BP
RVK2	Reversal Check Relay 2	01324	Q R, 40	01016 01016	BP
RVKA	Reversal Check Auxiliary	01324	40	01016	BN
RVKL	RVKA Relay Operate Memory	01324	40	01016	BN
S(0-9)	Select Chain Relays (0-9)	01301	1	01003	CQ
SA	Sender Attached	01309	162	01048	DF
SAF	Sender Attached Forward	01335	161	01046	EB
SB	Set PG on Back Contact	-	3	01005	BQ
SBF	Sleeve Busy Follower	01325	34	01016	M
SCDZ	TSP Cn. Toll & Dial Zero	01330	160	01045	EE

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
SCN	Special Toll Coin	01330	160	01044	EE
SCN1	Special Toll Coin Aux- iliary	01330	160	01045	EE
SCN2	Special Toll Coin Aux- iliary	01330	160	01045	EE
SDET	Stop D Release Timing	01317	162	01048	DE
SDF	Supervision Delay Follower	01314	21	01011	E
SDR1	Sender Release 1	01309	17	01011	E
SDR2	Sender Release 2	01309	17	01011	E
SDT	Supervision Delay Test Function	01304	6 151	01007 01033	M
SF	Select Chain Forward	01301	1	01003	CQ
SIX	Six Pulse	01337	167	01051	DC
SK	Soak	01313	19	01011	F
SK1	Soak 1	01313	22 152	01012 01034	D
SK2	Soak 2	01313	19	01011	F
SL	Sleeve	01314	22 152	01012 01034	D
SL1	Sleeve 1	01314	22 152	01012 01034	D
SLK	Sleeve Check	01303	26	01006	BH
SMA	Special Test A	01316	160	01044	EF
SMA1	Special Test A Auxiliary	01316	160	01044	ED
SMB	Special Test B	01316	160	01044	EF
SMB1	Special Test B Auxiliary	01316	160	01044	ED
SP	Start Pulsing	01307	3 50	01005 01032	BQ
SP (1-2)	Start Pulsing (1-2)	-	11 41	01005 01017	BS
SPB	Substitution Pass Busy	01302	4	01006	BJ
SPCT	Start Pulse for Combined Trunks	01308	170	01065	ED

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
SPD	Sim Pos Disconnect	01331	161	01046	EB
SPG	Start Pulsing	01324	11 41 49	01005 01017 01031	BM
SPGA	SPG Auxiliary	01324	41 49	01017 01031	BM
SPT	Special Toll Trunk	01332	161	01047	EA
SR	Slow Release	01309	13	01004	K
SRK	Sender Releasing Check	01309	17	01011	F
SS	Select Chain Step	01301	1	01003	CQ
SSP	Sim Pos Sleeve	01331	161	01046	EC
ST	Start	01302	1	01003	CN
ST(1-3)	Test Start (1,2,3)	01302	5	01004	M
ST4	Test Start 4	01302	5	01004	H
STA	Stations Digit	01308	46	01029	BT
STAC	Station Class	01333	177	01065	EA
STF	Start Forward	01333	161	01046	EB
STL	Second Test Line	01306	12	01011	IR 0R1
STM	Start Timing	01334	161	01046	EB
STO	Signal Time-Out	01303	166	01050	DC
STO1	Signal Time-Out Auxiliary	01303	166	01050	DC
STO2	Signal Time-Out Auxiliary	01336	166	01050	DC
STP	Stop Pulsing	01320	G,H 49	01008 01031	BM
STP1	Stop Pulsing 1	01320	3 50	01005 01032	BQ
STS	Start Pulse Send	01308	46	01029	BT
STS1	Start Pulse Send Auxiliary	01308	158	01042	BU
SUP	Supervision Class	01329	49	01031	BW
SUPR	Supervision Returned	01325	164	01049	BU
SXD	Start X Digit	01320	155	01035	BU
SXTY	Sixty Pulse	01337	167	01051	DC

