# 37

CROSSBAR SYSTEMS
NO. 3
OUTGOING SENDER AND CONNECTOR
CIRCUIT
MF AND DP OUTPULSING

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT) PAGE



TABLE OF CONTENTS (CONT) PAGE

## SECTION I - GENERAL DESCRIPTION

### 1. PURPOSE OF CIRCUIT

1.01 The outgoing sender is used on calls, from a No. 3 crossbar office, which require that digital information be sent to another office. The sender is capable of outpulsing the digit information either by dial pulsing (DP) or by multifrequency (MF) pulsing.

### 2. GENERAL DESCRIPTION OF OPERATION

SEIZURE AND OPERATION WITH MARKER

2.01 When the marker has ascertained from the called number that a call is outgoing and that an outgoing sender is required, the marker selects an idle sender. The outgoing sender connector connects the sender to the marker and the marker transfers to the sender the information necessary to complete the call. The marker selects an idle outgoing or 2-way trunk and causes the outgoing sender link to attach the sender to the trunk.

2.02 The senders are arranged in one group and appear on the verticals of the two outgoing sender link switches. Each switch is strapped and wired so that it is electrically four switches. Each sender is multipled to every fourth hold magnet on the switches while each level serves four trunks. All senders are accessible to all of the trunks which require a sender to complete a call.

2.03 The outgoing sender connector consists of control relays and four connector relays per sender per marker. The control relays operate the connector relays which cut through the leads over which the marker will control the sender and the leads over which information is stored in the sender. The control relays arrange that the markers prefer different senders and give preference to a marker trying to seize a sender. Through the connector, the marker transfers to the sender all of the information necessary to complete the call. This includes the dialed number, the number of digits to delete, the arbitrary digit or intercept class digit, if any, to be prefixed, the type of outgoing trunk and the type of outpulsing MF or DP. When an ANI call is being set up, the marker also stores the directory line number, an office indication, and an ANI information digit indication in the sender.

2.04 The marker establishes the connection between the calling line and outgoing trunk. After the marker has checked the channel and the link connection between the trunk and sender and has checked that the sender has stored the information sent to it, it transmits an advance signal to the sender. The advance is the signal which tells the sender that the marker is about to release and that the sender should assume supervisory control of the call, control of the link between it and the trunk and that it should complete its functions.

2.05 From this point on if the call is abandoned the sender will release immediately.

2.06 A timed interval is allowed from seizure to release of the sender on each call. Should some trouble condition prevent completion of the call, a time out will occur. The sender will open the sleeve lead holding the channel releasing the connection to the calling line. The calling customer will receive reorder tone from the line lockout state the line is forced into. The sender will cause the trunk identifier to identify and record the trunk and sender number. At the same time the sender will attempt to release. If the test circuit cancel time release key is operated the sender will stick, if no other sender is, until manually released.

SIGNALING AND OUTPULSING

2.07 Provision is made for adding one arbitrary digit at the start of each call. Four different digits are cross connectable within the sender as the arbitrary digit. If automatic intercept service (AIS) is provided, three of the digits must be cross-connected as intercept class digits. When an arbitrary digit is to be sent the marker selects the digit to be sent by operating the proper relay in the sender.

2.08 The sender is capable of generating the A, B, and C digits of the two office codes possible in the No. 3 crossbar office. The digits are cross connected in the sender. When required, the marker selects which of the two office codes is to be outpulsed by operating the proper relay in the sender. If the call is an AIS call, the office code will be outpulsed following the intercept class digit. On ANI calls the office code will follow the ANI information digit which precedes the calling number.

2.09 Provision is made for deleting from outpulsing from one to three digits under control of delete marks sent by the marker which preoperates certain steering relays. Deletion always begins with the A digit and progresses successively through the C digit. The delete one mark causes the sender to delete the digit stored in the A digit register while the delete three mark causes the sender to delete the A, B, and C register digits. The arbitrary digit can be used in conjunction with the delete marks with the arbitrary digit preceeding the deletion.

2.10 The sender is capable of outpulsing the digit information either by dial pulsing or by multifrequency pulsing. With no pulsing indications from the marker the sender will prepare to dial outpulse on a bylink basis as to a step-by-step office. The marker can set the sender to dial pulse to a register or to multifrequency outpulse either on local routes or on an ANI basis. The sender changes the length of some of the timing intervals on the basis of the outpulsing to be used and also according to the trunk type (one-way or 2-way) used.

2.11 Upon receipt of the advance signal from the marker, the sender closes the outgoing tip and ring to the supervisory relays and makes a polarity test of the loop. On calls over 2-way trunks, the loop is closed before the advance signal is received. The sender expects different start dialing signals according to the class-of-call information registered in it and also whether the outpulsing is to be DP or MF.

A. Dial Pulse Signaling and Outpulsing

2.12 The dial pulse signaling and outpulsing:

(a) On a step-by-step class, on-hook polarity is translated as a start dialing signal. An initial off-hook polarity is construed as a reversed trunk. On this class an interval is timed before the loop is closed to insure that the trunk is fully released from a previous connection.

(b) On a sender class call the sender requires a change of supervision from off-hook to on-hook as a start dialing signal. This class is used with trunks which terminate in sender type offices and which require time for sender selection. The reversal from off-hook to on-hook is transmitted by the receiving circuit as an indication that it is ready to receive pulses. The initial supervision may be either on-hook or off-hook. On this class also, an interval is timed before the loop is closed to insure complete release from a previous connection.

(c) On a 2-way trunk class, the sender starts dialing on receipt of an on-hook supervisory signal. This may be preceded by an off-hook signal but it is not a requirement. For this class the loop is closed immediately upon seizure but an interval is timed before the polarity is determined in order to prevent an initial on-hook, which is immediately followed by an off-hook, from being translated as a start dialing signal.

(d) On a 2-way trunk class to senderized offices, a change in polarity from off-hook to on-hook is required for the sender to start dialing. On this class the loop is closed and polarity is checked immediately upon sender seizure.

(e) When the start dialing signal is received, the sender pulses out the registered number. This pulsing may be loop or battery ground as directed by the marker, and is at the rate of ten pulses per second.

(f) During each interdigital interval except the one preceding the units digit, a polarity test is made of the loop and receipt of an off-hook signal on the step-by-step or 2-way class is translated as a stop dial signal. A return to on-hook supervision is translated as a go signal. A second stop signal is construed as an overflow signal. A continuous off-hook signal during the interdigital interval on a sender class call is construed as a reversed trunk. The polarity test is canceled after the tens digit to prevent a quick answer by an operator at a PBX reached by a level hunting connector from being construed as a stop dial signal.

(g) After the last digit is outdialed, the sender transfers the supervision back to the trunk and releases making itself available for another call.

B. Multifrequency Signaling and Outpulsing

2.13 The multifrequency signaling and outpulsing:

(a) On a non-2-way class call, a change in polarity from off-hook to on-hook is required for pulsing to start. The initial supervision may be either on-hook or off-hook. On this class an interval is timed before the loop is closed to insure that the trunk is fully released from a previous connection.

(b) On a 2-way class call, the loop is closed and the polarity determined immediately upon sender seizure. On this class of call, a change in polarity from off-hook to on-hook is required for the sender to start pulsing.

(c) After a start-pulsing signal has been recognized by the sender any change in supervision to off-hook is construed as a reversed trunk and the sender is trouble released.

(d) Provision is made for generating six multifrequency supply frequencies in the sender by means of two transistor oscillators.

(e) After all the digits are pulsed out, an end-of-pulsing or start signal is transmitted, supervision is returned to the trunk, and the sender is released.

C. Automatic Number Identification (ANI)

2.14 Provision is made for operation with automatic number identification, ANI. This feature is for traffic routed to a CAMA office for completion and billing. The sender must also outpulse the calling number so that the billing functions can be performed. Toward that end on ANI calls, the marker stores in the sender the 4-digit calling line directory number plus marks specifying that the call is an ANI call and which office code to send as part of the calling number. The marker also stores a mark in the sender which controls the ANI information digit to be sent.

2.15 After the sender completes outpulsing of the called number it resets its digit register and steering circuit and prepares to send the calling number to the CAMA sender. When the CAMA sender is ready to receive the calling number, it signals the No. 3 crossbar sender to begin outpulsing. The sender outpulses as follows:

(a) When the sender processes an automatically identified call, that is, the calling number has been successfully ascertained, it sends an information digit which, when translated by the CAMA sender, denotes that the call is automatically identified. This information digit is followed by the seven digits of the calling number plus a start signal. The CAMA sender transfers this calling number to the CAMA transverter for entry on the AMA tape.

(b) When the sender handles a call in which trouble has been encountered in ascertaining the calling number, it sends only a KP signal and an information digit. This information digit, when translated by the CAMA sender denotes that an "identification failure" has occurred. The CAMA sender then connects to an operator position and the call is handled as an operator identified CAMA call.

(c) When the sender handles a call made from a multiparty customer in which identification of the calling number is not possible, it sends only a KP signal and an information digit. This information digit, when translated by the CAMA sender, denotes that this is an "operator identified" call. The CAMA sender then seizes an operator position and the call is handled as an operator identified CAMA call.

Following the ANI transmission the sender releases.

D. Operation With Traffic Service Positions

2.16 The sender is arranged to transmit more than one nondigital combination of two frequencies as a special ST start signal. Variable start signals are used where call class marks are required to identify combined traffic over a common trunk group to a Traffic Service Position System No. 1 or to a crossbar tandem traffic service position. Two marks from the marker, either singly or simultaneously, prepare the sender to send out special ST pulses following the called number which indicate coin or noncoin, 0+ or 1+ traffic.

2.17 The sender under control of marks from the marker can delete the called number from outpulsing on ANI routes to service operators.

MAINTENANCE

A. Operation With Test Circuit

2.18 Sender tests are performed by originating a call requiring a sender. A call requiring an outgoing trunk is made and when the sender outpulses, the pulsing path is diverted from the trunk to a jack in the sender from where it is patched to the test circuit where the outpulsing is monitored.

B. Make Busy

2.19 A key per sender is provided at the test circuit which is used for making the sender appear busy to service calls. Calls from the test circuit will override the made busy condition.

## SECTION II - DETAILED DESCRIPTION

### 1. SENDER SEIZURE

SENDER CONNECTOR - FS13 AND FS14

1.01 The sender connector circuits provide the paths over which markers seize senders, control the connection to them, and store information in them. The connector is composed of two parts. The control relays, SS(0-9) and CB(0-9) which appear on FS13, control the selection and operation of the connector relays EA(0-4), EB(0-4), EC(0-4), ED(0-4), and OA(0-4), OB(0-4), OC(0-4), OD(0-4) which appear on FS14. There is one CB- connector busy relay and one SS- seize sender relay per sender per marker. The even numbered relays are associated with the even numbered marker (0). The odd numbered CB- and SS- relays are associated with the odd numbered marker (1). An even numbered CB- and SS- relay and an odd numbered CB- and SS- relay are associated with each sender.

1.02 The even connector relays EA(0-4), EB(0-4), EC(0-4), and ED(0-4) are used to connect the even numbered marker (0) to the senders. The odd connector relays OA(0-4), OB(0-4), OC(0-4), and OD(0-4) connect the odd marker to the senders. That is, connector relays EA0, EB0, EC0, and ED0 connect marker (0) to sender (0) and relays OA0, OB0, OC0, and OD0 connect marker (1) to sender (0) and so on.

1.03 Cross Connections - There are two sets of cross connections which are applied to the sender connector control circuitry which arrange the connector for operation with positions which are either equipped or not equipped with senders. The cross connections per part 4 of the Cross Connecting Table shown on sheet D2 of the SD provides a ground for the SS- relays serving each equipped sender. The ground will allow the SS- relays to operate when connection to their sender is desired, and conversely, absence of the ground at the unequipped sender positions insures that those SS- relays will not operate under any circumstances. The cross connections per part 5 of the table provide for operating the CB- relays at unequipped sender positions. The CB- relays, when operated at the unequipped sender positions from a ground applied to the LCB- leads by the markers when attempting to seize an idle sender, will make that (unequipped) sender position appear busy. The No. 5 transfer contact of the operated CB- relays will pass the resistance battery, appearing on them from the marker, to the next equipped idle position.

SEIZURE

1.04 The calling customer, in the case of an outgoing call, dials the area code if needed, the called office code and directory line number into an originating register to which the calling line has been connected. When all of the digits have been received, the originating register transfers them to the marker which translates them and determines from the area code or the called office code that a sender and an outgoing trunk are needed to establish the call. The marker then seizes an idle sender by means of the connector circuit. The marker also selects an idle trunk and attaches the sender to the trunk through the outgoing sender link.

