45

CROSSBAR SYSTEMS
NO. 5
OUTGOING SENDER CIRCUIT
MULTIFREQUENCY

TABLE OF CONTENTS

SECTION I - GENERAL DESCRIPTION

1. GENERAL DESCRIPTION OF OPERATION

1.01 The outgoing multifrequency pulse sender is used on calls where the transmission of information from one office to another is on a multifrequency signaling basis. Five frequencies in the voice range are used and each digit is assigned a combination of two of the frequencies. In order to provide a measure of protection against false registrations, due to the detection of talking frequencies, the signal receiver or detector at the receiving office remains in a nonreceiving state until it receives a gate opener or keypulsing signal consisting of one of the 5-digit signals in combination with a sixth voice frequency signal. After receipt of the keypulse signal, the signal receiver recognizes the combination of the sixth frequency in combination with another of the digit frequencies as the start marker or end of pulsing signal. With this type of operation, and with the keypulse signal immediately followed by the digit signals and the start signal, the possibility of false registrations due to talking is quite remote.

1.02 The sending office must be equipped with a frequency supply and the receiving office must be equipped with a signal receiver.

1.03 The association of the sender with the other units of the No. 5 crossbar office is shown in the block diagram in Information Note 301 of the SD. The calling customer, in the case of an outgoing call, dials the called office code and numerical digits into an originating register to which the calling line is connected by a dial tone connection through the line link and trunk link frames. When the entire number has been received, the originating register transfers it to the marker which translates the code and determines that the called office requires multifrequency pulses. The marker then selects an idle multifrequency sender with access to an idle outgoing trunk and connects to it by means of the outgoing sender connector. The marker also selects an idle trunk and connects the trunk to the sender by means of the sender link.

1.04 Senders are provided in groups of ten senders, maximum, and appear on horizontal levels of the sender link switch which multiplies to any additional switches required to load the sender group with trunks which appear as vertical units.

1.05 The outgoing sender connector consists of two channels, one a control channel, which is individual per-sender-per-marker, and the other a common channel which is common to all senders of the group and to all markers, and which carries a majority of the leads. The control channel carries leads over which the marker can retain control of the sender and leads which carry information which the marker may not be able to obtain in time to transfer through the common channel without increasing its holding time.

1.06 Through the connector, the marker transfers to the sender all the information necessary for the completion of the call. This includes the dialed number, the number of digits to delete, the arbitrary digits, if any, to be prefixed, and the type of outgoing trunk.

1.07 The marker also causes a connection to be established between the calling line and the outgoing trunk through the line link and trunk link frames. When the marker has checked the connection between the calling line and the outgoing trunk, the trunk and the sender, via the sender link, and that the sender has received the correct information through the outgoing sender connector, it transmits an advance signal to the sender through the control channel as an indication that the sender should assume supervision and complete the call.

1.08 The action of the sender on a tandem call is similar except that the registration is transferred from an incoming register rather than from the originating register.

1.09 On a nontwo-way class call with class relay CL2 normal, 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.

1.10 On a 2-way class call, option ZR provided, with class relay CL2 operated, pulsing is started on receipt of on-hook supervision. This may be preceded by off-hook supervision but it is not a requirement. On this class the loop is closed immediately upon seizure but an interval is timed before the polarity is determined to prevent an initial on-hook which is immediately followed by an off-hook signal from being translated as a start-pulsing signal.

1.11 On a 2-way class call, option ZS provided, with class relay CL2 operated, 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.

1.12 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.

1.13 The digit registers are dry-reed type relays with five coils per package and each coil is associated with two contacts, one for locking and one for loading. The number translation is made by associating one set of recapture relays, equipped with translating springs, with the digit register. These recapture relays are successively associated with the digit register relays as they are pulsed out, the transfer from one digit to the next being made during the signal-off period.

1.14 Provision is made for generating six multifrequency supply frequencies in the sender by means of transistor oscillators or for connecting to a common source which supplies all the circuits in the building.

1.15 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.

1.16 If the call is abandoned, the sender will release immediately except while connected to a transverter when it will be held until transverter release.

1.17 In nonoverload periods a timed interval of 16 seconds, nominal, is allowed from seizure to release of the sender for each call. In case some trouble condition prevents completion of the call a time-out will occur and the trunk overflow relay will be operated. If the cancel timed release key associated with the sender is normal, the sender will release. If the cancel timed release key for the sender is operated, the sender will be held until manually released.

1.18 A sender group overload control feature is provided to prevent an overload condition at one office from creating an overload condition at another office. When the sender closes the tip and ring leads for trunk test, an intersender timer of 5.7 seconds, nominal, is started for timing the interval required for obtaining access to a sender or register at the terminating office. If a connection to a sender or register at the terminating office is delayed, the timer will function and will close a circuit through which the marker can cause release of the sender if the marker finds an all-senders-busy condition. A time-out of the timer causes no reaction unless the marker finds an all-senders-busy condition. The timer is stopped or released, if operated, when a start-pulsing signal is received. If the sender is released, as a result of the intersender time-out and the all-senders-busy condition, the sender time-out release traffic register will be scored.

1.19 Provision is made for adding one, two, or three arbitrary digits at the start of each call. These digits are received from the marker.

1.20 Provision is made for deleting from outpulsing from one to six digits under control of a delete relay operated by the marker. The deletion always begins at the A digit and progresses successively to the F digit. A delete one mark would cause the sender to delete only the A digit, while a delete three mark would cause the sender to delete the A, B, and C digits. Arbitrary digits can be used in conjunction with the delete marks with the arbitrary digits preceding the deletion.

1.21 The sender is arranged to connect ground to the trunk guard lead, except on dial coin zone calls, to the marker upon seizure and to retain the ground connection until the continuity of the trunk conductors is ascertained. The marker, in light-load periods, will time for disconnection of this ground and, if it is not disconnected within a predetermined interval, a trouble record will be made. This feature is for detecting and recording open trunks.

OPERATION WITH LAMA

1.22 Provision is made for operation with automatic message accounting circuits. When this is required, the sender is equipped with a group of memory relays of the dry-reed type for receiving, from the marker for transfer to the transverter, information pertaining to the identity of the calling line, the recorder to which the trunk is assigned, and other information pertaining to the called number. The sender is also equipped with general purpose relays for controlling the connection to the transverter connector.

1.23 When the sender receives the advance signal from the marker on a LAMA-class call, it starts the transverter connector which connects the sender to a transverter. The sender then transfers to the transverter all the information necessary for the initial entry.

1.24 When the initial entry is complete, the transverter transmits a release signal to the sender which then signals the connector to release the connection.

1.25 Provision is made in the sender for accepting a trouble release signal from the transverter. A first trial trouble release will be absorbed in the transverter connector which will then reconnect to a transverter, usually a different one, for a second trial. If the second transverter also encounters trouble, the transverter will, in the case of detail-billed calls, transmit a trouble release signal to the sender. In the case of bulk-billed calls the transverter on second trial will transmit a regular release signal to the sender. A trouble release from the transverter will cause operation of the trunk overflow relay and release of the forward connection.

1.26 The sender is arranged to delay pulsing of the last digit until a regular release signal is received from the transverter in order to prevent the call from being completed and the called party from being signaled before the LAMA record is completed.

1.27 The sender is arranged to prevent release of the sender and trunk in case of abandonment while the transverter is connected.