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<u>Relay Design</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
T(0,1,2, 4,7)	Tens Digit of Call Identity Index (0,1, 2,4,7)	01311	15	01010	H
TA	Time Alarm	01317	32	01011	BG
TA1	Time Alarm 1	01317	32	01011	BG
TB	Trouble Timing	01317	32	01011	BG
TBL	E&M Trouble	01326	166	01050	DA
TCO	TC Relay Operate	01324	40	01016	BP
TCBM	Trans Conn Busy	01334	161	01046	EC
TCR	Test Code Reg	01333	161	01046	ED
TE	Timing Entry	01317	25 153	01012 01035	B
TEC	End of Timing Cycle	01333	161	01047	EB
TETP	End of Time Period	01339	167	01051	BD
TG	Trunk Guard	01323	8 40	01004 01016	J
TG1	Trunk Guard 1	01324	8 40	01004 01016	L
TGK	Trunk Guard Check	01309	J K	01004	K
TGK1	Trunk Guard Check 1	01309	13	01004	K
TGM	Trunk Guard Marginal	01309	13	01004	K
TGR	Trunk Guard Ring	01309	13	01004	K
TGS	Trunk Guard Sensitive	01309	13	01004	K
TGS1	Trunk Guard Sensitive 1	01309	13	01004	K
TH	Thousands Digit	01308	46	01029	BT
TH1	Thousands Digit Auxiliary	01308	158	01042	BU
TK(1-2)	Tens Check (1-2)	01311	15	01010	H
TL1	Test Lead "L"	01325	20	01011	BR
TL1K	TL1 Check	01324	40	01016	L
TLB	Test Line (B)	01306	12	01011	L
TLT	"TL1" Lead Transfer	01325	20	01011	BU
TMC(1,2,3)	Timing Counter Relays	01339	167	01051	BD

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<u>Relay Desig</u>	<u>Functional Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
TMT	Timing Test	01313	162	01048	DE
TMTA	Timing Test Auxiliary	01313	162	01048	DF
TN	Tone Detector	01322	35	01016	A
TND	Tens Digit	01308	46	01029	BT
TOHF	Tdm Op Hold Fail	01336	162	01048	DE
TOHT	Tdm Op Hold Tst	01336	162	01048	DE
TOK	OK Pulse	01337	167	01051	DB
TR	Rime Release Entry	01315	165	01049	E
TRCY	Timing Recycle	01339	167	01051	BD
TRL	"TRL" Lead Test	01306	12	01011	L
TRM	Transmission Test	01313	18	01040	P
TS	Terminating Sup	01335	161	01046	EC
TT	Ten Thousands Digit Steering	01308	46	01029	BT
TT(1-4)	TTA (Recorder Relay) Test (1,2,3,4)	01312	24	01013	B
TTH	Ten Thousands Digit	01328	41 49	01017 01031	BM
TTT	Transverter Trouble Test	01312	16	01010	K
TU	Tens Unit of Call Identity Index	01311	15	01010	H
TV(1-2)	Transverter (1,2)	01312	16	01010	K
TVA	Transverter Attached	01309	6 151	01007 01033	L
TVR	Transverter Release	01334	161	01046	EB
TW	Timing W Relay	01317	32	01011	BG
TW1	Timing W1 Relay	01317	32	01011	BG
TZ	Timing Z Relay	01317	32	01011	BG
TZ1	Timing Z1 Relay	01317	32	01011	BG
U	Units Digit	01308	46	01029	BT

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<u>Relay Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
U(0,1,2 4,7)	Units Digit of Call Identity Index (0,1,2,4,7)	01311	15	01010	G
UK(1-2)	Units Check (1,2)	01311	15	01010	G
VA	Test Variation A	-	38	01016	-
VAA	VA Auxiliary	-	4	01006	BH
VARC	VA Reserve Connector	-	43	01015	Test Conn
VB	Test Variation B	-	39	01016	Test Conn
VBA	VB Auxiliary	-	41	01017	BR
VBRC	VB Reserve Connector	-	43	01015	Test Conn
W	Interdigital Timing W Relay	01320	11 41 48	01005 01017 01030	BS
WK	Wink Check	01324	40	01016	K
WKF	Wink Failure	01326	166	01050	DB
WKOK	Wink OK	01326	166	01050	BD
WKT	Wink Timing	01326	166	01050	DB
WKS	Wink Start	01326	166	01050	DA
WOK	Wink Off Check	01325	156	01035	E
WOT	Wink Off Test Class	01325	34	01016	M
WR	Interdigital Timing WR Relay	-	11 41	01005 01017	BS
WS	Wink Start Trunk Class	01329	41 49	01017 01031	BM
XD	X Digit	01308	155	01035	BU
XM	Transmission	01304	6 151	01007 01033	N
Z	Interdigital Timing Z Relay	01320	11 41 48	01005 01017 01030	BS
ZCN	Dial Zero Coin Class	01332	161	01047	EA
ZEM	Dial Zero Trunk (E&M)	01329	160	01045	EF
ZL	Dial Zero Trunk (Loop)	01329	160	01045	EF
ZNC	Dial Zero Noncoin	01332	161	01047	EA