1.05 Each marker has two start leads over which it can seize an idle sender. The marker uses each lead on alternate calls. In this way the markers prefer different senders on alternate calls which helps towards uniform sender usage. Leads STA0 and STB0 serve marker (0). When the marker connects resistance battery to lead STA0, it will prefer sender (0) and lead STB0 will prefer sender (2). Leads STA1 and STB1 serve marker (1) and prefer sender (1) and sender (3), respectively. The marker connects resistance battery on one of the ST-- leads and that potential appears at 5 fixed or 8 fixed contact of the CB- relay serving the preferred sender. If the sender is busy, the CB- relay will be operated and the potential will pass through 5 make or 8 make CB- and 6-break of the associated SS- relay to the 5 or 8 fixed of the CB- relay serving the succeeding sender. When the potential arrives at an unoperated CB- relay, it operates the associated SS- relay. An SS- operated:

(a) Opens the start lead with its 6 break contact. This prevents the starting potential from operating a succeeding SS- relay or appearing on the all senders busy lead to the marker.

(b) Operates the associated connector relay through the 1 and 11 make-contacts.

(c) Locks to the start lead through an 01 contact on an associated connector relay.

(d) Operates the ON1 relay.

The operation of the connector relays and the ON1 relay prepare the sender to receive information from the marker. The connector relays cut through information leads from the marker to the sender. Over these leads the marker will store in the sender the dialed number, the type of pulsing required, trunk type information, class of call information, the calling line directory number and an office mark on ANI calls, the arbitrary digit if required and delete digit marks if applicable. The ON1 relay operated provides locking grounds for the relays operated by the marker when storing this information in the sender. The ON1 relay also operates the SB sender busy relay. The SB operated:

(e) Partially closes, through 9 make, a path from ground to the SB lead to the alarm circuit.

(f) Grounds the SB and, on multifrequency calls, the MF lead to the traffic usage recorder.

(g) Operates the two CB- relays of the connector control circuit associated with the sender.

1.06 The operated CB- relays transfers the start lead toward the connector control circuit of the succeeding sender. The CB- relays remain operated for the same length of time as the sender. Three make or 10 make of the CB- relays provide a lock path for these relays which prevents the CB- relays from releasing at the same time as the sender when a marker is connected to another sender. This prevents a change in state of the start lead over which the marker is controlling the connection to another sender.

1.07 The SS- relay remains operated under control of the marker and release at the same as the marker. Six break of a released SS- closes the start lead from a make-contact of the associated CB- relay to the succeeding control relays.

SIMULTANEOUS SEIZURE

1.08 If both markers simultaneously attempt to seize the same sender, one of two possibilities will occur. One possibility is that the SS1, SS2, SS5, SS6, or SS9 relay will operate alone. In this case, these relays will have operated before their associated SS- relay could operate and lock to ground on its 9 make-contact. The 10 break-contact of the operated SS- relay removes the ground from the associated SS- relay preventing its operation. The marker which the operated SS- relay serves gains preference to the sender and the other marker will gain preference to a succeeding sender once the CB- relays operates. The other possibility arising from a simultaneous seizure is that both SS- relays associated with the sender operate. In this case, the SS0, SS3, SS4, SS7, or SS8 will also operate and lock to ground on its 9 make-contact. The 2 and 12 break-contacts of these relays remove ground from the 1 and 11 make-contacts of their associated SS- relay preventing the operation of the connector relays which they control. The marker served by the SS1, SS2, SS5, SS6, and SS9 now waits for the CB- relays to operate and when the SS- relay serving it releases, the marker gains preference to a succeeding sender.

ALL SENDERS BUSY

1.09 When all senders are busy all CB- relays are operated. Under this circumstance, the potential marker (0) applies to leads STA0 or STB0 when attempting to seize a sender appears at 12 break of the SS2 relay. The potential from marker (1) appears at 12 break SS5 relay. In both instances because all CB- relay are operated and no SS- relay can operate, the resistive battery will appear on the ASB- lead to the marker attempting to seize a sender. The all senders busy relay in the marker operates causing it to route advance.

DIGIT REGISTRATION - FS2

1.10 The called number digits are registered on a 2-out-of-5 basis on dry reed relays. The unit for each digit consists of a can which encloses five independent coils with each coil associated with two make contacts. One side of each of the coils is wired internally to one of its associated contacts for locking purposes and a single lead wired to a terminal. The other contact of the locking contact pair, the other side of the coil, and both contacts of the load contact pair are wired to individual terminals. These terminals extend to both front and rear of the relay. For ease of wiring three sets of terminals are strapped internally. These are the battery side of the coils, the locking contact of the relay, and one side of the load contact.

1.11 The marker operates these relays on a 2-out-of-5 basis using the "additive" code and checks that the sender returns a ground for each relay operated. In this manner the marker checks that the desired sender relays operate and lock for each digit and that no undesired registration exists. Since the number of digits a sender receives on calls varies, a further indication is used to mark the end of the last digit. This is the start or end-seven registration and consists of operating the seven relay in the position one beyond the last registered digit. This mark permits the sender to detect missing digits since the registration must consist of 2-out-of-5 for each of a variable number of digits followed by an end-seven which is followed by none-out-of-5.

1.12 The sender is arranged to register up to ten digits, A through K, as recorded in the originating register. An ST7 start-seven relay is provided to record the start-seven signal whenever ten digits are registered in the sender; that is, when there is a digit stored in the K digit register.

CLASS INFORMATION - FS5

A. DP Class

1.13 This sender is capable of either dial pulse (DP) or multifrequency (MF) outpulsing as determined by the marker from the routing of the call. In general DP outpulsing will be used on calls to step-by-step (SXS) offices; MF pulsing will be used on routes to all other types of offices. The sender is arranged as a DP bylink sender. That is if on a call the class relays which control the types of outpulsing are not operated namely the ANI, DPR, MF, and MF1, the sender will outpulse dial pulses on a bylink basis.

B. DPR Class

1.14 The marker operates the DPR dial pulse to a register relay on DP routes to other than SXS offices. The DPR relay contacts set the supervisory control circuit (FS6) to require a change of supervision from off-hook to on-hook as a start dial signal from the distant office.

C. MF Class

1.15 On local MF, non-ANI routes the marker operates the MF class relay. The operated MF relay operates the MF1 relay and they both lock operated to ground on 4 make ON1. The MF and MF1 relays condition the sender to perform as a multifrequency sender as follows:

(a) Relay MF contact No. 1 transfers pulsing control of the steering circuit from 7 break Z relay to 5 break PG relay.

(b) Their contacts in FS6 change the timing intervals of both the TM and ATM timers.

(c) They set the supervisory control circuit of FS7 to require an off-hook to on-hook start dial signal from the distant office.

(d) Partially close a path to ground from the MF lead to the traffic usage recorder.

(e) The MF1 contact No. 7 transfers control of the LD last digit relay lock path to a PG relay break-contact.

(f) Disable the pulse counting relays of FS8 which are used on dial pulse calls.

(g) They configure the outgoing tip and ring circuit of FS10 into the MF pulsing mode.

(h) In the pulse generator, FS11, transfer contacts of MF1 change the speed and percent break from the dial pulse 10 pulses per second, 63 percent break to the MF 7.2 pulses per second, 50 percent break.

(i) Complete a path to ground to turn on the MF tone generator, FS12.

D. ANI Class

1.16 On calls routed through CAMA offices for completion and billing, the marker operates the ANI relay. The ANI relay operated operates the MF and MF1 relays through its 2 make-contact. The 2 break-contact prevents the operating ground to the MF and MF1 relays from appearing on the MF lead to the marker, causing a test failure. The MF relays set the sender for MF outpulsing. The ANI relay causes the sender to recycle after outpulsing the called number and to outpulse an ANI transmission which consists of a KP pulse, an information digit, and the calling number if available. If the calling number is not available, the sender releases after the information digit. For ANI calls the marker must supply the sender

with additional information which it requires to complete the call. The marker stores the calling line directory number in the ANI register in FS9. The sender also receives calling office, special start pulse, and information digit information from the marker.

Calling Office

1.17 The sender has cross connected within it the office A and office B three digit, ABX office codes. The marker on ANI calls operates the OA office A relay or the OB office B relay so that the sender prefixes the calling office code to the directory number of the calling line during the transmission of the calling number as a part of ANI calls.

Information Digits

1.18 During the transmission of the ANI information an information digit follows immediately after the KP pulse. The sender is arranged to send a zero information digit which informs the CAMA sender that the call is automatically identified and that the calling number will follow. However if the marker fails to obtain the calling number or a digit is mutilated, it will operate the IF identification failure relay in the sender. If the calling party is on a multiparty line and cannot be identified, the marker operates the OI operator identified relay in the sender. Break contacts on both relays open the lock path of the OA and OB relays causing them to release with the marker. The IF relay causes the sender to follow the KP pulse with a 2 and the OI follows with a 1. Both information digits tell the CAMA sender that a CAMA operator is required to complete the call. The sender releases after sending these information digits.

Special ST Pulses

1.19 Where ANI calls are over combined routes of coin, noncoin, 0+, 1+, or 0 traffic, special start pulses at the end of the called number transmission are required for identification at the Traffic Service Positions System No. 1 office. The marker operates the PO pull zero or NC noncoin relay or both to tell the sender which special start pulse to send.

Delete Called Number

1.20 On ANI routes to service operators (ACD), the called number is omitted. To accomplish this the marker operates the DLN delete called number relay in the sender. The DLN operated causes the sender to recycle before sending the called number and to proceed with the ANI outpulsing.

E. CL1, CL2, and CL3 Classes

1.21 The CL1, 2, and 3 class relays are the relays which set up the conditions in the sender which allow it to work with certain trunks. With those relays normal the sender is set up to work with one-way trunks and will perform loop pulsing on dial pulse routes. The CL1 relay operated on a DP call changes the loop configuration of the tip and ring circuit, FS10, to a battery-ground configuration. That is, the sender when outpulsing does not break the loop to generate the dial pulses but applies and removes 210-ohm ground (RG resistor) on the ring and 210-ohm battery (TB resistor) on the tip.

TWO-WAY CLASS

1.22 The CL2 class relay prepares the sender to complete calls through a 2-way trunk. Contacts on the CL2 relay:

(a) Set the supervisory control circuit, FS6, to respond correctly to supervisory signals received from the 2-way trunk.

(b) Change the timing interval timed by the ATM timer.

(c) Lengthens the DP interdigital interval.

(d) Configure the tip and ring circuit to apply early loop closure toward the distant office.

The CL3 relay when operated by the marker operates the CL1 and CL2 relays. In this state the sender is prepared to provide battery-ground pulsing over 2-way trunks on DP routes.

ARBITRARY DIGITS

1.23 The sender is capable of outpulsing one arbitrary digit. Four different digits are cross-connectable in the sender. The cross connect terminals serve the same function as the dry reed register relays and connect directly to the steering contacts of the ADS arbitrary digit steering relay for connection to the recapture relays. The marker selects which arbitrary digit is to be sent by operating the AD1, 2, 3, or 4 relay when an arbitrary digit is

required. Later when the sender is preparing to outpulse, the ADS steering relay is operated by a ground which is cut through 10 make AD1 or AD3 or 3 make AD2 or AD4. The ground appears on MF calls when the KP signal is being sent and on DP calls before outpulsing starts. Contacts 1, 2, 3, 4, and 7 of the ADS cuts through the cross connections on which grounds are connected from contacts 8 and 9 make of AD1 and AD3 or contacts 2 and 4 make of AD2 and AD4.

1.24 If an arbitrary digit is used on an ANI call, the AD1, 2, 3, or 4 relay operated is released when the sender recycles at the end of the called number outpulsing. Nine break of R relay, which operates at that time, opens the lock path of the AD- relays and releases the operated AD- relay. In this manner the ADS steering relay can be used to send the ANI information digit. Grounds through 2 and 5 make CSR are cut onto the same ADS steering contacts, as are the arbitrary digit cross connections had been, for control of the RR- recapture relays.

AUTOMATIC INTERCEPT SERVICE

1.25 When automatic intercept service is available to the No. 3 crossbar office, three of the arbitrary digits cross connections must be dedicated to providing the class of intercept digit. For blank number intercept the marker operates the AD1 relay. The digit 0 must be cross connected for the AD1. Trouble intercept will cause the marker to operate the AD2 relay which must be cross connected to send a digit 1. Changed number which is regular intercept will result in AD3 being operated and it must be cross connected to send a digit 3.

DELETION OF DIGITS

1.26 In many cases, particularly when direct trunks are available to the called office, the sender will be required to omit or delete some or all of the digits of the called office code. The sender is arranged to delete 1, 2, or 3 digits; the A digit or the A and B digits or the A, B, and C digits. A delete signal from the marker causes the sender to preoperate a steering relay which will cause the digit steering circuit, FS4, to step past the digits to be deleted during outpulsing. The BS steering relay preoperated will delete one digit namely the A digit. To delete the A and B digits the CS is preoperated and the DS preoperated deletes the A, B, and C digits.