1.28 The sender is arranged to function on an 8.1-second, nominal, timing interval during the transverter functioning time. If a time-out occurs and connection has actually been made to a transverter, the trunk overflow relay will be operated but the sender and trunk will be held until a release has been received from the transverter. If some trouble had prevented a connection to a transverter, the time-out will cause release of the sender.

1.29 Provision is made for associating the sender with intraoffice trunks for controlling the initial LAMA entry for calls over these trunks. In these cases the sender is given a no-pulsing class. The no-pulsing class serves to prevent release of the intraoffice trunk in case of abandonment while the transverter is connected.

INTERNATIONAL DIRECT DISTANCE DIALING

A. LAMA Arrangement

1.30 The interim arrangement for International Direct Distance Dialing (IDDD) is provided only in offices arranged for LAMA operation. On an IDDD call, the marker connects the calling customer to a tandem trunk and requests an outgoing MF sender. When the marker seizes the sender it registers in the sender all the information required for a LAMA call. In addition, the marker registers in the sender the code pattern mark CP0, CP2 as a signal that this is an IDDD call. When the marker is arranged for 3-digit code conversion it registers in the sender 3 arbitrary digits AR2/5, BR2/5, and CR2/5 to identify the particular gateway office required to handle this call. When the marker is not arranged for 3-digit code conversion, it registers in the sender one arbitrary digit CR2/5. The sender then generates two additional arbitrary digits AR2/5 and BR2/5 to form the 3-digit gateway identification code. On receipt of an on-hook from the tandem office, the sender will start its first stage outpulsing and outpulse the gateway identification code in the form KP-xxx-ST into the tandem office.

1.31 The tandem office then switches the call to the proper gateway office. At the same time, the sender releases its steering relays, its arbitrary digit register relays, and recycles to prepare for its second stage outpulsing.

1.32 When the gateway office is ready to receive its digits it returns an off-hook wink to the MF sender and the MF sender outpulses a maximum of 11 digits in the form KP-country code-national number-start signal into the gateway office.

1.33 When the sender transmits the start pulse at the end of the second stage outpulsing, the end of pulsing EP relay operates and the sender proceeds to disconnect.

1.34 At the time the marker seized the sender and operated the advance AV relay in the sender, the sender called in a transverter and transferred the calling line location to the transverter as described in the paragraph, OPERATION WITH LAMA.

B. Traffic Service Position System (TSPS) Arrangement

1.35 On this type of IDDD call the marker will register classes 1, 3, 5, 8 in the sender. The combination of classes and 8 will signal the sender that this is an IDDD call being routed through TSPS No. 1 office. Classes 3 and 5 are the ANI classes which provide the ANI features required to complete this call. The marker will also register the called country code and national number (maximum 12 digits) in the sender plus the line location of the calling line number and other information required by the sender on an ANI call.

1.36 The sender then generates a prefix digit 1 and outpulses the prefix digit, country code and national number into the TSPS office. The sender then performs the following ANI functions. The sender recycles to release its digit registers, it calls in an ANI transverter and gives it line location of the calling customers line. The transverter in turn returns to the sender the calling line directory number and registers this number on the digit registers.

1.37 The sender outpulses the calling line directory number to the TSPS office and then releases.

OPERATION WITH DIAL COIN ZONE TRUNKS OR JUNCTORS

1.38 Provision is made for operation with dial coin zone trunks or junctors. The coin zone trunk or junctor does not give a loop closure until an attendant answers to supervise coin operation and then disconnects. The TG and OF relays are therefore used to detect the attendant answer and disconnect.

1.39 The sender provides a timed interval while the trunk or junctor is waiting for the coin attendant to answer. If this interval is exceeded, a path is closed for the marker to release the sender if it encounters an all-senders-busy condition.

1.40 When the attendant answers, the sender tip and ring loop is closed by on-hook battery, TG and TG1 relays operate, and the timing is canceled. The all-senders-busy release path is also opened. The attendant is given an unlimited time to complete the functions.

1.41 When the attendant disconnects, the trunk or junctor gives the sender off-hook supervision and sends a loop closure to the called office. The off-hook causes to the sender OF and OF1 relay to operate to restart the TM trouble timer and the intersender timer.

1.42 Reception by the coin-zone trunk or junctor of an off-hook signal from the called office causes the trunk or junctor to connect its outgoing tip and ring to the sender for supervision.

1.43 The called office, when it is ready to receive pulsing, changes supervision to on-hook which causes the sender to start pulsing. The sender transmits the called number and releases from the connection.

1.44 If the office is equipped for LAMA, the circuit may be arranged to make a LAMA record. When this is done, the last digit is not sent until the LAMA functions have been completed. The sender does not differentiate between a regular transverter release and a trouble release on dial coin zone calls. It completes the call in either case as soon as the release is received.

OPERATION WITH AUTOMATIC NUMBER IDENTIFICATION

1.45 Provision is made for operation with Automatic Number Identification (ANI). This feature is available for use in offices not equipped with LAMA in which traffic is routed to a CAMA office at some distant point for completion and billing. When this feature is used, the sender uses a group of memory relays of the dry-reed type for receiving calling line identification information from the marker. These memory relays are the same relays that are provided for LAMA. Now, however, the calling line identification information is transferred to the ANI transverter after the called number has been outpulsed. This information is translated into a 7-digit calling number by the ANI transverter and sent back to the sender where it is stored on relays previously containing the called number. These relays are reset at the completion of the outpulsing of the called number. When the CAMA sender is ready to receive the calling number it signals the MF sender which, if successful in ascertaining the calling number from the ANI transverter, outpulses it. Following this, the sender releases.

1.46 The calling number contains an arbitrary "information" digit which is sent immediately after the KP pulse but before the 7-digit directory number. The numerical value of this digit, when translated by the CAMA sender, determines the procedure to be used by the CAMA sender.

1.47 When the sender processes a fully automatically identified call, that is, the calling number has been successfully ascertained from the ANI transverter, it sends an information digit which, when translated by the CAMA sender, denotes the call is still 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.

1.48 When the sender handles a call in which trouble has been encountered in ascertaining the calling number or in which the sender times out waiting to be served by a transverter, 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 attendant position and the call is handled as an attendant identified CAMA call.

1.49 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 "attendant identified" call. The CAMA sender then seizes an attendant position and the call is handled as an attendant identified CAMA call.

1.50 A feature is provided for a second trial of an ANI transverter in the event that the first trial calling number is not checked out by the ANI transverter. A transverter trouble release causes the MF sender to reset its calling number registers and causes a second ANI transverter to be seized. If the calling number information from this ANI transverter checks out satisfactorily, this number is outpulsed and the call is completed on an automatic number identification basis. In the event that the second trial of the calling number identification fails, the call is treated as an identification failure. The information digit is then changed from one indicating an automatic identification failure to one indicating an identification failure and this digit is outpulsed to the receiving office where the call is handled as an attendant identified call.

OPERATION WITH COMBINED ANI-LAMA

1.51 Provision is made for combined ANI-LAMA operation. This feature is available for use in offices handling PPCS calls routed through a traffic service position. A modified AMA transverter is used for this type of operation. This transverter performs both the LAMA and ANI functions.