4.2 Index of Lamps

<u>Lamp Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
2WC	2W Loop Compensation Cl	01329	49	01031	
2W3	2- of 3-Wire Class	01329	49	01031	
3W	3-Wire Trunk Class	01325	34	01016	
3WS	3-Wire Code Selector Trunk Class	01325	156	01035	
10BL	10-Digit Bylink Trunk	01329	171	01066	
AlP	ANI #1 Crossbar & Panel	01329	49	01031	
ABR	Abbreviated Test Pattern	01305	7	01007	
ADR	A & D Relay Release	01314	22 152	01012 01034	
AEF	Answer Entry Failure	01313	20	01011	
AMAE	AMA Error	01334	169	01052	
ANI	Automatic No. Identification Cl	01330	154	01040	
ANS	Answer Test Function	01305	6 151	01007 01033	
AOP	A Relay Operate Test Function	01305	6 151	01007 01033	
AOP(1-2)	A Relay Operate Test (1-2)	01305	40	01016	
BBC	Busy Back Completed	01313	19	01011	
BL	Bylink Trunk	01330	41 49	01017 01031	
BR	Busy Reserve Trunk	01303	4	01006	
BRL	B Relay Release	01314	22 152	01012 01034	
BT	Busy Trunk	01303	4	01006	
CAS	Control Advance Sender Attached	01318	26	01006	
CAT	Control Advance Trunk Attached	01318	26	01006	
CEM	Combined E&M Trunk	01330	169	01052	
CHL	"CH" Lead Release	01312	24	01013	

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<u>Lamp Design</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
CIF	Coin Information Error	01334	169	01052	
CLP	Combined Loop Trunk	01330	169	01052	
CMF	Convertible MF Trunk	01329	171	01066	
CN	Coin Trunk	01330	169	01052	
COF	Channel Overflow	01309	12	01011	
CR	Cancel Release Entry	01315	165	01049	
CSO	CS Relay Operate	01313	20	01011	
CSS	CS Relay Soak	01313	19	01011	
CST	CS Relay Test Function	01305	6 51	01007 01033	
CTP	Call Through Pattern	01305	7	01007	
CTK1	Cancel Timing Ck	01334	169	01052	
CTL	Coin Toll Trunk	01329	169	01052	
CTT	Call Through Test Function	01305	6 151	01007 01033	
D2H	D2 Relay Hold	01314	22 152	01012 01034	
D2M	D2 Relay Minimum Re- lease Time Test	01317	25 153	01012 01035	
DCL	DC Load Test	01309	17	01011	
DE	Disconnect Entry	01314	22 152	01012 01034	
DFT	D Relay Functions Test	01305	6 151	01007 01033	
DIS	Disconnect Test Function	01314	6 151	01007 01033	
DLP	D Relay Locking Path	01309	17	01011	
DO	D Relay Operated	01309	17	01011	
DP	Dial Pulse Trunk Class	01330	11 49	01005 01031	
DS	D Relay Shunt Test Failure	01317	25 153	01012 01035	
DST	D Relay Shunt Test Function	01305	6 151	01007 01033	
DTBL	Data Trans Trouble	01334	169	01052	

<u>Lamp Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
DTCB	Data Trans Conn Busy	01334	169	01052	
DTF	Diode Test Failure	01310	169	01052	
DZ	Dial Zero Trunk	01330	169	01052	
E	Early Timing Entry	01316	23	01013	
EC	End of Cycle	01301	1	01003	
ECF	Coin Toll Trunk (E&M)	01329	169	01052	
EM	E&M Signaling Class	01330	49	01031	
EMD	TSP DP Trunk (E&M)	01329	169	01052	
EMF	TSP MF Trunk (Loop)	01329	169	01052	
EMT	E&M Trouble	01326	169	01052	
END	End of Test Function	01305	6 151	01007 01033	
ESLC	ESS Trunk (Loop) Coin	01329	169	01052	
ESLN	ESS Trunk (Loop) Noncoin	01330	169	01052	
ESZC	ESS Dial Zero Trunk, Coin	01329	169	01054	
ESZN	ESS Dial Zero Trunk, Noncoin	01329	169	01054	
FC	False Charge	01312	16	01010	
FFF	Flash Forward Failure	01313	157	01041	
FOT	False Overtime	01316	23	01013	
FOTT	False Overtime Test	01316	23	01013	
FR	Fundamental Ring Trouble	01309	13	01004	
FRV	Fundamental Reversal	01309	13	01004	
FS	False Supervision	01325	36	01016	
FT	Fundamental Tip Trouble	01309	13	01004	
FTE	False Timing Entry	01316	23	01013	
FTFR	Fundamental Tip & Ring Crossed	01309	13	01004	
FTM	False Timing	01338	169	01052	
FTR	Fundamental Tip & Ring Test Function	01305	6 151	01007 01033	