OPERATION OF SENDER LINK

1.27 The marker, as it is registering information in the sender, selects an idle trunk to the desired destination, connects to the trunk through the trunk switch and connector circuit and operates the trunk F relay. The operated F relay in the trunk operates the select magnet of the level to which the trunk is connected on the OSL switch on which the trunk appears. The select magnet off-normal contact closes the path to a VG- vertical group relay in the OSL. Contacts of the VG- relay enable hold magnets on the OSL switch which close crosspoints to which the trunk is connected. Earlier, ground connected by the sender connector relays to lead OS- registered in the marker the identity of the sender which it had seized. Ground on a sender lead from the marker to the OSL is steered by the VG- relay to the hold magnet which upon operating closes the set of crosspoints which attach the sender to the trunk. Five leads T, R, AB, D, and SL are cut through between the sender and trunk. The sixth lead HM connects the hold magnet through crosspoints to the sender and to the ON off-normal relay. When the crosspoints close, ON operates. The ON connects ground to the D lead operating the D relay in the trunk. The same ground operates the CT cut-through relay in the sender. The trunk D relay transfers the outgoing tip and ring leads to the sender. It also transfers the trunk sleeve ground into the sender over the AB lead operating the sender LR line release relay. The AB lead ground is brought through 10 break RO and SL diode to the SL lead to the trunk. While the sender is attached to the trunk, its RO relay has control of the channel to the calling line. The LR relay closes a holding ground through its 6 make contact to ON relay and to the sender link hold magnet. This ground causes release of the polarized SHM relay in the marker as an indication that the link crosspoints are closed and locked.

SENDER ADVANCE

1.28 The marker sets up the connection between the calling line and the outgoing trunk, and when it is satisfied that all information has been properly recorded, it operates the (AV) sender advance relay. Relay AV locks to an ON contact which also provides a holding circuit for ON1. The locking ground operates the (AVK) check relay in the marker. The operation of the

AV relay is a signal to the sender that it should proceed with the call.

## 2. TRUNK TEST AND SUPERVISORY CONTROL

### TRUNK TEST TIMING

2.01 The sender provides a timed cover up interval, for those outgoing trunks which are subject to immediate reseizure in a No. 3 office, before closing the loop to make trunk test. This interval insures that the far end has time to release fully from a prior call. On DP 2-way trunks which provide their own cover up, the sender closes the loop immediately but times an interval before determining the polarity of the trunk tip and ring conductors. This interval is sufficient to allow a seizure signal to travel to the far end and an on-hook supervisory signal to return. On MF 2-way trunks the loop is closed and the polarity determined immediately upon sender seizure.

2.02 After the timed interval, the sender determines the polarity, if it has not already done so, of the tip and ring conductors and when it recognizes the proper polarity or the proper change in polarity according to the class of call, it starts outpulsing.

### A. ATM Timer - FS7

2.03 The trunk cover up interval is timed by the ATM auxiliary timer. The ATM timer consists of the ATM (three transistor) time delay control circuit, component assembly, the ATM relay and the networks of resistors, capacitors, and relay contacts connected to the B3, C3, CP3, and I3 leads of the time delay control circuit. The 300-ohm ATM resistor provides a low-resistance path over which the ATM capacitor is charged when the timer is recycled. The 40-microfarad B3A capacitor, as with the ATM resistor, does not affect the timing, but is provided to prevent any high-frequency surges on the 48-volt supply from affecting the timer. The ATM capacitor in series with the ATM2, 3, or 4 resistors form the RC networks whose time constants determine the length of the time intervals which are timed. Selection of the intervals is provided by the transfer contacts on the CL2 and MF relays associated with the ATM- resistors and capacitors. Control of the timer resides on the I3 lead to the time delay control circuit. Ground on that lead maintains the ATM capacitor in a charged state and holds the control circuit in the state in which it grounds its L3 output lead. Ground on the L3 lead holds the TTK relay nonoperated. Timing begins when ground is removed from the I3 lead. The RC network discharges into the control circuit via the I3 lead and initially maintains the control circuit in its previous state. The discharge current diminishes in the manner typical of an RC circuit and at the end of the desired time interval has been reduced to a quantity which is no longer sufficient to maintain the time delay control circuit in its present state. The control circuit changes state, battery is applied to its L3 lead and the TTK relay operates as a signal that the desired interval has elapsed.

2.04 When the ATM time delay circuit times out, it operates the TTK trunk test relay. The TTK operated:

(a) Remains operated under control of 4 break of the ON relay. Its 4 break opens the path from 5 make TMC. The path from ground through 5 make TMC and 4 break TTK to the I3 lead of the timer is used as a check that TMC is released and not stuck operated. This insures that the TMC can perform its recycle functions on the TM timer and not hold it inoperative.

(b) The 10 make-contact closes ground to the pulse counting relays.

(c) Closes ground from 1 make ON, 11 make AV, 8 break SD, 11 make TTK to operate the KP relay on MF calls or the first steering relay through 1 break MF1 on DP calls.

(d) The 9 make closes the tip and ring loop on FS10 as a seizure signal to the distant end on one-way trunks.

(e) Operates the TMC relay.

2.05 The first indication received by the sender that the trunk is attached is the operation of relay ON. The ON operating breaks the timer I3 lead through its 4 break-contact. This is the signal which starts the trunk cover up timing interval, which at its end, results in the TTK relay operated and locked. The operation of the sender (other than the lengths of the timing intervals) is much the same for MF or DP calls up to the operation of the TTK relay. However, because the tip and ring circuit configurations for DP and MF calls are completely different and because the distant offices and the signals exchanged with them are very different, the operation of the sender from trunk test through outpulsing is also different and therefore will be described separately.

### DIAL PULSE TRUNK TEST

### A. Initial Trunk Test

2.06 When the AV relay operates, indicating that an advance signal has been received from the marker and when TTK has operated indicating that the trunk cover up interval has been timed the TMC relay operates operating BD relay. The BD disconnects a short around the TG and OF relays enabling

them. If the CL2 and DPR relays are both operated (2-way class, wink start), the short around TG and OF is removed by them.

B. Step-By-Step Class

2.07 The sender is normally set for the step-by-step class with both CL2 and DPR class relays normal. This class, as its name implies, is used mainly for nonintertoll and one-way trunks which terminate in a local or tandem office step-by-step selector. These trunks are on-hook when normal and are ready to receive pulses as soon as the distant line relay and its auxiliary relay operate.

2.08 When BD operates to disconnect the short from the windings of the TG and OF relays, TG operates to the battery and ground at the terminating office but OF does not operate. The TG operating closes a path through the SD diode, 4 break OF1, 4 break MF1, 10 break DPR, 2 break MF1, 2 make BD, and 1 make TMC to operate the SD start dialing relay.

C. Sender Class

2.09 With class relay DPR operated, the sender requires a change of supervision from off-hook to on-hook as a start dialing signal. This class is used for trunks which terminate in offices requiring time for the selection of a sender or register. These trunks, in general, are on-hook when normal, change to off-hook when the line connects to a sender or register and then revert to on-hook when the sender or register is ready to accept pulses. Since some trunks may be off-hook when normal and since the initial on-hook interval is variable and may not be of sufficient duration for recognition, it is not required by the sender. If it is recognized, however, it is recorded and the trunk guard TG1 relay is operated and locked.

2.10 The BD operates to remove the short from the windings of the TG and OF relays and to enable the contacts of these relays. If the supervision is on-hook, OF remains normal and TG operates operating TG1 through 10 make DPR. When the trunk becomes off-hook, OF operates to cause operation of OF1 through 11 make DPR. When the distant sender or register is ready to receive pulses, it reverses the tip and ring leads to on-hook supervision. The OF and TG release but TG reoperates to cause operation of the SD start dial relay over a path which includes 4 make of the OF1 relay.

D. Two-Way Class

2.11 The 2-way class with class relay CL2 operated is used for trunks which provide their own cover up interval for insuring complete release, such as any 2-way trunks or trunks to link type community dial offices. For the 2-way trunks an immediate seizure signal must be sent to the distant end, in order to minimize the possibility of simultaneous seizure, and this is started by the operation of the F relay of the trunk. The loop closure is paralleled in the sender upon seizure by the operation of relay CL2. For trunks to link type community dial offices, the trunks appear on-hook initially, change to off-hook immediately on seizure and revert to on-hook when ready to receive pulses. Neither of the initial on-hook or off-hook intervals is of sufficient duration under some conditions to be detected.

2.12 For these trunks the sender closes the loop immediately upon seizure and then times an interval of 430 milliseconds, nominal, which is sufficient to cover the initial on-hook interval and then cuts in the OF and TG relays and enables their contacts. If the supervision is off-hook, dialing is delayed. If the supervision is on-hook or when it becomes on-hook, dialing starts.

2.13 The BD operates to remove the short from the windings of the TG and OF relays and to enable the contacts of these relays. If the supervision is off-hook, OF operates to operate TG1 through 8 make CL2. If the supervision is on-hook or when it becomes on-hook, TG will operate with OF normal to operate the SD start dial relay over a path through number 4 transfer contacts of the OF1 relay. The make- or break-contact is in the path according to whether an off-hook was received or not.

2.14 In cases where the signaling between offices is on an E and E lead basis, the sender provides loop pulsing to the trunk which converts it to pulses on the M lead.

E. Two-Way Class - Wink Start

2.15 On calls to 2-way trunks which require time for register and/or sender selection, the DPR relay is operated in addition to the CL2 relay. On this class the loop is closed early and the sender requires a change of supervision from off-hook to on-hook (wink start) as a start pulsing signal. These trunks, in general are on-hook when normal, change to off-hook when the line connects to a register or sender and then revert to on-hook when the register or sender is ready to accept pulses.

2.16 For these trunks the sender closes the loop and cuts in the OF and TG relays immediately upon seizure. If the supervision is off-hook, OF operates to operate OF1 through 11 make DPR. When supervision becomes on-hook, OF releases and TG operates to operate the SD start dial relay through 4 make OF1 operated. An initial on-hook would have caused the TG1 to operate.

2.17 The following Table 1 summarizes the various classes and the timing and signaling required to complete trunk test and receive the start-dial signal.

TABLE 1

Initial Trunk Closure - Supervision

| Class | Loop Closure | Trunk Coverup Millisec (Nominal) | Trunk Type | Type Office In Which Trunk Terminates | Normal Initial Supervision | Trunk Trouble Conditions |
|---|---|---|---|---|---|---|
| Step-by-Step (Neither CL2 nor DPR) | Delayed | 800 | Any 1-Way | Nonlink Type SXS Local or Tandem | On-Hook | Off-Hook During Initial Interval Operates TRL Directly |
| 2-Way (CL2) | Early | 430 | Any 2-Way | Nonlink Type SXS Local or Tandem | On-Hook | Continuous Off-Hook During Initial Interval Causes Sender to Time Out |
| | | | Any 2-Way | Sender (Register) Type No. 5 Crossbar) (Tandem) (Etc) | Off-Hook then On-Hook Note 1 | (If Sender Recognizes Continuous Off-Hook During Initial Interval, it Times Out. If Not, it will Recognize a Continuous Off-Hook During an Interdigital Interval and Time Out. |
| | | | Any | Link Type CDO | Off-Hook then On-Hook Note 1 | |
| Sender (DPR) | Delayed | 800 | Any 1-Way | Sender (Register) Type Local or Tandem | Off-Hook then On-Hook Note 2 | (If Sender Recognizes Continuous Off-Hook During Initial Interval, it Times Out. If Not, it will Recognize a Continuous Off-Hook During an Interdigital Interval and Time Out. |

Note 1 - A short On-Hook may precede the initial Off-Hook but this is covered by the trunk timing period. Only an On-Hook is required to start outpulsing.

Note 2 - An initial On-Hook may precede the Off-Hook. An Off-Hook followed by an On-Hook is required to start outpulsing.

F. The DP Start Dialing Signal

2.18 For all the classes of calls described above the successful completion of trunk test results in the operation of the SD start dialing relay. The SD operated:

(a) Locks through its 12 make-contact.

(b) Opens the operate path of the first digit steering relay.

(c) Operates the second digit steering relay.

(d) Provides ground to the operate path of the EP relay.

(e) Makes a closure in the SG relay path.

(f) Releases a slow-release TMC relay.

(g) Through 9 make recycles TM timer.

The TMC released restarts the TM timer and releases BD relay. The BD released releases the CPG control pulse generator relay which allows the pulse generator to begin outpulsing the first digit. The BD also recloses the loop around the OF and TG relay disabling them while simultaneously placing the loop under control of contacts on the PG, SP, and W relays. The TMC relay is slow to release to delay the first open of the first digit for a time sufficient to allow the line relay in the distant office to become soaked.

G. Reversed Trunks

2.19 The sender is arranged to detect trunks on which the tip and ring conductors have been inadvertently reversed. Such reversals will cause the off-hook and on-hook signals to be reversed. The method of detection varied with the class as follows:

Step-by-Step Class

2.20 For this class with neither the CL2 nor the DPR class relay operated, the sender does not expect an off-hook supervisory signal during the initial trunk test interval and any off-hook will be construed as a reversed trunk. During the initial trunk testing interval, any operation of OF will cause operation of TRL through break contacts of CL2 and DPR. The TRL causes operation of RO to set the calling customer to line lockout and reorder tone. If the SCTR key is normal, or the SSR relay operated the sender will release but if the SCTR key is operated and the SSR released the sender will be held until manually released.