OPERATION WITH TRAFFIC SERVICE POSITION (INCLUDING PPCS)

1.52 The sender is arranged on a CL8 class basis to transmit more than one non-digital combination of two frequencies as a start ST signal. The variable start signal is used where the call class marks are required to identify combined traffic over a common trunk group to a Traffic Service Position System No. 1.

1.53 With option YK provided, two non-digital frequency combinations are used as call class marks to permit sending 0+ and 1+ coin traffic over a common trunk group to a traffic service position. In this application the 10-1 start pulse combination is transmitted after the called number in place of the usual 10-7 start combination to indicate the 0+ (person-to-person, collect, special) call. A CL8 class mark from the marker will cause the sender to transmit the 10-1 start signal.

1.54 With option YJ provided, the CL8 signal is used in combination with the CR arbitrary digit information to determine the start signal combination to be transmitted after the called number. Four of the five possible start signals can be used to indicate coin and noncoin; and 0+ and 1+ traffic. The combination of 10-0, 10-1, 10-2, and 10-4 will be transmitted by the sender upon receipt of the CR digit registration of 7-0, 7-1, 7-2, and 7-4, respectively, and class CL8. The standard 10-7 start pulse will be transmitted with or without the receipt of CL8, but without a CR digit.

1.55 If the call is PPCS, the sender will, on a class combination basis, send forward either the calling number (classes CL3, CL5, and CL7) or an attendant identification signal (classes CL5 and CL7) to the traffic service position.

MAINTENANCE

A. Monitor

1.56 Provision is made for associating the sender with the automatic monitor, register, and sender test circuit where this circuit is equipped to function with the sender. The monitor circuit is used either as a sender test circuit, where the various types of calls can be simulated and checked, or as a monitor where the monitor circuit is associated with the senders on a random basis on service calls and checks the accuracy of the outpulsing.

1.57 On ANI sender test calls the monitor circuit is used to check both the called and calling number. When the monitor is actually monitoring ANI calls, the called number only is checked.

B. Sender Test Circuit

1.58 Where the monitor circuit is not provided, the sender can be tested by the sender test circuit. In these cases the marker under control of the master test control circuit is used to set up the call to the sender and the supervision is controlled by the sender test circuit.

C. Make-Busy

1.59 A jack per sender is provided at the master test frame for making the sender appear busy to service calls. Certain calls from the master test frame will override the made-busy condition.

SECTION II - DETAILED DESCRIPTION

1. SENDER SEIZURE

GENERAL

1.01 When the marker has ascertained from the code that the call is outgoing and the services of an outgoing sender are required, the marker selects a sender of the proper type with access to an outgoing trunk to the called office. The marker then connects to the sender by means of the outgoing sender connector and transfers to it all the information necessary for the completion of the call. The marker also selects an idle trunk and connects it to the sender by way of the sender link and connects the trunk to the calling line, or to the line link appearance of the calling trunk if a tandem connection is being set up by linkages on the trunk link and line link frames. When the marker is satisfied that the sender has all the required information recorded and that the sender link, line link, and trunk link connections are satisfactory, it gives the sender an advance signal causing the sender to proceed with its functions.

1.02 Outgoing senders appear as horizontals on the sender link crossbar switch and each level is multipled to a similar level on other switches as required. This limits the number of senders in a sender link group to a maximum of ten. Trunks appear as the vertical units of the sender link crossbar switches. The sender link crossbar switch is a 6-wire switch and closes five leads between the trunk and the sender with the sixth lead being used to hold the sender link hold magnet operated.

1.03 The wire spring outgoing sender connector is shown on three separate schematic drawings. These are a preference control circuit, which controls the marker and sender preference; a sender multicontact cut-in relays; a marker part, which consists of the marker multicontact cut-in relays; and a 24-make wire-spring relay, which is provided on a per-sender-per-marker basis. These three parts replace similar parts of the former connector which was covered by a single schematic drawing. In this description the term connector will be used to mean the former connector or any of the three parts of the wire-spring connector.

1.04 The multicontact relay part of the connector is arranged to carry the digit registration leads, the AMA identification leads and all class and other information leads where the marker has the necessary information early in the call. This part is common to all markers and to a number of senders up to the capacity of the connector. The multicontact relays are controlled by the preference relays so that only one set of sender relays and one set of marker relays are operated at any particular time. With both the sender relays and the marker relays operated, the leads are cut through from marker to sender. These relays are held operated only for a time sufficient to pass the required information and are then released so that other markers and other senders can use the connector.

1.05 The per-sender-per-marker cut-in relay being individual to each sender and each marker can be held operated as long as required by the marker without affecting other markers or other senders. This relay, designated S in the wire spring connector, is used to operate the sender off-normal relay which locks all the information transferred through the multicontact relays. It is also used to pass information which the marker may have to obtain after connecting to the trunk link frame and, consequently, may not have in time for transfer through the multicontact relays. The recorder number assigned to the trunk for LAMA purposes is an example of the information that is not always available in time for transfer through the multicontact relays. The S relay is also used for passing the advance signal to the sender when the marker is satisfied that the entire connection is satisfactory and for passing a reorder signal to the sender if the marker finds the connection unsatisfactory. (The S relay ← is also used for connecting the trunk guard lead between the sender and marker. This lead is used by the sender to inform the marker when the trunk has been tested and found continuous. The sender, upon seizure, grounds this lead and when a test for battery and ground the tip and ring conductors has been satisfied, the sender disconnects → the ground.) On dial coin zone calls, the ground is removed from the TG lead without waiting for the continuity test of the trunk conductors. The marker, in light-load periods, will delay its release after sending the advance signal to the sender until the ground is disconnected from the TG lead or for a timed period sufficient to cover the sender trunk test interval. If the marker finds that the ground is still connected at the end of this interval, it causes a trouble record to be made, indicating the particular circuits used on the call. The marker will then cause release of the sender by operating the sender reorder relay.

SELECTION OF SENDER

1.06 The marker, having determined that the call is outgoing and requires the services of a multifrequency pulse sender, selects an idle sender and connects to it through the outgoing sender connector. The sender off-normal ON1 relay operates over lead ON1 through the connector S relay. The ON1 operates the sender-busy SB relay to make the sender appear busy, starts the sender TM timing circuit, and closes ground to various leads for holding all relays operated by the marker.

1.07 The marker transfers the code and numerical digits to the sender. These digits are recorded in the sender in the same order that they recorded in the originating or incoming register.

1.08 The marker also records in the sender any class and delete information required on the call.

1.09 On a LAMA class of call, the marker also records in the sender the identity of the calling line and other information required for completing the AMA initial entry record.

OPERATION OF SENDER LINK

1.10 The marker at this same time selects an idle trunk to the desired destination, connects to the trunk through the trunk link frame, and operates the trunk relay F.

1.11 The selected sender determines the select magnet of the sender link and the trunk F relay determines the hold magnet of the sender link. The marker causes operation of the select magnet and then the hold magnet to connect the trunk to the sender through the crosspoints. Five leads: T, R, AB, D, and TM; are closed between trunk and sender and a sixth lead, HM, connects the hold magnet to the sender where it connects to the winding of the off-normal ON relay. When the crosspoints close, relay ON operates. Relay ON connects ground to lead D to cause operation of relay D in the trunk and the cut-through CT relay in the sender. The trunk D relay closes a circuit for operating the auxiliary supervisory SI relay of the trunk which, in turn connects ground to the abandon call AB lead to the sender to cause operation of the line release LR relay. Since the trunk S1 relay connects the trunk CS supervisory relay to the outgoing tip and ring with the trunk D relay normal, the trunk S1 is operated through the trunk D relay operated to insure that D transfers the outgoing tip and ring leads to the sender before S1 operates. Relay LR closes a holding ground to ON and to the sender link hold magnet and this ground causes release of a polarized relay in the marker as an indication that the link crosspoints are closed and locked.