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<u>Lamp Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
G(00-19)	Group (00-19)	01301	A,B,C	01004	
GLD	TSP DP Trunk (Loop)	01329	169	01052	
H(0-9)	Hold (0-9)	01301	1	01003	
IE	Initial Entry	01312	16	01010	
IET	Initial Entry Test Function	01305	6 151	01007 01033	
JHF	Joint Hold Failure	01313	157	01041	
L	Late Timing Entry	01316	23	01013	
LM	TSP MF Trunk (Loop)	01329	169	01052	
MDO	Message Register Double Operation	01312	157	01041	
MF	MF Trunk Class	01330	49	01031	
MRF	Message Register Failure	01314	157	01041	
MRM	Message Register Manual Test	01305	157	01041	
NAD	Non-ANI DP with Supervision	01329	154	01040	
NAS	Non-ANI with ANI Supervision	01329	154	01040	
NML	Normal Test Pattern	01305	6 151	01007 01033	
NR	Normal Release Entry	01315	165	01049	
NST	Nonsupervision Trunk	01329	36 49	01016 01031	
OA(0,1,2)	Orig Area	01333	169	01052	
OBT	Originating Busy Test	01302	4	01006	
OF	Overflow Tone	01305	40	01016	
PAS	Panel Auxiliary Sender	01329	154	01040	
PCI	PCI Trunk Class	01330	3 50	01005 01032	
PDTT	Pos & Data Trans Tst	01305	169	01052	
PLA	Outpulsing Function (A) Office Code	01320	6 151	01007 01033	

<u>Lamp Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
PLB	Outpulsing Function (B) Line No.	01305	6 151	01007 01033	
PMR	PBX-Message Register Trunk	01329	157	01041	
POT	PBX-Operator Trunk	01329	157	01041	
PP	Preliminary Pulse	01308	49	01031	
PRKO	Pos Recall Ck Orig End	01333	169	01052	
PRT	Particular Recorder Test	01301	1	01003	
PXL	PBX Trunk	01329	157	01041	
RBT	Ring Back Test	01305	169	01052	
RT	Reserve Trunk	01319	4	01006	
RTA	Reserve Trunk Attached	01303	6 151	01007 01033	
RTL	Return Test Line Function	01305	6 151	01007 01033	
RTO	RT Relay Operated	01302	4	01006	
S(0-9)	Select (0-9)	01301	1	01003	
SDT	Supervision Delay Test Function	01305	6 151	01007 01033	
SMA	Special Test A	01316	169	01052	
SMB	Special Test B	01316	169	01052	
SMP	Sim Pos Attached	01331	169	01052	
SPT	Special Toll Trunk	01330	169	01052	
SUPV	Supervisory Lamp	01313	19	01011	
SVT	Supervisory Trunk Class	01329	49	01031	
T(0,1,2, 4,7)	Tens Digit of Call Identify Index(0,1,2,4, 7)	01311	15	01010	
TA	Time Alarm	01317	32	01011	
TCMB	First Test Line	01334	12	01011	
TLL	First Test Line	01306	12	01011	
TL2	Second Test Line	01306	12	01011	

<u>Lamp Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>	<u>Plate</u>
TMT	Timing Test	01313	169	01052	
TOHF	Tdm Op Hold Failure	01336	169	01052	
TR	Timed Release Entry	01315	165	01049	
TT	Transverter Trouble	01312	16	01010	
U(0,1,2, 4,7)	Units Digit of Call Identity Index (0,1,2,4,7)	01311	15	01010	
VAR	VA Test, Reserve Trunk	-	1	01003	
VBR	VB Test, Reserve Trunk	-	1	01003	
WO	Wink Off	01325	34	01016	
WS	Wink Start Trunk	01329	41 49	01017 01031	
XM	Transmission Test Function	01305	6 151	01017 01033	
ZEM	Dial Zero Trunk (E&M)	01329	169	01052	
ZL	Dial Zero Trunk (Loop)	01329	169	01052	