Sender Class

2.21 On a sender class call with class relay DPR operated, the sender may receive either on-hook or off-hook supervision initially so that the initial supervision cannot be used for detection of reversed trunks. The sender does require a change from off-hook to on-hook as a start pulsing signal. If the trunk were connected for on-hook supervision while normal and were reversed to give off-hook and the sender detected this off-hook, the change in supervision of the trunk due to the distant sender or register being attached would be detected as a change to on-hook on the reversed trunk and would be translated as a start dial signal. The change in supervision due to the reversal after a timed interval by the distant sender or register when it was ready to receive pulses would not be detected until the interdigital interval after the first digit when it would result in the operation of OF and SG. The SG would cause dialing to stop and, since there would be no further on-hook, the sender would outpulse no further digits but would time out.

2.22 If the initial supervision normally on-hook but reversed to off-hook were not detected, the sender would receive only on-hook followed by off-hook and would not start dialing the first digit but would time out. The operation of the sender on a time-out is described in the part on Timing.

2.23 On this class, if the call is abandoned during the sender timing interval, the sender releases, releasing the trunk. On the sender class, the call may be terminated prematurely by an overflow condition resulting in periodic line reversals. In this case the first reversal of the trunk detected in an interdigital interval will operate OF and SG. A return to on-hook will cause operation of SG1 allowing another digit to be outpulsed and any additional off-hook signal during an interdigital interval will cause operation of the sender RO relay to effect release of the sender.

Two-Way Class

2.24 On a 2-way class with class relay CL2 operated, the initial supervision detected by the sender may be either a steady on-hook or it may be an off-hook followed by an on-hook as a start dialing signal. Trunks with the tip and ring conductors inadvertently reversed would reverse these signals, and if a steady off-hook were received, the sender would not start dialing but would time out. If on the other hand an on-hook were received which later changed to off-hook, dialing would start; the off-hook would be detected during the interdigital interval following the first digit when OF would operate and operate SG. The SG would stop the dialing and cause a sender time out. The operation of the sender on a time out is described in the part on Timing. On this class if the call is abandoned during the sender timing interval, the sender releases releasing the trunk.

MF PULSING TRUNK TEST

A. Regular Class

2.25 This class includes all one-way trunks when class CL2 relay remains normal. The sender requires a change of supervision from off-hook to on-hook as a start-pulsing signal. These trunks, in general, are on-hook when normal, change to off-hook when the line connects to a sender or register and then revert to on-hook when the sender or register is ready to accept pulses. Since some trunks may be off-hook when normal and, since the initial on-hook interval is variable and may not be of sufficient duration for recognition, it is not required by the sender. If it is recognized, however, it is recorded. When AV has operated, indicating that the marker has completed its job of establishing the connection, and when KP has operated after operation of TTK, indicating that the trunk cover-up interval has been timed, the tip and ring leads are closed to the windings of the OF and TG relays.

2.26 If the supervision is on-hook, OF remains normal, but TG operates to operate TG1 through 4 make MF1. The TG1 locks operated as a record of the initial on-hook and opens a lock path of LR in FS1. When the trunk becomes off-hook, OF operates to cause operation of OF1. When the distant sender or register is ready to receive pulses, it reverses the tip and ring leads to on-hook supervision and OF and TG release but TG reoperates to cause operation of the start pulsing SD relay through 4 make OF1.

B. Two-Way Class

2.27 The 2-way class with class relay CL2 operated is used for 2-way local trunks and for one-way and 2-way intertoll trunks. The sender always receives its supervision on a loop basis and any trunks which have supervision over leads other than the talking path have provision for converting the supervisory signals to a loop basis for use by the sender. In the case of 2-way trunks an immediate seizure signal must be sent to the far end, in order to minimize the possibility of simultaneous seizure, and this is started by the operation of the F relay of the trunk. The loop is closed early in the sender by the operation of CL2 in order to maintain the seizure signal after release of the trunk F relay. This early loop closure serves no purpose on calls over trunks which have supervision over leads other than the talking path.

2.28 These trunks may have on-hook supervision initially but this changes to off-hook as soon as the seizure signal is sent to the far end and an acknowledgment is returned. It reverts to on-hook when the distant sender or register is ready to receive pulses. The CL2 relay operating early closes the tip and ring loop and the polarity is determined immediately upon sender seizure. On this type of call, a change from off-hook to on-hook is required for the sender to start pulsing. Since these trunks provide their own cover up interval the ATM timer is not used for a trunk cover interval but still times before operating the TTK relay.

2.29 If the initial supervision is off-hook, OF operates to operate OF1 but pulsing is delayed. If the initial supervision is on-hook, TG operates alone to operate TG1. When the supervision does change from off-hook to on-hook, OF and TG release but TG reoperates to operate SD through 4 make of the OF1.

C. The MF Start-Dialing Signal

2.30 Successful completion of trunk test results in the operated SD start-dialing relay as signal to begin outpulsing. The SD operated:

(a) Locks operated through its 12 make-contact.

(b) Through its 12 make-contact closes ground to the operate paths of the EP, R, and STP relays.

(c) Opens the operate path of the operated and locked KP relay.

(d) Releases the slow-release TMC relay.

(e) Through 9 make recycles the TM timer.

(f) Releases the CPG relay.

The CPG released enables the transistorized pulse generator which begins pulsing the PG relay.

D. Reversed Trunks

2.31 The sender is arranged when outpulsing the called number to detect trunks on which the tip and ring conductors have been inadvertently reversed. Such reversals will cause the off-hook and on-hook signals to be reversed.

2.32 On the regular class with class relay CL2 normal, if the sender recognizes the initial on-hook supervision reversed to off-hook it will start pulsing on the off-hook supervision reversed to on-hook and the subsequent on-hook reversed to off-hook will cause the operation of OF followed by TRL. If the initial on-hook supervision were not detected, the sender would not receive a change from off-hook to on-hook and would time out.

2.33 If the sender recognizes the delay pulse off-hook signal reversed to on-hook, on a 2-way class call with class relay CL2 operated, it will start pulsing and the subsequent on-hook reversed to off-hook will cause operation of OF followed by TRL. If the initial off-hook supervision were not recognized, the sender would not receive a start-pulsing signal and would time out and operate TRL.

3. OUTPULSING

GENERAL

3.01 The operation of the SD relay is a start-dialing signal to the sender. The sender sends to the office at the far end, which is now prepared to receive them, the digits needed for the completion of the call. Therefore the SD relay starts the pulse generator. The pulse generator supplies pulses of the proper duration which are needed to transmit the digit information. Pulses are supplied to the steering circuit so that it can step through its chain connecting in order the registered digits to

the recapture relays so that they may be translated for outpulsing. The pulse generator also applies the MF tones to the tip and ring on that type call or the dial pulse make/breaks on those calls as well as pulses to the dial pulse counter.

3.02 The steering circuit successively connects the digit registers to the recapture relays in the order the digits are to be sent. It will also delete digits should the marker over the DL1, 2, or 3 leads have caused a steering relay to be preoperated.

RECPATURE PRINCIPLE - FS3

3.03 The use of the reed-type register relays with the limited number of contacts necessitates the use of a set of translating or recapture relays for obtaining additional contacts for use at the time the digit is being transmitted. The RR- recapture relays consist of five general purpose relays which are associated with the digit registers successively by the steering circuit. The RR- relays are used to change the 2-out-of-5 registration to a 1-out-of-10 translation for control of the dial pulse generator or to cause the oscillators (FS12) to generate the proper combination of two frequencies for MF outpulsing. Contacts of the recapture relays in FS11 form the 2-out-of-5 logic for control of the pulse generator or to cause a trouble release as a guard against mutilated digits. These relays generate the end-of-pulsing signal to the sender.

PULSE GENERATOR - FS11

3.04 The pulse generator is a transistorized, free-running multivibrator. Transistors Q1 and Q2 are the active elements whose durations being on or off are controlled by RC networks made up of the C1 and C2 capacitors and their associated resistors.

3.05 The length of the period of one cycle of the pulse generator is controlled by the MF1 relay transfer contacts 5 and 8. This relay changes the RC network time constants of the multivibrator by cutting different resistances into the RC network. The proper pulsing speed and percent break for dial pulse outpulsing or multifrequency outpulsing is achieved by the resistors affecting the periods of the multivibrators two states. Resistor PG3 is associated with capacitor C8 and resistor PG5 is associated with capacitor C9 during multifrequency pulsing; resistor PG6 goes with C8 and PG10 with C9 during dial pulsing. The pulsing speed and percent break of both the MF and DP pulsing is not adjustable in this pulse generator.

3.06 Pulsing control of the multivibrator resides with the CPG control pulse generator relay. When the sender is seized, ON operates and supplies ground to the transistor circuit and also closes a path to CPG operating it. The CPG operated prevents the multivibrator from pulsing by holding it in its zero state, Q1 conducting, Q2 off. The CPG through its 12 make-contact prevents Q2 from turning on by applying ground through PG11 to the base of Q2. With Q1 conducting C9 charges to 48-volt battery through PG7.

3.07 The start-dialing signal results in CPG releasing. When it releases it not only removes ground from the base of Q2 but through its 8 break-contact, a transfer 5 contact of MF1 and resistors PG3 or PG6 applies negative battery at the junction of C8 and the base of Q2. The Q2 transistor begins conducting. Then Q2 conducts in the saturated mode thereby causing ground potential to appear at its collector and on one side of C9. Because that capacitor is charged, its other side which is attached to the base of Q1 is forced to become positive with respect to ground. The Q1 is turned off. The multivibrator is in state one. That is, Q1 off, Q2 conducting. The C8 is charging rapidly through Q2 and PG1 resistor to battery. The C9 is discharging through PG5 or PG10 and a transfer 8 contact of MF1 to battery. The length of time that the pulse generator remains in state one is dependent on how long C9 takes to discharge and that is controlled by the size of the resistance in its discharge path.

3.08 The multivibrator remains in state one until C9 discharges. This occurs when the point in the circuit at the junction of C9 and the base of Q1 becomes slightly negative. Then Q1 turns on and saturates. Capacitor C8 shifts the base voltage of Q2 positively shutting it off. The pulse generator is back to state zero. Then C9 charges rapidly through Q1 conducting, and PG7 to battery. The C8 starts discharging through PG3 or PG6 resistance in series with it, a transfer five contact of MF1 to battery. The length of time the multivibrator remains

in state one now depends on the time constant C8 forms with the resistance it discharges through. However, when C8 discharges sufficiently to shift the base of Q2 to a slightly negative potential that transistor will turn on and the pulse generator will again change state.

3.09 The pulse generator continues pulsing until CPG is again operated. Then the multivibrator will be thrown into or held in state zero and remain there.

3.10 Transistor Q3 is the output transistor of the multivibrator. It is controlled directly by transistor Q2. When Q2 is turned on during state one of the multivibrator it electrically shorts the Q3 base and emitter. Therefore in state one Q3 is turned off. But during state zero Q2 is off and Q3 is on and saturated. With Q3 on, ground appears on its collector. This ground turns on and saturates Q4 transistor which operates the PG relay. Zener diode CR5 protects Q4 from transient voltage spikes generated when PG relay releases. The Q4 drives PG relay and when it is on, PG is operated. Therefore PG whose contacts perform the pulse generator work in the sender, follows the states of the multivibrator being operated when that circuit is in state zero and released when it is in state one.

A. KP Pulse

3.11 When the sender is in the MF pulsing mode, the first signal sent to the other end is the KP signal; sent under control of the KP relay. It is required that the KP signal be transmitted for a longer period than digits. Therefore, when that signal is being sent, KP relay is operated and its 6 break-contact removes a short around resistor PG5A. The PG5A increases the time in which C9 capacitor can discharge resulting in the KP signal being transmitted longer through the contacts of the released PG relay. The KP signal will have a duration of at least 87 milliseconds.

B. Battery and Ground Pulsing

3.12 The pulsing speed and percent break of the pulse generator are not shifted when the CL1 battery-ground pulsing class relay is operated on DP calls. The Circuit Requirements Table with the included diagram insure, in the worst case, that battery and ground will not be removed or applied to the tip and ring for too short a duration compared to that which has been traditionally allowed.

STEERING - FS4

3.13 The digit steering circuit consists of a keypulse steering relay, one steering relay per digit, and a start pulse steering relay. Each has five break-contacts one for each recapture relay so that the recapture relays are connected to the digit register of the digit being sent. The contacts are arranged so that the digit register of the operated steering relay nearest the KP relay controls the recapture relays.

3.14 On DP calls, the steering relay for the first digit to be outpulsed is operated when AV operates at marker advance. That will be the AS relay unless:

(a) An AD- relay is operated; then ADS will operate in preparation of outpulsing an arbitrary digit.

(b) The OA or OB is operated in which case AOS steering relay will operate.

(c) There are to be deleted digits in which case BS, CS, or DS will have been preoperated.