SENDER ADVANCE

1.12 The marker sets up the line link trunk link connection between the calling line or incoming tandem trunk and the outgoing trunk, and when it is satisfied that all information has been properly recorded, it operates the sender advance relay AV. Relay AV locks to an ON contact which also provides a holding circuit for ON1, and the locking ground operates the check relay AVK in the marker. The operation of the AV relay is a signal to the sender that it should proceed with the call.

DIGIT REGISTRATION

1.13 The code and numerical 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.

1.14 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 a sender relay operates and locks for each desired condition and that no undesired registration exists. Since the number of digits a multifrequency sender receives on different calls may be variable, a further indication is used to mark the end of the registration. 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 a circuit to detect missing

digits since the registration must consist of 2-out-of-5 for each of a variable number of positions followed by an end-seven which is followed by none-out-of-5.

1.15 The sender is arranged to handle up to eleven digits, A through H and J through L, as recorded in the originating or incoming register. A general purpose Start-Seven (ST7) relay is provided to record the start-seven signal whenever there is no register relay provided in the position one beyond the last registered digit.

ARBITRARY DIGITS

A. CR-, BR-, and AR- Digit Registers

1.16 Provision is made in the sender for registering up to three arbitrary digits. These arbitrary digits originate in the marker and are used for code conversion and for code prefixing. Any digits registered on the arbitrary digit registers will be transmitted ahead of digits registered on the A through L digit registers. A single arbitrary digit will be registered on the CR register, two arbitrary digits will be registered on the BR and CR registers, and three arbitrary digits will be registered on the AR, BR, and CR digit registers. In order of transmission, AR is always followed by BR, and BR is always followed by CR. A dial arbitrary digit relay is normally connected to the 0, 1, 2, and 4 leads of its corresponding register so that if a registration occurs the dial relay will operate to cause transmission of the corresponding digit. The dial relay locks and opens its operating path on sequence contacts, thus individualizing the output leads.

B. CL1 Class

1.17 Provision is made for causing the sender to outpulse two fixed arbitrary digits on a CL1 class basis. These two digits may be used as a one-one prefix to be transmitted ahead of the digit registered on the CR- arbitrary digit register or on regular digit register, A to G, with the proper DL- relay operated, or they may be used as the fixed first two digits of an XXX code with the third digit controlled by the CR- digit register.

1.18 Cross-connecting terminals are provided at the output of the AR- digit register, at the output of the BR- digit register, and at the contacts of the CL1 class relay. These terminals can be connected so that with CL1 operated, the terminals at the output of the AR- and BR- digit registers are grounded exactly as if the corresponding digits were registered in the AR- and BR- registers.

1.19 If it is desired to transmit a one-one prefix, both the AR and BR digits would be connected as ones. The steering circuit is arranged so that if nothing is registered in the CR- digit register, this digit position will be skipped.

C. International Direct Distance Dialing (LAMA Arrangement)

1.20 On an IDDD call, the sender is arranged to outpulse a gateway identification code consisting of three arbitrary digits AR2/5, BR2/5, CR2/5. When the marker is arranged for 3-digit code conversion, the marker operates relays AR2/5, BR2/5, CR2/5 in the sender. When the marker is not arranged for 3-digit code conversion, the marker operates only one pair of arbitrary digit relays CR2/5 in the sender. The other two arbitrary digits AR2/5 and BR2/5 are generated in the sender by means of cross-connections at terminals AR2/5, BR2/5, and terminals AGA, AGB, BGA, and BGB.

D. International Direct Distance Dialing Traffic Service Position System Arrangement

1.21 On an IDDD call the sender is arranged to outpulse a prefix digit one as a signal to the TSPS office that this is an IDDD call. This prefix digit is generated by the cross connection terminals AGA, AGB, and terminal AR0, 1 and is outpulsed as an arbitrary digit.

DELETION OF DIGITS

1.22 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 code digits. This is done under control of a delete signal from the marker and provision is made for deleting any number of digits from one to six. The delete relay can be used in conjunction with the arbitrary digit relays for code substitution or conversion.

RECAPTURE PRINCIPLE

1.23 The use of the reed-type register relays with a 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 recapture relays consist of five general purpose relays which are associated with the digit registers, progressively, by the steering circuit. These relays are used for connecting the proper combination of frequencies to the repeating coil for transmission and also for operating the end of pulsing relay after the start pulse is transmitted.

STEERING CIRCUIT

1.24 The digit steering circuit consists of a keypulse steering relay, one relay per digit, a start pulse steering relay, and an end steering relay. Each relay has five transfer contacts, one for each recapture relay, used for associating the recapture relays with the digit register of the digit being transmitted. The contacts are wired so that with two steering relays operated the relay nearest the KP position controls the recapture relays.

1.25 The steering relays are controlled from an ON1 ground. When both AV and ATM have operated, KP operates in preparation for transmission of the keypulse frequency signal. The marker operates any delete relay required and causes registration of any arbitrary digits required. These in turn cause operation of the corresponding arbitrary delete relays. From these relays the sender determines the first digit to transmit following the keypulse signal. With these relays operated, a locking path is established for KP through the contacts of the delete relays and through the back contacts of all the remaining steering relays in the chain to the ON1 ground. Relay KP locks and opens the circuit to ATM to start a recycle of the ATM timer so that it can be used for intersender timing. The ATM timer releases and opens the operating circuit for KP. When SP operates, indicating the completion of trunk test, an operating path is closed for the steering relay for the first digit to be transmitted. This circuit is through PG1 normal, KP operated, and through the delete relays operated or normal to the proper relay. If a digit were registered on the AR digit register DAR would be operated and ARS would operate. If no delete relays were operated the ON1 ground would be carried through the back contacts of all the DL relays to operate AS. If DL3 were operated DS would be operated.

1.26 The steering relay for the first digit operates through its own continuity transfer contacts and locks through the contacts of the remaining steering relays. This steering relay associates the recapture RR- relays with the digit register for the first digit to be transmitted and, on a second continuity transfer contact, transfers the locking circuit for the KP relay from the ON1 ground connection to the operating ground for the digit steering relay. When this locking circuit is opened, as it will be when PG1 operates to terminate the keypulse signal, KP releases. When PG1 releases on its next cycle, the ON1 ground is closed through the operated steering relay to cause operation of the steering relay for the second digit. The circuit progresses in a similar manner for each digit with PG1 releasing to cause operation of the steering relay for the digit to be transmitted next and PG1 operating to cause release of the steering relay for the digit just transmitted.

LAST DIGIT INDICATION

1.27 The steering relays also control the last digit LD relay which is used to indicate the number of digits registered. The LD relay has two general functions. First, it is used to cancel any off-hook indication received after the tens digit is transmitted and, second, it enables the sender to withhold transmission of the units digit until the transverter has completed its functions on AMA class calls.