4.3 Index of Keys

<u>Key Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
ACO	Alarm Cut-Off	01317	32	01011
APB	Automatic Pass Busy	01302	4	01006
CA	Control Advance	01318	26	01006
CDZ	Combined Dial Zero		169	01052
CTM	Cancel Timing		169	01052
CTT	Call Through Test	01305 8,19,21	9 46	01008 01029
D2M	D2 Relay Minimum Release Time Test	01317	25 153	01012 01035
DH	D Relay Hold	-	17	01011
DTI	Display Trouble Indication	01305,19	4	01006
DTR	Disconnect Timed Release	01316	23	01013
FDTR	False Disconnect Timed Release	01316	23	01013

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<u>Key Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
FOT, FOT1	False Overtime Test	01316	23	01013
FOTR	False Overtime Test Release	01316	23	01013
Frame Line	Connect Tel Circuit to Frame Line	01306	14	01006
MRM	Message Register Manual Test	01304,18	157	01041
Nat Code	National Dialing Code	01308	9 46	01008 01029
ORB	Override Busy	01318,29	49	01031
PAS	Panel Auxiliary Sender	01329	154	01040
POT-PMR	POT-PBX Operator Trunk PMR-PBX Message Register Trunk	01329	157	01041
PRT	Particular Recorder Test of Trunks	01301	1	01003
RAN	Reserve Trunk, ANI or Non-ANI	01329	154	01040
REP	Repeat Test on Same Trunk	01302,18	4	01006
RN	Restore to Normal	01303	1	01040
RS	Reserve Trunk Supervision	01329	49	01040
RTS(00-19)	Reserve Trunk Substitution	-	27	01009
SMA	Special Test A	01305,16	169	01052
SMB	Special Test B	01305,16	169	01052
ST	Start	01301,2	1	01003
TA	Time Alarm Cut-Off	01317,18	32	01011
THB	Trunk Hold Busy	01302,3	27	01009
TRL	"TRL" Lead Test	01306	12	01011
VAR	VA Test Reserve Trunk	-	1	01003
VBR	VB Test Reserve Trunk	-	1	01003
WATS	Test WATS Trunks	01329	157	01041

4.4 Index of Jacks

<u>Jack Desig</u>	<u>Fundamental Meaning</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
TEL	Telephone Circuit	01306	14	01040
R	Transmission Test Receive	01323	18	01040
S	Transmission Test Send	01313	18	01040
TN	TN Relay Test Jack	01322	35	01016
P	P Relay Contact	01321	47	01030
CSO	CSO Relay Test Jack	01323	14	01040

4.5 Leads to Other Circuits

<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
CHG	Recorder Circuit	01312	24	01013
CHK		01312	24	01013
CHT		01312	24	01013
CR		01315	165	01049
NR		01315	165	01049
TR		01315	165	01049
TTA		01312	24	01013
TUC		01312	24	01013
T(0,1,2,4,7)		01311	15	01013
TER		01312	15	01010
U(0,1,2,4,7)		01311	15	01010
B	Recorder 00	01312	5	01004
AMA	Sender Link & Cont Ckt	-	29	01014
ANI		01319	29	01014
CS(0-6)		01319	29	01014
HXA or HXB		01319	29	01014
NAMA		-	29	01014
NANI		01319	29	01014
NPAS		01319	29	01014
PAS		01319	29	01014

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<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
RC(0-2)		01319	29	01014
RN(0,1,2,4,7,13)		01319	29	01014
ST		01319	D,E,F	01014
DT1	Transverter Circuit	01319	4	01006
TTT		01312	151	01033
TVA		01309	151	01033
ACI	Reserve Trunks	01303	44	01015
DI		01319	4	01006
DIB		01319	D,E,F	01014
DIC		01319	29	01014
DID		01319	29	01014
NS		01303	44	01015
PAS		01303	44	01015
ST		01319	D,E,F	01014
S		01319	2 33	01004 01015
A (DL)	Interrupter Frame Ckt	01316	23	01013
A (DR)		01316	23	01013
A (DS)		01316	23	01013
A (DT)		01314	152	01034
A (GT)		01337	167	01051
A (HD)		01303	4	01006
A (RT)		01322	157	01041
B (BB)		01313	19	01011
B (BY)		01317	32	01011
B (DL)		01316	23	01013
B (DR)		01316	23	01013
B (DS)		01316	23	01013
B (DT)		01314	152	01034
B (GT)		01337	167	01051