3.15 On MF calls the KP steering relay is operated after marker advance and the trunk cover interval has elapsed; AV and TTK having operated. The KP signal is always sent first on MF calls.

3.16 The SD relay operates as the start-dialing signal and in doing so provides a path through its 8 make-contact to operate the steering relay for the next digit to be outpulsed. On MF calls the path is through 11 make of the KP and on DP calls it is through the 11 break contact of KP. The SD operated also places the steering chain under control of one of a pair of pulsing contacts. On MF calls 5 break of the PG will provide the pulses to step the steering chain. On DP calls, control the circuit is through 7 break Z relay which operates and releases during the interdigital intervals. When the second steering relay operates, the lock path of the previous steering relay is placed under control of the pulsing contacts. When PG operates at the end of an MF digit or when Z operates in the interdigital interval, the steering relay of the transmitted digit releases. The releasing steering relay also releases its digit register relays. When the pulsing contacts 7 break Z or 5 break PG close at the start of another digit, they bring up the next steering relay. Thus, the steering chain steps through its relays

until the end-of-pulsing signal is generated. Steering relays are operated over a path which includes their own 8 break-contact. They lock through their own 8 make-contacts and 6 break of the remaining steering relays to off-normal ground. They are released when the PG or Z relays remove ground from the lock path which has been transfered to the pulsing contacts through 6 make of the next steering relay.

DIGIT DELETION

3.17 The KP and the ADS, AOS, BOS, and COS relays, when operated, lock through their 8 make-contacts and a chain of steering contacts reaching only as far through the steering circuit as the AS relay. With this arrangement the KP signal and/or arbitrary digits can be sent when digits are to be deleted, as the locking paths of these steering relays are not controlled by the BS, CS, or DS relays. The BS, CS, or DS are preoperated to delete 1, 2, or 3 digits, respectively. The AS relay operates during the transmission of the KP signal or an arbitrary digit. However, its lock path is immediately placed under control of the steering circuit pulsing contact through a 6 make-contact of the preoperated BS, CS, or DS. The AS releases at the end of the digit being sent. The preoperated steering relay now controls the next digit to be sent which in effect deletes the digits registered between it and the AS relay.

LAST DIGIT INDICATION

3.18 The last digit LD relay is used to cancel any off-hook indication received after the tens digit is transmitted. It also, upon releasing, partially closes a path to the EP, R, STP, and SSS relays which function at end of outpulsing of the called and calling numbers. The LD relay is attached to the output leads from the digit registers, FS3, on the side opposite of the steering relay break-contacts from the recapture relays. Therefore, when the sender is outpulsing the next-to-last digit and the last digit steering relay has operated, there are no longer any paths to ground through operated digit register relays. However, the LD remains operated being locked through its 2 make-contact and a contact on the PG or SP relay. But in the interdigital interval, the lock path opens (PG or SP operated) and LD releases.

DIAL PULSING

A. General

3.19 The outpulsing of each digit is under control of the pulse generator, the pulse counting relays, steering relays, and recapture relays. Outpulsing starts when BD releases at the end of trunk test releasing CPG and starting the pulse generator.

B. Pulse Counting Relays - FS8

3.20 The pulse counting relays P1 to P5 are used to count the number of dial pulses generated and are then recycled and used to time the interdigital interval. The P1 and P2 act as a pulse divider and P3, P4, and P5 are used to differentiate between the different pairs of pulses.

3.21 When the sender is seized, ON operates to operate PG and shortly thereafter LR operates. When PG releases at the start of pulsing, P1 operates and locks through a break-contact of P2. One-half cycle later PG reoperates and operates P2. The P2 locks to a P1 make-contact and transfers the P1 circuit to the PG make-contact. At the end of the pulse cycle PG releases, releasing P1 but P2 holds to the back contact of PG. On the next reoperation of PG, P2 releases. This cycle of P1 and P2 is then repeated for every two cycles of PG. When P1 releases at the end of the first cycle with P2 operated, P3 operates. With P1, P2, and P3 operated during the third pulse cycle, P4 operates and remains operated until the ninth pulse cycle. The P3 releases at the start of the fifth pulse cycle but reoperates again during the eighth pulse cycle. The P5 operates during the sixth pulse cycle. The following table gives the sequence of these operations.

| Pulse | PG | P1 | P2 | P3 | P4 | P5 | Counting Relays Remaining Operated |
|---|---|---|---|---|---|---|---|
| 1 | RLS | 0 | | | | | |
| | OPR | | 0 | | | | P1, P2 |
| 2 | RLS | R | | 0 | | | |
| | OPR | | R | | | | P3 |
| 3 | RLS | 0 | | | | | |
| | OPR | | 0 | | 0 | | P1, P2, P3, P4 |
| 4 | RLS | R | | | | | |
| | OPR | | R | | | | P3, P4 |
| 5 | RLS | 0 | | R | | | |
| | OPR | | 0 | | | | P1, P2, P4 |
| 6 | RLS | R | | | | | |
| | OPR | | R | | | 0 | P4, P5 |
| 7 | RLS | 0 | | | | | |
| | OPR | | 0 | | | | P1, P2, P4, P5 |
| 8 | RLS | R | | 0 | | | |
| | OPR | | R | | | | P3, P4, P5 |
| 9 | RLS | 0 | | | | | |
| | OPR | | 0 | | R | | P1, P2, P3, P5 |
| 10 | RLS | R | | | | | |
| | OPR | | R | | | | P3, P5 |
| 11 | RLS | 0 | | R | | | |
| | OPR | | 0 | | | | P1, P2, P5 |

3.22 A feature of the counting circuit is the signal when a count of more than 10 is reached, that is P5 operated and P3 and P4 normal. If this condition is reached it indicates a trouble condition; either, only one RR- relay operated or some trouble prevented the SP relay from operating at the proper time. The TRL relay is operated immediately through 1 make P5, 7 break P4 and 6 break P3.

C. Digit Control Relays

3.23 The digit control relays include the between digit relay BD, the stop pulsing relay SP, and the function dividing relays W and Z.

3.24 The BD relay, when normal, short circuits the windings of the TG and OF trunk testing relays through its 6 break. The BD operates for the initial trunk test and during each interdigital interval to enable these relays. The BD also exercises a certain amount of control on the dial pulse generator causing the generator to stop at the end of the interdigital interval if BD is held for some reason.

3.25 Initially, BD operates from TMC. It is controlled by the stop-go relays SG and SG1 and by the Z relay which causes its operation early in an interdigital interval.

3.26 On battery ground pulsing, BD changes the conditions on the tip and ring from loop to battery-ground for pulsing and from battery-ground to loop for supervision during the interdigital interval.

3.27 The stop pulse relay SP is used to terminate the dial pulses for each

digit and for each interdigital interval. As the dial pulse generator operates, the number of operations of the PG are counted on the P1 to P5 relays. The contacts of the P1 to P5 relays are wired so as to connect the SP winding to 10 paths, [1] to [10], through the appropriate combinations of the P1 to P5 relays. The 10 paths are connected to an ON ground through corresponding 2-out-of-5 combinations on the RR- relays or through contacts on Z. Thus, if six dial pulses are required, the RR2 and RR4 relays will be operated and, when the P- relays have counted up to 6; P1 and P3 normal, P4 operated, the ON ground is connected to SP to cause its operation during the operated half cycle of PG. The SP opens one path supplying ground to the operating and locking circuits for the counting relays. One-half cycle later, PG releases and transfers on a continuity basis the winding of SP to its own locking contact and opens the ground from the counting relays causing the release of any operated P- relays. When PG reoperates one-half cycle later, SP releases and the ground for operating the counting relays is restored.

3.28 After the completion of trunk test, BD releases to cause the first digit to be dialed and at this time Z is normal so that SP is under control of the RR- relays. When the P1 to P5 relays count to the combination closed by the RR- relays, SP operates and operates W. Both SP and W close contacts in parallel with the dialing contact of PG to prevent further opens of 10 break PG from being effective on the tip and ring. On the next operation of PG, SP releases and operates Z with W remaining operated. The Z operates BD to enable the TG and OF supervisory relays and also closes a circuit around the RR- contacts to the counting relay contacts controlling SP to cause operation of SP after a predetermined number of interdigital pulses or cycles of the interrupter. For an interdigital interval of six and one-half cycles of the interrupter the counting relays actually count only to four before SP operates. This apparent undercount is required since one cycle is lost in recycling the counting relays at the start of the interdigital interval and one and one-half cycles are used at the end of the interdigital interval to again recycle the counting relays. At the end of the fifth cycle, PG operates, operating SP which in turn releases W. Then, at the end of the sixth cycle, PG operates releasing SP which releases Z followed by BD. With both W and SP normal, the next opening of PG is effective on the tip and ring and with Z released, SP is under control of the counting relays and the RR-relays.

3.29 This cycle of events, which can be summarized as follows, is repeated for each digit. The BD releases and the digit is dial pulsed. The SP operates to terminate the digit and operates W and recycles the counting relays. The SP releases operating BD and Z which resets the counting relays to count the interdigital interval. One and one-half cycles from the end of the interdigital interval, SP operates, releasing W and recycling the counting relays. The SP releases, releasing Z which places SP under control of the counting relays and the RR- relays which count the next digit to be dial pulsed. The Z releases BD which enables the dial pulses to be put on the T and R.

3.30 A contact on Z is used to advance the digit steering circuit during the interdigital interval. When Z operates, the steering relay for the digit just transmitted is released. This associates the RR- relays with the digit to be transmitted next. When Z releases, the next steering relay is operated.

D. Battery Ground Pulsing

3.31 The sender, under control of class relay CL1 operated, will provide battery and ground pulsing rather than loop pulsing. This type of pulsing permits pulsing over longer loops than would otherwise be possible by doubling the voltage on which the distant pulsing relay operates. The distant pulsing relay must hold on the loop closure and the polarity tests of the trunk are always made on a loop basis.

3.32 With CL1 and BD operated, the tip and ring are connected on a loop basis to the OF and TG relays. However, with BD normal, the ring lead is connected through PG and TTK or CL2 operated and the RG resistor to ground. At the distant office this lead is connected through the pulsing relay to battery. The tip lead is connected through PG and the TB resistor to battery. At the distant office this lead is connected through the pulsing relay to ground. Thus each lead

has an effective 48-volt battery for operating the distant pulsing relay. The battery ground condition is maintained at the start of the interdigital interval for one full pulse cycle to permit the distant relay to become soaked and then BD is operated to restore the tip and ring to a loop configuration.

E. Stop-Go Dialing

3.33 On calls which are routed through a tandem point such as a step-by-step tandem to a sender type office or to a link type CDO, some additional time must be provided in the interdigital interval to permit the dial pulse receiving equipment to be connected to the line. When such a condition is encountered, off-hook supervision is returned to the sender as a stop-dial signal. Then when the distant circuit is ready to receive dial pulses, the supervision is changed to on-hook. Provision is made for accepting a stop dial on all classes; however, on the sender class where a sender or register at the terminating office accepts all the digits, a stop dial will never be received. A continuous off-hook on this class during the interdigital interval will be construed as a reversed trunk.

3.34 At the end of the first pulse cycle of the interdigital interval, BD operates from Z and removes the short from the OF and TG relays to enable their contacts. If the supervision remains on-hook, OF will remain normal and TG will operate causing no reaction. If the supervision is off-hook or changes to off-hook, OF operates to cause operation of the stop relay SG. The SG locks, closes an auxiliary circuit to hold CPG and stop the pulse generator at the end of the normal interdigital interval, closes an additional holding circuit to BD, and reoperates TMC to prepare to recycle the TM timer.

3.35 When the supervision reverts to on-hook, OF releases and TG reoperates to cause operation of SG1 through TMC and SG operated. The SG1 locks and opens the auxiliary circuit to BD again placing BD under control of Z. The SG1 and TMC operated recycle the TM timer. The TMC is slow-release to allow the distant pulse receiving circuit to become ready to receive dial pulses. When TMC releases, BD releases to start the dial pulse generator dialing the next digit.

3.36 In some step-by-step selectors the off-hook supervision or stop is actually produced initially by the selector itself after it has reached the desired level but before it has started to hunt and in other step-by-step selectors the off-hook supervision or stop occurs after the hunting interval. In the former cases the interdigital interval must be extended to cover the hunting interval so that the stop will not be missed. Other factors affecting the interdigital time are the round trip transmission time of the signals over the line facilities and switching time in a tandem office.

F. End-of-Dial Pulsing

3.37 After the sender has outpulsed the last digit and releases that steering relay, the RR7 is the only recapture relay operated. It is operated from 2 make of the STS relay or the start-seven registration in the digit register following the last digit. The 10 make of the RR7 closes a path through break contacts of the other RR- relays and 1 break LD to operate the STP stop pulsing relay. The STP operated causes the steering circuit to step again when PG releases following the operation of Z relay. The RR7 releases completing a path through 2 make of the STP to operate EP. The EP operates the CPG relay stopping the pulse generator and initiating sender release.