1.28 Relay LD is double wound and is operated initially on its primary winding when ON operates. It is held on its secondary winding which is connected in series with the digit register relays. When the first digit steering relay operates from SP at the completion of trunk test, the direct locking ground for the digit register two digits beyond is disconnected and the secondary winding of LD is connected in series with the locking circuit by means of continuity transfer contact. This prevents release of the digit registration and provides a holding circuit for LD when the primary winding is opened. The LD is designed to hold itself operated through its secondary winding with current supplied through one or more register coils. The 4300-ohm

resistor also holds the digit registration in case there is a loss of continuity of the transfer contact.

1.29 In order to permit the sender to determine in advance where no digit or an end-seven signal is registered, the connection from each steering relay is made to the digit register two digits ahead.

1.30 After the keypulse signal is transmitted, the primary winding of LD is opened by the release of KP. Subsequently the steering relay for the second digit to be transmitted is operated and adds the digit register for the digit three ahead of the first digit to be transmitted in series with the LD secondary winding, so as to provide a new holding circuit when the steering relay for the first digit is released.

1.31 A typical example of the operation of the LD relay is as follows: Assume a registration of one arbitrary digit and seven additional digits with delete three. When KP operates, CRS will operate to connect LD in series with the E-digit register which has two coils operated. When PG1 releases to transmit the CR digit, DS will operate to connect LD also to the F-digit register which has two coils operated. After the CR digit is transmitted, CRS releases, disconnecting LD from the E-digit register. When PG1 releases to transmit the D digit, ES operates to connect LD to the G-digit register which has two coils operated. After the D digit is transmitted, DS releases, disconnecting LD from the F-digit register. Then FS operates connecting LD to the H digit register which has H7 operated. When the E digit is transmitted, ES releases, disconnecting LD from the G-digit register, requiring LD to hold in series with H7. The GS operates, connecting LD to the J-digit register which has no coils operated and when the E digit is transmitted, FS releases allowing LD to release.

1.32 A similar type of operation occurs on calls with other sequences of digits with the LD being walked down the steering chain and being held on an overlap basis until a point is reached where there is no registration, at which time LD releases.

1.33 In order to provide continuity for LD and to permit it to be connected two digits ahead, considering only those digits to be transmitted, the contacts of the delete relays are wired so as to remove from consideration any digits to be deleted from pulsing. This is required when there are arbitrary digits and deleted digits on the same call and there is only one digit in addition to the arbitrary digits to be transmitted. It is also required to cause release of LD before transmission of the digit when there are deleted digits and there is only one digit to be transmitted.

2. TRUNK TEST AND SUPERVISORY CONTROL

GENERAL

2.01 The sender provides a timed cover-up interval before closing the loop to make trunk test for those trunks which are subject to reseizure immediately on release at the originating end. This interval insures full release at the distant end from prior calls. On 2-way trunks and one-way intertoll trunks, which provide for their own cover up, the sender closes the loop immediately but times an interval before determining the polarity with option ZR provided. With option ZS provided, the loop is closed and the polarity determined immediately upon sender seizure. When the sender recognizes the proper polarity or the proper change of polarity, it starts pulsing.

2.02 Provision is made for four types of supervision. These are described as follows:

(a) Regular Class - Neither CL2 nor CL4 relay operated. Calls are completed on ordinary one-way trunks. A change from off-hook to on-hook is required to start pulsing.

(b) Two-Way Class - Relay CL2 operated. Call is completed to intertoll or local 2-way trunks. With option ZR provided, pulsing starts with on-hook supervision which may or may not have been preceded by off-hook. With option ZS provided, pulsing starts with a reversal from off-hook to on-hook.

(c) Dial Coin Zone Class - Relay CL4 operated. Call is completed to dial coin zone trunk or junctor. Supervision in the sender is open loop until the attendant answers when it goes on-hook. A change from on-hook to off-hook indicates attendant disconnect. A change from off-hook to on-hook is required to start pulsing.

(d) Automatic Number Identification - Relay CL5 operated with or without CL3 or AMA relay operated. After the sender outpulses the called number, a change in supervision from on-hook to off-hook indicates the CAMA sender is ready to receive the calling number. The "information" digit, followed by the full calling number if automatic identification was made, or only the "information" digit, if automatic identification failed or is not desired, is then outpulsed.

TRUNK TEST TIMING

2.03 The trunk cover-up interval is timed by the auxiliary timer ATM. This timer provides a time of 460 milliseconds, minimum, 600 milliseconds, nominal, and 900 milliseconds, maximum, with CL2 normal or 280 milliseconds, minimum, 370 milliseconds, nominal, and 570 milliseconds, maximum, with option ZR provided and CL2 operated, for the trunk test interval. The cover-up interval is equal to this time plus the functioning time of some general purpose relays. The ATM timer consists of the ATM relay, the ATM tube, and the associated capacitors and resistors. The ATM tube is a cold cathode gas tube with characteristics such that no current will flow unless the gas is ionized. A potential of 130 volts between the main anode terminal 2 and the cathode terminal 4 is insufficient to cause ionization. A voltage of 72 volts, nominal, across the control anode terminal 1 and the cathode terminal 4 will cause ionization. The voltage across the 1 and 4 terminals is equal to that on the ATM capacitor which is controlled in the time by the value of the capacitor and the value of the charging resistor.

2.04 With ON normal, the ATM capacitor is discharged through the discharge resistor ATM2. When ON operates, this discharge path is opened and one side of the capacitor is connected through the winding of ATM to ground. This establishes a charging circuit for the ATM capacitor through the charging resistor ATM3 and ATM4 to the 130-volt potential. When the charge reaches 72 volts nominal, the gas in the tube will ionize and current will flow from the 130-volt source through the main gap terminals to operate relay ATM. At this time AV usually will be operated, or when it is operated by the marker the KP steering relay operates and opens the circuit to ATM. The timer is then recycled for timing the intersender interval. The ATM releases and, with KP operated, operates ATC to restart the timer on other than dial coin zone calls, ATC locks. The ATM1 resistor is provided to prevent any appreciable current flow in the control gap when the gas ionizes. The ATMA capacitor is provided to prevent any high-frequency transients which may be picked up on the 130-volt or other wiring leads from affecting the time of the timer. The timer is started by ON since the operation of ON over lead HM is the first indication to the sender that the trunk has been seized.

2.05 The resistor, in series with the ATM winding, is provided to reduce the current through the tube to prolong its life.

REGULAR CLASS

2.06 This class includes all one-way trunks except intertoll and 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 and the trunk guard TG lead to the marker is opened as an indication of a satisfactory trunk test. This feature is described in the paragraphs on Trunk Test Indication to Marker. When AV has operated, indicating that the marker has completed its job of establishing the connection, and when KP has operated after operation of ATM, 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. The KP contact in the tip and ring circuit is paralleled by a contact on ATC to maintain a closure after KP releases after transmission of the keypulse signal.

2.07 If the supervision is on-hook, OF remains normal, but TG operates to operate TG1. The TG1 locks and opens the TG lead to the marker. 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 releases and RT releases but reoperates to cause operation of the start pulsing SP relay through OF1 operated. Relay SP locks, opens the path used for operating the keypulse steering relay, operates the steering relay for the first digit to be transmitted, connects the keypulse frequencies through the operated KP relay contacts to the T repeating coil, and starts the PG interrupter as described in the section on pulsing.