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<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
A (HD)		01303	4	01006
B (TT1)		01317	32	01011
B (TT2)		01317	32	01011
F (DL)		01316	23	01013
F (DR)		01316	23	01013
F (DS)		01316	23	01013
F (DT)		01314	152	01034
F (GT)		01337	167	01051
F (HD)		01303	4	01006
A	AMA Trunks	01303	33	01015
CBA		01335	163	01049
CBS		01335	163	01049
CBST		01335	163	01049
CC		01337	163	01049
CSF		01325	44	01015
CTT		01331	163	01049
D		01309	33	01015
DIA		01319	33	01015
DVR		01310	163	01049
E		01326	44	01015
E1		01326	163	01049
HMG		01337	163	01049
M		01326	44	01015
ML		01326	49	01031
M6		01337	163	01049
M60		01337	163	01049
MR		01314	44	01015
NTT		01331	163	01049
OK		01337	163	01049

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<u>Load Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
R	AMA Trunks	01322,23	33	01015
R1		01322	44	01015
R2		01322	44	01015
RA		01324	163	01049
RT		01303	33	01015
RTB		01337	163	01049
RTL		01303	33	01015
RV		01303	33	01015
S		01303,19	33	01015
S1		01325	44	01015
T		01322,23	33	01015
T1		01322	44	01015
T2		01322	44	01015
TL1		01325	44	01015
TL2		01324	44	01015
TST		01309	33	01015
TT		01331	163	01049
1	Misc Ckt for Other Test Frames	01317	32	01011
2		01317	32	01011
AG	Floor Alm Frm Fuse & Time Alm Ckt	01317	32	01011
MA		01317	32	01011
TA		01317	32	01011
RC	Inc Reg Link Fr Misc Ckt	01318	4	01006
RC	Transverter Tbl Indicator or Tbl Rec Fr Misc Ckts	01318	4	01006
TTMB		01331	161	01046
RC	Trunk Link Misc Ckt	01318	4	01006
RC	Call Identity Indexer Misc Ckt	01318	4	01006
RC	Recorder Misc Ckt	01318	4	01006

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<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
RC	Trunk Frame Misc Ckt	01318	4	01006
T	Frame Line Circuit	01306	14	01006
R		01306	14	01006
R	Office Link via HMDP	01309	18	01006
S		01314	151	01033
SL		01306	12	01011
T		01309	18	01006
MC	Miscellaneous Circuit for Message Register Rack	01314	157	01041
MRN		01314	157	01041
MRR		01323	157	01041
MRT		01323	157	01041
RC	Trk Auto Test Misc Ckt	01318	4	01006
T(0,1,2,4,7,10)	MF Current Supply to Distribution Circuit	01327	45	01028
R(0,1,2,4,7,10)		01327	45	01028
DI(1st-10th)	Grp of Decades Assoc With Same Recorder	01319	31	01014
A(0,1,2,4,7)	Data Transfer Circuit	01333	161	01046
AMAE		01331	161	01046
B(0,1,2,4,7)		01333	161	01046
C(0,1,2 4,7)		01333	161	01046
CIF	Data Transfer Circuit	01331	161	01047
CS(00,0-5)		01332	161	01047
D(0,1)		01333	161	01046
DGN(0,1,2,4,7)		01333	161	01047
DTBL		01331	161	01046
DTOK		01331	161	01046
E(0,1)		01333	161	01046
EC		01333	161	01047

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<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
ET		01333	161	01047
F(0,1)		01333	161	01046
FC		01333	160	01044
G(0,1)		01333	161	01046
HS		01333	160	01044
IP		01332	161	01047
M(0-4)		01333	169	01052
NIT		01332	161	01047
OA(0,1,2)		01332	161	01047
OI		01332	161	01047
OIT(0,1,2)		01332	161	01047
OMA		01332	161	01047
OP		01332	161	01047
OP1		01332	161	01047
OPST		01333	161	01047
OTP(0,1,2,4,7)		01332	161	01047
PC		01335	161	01046
PP		01333	161	
PTOS		01331	161	01046
RC(0,1,2) ("Mfr Disc")		01332	161	01047
RCL		01332	161	01046
RN(0,1,2,4,7,13)		01332	161	01047
RTH1		01333	160	01044
RTT(0,1)		01333	160	01044
RTU(0,1)		01333	160	01044
SPT		01332	161	01047
STA		01333	160	01044
STD1		01331	161	01046
STD11		01331	161	01046
STOP		01331	161	01046