MULTIFREQUENCY PULSING

A. General

3.38 The application of the frequencies to the tip and ring circuit and the speed of pulsing is under control of the pulse generator. The frequencies transmitted are controlled by the recapture relays.

B. Assignment of Frequencies

3.39 The multifrequency signals are generated in the sender by means of transistor oscillators. Six frequencies in steps of 200 cycles from 700 to 1700 cycles are used. The first five are assigned on a 2-out-of-5 basis to the digits 0 to 9 and the sixth is used in combination with others of the first five for a gate opener or key-pulse, for a start or end pulse. These frequencies are assigned designations 0, 1, 2, 4, 7, and 10 so as to fit in with the standard additive 2-out-of-5 code. The frequencies and their assignments are as follows:

| | Frequency | | | | | |
|---|---|---|---|---|---|---|
| | 700 | 900 | 1100 | 1300 | 1500 | 1700 |
| Digit | Designation | | | | | |
| | 0 | 1 | 2 | 4 | 7 | 10 |
| 0 | | | | x | x | |
| 1 | x | x | | | | |
| 2 | x | | x | | | |
| 3 | | x | x | | | |
| 4 | x | | | x | | |
| 5 | | x | | x | | |
| 6 | | | x | x | | |
| 7 | x | | | | x | |
| 8 | | x | | | x | |
| 9 | | | x | | x | |
| Keypulse | | | x | | | x |
| ST Pulse | | | | | x | x |

C. MF Generator - FS12

3.40 Transistors Q6 and Q7 and their associated circuitry form two modified Hartley oscillators which generate the MF tone which are linearly mixed in the grounded base amplifier at transistor Q5. The Q6 oscillates at 700, 900, 1100, 1300, and 1500 Hz. The Q7 oscillates at 900, 1100, 1300, 1500, and 1700 Hz. The oscillator output voltages are controlled by the R7 and R8 voltage divider across reference diode CR6. The Q6 and Q7 saturate at the divider voltage limiting the peak AC excursions. Because base drive increases with frequency, the R15-R17-C6 and R19-R22-C7 networks form low pass filters in the Q6 and Q7 feedback paths which provide additional amplitude stabilization with frequency. The output current from the oscillators to the Q5 mixer is adjustable by the R3 and R12 potentiometers.

3.41 The C1 and C2 capacitors are the oscillator tank capacitors. They are charged between the R7-R8 and R9-R10 voltage dividers. When a pair of MF tones is to be transmitted, the RR- recapture relays disconnect the C1 and C2 tank capacitors from the potential appearing at the R7-R8 divider and connects the capacitors to the desired taps on the L1 and L2 tank coils. The PG relay releasing at the start of an MF digit grounds the side of the C1 and C2 capacitors tied to the R9-R10 voltage divider. The other side of the capacitors become positive causing them to discharge into their respective L1 and L2 inductors. The tank circuit oscillates and sufficient amplification is obtained from the Q6 and Q7 transistor circuits to drive the tuned circuit and maintain the oscillations. Therefore the circuits act as oscillators. The oscillator frequencies are coupled through potentiometers R3 and R12 through C3 to the Q5 amplifier where they are mixed and amplified. The final output is two mixed frequencies applied through B resistor to transformer T.

3.42 When PG reoperates to terminate the digit being transmitted, ground is removed from the C1 and C2 capacitors and the oscillators shut off. Before PG releases again to transmit the next digit, the capacitors recharge and the oscillations in the tank circuit damp out.

3.43 The recapture relays select the pair of MF tones to be transmitted. The KP and STP relays control the generation of the 1700-Hz tone for the KP and ST pulses. Two contacts of each RR- relay are used, one contact being associated with the inductor in each oscillator. The make half of the contacts are wired so that the L1 inductor always generates the lower frequency while the L2 inductor always generates the higher frequency. The break contacts are connected so that the tank capacitors C1 and C2 are charged prior to the transmission of each digit to permit immediate full volume start of oscillation.

TRANSMISSION OF DIGITS

3.44 The T transformer, capacitors A, B, C, and D and the L inductor couple the unbalanced signal to the trunk which is balanced with respect to ground. Transformer T has very low capacity between its primary and secondary windings and provide a high

degree of protection from longitudinal lightning surges. Capacitors A, B, C, and D, which are effectively in series, charge to provide protection against metallic voltage surges. These capacitors also block DC currents from flowing into or out of the windings of the T transformer. The entire combination provides very high return loss to the trunk.

3.45 When the KP relay is operated the 2 and 10 frequencies are generated for transmission over the tip and ring leads. Relay PG operates after a timed interval of no less than 87 milliseconds to turn off the oscillators and terminate transmission of the KP frequencies. Relay KP releases to enable the RR- relay contacts controlling the oscillator tank circuit. The recapture relays are connected to the register of the first digit to be sent under control of the steering relay operated during transmission of the KP pulse. When PG releases the two frequencies which make up the first digit are generated and transmitted. In approximately 70 milliseconds, relay PG reoperates to terminate the first digit and releases the first digit steering relay which transfers control of the RR- relays to the succeeding steering relay. In about 70 milliseconds, PG releases to outpulse the second digit. This process continues with a pair of frequencies being transmitted each time PG releases. The RR- relays change their pattern in the interdigital interval when PG is operated.

3.46 When all digits registered have been transmitted, the RR- relays will be connected to the register which has the start seven registered in it. This will result in RR7 being the lone RR- relay operated. On 10-digit calls, RR7 will be operated from ground on 4 make ST7. With RR7 operated and the remaining RR- relays released the operate path to the STP relay is completed through 10 make RR7. This causes the start pulse frequencies 7 and 10 to be transmitted. When PG operates to terminate the ST pulse, RR7 will be released and with all of the RR- relays now normal the EP end of pulsing relay will operate through 10 break RR7 and 2 make STP. Relay EP removes the last ground holding CT operated which releases causing the sender to release.

TWO-OUT-OF FIVE CHECK

3.47 A feature is provided in the pulse generator control circuit FS11 to check that 2-out-of-5 recapture relays are operated for each digit outpulsed. A logical not 2-out-of-5 circuit of recapture relay contacts is connected through 9 break of the PG relay to the TRL trouble release relay. The recapture relays are connected from one digit register to the next while PG is operated and unless two and only two of these relays remain operated when PG releases at the start of a digit, TRL will operate. The TRL operated causes the sender to set the calling customer to line lock out and to release.

## 4. RELEASE OF SENDER

GENERAL

4.01 The sender is designed to pulse out the digits registered and then turn the supervision over to the trunk and release. Since the number of digits the sender receives is variable, the pulsing of the last digit is under partial control of LD. The end of pulsing, or release control relay, EP is under control of the RR- relays.

4.02 After the last digit and start pulse have been transmitted all RR- relays are normal and cause operation of the EP relay. Relay EP releases the trunk D relay to establish a holding path for the forward connection and releases CT. The CT is slow-release to insure that D is released before the sender opens the tip and ring leads. The CT releases LR which in turn releases ON followed by ON1. Relays ON and ON1 allow release of all other operated relays. The sender busy CB relays in the connector release to allow the sender to be seized by a marker.

## 5. SENDER TIMING

GENERAL

5.01 The sender has two timers. The ATM timer times the trunk cover up interval and is explained in detail in 2.01 through 2.05. The TM timer is the overall timer for the sender. It is recycled after successful trunk test on all calls and after outpulsing of the called number on ANI calls and after stop-go supervision on DP calls. In case of a TM time-out, the sender releases the connection to the calling line and if the cancel timed release key SCTR at the test circuit is normal, the sender releases. If the SCTR key is operated and the SSR relay normal the sender will stick

until manually released. In this case the trunk will also be held but not the customer. If the sender sticks, the forward connection is released (the tip and ring opened) by CT and LR releasing except for 2-way trunks where the closure is maintained across the tip and ring.

5.02 In the event of a sender time out, the stuck sender plant register will be scored and the trunk identifier circuit will be caused to identify the trunk and sender involved. If the sender is stuck by the operated SCTR key, a major alarm will be sounded after a 10- to 15-second interval.

TM TIMING

A. TM Timing Circuit - FS7

5.03 The TM timer consists of the TM (three - transistor) time delay control circuit, the TM relay and the network of resistors, capacitors, and relay contacts connected to the B3, C3, CP3, and I3 leads of the time delay control circuit. The 300-ohm TM resistor provides a low-resistance path over which the TM capacitor is charged when the timer is recycled. The 40-microfarad B3 capacitor does not affect the timing, but is provided to prevent any high-frequency surges on the 48-volt supply from affecting the timer. The TM capacitor in series with the TM1 or TM3 resistor forms the RC network whose time constant determine the length of the time intervals which are timed. Selection of the intervals is controlled by transfer contacts on the SD and MF relays. Control of the timer resides on the I3 lead to the time delay control circuit. Ground on that lead maintains the TM capacitor in a charged state and holds the control circuit in the state in which it grounds its L3 output lead. Ground on the L3 lead holds the TM relay nonoperated. Timing begins when ground is removed from the I3 lead. This happens when the sender is seized; 7 break of ON breaks ground from the I3 lead.

5.04 With ground removed, the RC network discharges into the control circuit via the I3 lead and initially maintains the control circuit in its previous (off) state. The discharge current diminishes in the typical RC circuit manner and at the end of the timed interval is reduced to a quantity which is no longer sufficient to maintain the time delay control circuit in its off state. The control circuit changes state, battery is applied to the L3 lead and the TM relay operates as a signal that the sender has timed out.

B. Action on Sender Time Out

5.05 The TM operated operates the TRL relay which grounds the stuck sender register lead SS to the plant register circuit, grounds the ALM lead to the alarm circuit, operates the RO reorder relay and stops the pulse generator. On calls to 2-way trunks, 2 make TRL and 9 make CL2 bridge the tip and ring to maintain the forward seizure so that the trunk cannot be seized by the far end.

5.06 The RO relay operated:

(a) Splits the AB and SL leads through its 10 break-contact. This removes ground from the sleeve of the channel to the calling line releasing the connection. The calling customer receives reorder tone from the line lock-out state of the line circuit.

(b) Grounds the ST lead to the trunk identifier circuit causing it to identify and record the trunk and sender.

(c) Releases the slow-release CT relay.

The CT disconnects ground from the SS lead and releases the LR relay. The CT also opens the tip and ring leads to release the forward connection on one-way trunks.

5.07 The TRL also grounds the SR lead to all other senders. This operates the SSR relay in all senders but this one. The SSR relays have their 1 break-contact in series with SCTR key contact. The SSR operated will override the SCTR key functions and insures that only one sender at a time may be held (stuck) by operated SCTR keys.

5.08 If the SCTR key is normal, or SSR operated, the release of LR will cause release of ON, followed by ON1 and by other operated relays of the sender. The TRL will release from ON1 to remove the ground from the ALM lead.

5.09 If the SCTR key is operated and SSR released, ON will be held through TRL to maintain the grounds on leads LP and ALM. The ground on lead ALM will cause the major alarm to operate with the R-S-TOA indication. If the MB sender make-busy relay is operated ground is removed from the ALM lead retiring the alarm. The SMB lamp is not extinguished, however.

5.10 When the SCTR key is restored to normal, ON releases allowing release of the operated relays of the sender. The TRL

releases from ON and removes ground from the ALM lead. If some trouble prevents release of ON and the sender when the SCTR key is normal, the alarm will be brought in as described for the SCTR key operated.

C. TRL Without TM

5.11 Under certain trouble conditions TRL can be operated directly without waiting for TM to operate. One of these is the detection of a reversed trunk. Another is a 2-out-of-5 check failure. Another is a failure of the DP pulse counting circuit when it fails to stop after counting to 10 pulses. In these cases TRL will perform its functions the same as on a regular sender time-out. In this case 9 make TRL stops the TM timer. This will prevent the TM timer from timing out as a troubleshooting aid.

D. TM Timer Recycling

5.12 The TM timer times for an interval of 7.5 to 9.0 seconds from seizure, ON operated, until trunk test is completed and the start dialing signal is received. The interval is the same for all calls. When SD operates ground from 5 make TMC through 9 make SD to the timer I3 lead stops the timer and recharges the TM capacitor. The SD releases slow-release TMC which provides sufficient time for the recycling of the timer. When TMC releases, timing resumes but if the call is DP the next timing interval is 23 to 27.5 seconds long. For MF calls the next interval is 7.5 to 9.0 seconds long.

5.13 On ANI calls, the R relay operates at the end of the outpulsing of the called number. The 6 make of R completes a path to operate the TMC relay. Recycling does not take place at this time as 4 break R prevents grounding of the timer I3 lead. As the sender resets to outpulse the calling number, it operates the R1 relay which releases both the R and TMC relays. However during the slow-release interval of the TMC when R has already released the I3 lead is grounded and the timer is recycled.