TWO-WAY CLASS - OPTION ZR PROVIDED

2.08 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 AV in order to maintain the seizure signal after release of the trunk F relay for loop supervision trunks. This early loop closure serves no purpose on calls over trunks which have supervision over leads other than the talking path.

2.09 These trunks may have on-hook supervision initially but this changes to off-hook upon seizure as soon as the seizure signal is sent to the far end and an acknowledgement is returned. It reverts to on-hook when the distant sender or register is ready to receive pulses. Neither the intial on-hook nor the off-hook signal is of sufficient duration to insure recognition by the sender under all conditions, consequently, the sender is arranged to ignore the supervision initially for a period long enough to cover the initial on-hook and then to start pulsing with on-hook supervision.

2.10 Since these trunks provide their own cover-up interval, the ATM timer is not required for this purpose and it is used on the CL2 class for timing the cover up of the initial on-hook signal. The time of the timer is reduced to 280 milliseconds, minimum, 370 milliseconds, nominal, and 570 milliseconds, maximum by the operation of the CL2 relay. The circuit for operating SP is not closed until ATC operates as a result of the operation and subsequent release of ATM. If the initial supervision is off-hook, OF operates to operate OF1 which opens the TG lead to the marker but pulsing is delayed. If the initial supervision is on-hook, TG operates to operate TG1 and SP. The TG1 opens the TG lead to the marker. If the supervision is off-hook and then changes to on-hook, OF releases and TG releases but reoperates to operate SP. The SP locks, opens the operating circuit for the keypulse steering relay, operates the steering relay for the first digit to be transmitted, connects the keypulse frequencies through the operated KP relay contacts to the T repeating coil and starts the PG interrupter. The SP also opens the circuit to ATM to terminate the intersender timing interval.

TWO-WAY CLASS - OPTION ZS PROVIDED

2.11 With option ZS provided the sender will function in a similar manner as class CL2 calls to option ZR provided, with the exception that the loop is closed and the polarity determined immediately upon sender seizure. On this type of call, a change in polarity from off-hook to on-hook is required for the sender to start pulsing. Also, the ATM timer is not used on this arrangement since the loop must be closed early to recognize the trunk integrity check.

TIMING FOR TSPS NO. 1 AND AIS

2.12 On calls to traffic service position system No. 1 and to automatic intercept service over trunks which provide their own cover-up interval, provision is made on a cross-connection basis to eliminate the trunk test timing interval. Front contacts of the class CL8 relay (calls to TSPS) and of the class CL13 relay (calls to AIC) connect resistor ATM8 in parallel with resistor ATM3. The ATM6 resistor reduces the time of the timer to 30 milliseconds, minimum, 48 milliseconds, nominal, and 75 milliseconds, maximum.

TIMING FOR EXPANDED EPSCS DIGIT 8 - OPTION WP

2.13 On EPSCS calls over 2-way trunks which provide their own cover-up interval, provision is made on a cross-connection basis to eliminate the trunk test timing interval. Front contacts of the CL7 and CL2 relays connect resistor ATM6 in parallel with resistor ATM3. This parallel combination reduces the time of the timer to 33 milliseconds minimum, 50 milliseconds nominal, and 66 milliseconds maximum.

TRUNK TEST INDICATION TO MARKER

2.14 In light-traffic periods, the marker will remain connected to the sender through the control connector channel for an interval sufficient to permit the sender to make a test for battery and ground on the

trunk tip and ring conductors. When the sender is seized the ON relay connects ground to the TG lead to the marker except on dial coin zone calls. This lead remains grounded until the sender detects battery and ground at the tip and ring leads or until the sender reorder RO relay is operated. In the event that the marker, in a light-load period, completes its timing cycle before the ground is removed from the TG lead, it will cause a trouble record card to be made giving the details of the call and then cause the sender RO relay to be operated. Operation of the RO relay will cause operation of the overflow relay of the trunk and release of the sender.

2.15 Relay ON operates as a result of the sender link crosspoint closure and closes ground to lead TG to the marker through the marker connector. After the trunk timing interval, the OF and TG relays are connected in series with the tip and ring leads and their contacts enabled. If these leads are continuous, one or both of the TG and OF relays will operate to operate TG1 or OF1. Either of these relays will disconnect the ground from the TG lead thus indicating to the marker that the trunk test is satisfactory from the standpoint of continuity. When the sender is used for dial coin zone service, the trunk or junctor does not close the loop to operate the TG and OF relays until the attendant answers. This would probably not be until after the marker had timed out on trunk test. Therefore, the CL4 relay disconnects the ground from the TG lead. In case RO is operated prior to trunk test, the ground is disconnected from the TG lead. On certain calls such as no-digit calls where the sender does not make trunk test, the marker opens the TG lead by its own class relay contacts.

2.16 In heavy-traffic periods, the marker will disconnect from the sender before the sender completes trunk test and in this case the sender can be required to make trunk test before release, by the operation or pulling out of the associated cancel timed release key CTR at the master test frame jack, lamp, and key circuit. This causes a locking circuit to be applied to LR until the trunk test is satisfied as indicated by the operation of TG1 or OF1. This locking circuit is not closed until AV operates so as to prevent locking LR on calls for which partial information has been received at the sender and then the call is abandoned. This might occur when the call enters this office by way of an incoming register. The LR locking circuit is opened by EP to take care of no-digit class calls when the sender does not make trunk test, and by the release of CT to take care of those calls which end before trunk test by the operation of RO relay.

2.17 When AV operates, an ON ground is connected to the LR winding through key CTR operated, normal contacts of TG1, OF1, and EP and operated contacts of AV, CT, and LR. If EP, TG1, or OF1 operate this path is opened. When RO operates, it releases CT which opens the path. If the path remains closed, the sender cannot release since LR holds ON and ON holds LR. If this occurs, the timing circuit will function to cause a sender time-out alarm. The sender can be released by releasing (pushing in) the CTR key.

REVERSED TRUNKS

2.18 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.

2.19 On the regular class with class relays 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.

2.20 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 to operate TRL.

2.21 Operation of TRL indirectly causes operation of the overflow relay of the trunk and release of the sender if the cancel timed release key for the sender is normal. If the CTR key is operated, the sender is held until manually released.

2.22 If the call is abandoned before TRL operates, the sender will release.

3. PULSING

GENERAL

3.01 The time of application of the frequencies to the line and, consequently, the speed of pulsing is under control of the pulse generator. The frequencies actually transmitted are controlled by the recapture relays.

PULSE GENERATOR

3.02 The pulse generator consists of the PG and PG1 relays and the associated capacitors and resistors. Relay PG is a mercury contact relay with two windings. This relay has a single armature spring which closes with two separate back contacts and with two separate front contacts. The actual contact is made through a film of mercury; consequently, there should be no contact erosion. In this circuit the two front contacts are used in parallel and the back contacts are not used. This relay is polarized so that it can be controlled by current direction and it is not biased, so that with no current flowing the armature takes no definite position; that is, it may close with the front contacts or it may close with the back contacts. The current reversals are under control of the auxiliary relay PG1, which in turn is under control of PG, thus completing the self-interrupter circuit.