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<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
ZCN		01332	161	01047
ZNC		01332	161	01047
A(0,1,2,4,7)T	To Transverter Conn Circuit	01334	161	01046
B(0,1,2,4,7)T		01334	161	01046
C(0,1,2,4,7)T		01334	161	01046
CBS		01334	161	01046
CNM		01334	161	01046
CS(00,0-5)		01334	161	01047
FN		01334	160	01044
IC		01334	161	01046
LAC		01334	161	01046
NIT		01334	161	01047
NSD		01334	161	01046
NST		01334	161	01046
OD		01334	161	01046
OF(0,1,2,4,7,00, 10,20)		01334	161	01047
OI		01334	161	01047
OMA		01334	161	01047
POS		01334	161	01046
R(0,1,2,4,7,13)		01334	161	01047
RC(0,1,2) ("Mfr Disc")		01334	161	01047
ROM		01334	161	01046
SP		01334	161	01046
STV		01334	161	01046
TCMB		01334	161	01046
TRL		01334	161	01046
TTF		01334	161	01046
TVR		01334	161	01046
UTTH		01334	161	01046

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<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
AOK	Aux Trunk Test Circuit	-	34	01016
AOK1		-	34	01016
CL		-	41	01017
E		-	37	01016
EMS		-	34	01016
M		-	37	01016
R		-	41	01017
R1		-	41	01017
SP		-	41	01017
SP1		-	41	01017
SRK		-	41	01017
SRK1		-	41	01017
T		-	41	01017
T1		-	41	01017
TL		-	41	01017
TL1		-	37	01016
CC	Timer Link & Controller Circuit	01338	160	01044
M6		01337	160	01044
M60		01337	160	01044
OK		01337	160	01044
RC		01318	4	01006
TTF		01337	160	01044
CC	TSP No. 100A Link & Conn Ckt	01310	160	01044
IC		01334	161	01046
KPR		01335	161	01046
OS		01335	161	01046
PA		01331	161	01046
RB		01310	166	01048
RC		01318	4	01006

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<u>Lead Desig</u>	<u>To</u>	<u>OS SH</u>	<u>Fig.</u>	<u>SD SH</u>
RF		01335	161	01046
RLF		01335	160	01044
S		01331	161	01046
SA		01335	161	01046
TL		01310	162	
TS		01335	161	01046
DGN(0,1,2,4,7)	TSP No. 100A Link Controller Ckt	01332	161	01046
NBT		01331	161	01046
OKT		01331	161	01046
PCT		01331	161	01046
RC		01318	4	01006
STF		01331	161	01046
SA	AMA MF Sender Circuit	01309	162	01048
TTQ		01309	151	01033
A	Dual Channel Receiving Circuit	01326	160	01045
B		01326	160	01045
P1		01326	166	01050
P2		01326	166	01050
R1		01326	160	01045
T1		01326	160	01045

5. KEY CROSS REFERENCE TABLE

<u>Desig</u>	<u>CD Paragraph</u>	<u>Desig</u>	<u>CD Paragraph</u>
ACO	I-273; II-8, 41	CTT	I-2.21, 3.12, 3.14; 9.2, 9.4
APB	I-2.15, 2.17; II-1.31, 1.321, 1.323, 1.33, 1.3432, 10.43, 10.44, 11.4	D2M	I-2.582; II-6.2
CA	I-2.17, 2.73, 3.11, 3.12, 3.13; II-1.5, 5.7, 8.42, 9.2, 9.3, 9.4	DH	-MD-
CDZ	I-2.13	DTI	I-2.21, 3.13; II-9.3
CTM	I-2.5651; II-5.4211, 5.615	DTR	I-2.21, 2.562; II-5.611, 5.612, 5.613, 5.614, 5.62, 5.64
		FDTR	I-2.21, 2.563; II-5.611, 5.612, 5.613, 5.614, 5.63, 5.64