5.14 Should a stop signal be received from a SXS office during a DP call the SG relay is operated. Ground through 4 make SG operates the TMC relay. The 3 break of the SG prevents immediate recycling of the timer which continues to time should the stop be due to a reversed trunk in which case a time out is desired. However, when the go signal is received, SG1 operates and grounds the I3 lead to the timer. The 8 break of the SG1 releases slow-release TMC which when down restarts the recycled timer.

6. AUTOMATIC NUMBER IDENTIFICATION (ANI)

GENERAL

6.01 The sender is arranged to handle ANI calls on routes to CAMA offices. It has a 4-digit register on which the calling line directory number may be stored. It has class relays, the ANI, OI, IF, OA, and OB, which store information from the marker needed to complete an ANI call. It also has the means to reset its registers, timers, steering circuit and pulse generator and the means to receive supervisory signals from the CAMA office which are used to complete an ANI call.

6.02 When handling an ANI call to a CAMA office, the sender first sends the called number with arbitrary or delete digits, as required, in the same way it outpulses a regular non-AMA call. At the completion of sending the called number, instead of releasing the sender resets itself in preparation for sending out the calling party directory number. It transfers the calling line number from the ANI register, FS9, to the digit register, FS2. The sender recycles the timer and resets the steering circuit so that it will prefix the office code to the 4-digit line number. It also prepares to receive a wink signal from the CAMA office when it is ready to receive the ANI information.

6.03 When an off-hook signal indicating the CAMA sender is ready to receive the calling number information, the sender outpulses KP, X information digit, 7-digit directory number, and ST. Following the ST signal, the sender releases.

6.04 The ANI class calls are designated as automatically identified, AI, operator identified, OI, or identification failure, IF. In each type of call, an X information digit is sent immediately after the KP signal. On AI calls, however, in addition to the KP and X, the full calling number is sent followed by a start signal.

6.05 The X information digit is used to inform the CAMA sender of the type of ANI call that is being sent. Translation of the X digit by the CAMA sender is as follows:

| Digit | Translation |
|---|---|
| 0 | AI - Service Nonobserved |
| 1 | OI - Service Nonobserved |
| 2 | IF - Service Nonobserved |

AUTOMATICALLY IDENTIFIED (AI) CALL - SC4

6.06 On all ANI class calls the marker operates the ANI relay in the sender. On automatically identified calls it also operates the OA office A or OB office B relay and stores the directory line number in the ANI register in FS9. The ANI relay operates the MF and MF1 relays which prepare the sender to multifrequency outpulse.

6.07 When the ST pulse of the called number has been outpulsed the R reset relay operates through 5 make of the ANI relay. The R operates instead of EP which normally operates after the ST pulse. The R operated:

(a) Operates the CPG to stop the pulse generator.

(b) Releases the steering relays.

(c) Release the PO or NC relay and the AD1, 2, 3, or 4 relay, if operated.

(d) Operates relay TMC.

Relay TMC prepares a ground to recycle the TM timer and operates the R1 relay.

6.08 When R1 operates, it locks through its 3 make contact under control of 5 break of the KP. The R1 operated releases the STP so that it can detect sending of the ST pulse on the ANI transmission. Relay LD is operated from R1 and it enables the CSR CAMA sender ready relay. Two make of STP released opens the operate path of the R relay which releases. The R released grounds the I3 lead to the TM timer recycling it. The recycling ground is on 5 make TMC which is slow-releasing after the operation of the R1 relay. The ADT ANI digit transfer relay operates from ground over a path which includes 5 break R, 4 make R1, 11 break OT, and 5 break IF relays. Contacts of ADT in FS9 transfers the 4-digit calling line directory number to the A, B, C, and D digit registers of FS2. Four make ADT operates the E7 relay as the start-seven mark needed during outpulsing for generation of the ST pulse.

6.09 At this point, the sender awaits the wink signal from the CAMA sender signaling that it is ready to receive the calling line directory number. The wink causes OF relay to operate which operates the CSR over a path including 12 make R1 and 3 make MF. The CSR operated closes ground to the KP relay over its 3 make, 1 make ADT and 4 make R1. The KP operates and releases R1 which releases the ADT and CPG control pulse generator relay.

6.10 When CPG releases it enables the pulse generator, which starts pulsing by first releasing the PG relay. The PG released starts the tone generator which sends the KP signal frequencies. It also operates the ADS steering relay over a path which includes 5 break PG, 11 make KP, and 1 make CSR. The ADS cuts through the grounds on the 2 and 5 make-contacts of CSR to operate the RR4 and RR7 relays. The RR4 and 7 cause the sending of a zero as the AI information digit following the KP pulse. During transmission of the information digit, the AOS steering relay will operate from ground over a path through 9 make CSR, 3 make ANI, 8 make OA or OB, 11 make ADS, and 11 break KP. The AOS operated enables the sending of the calling office code as cross connected on the terminals in FS9 and controlled by relays OA and OB and steered for outpulsing by the AOS, BOS, and COS steering relays.

6.11 The sender outpulses KP, 0, ABC, xxxx ST. At the completion of the ST pulse, the RR7 relay releases and with CSR operated a path to operate EP is completed. The EP performs the same functions as on non-ANI calls, that is it stops the pulse generator and initiates sender release.

IDENTIFICATION FAILURE (IF) - SC4

6.12 If for any reason the marker cannot obtain the calling line directory number or if it can but detects a mutilated digit it will operate the identification failure IF relay at the same time it is operating the ANI relay. Digits may or may not be stored in the ANI register. They will not be required in any event. The

progress of the call is the same as on an AI call except that ADT does not operate and when CSR operates the KP relay is operated over a path through 5 make IF. When R1 releases, LD also releases as there is nothing registered in the A, B, C, or D registers which would keep LD operated. The ADS operates during the KP pulse and operates the RR0 and RR2 relays through its 2 and 4 make-contacts. This will set up the transmission of the digit 2 for the information digit.

6.13 The sender outpulses the KP and 2, only. When PG operates at the end of the information digit, ADS releases and with no digit stored in the A register the RR- relays all release. This causes EP to operate through a path which includes 3 make of the IF. The EP causes the sender to release.

OPERATOR IDENTIFIED (OI) - SC4

6.14 If the call to CAMA is from a multiparty line which cannot be identified, the marker operates the OI relay at the same time as it is operating the ANI relay. The call progresses exactly as described in 6.12 and 6.13 except:

(a) The KP relay operates through 11 make OI.

(b) Recapture relays RR0 and RR1 operate.

(c) The sender outpulses a KP and 1, only.

(d) The EP operates through 10 make OI.

## 7. TRAFFIC SERVICE POSITION (INCLUDING PPCS)

7.01 The sender is arranged to transmit more than one nondigital combination of two frequencies as a start signal. The variable start signal is used where call class marks are required to identify combined traffic over a common trunk group to a Traffic Service Position System No. 1.

7.02 The PO and NC relays are operated by the marker singly or in combination to form the special start pulse to be transmitted following the called number outpulsing. Four of the five possible start signals are used to indicate coin or noncoin and 0+ or 1+ traffic.

ZERO OPERATOR CALL - SC6

7.03 On PPCS zero operator calls the sender is able to send in place of the called number a KP, ST transmission where the ST pulse is a special start pulse. The KP, ST is followed by any of the three, AI, OI, or IF, ANI transmissions. The marker, on this type of call, operates the PO and or NC relays and the A7 relay. This places the start-seven in the A register and causes the sender to send a ST pulse following the KP pulse.

7.04 When special start pulses are to be sent, the sender operates the SSS send special start pulse relay when it detects the start-seven digit. As the last digit is outpulsed, LD has already released and a path to operate the SSS relay is complete through 1 break PG, 7 make MF1, 2 break LD, 4 make SD, and contacts on the NC and PO relays. Nothing further happens until completion of the last digit. Then the SSS operated causes the ST7 and STS relays to operate if they are not already, closes a path through 9 make to stop the pulse generator until two RR- relays are operated transfers control of the 0, 1, 2, and 4 leads to the RR- relays to contacts on the NC, PO, and STP relays.

7.05 The STP operates upon detecting that a start pulse is to be sent (R7 alone operated) and from ground on its 10 make-contact causes another RR- to operate. The second RR- operated enables the pulse generator and PG releases to start the MF tone oscillators. The high-frequency oscillator will generate the 10 frequency under control of 6 make STP. The lower frequency oscillator will generate tones 0, 1, or 4 under control of RR0, 1, or 4 which ever is operated. The NC alone causes tone 4 to be sent; PO alone tone 1; NC and PO tone 0.

7.06 At the end of the ST pulse, SSS releases as do both RR- relays and the R reset relay is then operated. The call follows the usual ANI sequences except when R operates it releases the PO and NC relays.

ANI ROUTES TO SERVICE OPERATORS - SC5

7.07 The marker operates the DLN delete called number relay on ANI calls to service operators such as to ACDs. The DLN prevents the sender from transmitting the called number which is registered in it. When trunk test is complete and DLN operated:

(a) The off-hook part of the wink operates OF1 and ground through 2 make OF1 and 11 make DLN immediately operates SD.

(b) Causes KP to release because 9 break DLN and 7 break SD have removed locking ground from the steering relays.

(c) Ground through 3 break KP and 8 make DLN operate relay R.

Relay R resets the sender and prepares it to make the ANI transmission.

## 8. AUTOMATIC INTERCEPT CALLS - SC7

8.01 This sender is capable of outpulsing to an Automatic Intercept Service Bureau. On calls which require intercept treatment the marker, in addition to operating the MF relay in the sender, operates the AD1, AD2, or AD3 relay. These relays control the class of intercept digit which is outpulsed following the KP pulse and which is needed by the bureau to handle the call. The following table explains their use.

| Intercept Class | Relay Operated | Information Digit |
|---|---|---|
| Blank Number | AD1 | 0 |
| Trouble | AD2 | 1 |
| Regular (Changed) | AD3 | 3 |

8.02 If the intercept is from an intraoffice call, the marker will have all seven digits dialed and will store them in the sender. However on incoming calls, it will have only four or five digits and in that case must also operate the OA or OB relay. The OA or OB will generate the office code of the called number and the directory digits will be outpulsed as stored in the digit register.

8.03 The number outpulsed has the form, KP, class of intercept, A, B, C xxxx, ST. The ADS steering relay is used to control outpulsing of the class digit and if OA or OB is operated the AOS, BOS, and COS steering relays will control the outpulsing of the office code. The sender releases following outpulsing of the ST pulse.

## 9. ABANDONED CALLS - SC8

9.01 In case the call is abandoned during sender functions, the sender will immediately release except where the SCTR key is operated at the test circuit and trunk test has not been completed.

IMMEDIATE RELEASE

9.02 The sender receives supervision from the trunk over the abandon call AB lead. This lead is grounded in the trunk by the auxiliary supervisory relay. If the call is abandoned the trunk disconnects the ground which release the LR relay in the sender. Six make of the LR removes ground from the OSL hold magnet and the sender ON relay. This causes the sender, the link and the trunk to release.

SCTR KEY OPERATED

9.03 When AV operates, a locking ground is completed to the LR relay from ground on the SCTR key, 1 break SSR, 2 make CT, 9 break TG1, 5 break OF1, 1 make AV, and 10 make LR. This provides that if a call is abandoned before time out and the trunk conductors are open, the sender will not release until time out and a record can be made by the trunk identifier circuit.

## 10. MAINTENANCE

SENDER MAKE BUSY

10.01 There is an SMB key per sender in the test circuit which when operated operates the sender MB make-busy relay. The MB relay operated:

(a) Grounds the SMB lead to the traffic usage recorder.

(b) Operates the SB relay and lights an SMB lamp at the test circuit.

(c) Opens the ALM lead to the alarm circuit.

(d) Partially closes ground to the TST test relay.

The SB relay operating operates the two CB-relays associated with the sender in the connector circiut. These relays make the sender look busy to the markers and they will not be able to seize the sender.

TEST CALL

10.02 To make a test call the sender is made busy and a cord is patched from the TST jack on the sender to the test circuit. This operates the TST relay in the sender. Later after the sender has been seized the outpulsing is diverted, by transfer contacts in the tip and ring, from the trunk to the TST jack. It then can be monitored at the test circuit.

## 11. TRAFFIC USAGE RECORDER CIRCUIT

11.01 The traffic usage recorder circuit is used for measuring the time in use of the various circuits in an office.

11.02 The SB lead is connected to a make-contact of the SB relay. The lead is grounded whenever the sender is busy in service, made busy or under test.

11.03 The MF lead connects to ground through an MF and an SB make-contact in series. This lead is grounded when the sender is service busy or under test handling an MF pulsing call.

11.04 The sender-busy for maintenance lead SMB is connected to ground through MB relay and is grounded whenever the sender is made busy.