3.03 When ON operates, it connects ground through a normal contact of SP to one side of the PG capacitor which is in series with the primary winding and to the PG1 resistor thus grounding out the battery and connecting ground to the -6 terminal of the secondary winding. At this time the 7 terminal, plus for the secondary winding and minus for the primary winding, is connected to resistance battery. The current in the secondary winding is in a direction to release PG but the current in the primary winding charging the PG capacitor is in a direction to operate PG. Initially the primary ampere turns are more powerful and the relay operates but, as the capacitors become charged the primary winding ampere turns decrease, the secondary winding ampere turns finally become controlling and cause PG to release. The circuit remains in this condition until SP is operated. The SP, in operating, disconnects the ground from the PG capacitor and from the PG1 resistor allowing the PG1 resistor battery to become effective and connects ground to the 7 terminal through PG1 normal contacts. This causes the current in the secondary winding to flow in a direction to cause operation of the relay and sets up a circuit for discharging and charging in the opposite direction the PG capacitor through the primary winding. At first the primary winding ampere turns are controlling and PG remains unoperated. Then, as the capacitor becomes charged, the primary ampere turns decrease and the secondary winding again takes control causing PG to operate. The PG, in operating with SP operated, operates PG1 to again reverse the circuits through both windings causing PG to release after a timed interval. This cycle is repeated as long as PG1 remains under control of PG. When it is desired to stop the interrupter, an auxiliary circuit to PG1 is closed, thus preventing release of PG1 and stopping the interrupter.

3.04 The time PG remains on its back and front contacts is controlled by the values of the capacitor and resistors. On this circuit two sets of constants are provided. With KP operated, additional resistance is inserted in the secondary winding circuit to reduce the ampere turns of this winding and thus increase the intervals. With KP normal, the interrupter is designed to give a speed of approximately 7.2 pulses per second.

3.05 Facilities are provided for adjusting and controlling the output of the interrupter for the digit pulsing condition with KP normal by removing or adding resistance in the network.

ASSIGNMENT OF FREQUENCIES

3.06 The multifrequency signals are generated in the sender by means of transistor oscillators or in the multifrequency current supply circuit. The frequencies are brought to the contacts of the translating relays on a lead per frequency basis. 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 keypulse, for a start or end pulse. These frequencies are assigned designations 0, 1, 2, 4, 7, and 10 so as to fit in with 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 (Regular)					x	x
ST Pulse (Special)	See Traffic Service Position					

GENERATION OF FREQUENCIES

3.07 Where it is economical, the frequency generator of App Fig. 6, wired per FS12, will be provided. This generator makes use of a transistor oscillator for each of the six frequencies. The power for operating the oscillators is obtained from the 48-volt source through a voltage divider circuit used in common by all six oscillators. The power is applied under control of the ON relay and, thus, the oscillators are started when ON operates at the start of the call and are stopped when ON releases on sender release.

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

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

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

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

TRANSMISSION OF FREQUENCIES

3.12 These frequencies are connected to the input side of the T repeating coil by the contacts of the recapture relays and the KP relay under control of the SP and PG1 relays. The higher frequency is always connected to one side of the coil and the lower frequency to the other side. In this manner one frequency lead serves as a return path for the other frequency.

3.13 When the KP and SP relays are operated, the 2 and 10 frequencies are connected to the input side of the repeating coil causing the transmission of these frequencies over the tip and ring leads. Relay PG1 operates after a timed interval disconnecting these frequencies from the

repeating coil. Relay KP then releases enabling the RR- relay contacts. These relays were associated with the first digit to be transmitted by the operation of a digit steering relay and when PG1 releases the frequencies for the first digit are connected to the input of the repeating coil. Relay PG1 then operates and terminates the first digit and releases the steering relay for the first digit thus placing the RR- relays under control of the next digit steering relay. Relay PG1 then releases causing transmission of this digit. This process is continued with a combination of frequencies being connected to the input of the repeating coil each time PG1 releases and the RR- relays changing their patterns, if required, during the operated time of PG1.

3.14 When all the digits registered have been transmitted, the RR- relays will be associated with a digit register which has only the -7 relay operated. This will cause operation of only the RR7 relay, which connects the frequencies 7 and 10 to the input of the repeating coil if the person paid collect special class relay CL8 is not operated. If the CL8 relay is operated, the frequencies 1 and 10 are connected to the input of the repeating coil. This is the start pulse combination. When PG1 operates, to terminate the start pulse, the steering relay will release to release RR7 and all the RR- relays will remain normal to cause operation of the end-of-pulsing relay EP.

3.15 Relay EP is sufficiently slow to operate to insure that it will not operate if all the RR- relays are normal momentarily when they are transferred from one digit to another. The LD contact in the EP circuit is for preventing the RR- contacts from closing any current to the EP until after the tens digit is transmitted. This reduces the erosion of these contacts. The EP relay in operating causes release of the sender.

TWO-OUT-OF-FIVE CHECK

3.16 A feature is provided in the pulse generator circuit to check that two of the five recapture relays are operated for each digit transmitted. An "except 2-out-of-5" circuit of the RR- contacts is connected to the locking circuit of the PG1 relay. The recapture relays are transferred from one digit to the next while PG1 is operated and unless two, and only two, of these relays remain operated PG1 will not release to advance to send the digit. This feature will serve to detect falsely closed and open contacts at the digit register and at the steering relays. If the PG1 relay fails to release, the timing circuit will function to cause release of the sender.

4. RELEASE OF SENDER

GENERAL

4.01 The multifrequency 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 and the end of pulsing or release control relay EP is under control of the RR- relays.

4.02 The LD relay is used also to look ahead so that the transmission of the last digit can be delayed until the AMA record is completed on LAMA class calls. This relay also disables the OF relay contacts so that a subsequent supervision reversal due to an overflow condition at the called office will not be construed as a reversed trunk. The operation of LD is described in Last Digit Indication. After the next to the last digit has been pulsed the associated digit steering relay will release and allow release of the LD relay. Relay LD closes a locking circuit to PG1 in series with a front contact of AMA. This circuit prevents release of PG1 as long as AMA is operated thus withholding the last digit until the LAMA record is completed.

4.03 When the last digit and start pulse have been transmitted all RR- relays will remain 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 release 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. Relay ON and ON1 allows release of all the operated relays. The sender-busy SB relay releases from ON1 and recloses the busy test leads.

5. SENDER TIMING

GENERAL

A. Nonoverload Timing - TM

5.01 The sender in nonoverload periods, except on LAMA class calls and dial

coin zone class calls, is allowed a fixed interval timed by the TM timer for completing the call. In the case of a TM trouble time-out, the sender operates the overflow relay of the trunk. If the cancel timed release CTR key for the sender at the master test frame is normal (pushed in), the sender will release. If the CTR key is operated the sender will hold until manually released. In this case the trunk will also be held, although the customer can release by abandoning the call. If the sender is held, the forward connection is released except in the case of a CL2 class trunk where a closure is maintained on the tip and ring.

5.02 On LAMA-class calls a shortened interval is allowed for the LAMA functions to be completed. If a LAMA release is received before the interval expires, the TM timer will be recycled and set for the trouble time-out interval. If the TM timer times out, it will cause the trunk to be set to overflow and the bid to the transverter to be withdrawn. If a transverter has not been connected, the sender will release. If a transverter has been connected, the sender will be held until a transverter release is received.

5.03 On dial coin zone calls a doubled time-out period is allowed for the attendant to answer. If there is no answer in the allowed time, the TM timer will operate to close a path which will allow a marker, finding an all-senders-busy condition, to release the sender. The TO lamp for the sender at the jack bay of the master test frame will light dimly until the sender is released or the attendant answers.