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<u>Desig</u>	<u>CD Paragraph</u>
FOT, FOT1	I-2.21, 2.564; II-5.611, 5.64
FOTR	II-5.64
Frame Line	II-9.2
MRM	I-3.14; II-9.4
Nat Code	I-2.64, 3.12; II-9.2
ORB	II-1.113, 1.325
PAS	I-3.23; II-1.113, 10.3
POT-PMR	I-2.52, 2.541, 2.561, 2.563, 2.564; II-2.35, 2.72, 5.21, 5.4, 5.41, 5.613, 5.62
PRT	I-2.11, 3.24, 3.3; II-1.12, 1.13, 10.44, 11.4
RAN	I-3.23; II-1.113, 10.3
REP	I-2.16, 2.17, 2.73; II-1.42, 1.51, 1.52, 8.42, 10.44, 11.4
RN	II-1.26, 1.136, 2.73

<u>Desig</u>	<u>CD Paragraph</u>
RS	I-3.23; II-1.113, 10.3
RTS-	I-3.24; II-10.4 (MD)
SMA	I-2.122, 2.24, 2.241, 2.41, 2.43, 2.5421, 2.5653, 2.5654; II-2.4, 2.41, 4.1, 4.111, 4.3, 5.4211, 5.617, 5.619
SMB	I-2.122, 2.42, 2.43, 2.5422, 2.5651, 2.5652; II-4.2, 4.3, 5.4221, 5.615, 5.619
ST	I-2.71, 3.12; II-1.121, 1.135, 1.14, 1.31, 9.2, 9.3, 10.41, 10.44, 11.4
THB	I-2.15, 3.24, 3.3; II-1.22, 1.23, 1.24, 10.41, 10.42, 10.43, 10.44, 11.1, 11.2, 11.3, 11.4
TA	I-2.73; II-8.41
TRL	I-2.251, 2.252; II-2.52
VAR, VBR	-MD-
WATS	I-2.13

SECTION IV - REASON FOR REISSUE

CHANGES

B. Changes in Apparatus

B.1 Added

FS, Resistor, 18AC, Fig. 171

D. Description of Changes

D.1 When testing Incoming Trunk, SD-27010-01, Issue 13B test circuit may fail in A operate test.

D.11 Issue 13B of SD-27010-01 removes the "RV" lead ("YQ" option) to the test circuit. This lead caused the RV and RVR relays in the trunk to be operated as soon as the trunk was seized by the test circuit. The RVR operated opened the start lead to the register before the trunk RT relay was operated.

With the "RV" lead removed the start lead is opened by the TC relay which operates approximately 38 msec after the test circuit seizes the trunk. However, before the TC is operated, the RT is operated placing the test circuit E capacitor across the tip and ring of the trunk operating and releasing the A, RA, and T relays. The sender which became attached proceeds to time-out operating its AV1, AV2, AV4 and releasing AV3 relays. The test circuit now attempts to make A relay operate test, operating the trunk A and RA relays but because the sender, which has never released from this trunk has its AV4 operated the "CO" lead to the trunk is open preventing the trunk T relay from operating and the test frame blocks actually attempting to outpulse.

D.12 The condition is corrected by including the SP relay contacts 6 and 7B in series with the AODA 1 and 2T contacts. This removes the E capacitor from the "T" and "R" leads to the trunk when it is seized. Option "WW" provides this correction and is made after-date Standard.

D.13 This change must be applied to all non-TSP offices arranged to test Incoming Trunk, SD-27010-01, Issue 13B and those TSP offices not arranged to test TSP Incoming Trunk, SD-27104-01 but containing Incoming Trunk, SD-27010-01, Issue 13B.

D.2 The FS (false supervision) lamp may light and test circuit block when testing SD-27092-01 trunks.

D.21 This condition results from the FS relay in the test circuit detecting a false reversal to the originating office when testing this trunk. The reversal occurs at the time the sender, SD-27024-01, operates its MRS relay to transfer from the MF receiver to the operator repeat coil. If the travel is short, the contact bunch time causes the CS relay to kick down. If the travel is extended, the operate path of the CS is opened and the CS releases. In either case the CS in releasing releases the RV relay sending the reversal recognized by the FS.

D.22 Since this reversal is not of sufficient duration to be recognized by present day electromechanical systems the test circuit is arranged to mask this reversal. This is done by desensitizing the FS relay after called number outpulsing.

D.23 This change, "WX" option, requires one 18AC resistor designated FS and minor wiring.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5623-RMW-RBC-RH

AMA TT-O