## SECTION III - REFERENCE DATA

### 1. WORKING LIMITS

1.01 The use of this circuit is limited as to loop resistance by the operating limits of the OF and TG supervisory relays. In general, however, the loop will be limited by the capabilities of the various types of equipment into which the dial pulses are transmitted.

| | TG and OF Relays | |
|---|---|---|
| Minimum Voltage (Called Office) | 45 | 48.5 |
| Maximum External Circuit Resistance - Ohms | 6400 | 6800 |
| Minimum Insulation Resistance - Ohms | 30,000 | 30,000 |

### 2. FUNCTIONAL DESIGNATIONS

2.01 The functional meanings of the designations of the operating elements of the sender are as follows:

2.02 Relays

| Designation | Meaning |
|---|---|
| AO,1,2,4,7 | A Digit |
| AD1,2,3,4 | Arbitrary Digit |
| ADS | Arbitrary Digit Steering |
| ADT | ANI Digits Transfer |
| ANI | Automatic Number Identification |
| AOS | A Office Digit Steering |
| AS | A Digit Steering |
| AV | Advance |
| BO,1,2,4,7 | B Digit |
| BD | Between Digits |
| BOS | B Office Digit Steering |
| BS | B Digit Steering - Delete One |
| CO,1,2,4,7 | C Digit |
| CBO-9 | Connector Busy |
| CL1 | Battery - Ground Pulsing |
| CL2 | Two-Way Trunk |
| CL3 | Two-Way Trunk and Battery - Ground Pulsing |
| COS | C Office Digit Steering |
| CPG | Control Pulse Generator |
| CS | C Digit Steering - Delete Two |
| CSR | CAMA Sender Ready |
| CT | Cut Through |
| DO,1,2,4,7 | D Digit |
| DLN | Delete Called Number |
| DPR | Dial Pulse to Register |
| DS | D Digit Steering - Delete Three |
| EO,1,2,... | E Digit |
| EAO-4 | Even A Connector |
| EBO-4 | Even B Connector |
| ECO-4 | Even C Connector |
| EDO-4 | Even D Connector |
| EF | End-of-Pulsing |
| ES | E Digit Steering |
| FO,1,2,4,7 | F Digit |

| Designation | Meaning |
|---|---|
| FS | F Digit Steering |
| GO,1,2,4,7 | G Digit |
| GS | G Digit Steering |
| HO,1,2,4,7 | H Digit |
| HS | H Digit Steering |
| HUO,1,2,4,7 | Hundreds Digit |
| IF | Identification Failure |
| JO,1,2,4,7 | J Digit |
| JS | J Digit Steering |
| KO,1,2,4,7 | K Digit |
| KP | Key Pulse Steering |
| KS | K Digit Steering |
| LD | Last Digit |
| LR | Line Release |
| MB | Make Busy |
| MF | Multifrequency Outpulsing |
| MF1 | MF Auxiliary |
| NC | Noncoin |
| OA | Office A |
| OAO-4 | Odd A Connector |
| OB | Office B |
| OBO-4 | Odd B Connector |
| OCO-4 | Odd C Connector |
| ODO-4 | Odd D Connector |
| ON | Off-Normal |
| ON1 | ON Auxiliary |

| Designation | Meaning |
|---|---|
| P1,2,3,4,5 | Pulse Counter |
| PG | Pulse Generator |
| PO | Prefix Zero |
| R | Reset |
| R1 | R Auxiliary |
| RO | Reorder |
| RRO,1,2,4,7 | Recapture Relays |
| SB | Sender Busy |
| SD | Start Dialing |
| SG | Stop-Go |
| SG1 | SG Auxiliary |
| SP | Stop Pulsing |
| SSO-9 | Seize Sender |
| SSS | Send Special Start Pulse |
| ST7 | Start Seven |
| STP | Start Pulse |
| STS | Start Pulse Steering |
| TO,1,2,4,7 | Tens Digit |
| TG | Trunk Guard |
| TG1 | TG Auxiliary |
| THO,1,2,4,7 | Thousands Digit |
| TM | Time Measure |
| TMC | Timer Control |
| TRL | Trouble Release |
| TST | Test |
| TTK | Trunk Test |

| Designation | Meaning |
|---|---|
| U0,1,2, 4,7 | Units Digit |
| W | W - Pulse Divider |
| Z | Z - Pulse Divider |

2.03 Time Delay Control Circuits

| Designation | Meaning |
|---|---|
| ATM | Auxiliary Timer |
| TM | Overall Timer |

3. FUNCTIONS

3.01 To be available for marker seizure if not in use on a service or test call or made busy.

3.02 To allow only one marker to seize the sender through the connector control, to become unavailable for seizure for the duration of a call.

3.03 To provide the marker with the identity of the sender it has seized.

3.04 If all senders are busy to give an all senders busy signal to a marker attempting to seize a sender.

3.05 To provide for operation of the off-normal relay ON1 by the marker over the ON1 lead through the sender connector and to provide locking grounds for the digit registers, class, and memory relays from ON1.

3.06 To register information transferred from the marker, via the sender connector concerning the numerical digits recorded in the originating or incoming register, the arbitrary digit, if any, to be dialed out, the number of digits to be deleted, the type of start dialing signal, whether loop, battery ground, or pulsing is to be used, whether MF or DP dialing is to be used and information pertaining to ANI.

3.07 To provide for operation of the off-normal relay ON over the hold magnet lead HM from the sender link circuit and to provide for holding the hold magnet over this lead.

3.08 To provide for operating the trunk splitting relay over the D lead through the sender link circuit.

3.09 To provide for operation of the line release relay LR over the AB lead through the sender link circuit and to recognize the presence of ground on this lead as an indication that the call has not been abandoned by the customer.

3.10 To provide for storage of the A, B, C, D, E, and F digits as recorded in the originating or incoming register even though these are not to be dialed out.

3.11 To provide for operation of the AV relay by the marker as a signal that the class and number information has been recorded satisfactorily in the sender and that the connection between the sender and the trunk has been established, and to await this signal before making trunk test.

3.12 To provide for sufficient delay in closing the tip and ring leads to the trunk, when one-way trunks are used, to allow the release of relays associated with the trunk at the terminating office which may have been operated on a previous call. This delay varies.

3.13 To provide for closing the loop immediately on seizure but to delay the test for trunk polarity for sufficient time to allow completion of the initial on-hook interval on calls to community dial offices or to allow time for the return of the seizure signal from the terminating office on calls over 2-way trunks.

3.14 To provide for testing the trunk conductors for continuity and polarity and to provide for detecting trunks on which the tip and ring leads have been inadvertently reversed.

3.15 To outdial on receipt of on-hook supervision to trunks terminating on regular step-by-step selectors.

3.16 To delay outdialing on 2-way class trunks until the supervision becomes on-hook.

3.17 To delay outdialing until a start dialing polarity reversal has been received on calls to offices requiring time for sender selection, DPR class.

3.18 To delay outpulsing on MF calls until a change of off-hook to on-hook is received.

3.19 To prevent release of the sender until a test for battery and ground on the trunk conductors has been completed satisfactorily in case the cancel timed release key is operated.

3.20 To delay dialing the first digit for a minimum of 60 milliseconds after trunk closure to allow the relays in the terminating office to be conditioned on DP calls.

3.21 To cause the dial pulse generator to start pulsing after trunk test has been completed satisfactorily and to count the number of pulses on counting relays on DP calls.

3.22 To associate a group of five recapture relays with the digit register for the first digit to be outpulsed and to control the number of pulses generated by the dial pulse generator by contacts on the recapture relays and on the counting relays.

3.23 To allow an interdigital interval consisting of a predetermined number of pulses between successive digits and to provide means for making this interval equal to six cycles plus one closed period on DP calls.

3.24 To release the counting relays after the last pulse of a digit has been dialed and to reuse them for counting the interdigital interval without stopping the dial pulse generator on DP calls.

3.25 To disconnect the recapture relays from the register for the digit just outpulsed and to connect these relays to the register for the digit next to be outpulsed during the interdigital interval.

3.26 To make a polarity test of the trunk during the interdigital interval on DP calls.

3.27 To recognize an off-hook supervisory condition, while outpulsing to a SXS office as an indication to stop dialing until the trunk again becomes on-hook on DP calls.

3.28 To recognize an on-hook supervisory condition after a stop dial as a go signal on DP calls.

3.29 To recognize a second stop or off-hook supervisory signal as a reorder signal and cause release of the sender on DP calls.

3.30 To cancel the polarity test of the trunk during the interdigital interval after the tens digit so that a line reversal, due to a quick answer by a PBX operator reached through a level hunting connector in a step-by-step office, will not appear as a stop dial signal.

3.31 On MF calls, to cause the pulse generator to start pulsing after trunk test has been satisfactorily completed and to transmit a keypulse of at least 87 milliseconds and then to outpulse at approximately 7.2 digits per second.

3.32 When pulsing on a battery ground basis to restore loop supervision after an interval equal to one pulse cycle measured from the start of the interdigital interval so that a polarity test can be made.

3.33 To dial at the rate of ten pulses per second on DP calls.

3.34 To cause trunk cut through after all digits have been dialed.

3.35 To open the tip and ring leads in the sender before releasing the sender link in order to minimize contact erosion at the crosspoints.

3.36 To provide for an overlap between the closure of the supervisory relay of the trunk to the trunk tip and ring leads and the opening of the tip and ring leads in the sender on sender release.

3.37 To restore all apparatus to normal on sender release.

3.38 To allow a time interval of 8.1 seconds for completion of trunk test and the start dialing signal and then recycle the overall timer.

3.39 On DP calls, to time an interval of 25 seconds from the start dialing signal to sender release.

3.40 On DP calls, to recycle the overall timer on a go supervisory signal which has followed a stop signal during outpulsing and to time another interval of 25 seconds until sender release.

3.41 On MF calls, to time an interval of 8.1 seconds from the start dialing signal to sender release.

3.42 On ANI calls, to recycle the overall timer following outpulsing of the called number and to time another interval of 8.1 seconds until sender release.

3.43 To cause the sender and trunk to be held stuck under control of the cancel time release SCTR key of the test circuit.

3.44 To allow only one sender in an office to be held stuck by the cancel time release key.

3.45 To connect ground to the ALM lead to the alarm circuit when the sender times out.

3.46 To connect a momentary ground to the SS stuck sender lead to the plant register circuit.

3.47 To ground the ST start lead to the trunk identifier circuit when the sender times out.

3.48 When the sender times out to split the AB and SL leads to the trunk which removes ground from the sleeve lead releasing the connection to the calling customer placing the line on line lock out and reorder tone.

3.49 To provide for opening the alarm lead when the sender is made busy from the test circuit.

3.50 To function with automatic number identified calls and to perform the following:

(a) To register the 4-digit calling party directory line number plus an office indication.

(b) To register and outpulse special start pulse codes.

(c) To delete the called number if required.

(d) To register and outpulse an identification failure or operator identified code.

(e) To recycle the overall timer and outpulse the KP signal, the AI information digit, generate and outpulse the office code, outpulse the line number and a ST pulse.

(f) To outpulse only KP and the information digit on OI or IF calls.

3.51 On AIS calls to register and outpulse the class of intercept digit, the called number and when required generate the called office code.

3.52 To provide for operation with the traffic usage recorder circuit.

3.53 To provide generation of the six multifrequency tones.

## 4. CONNECTING CIRCUITS

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

(a) Marker Circuit - SD-26384-01.

(b) Outgoing Sender Link - Trunk Identifier - SD-26395-01.

(c) Test Circuit - SD-26411-01.

(d) Alarm Circuit - SD-26393-01.

(e) Traffic and Plant Register Circuit - SD-26437-01.

(f) Traffic Usage Recorder Circuit - SD-95738-01 (Typical).

(g) Outgoing Trunk Circuit - SD-26398-01 (Typical).

(h) Two-Way Trunk Circuit - SD-26400-01 (Typical).

## 5. MANUFACTURING TESTING REQUIREMENTS

5.01 The sender shall be capable of performing all of the functions listed in this Circuit Description and meeting the requirements listed in the Circuit Requirements Table.

## 6. ALARM INFORMATION

TIME-OUT ALARM

6.01 If the sender encounters an extended delay in the progress of a call, the sender overall timer functions.

6.02 With the sender timed out and with the SCTR cancel timed release operated, or if the key is normal but the sender does not release, the sender will stick and after a period of 10 to 15 seconds the major alarm will function and the R-S-TOA lamp will light.

6.03 If in response to major alarm a lighted R-S-TOA lamp is found, the alarm may be silenced and the lamp extinguished by operating the SMB sender make-busy key at the test circuit.

6.04 The sender can be restored to normal by releasing the SCTR key.

FUSE ALARM

6.05 If in response to a major alarm an FA lamp is lighted, it is an indication that a fuse has operated at the frame. Replace the fuse to retire the alarm and extinguish the lamp.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-LCB

WE DEPT 355-JRF-KLF-DM

## 7. TAKING EQUIPMENT OUT OF SERVICE

SENDER CIRCUIT

7.01 In order to take the sender or any of its associated apparatus out of service, operate the associated SMB- key at the test circuit.

GENERAL PRECAUTIONS TO BE FOLLOWED WHEN WORKING ON THE APPARATUS

7.02 When working on the apparatus, the sender should be made busy. No further precautions are necessary other than those listed in the Circuit Requirements Table.