5.04 When the attendant answers, the TM timing is canceled and the TM relay, if operated, is released. If they were activated, the all-senders-busy release path is opened and the TO lamp is extinguished.

5.05 When the attendant disconnects, the TM timer starts the trouble time-out interval unless the LAMA features are used and a release has not been received from the transverter. In this case the timer is set for the LAMA short timing interval. If the shortened period expires, the bid for the transverter is withdrawn and the timer is recycled to the regular interval. If the second interval expires before a transverter release, the trunk will be set to reorder.

5.06 In case of a TM timer sender trouble time-out, the Timer-Out (TO) lamp for the sender at the jack bay of the master test frame will light until sender release occurs. If the CTR key is normal, the lamp will light only momentarily. If the CTR key is operated, the lamp will light steadily and the major alarm will operate in 10 to 15 seconds causing the R-S-TOA lamp to be lighted. Insertion of a No. 322A make-busy plug into the MB jack associated with the lighted lamp will retire the alarm and the R-S-TOA lamp and will make the sender busy to service calls, but will retain the TO lamp. The stuck sender plant register for the sender group will be operated as a result of a trouble TM time-out.

B. Overload (Intersender) Timing - ATM

5.07 A sender group overload control feature is provided for preventing an overload condition which cause a shortage of incoming registers (senders) at one office from creating an overload condition in other offices. The auxiliary timer is recycled after its operation in connection with the trunk cover-up interval and is used for timing the interval required for an incoming register or sender to be attached to the trunk and a start pulsing polarity returned. The auxiliary timer has a nominal time of 5.7 seconds for this function and, if the timer times out a path is closed to

the reorder relay so that the marker, if it finds an all-senders-busy condition, can cause release of the sender. If the start pulse polarity is received before the timer has timed out or if the timer has timed out before the marker has released the sender, the timer is disabled. The timer is started when the tip and ring leads are closed for trunk test. On dial coin zone calls, the ATM timer is not started until the attendant disconnects to allow the call to complete. The timer is disabled by the operation of the start pulse SP relay. This feature will cause the release of senders which are unable to proceed because of a shortage of registers or senders at the terminating office when there is also a shortage of senders at this office.

5.08 This timer does not affect the TM timing circuit and no visual indication is given at the master test frame of the timed out condition. The sender time-out release traffic register will be operated over the STR lead, if the sender is released by the marker as a result of a time-out coupled with an all-senders-busy condition.

5.09 If the delay before receiving the start-pulse signal persists until the TM timer functions, the subsequent operation of TRL will open the circuit to ATM.

TM TIMING CIRCUIT

5.10 The TM timing circuit consists of The TM relay, TM tube, and the associated capacitors and resistors. The TM is a gas filled cold cathode tube with characteristics such that no current will flow unless the gas is ionized and a potential of 130 volts across the main gap terminals 2 and 4 is insufficient to cause ionization. A potential of 72 volts nominal, however, across the control gap terminals 1 and 4 will cause ionization. The voltage across terminals 1 and 4 is equal to that on the capacitor TM, which is controlled in time by the value of the capacitor and the register in the capacitor charging path.

5.11 With ON1 normal, the TM capacitor is discharged through the discharge register TM2. When ON1 operates, this discharge path is open and one side of the capacitor connected through the winding of TM to ground. This establishes a charging path to the 130-volt potential.

5.12 If the call is completed within the allowable interval, ON1 releases, opening the charging circuit and reclosing the discharge circuit.

5.13 If the call is not completed within the allowable interval, the capacitor TM will become charged to 72 volts nominal and this voltage, across tube terminals 1 and 4, will cause the gas to ionize. Current will then flow in the main gap between terminals 2 and 4 to cause operation of the TM relay.

5.14 The time required for the timer to function is dependent on the tube characteristics, the voltage, the size of the capacitor, and the value of the charging resistor. In this circuit, the following capacitors and charging resistors are used to provide the timing intervals shown in the following table.

Timing For:	Capacitor	Charging Resistor	Timing (sec) Min	Max
Normal Timing	TM	TM3	12.7	24
AMA Transverter Functions	TM	TM3, TM4 in parallel	6.3	12
Coin Zone Dialing (No AMA)	TM, TMB in parallel	TM3	25.4	48
Coin Zone Dialing (With AMA)	TM, TMB in parallel	TM3, TM4 in parallel	12.7	24
IDDD Second Off-Hook	TM, TMB in parallel	TM7	15.0	28
IDDD Off-Hook Wink	TM	TM7	7.5	14

5.15 On LAMA class calls RLT operates when the transverter functions are completed. When option XL is furnished RLT operated connects the discharge resistor TM2 across the TM capacitor causing its discharge. The STT then releases to open this discharge circuit and start a new timing cycle. When option WB is furnished, relay RLT operated releases relay TMC to recycle the timer.

5.16 On dial coin zone calls an additional capacitor TMB is connected in parallel with the TM capacitor for the preoperator answer timing interval. This extends the initial timing interval to 25.4 seconds, minimum, 32.4 seconds, nominal, and 48 seconds, maximum. A current-limiting resistor TM6 is added in series with the TMB capacitor to prevent damaging any contacts connecting the capacitors together when they have unequal charges. The TM5 resistor discharges the TMB capacitor when it is not in the circuit.

5.17 When the attendant answers, the TG1 relay operates removing the TMB capacitor from the timing circuit and discharging it through the resistor TM5. The TG1 operating, with OF1 normal, operates CTM. When option XL is furnished, relay CTM operated opens the charging path for the TM capacitor and closes a path to discharge it. When option WB is furnished, relay CTM operated releases relay TMC to recycle the timer. The CTM relay also opens the holding path for the TM relay to allow it to release, if it is operated.

5.18 When the attendant disconnects, the OF1 relay operates releasing CTM. The CTM releasing restarts the TM timer. The timer with the AMA relay normal has a nominal time of 16.2 seconds. With AMA operated, the time is reduced to 8.1 seconds, nominal. If a transverter release, either regular or trouble, is received before the TM circuit times out, the timer is recycled for 16.2 seconds, nominal. If the transverter release is not received, TM operates to operate CTV1. When CTV1 operates, it operates CTM to recycle the TM timer to 16.2 seconds, nominal. When TM releases, CTV2 operates and opens the transverter start lead. The last digit is not pulsed out until the transverter releases.

5.19 The TM1 resistor is connected to the control anode terminal No. 1 to prevent excessive current flowing when the gas ionizes. The TMA capacitor is connected at anode terminal No. 2 to prevent any high-frequency surges, which may be picked up on the 130-volt supply lead, from affecting the operating time of the timer.

5.20 On ANI class calls, the TM timer is used to time various phases of the calling number operation. When the R relay operates immediately following the outpulsing of the ST pulse associated with the called number, the TM timer capacitor is discharged through the TM2 discharge resistor. A short timer later, the R relay releases and the recycling of the timer, following the outpulsing of the called number, is completed.

5.21 On automatically identified AI, ANI calls the ANI transverter seizure and functioning time is also included as a TM timing function. When the ANI transverter has ascertained the calling number and sent it back to the sender without encountering any difficulty, the RLT relay operates in the sender. This recycles the timer. If trouble is encountered in the first-trial ANI transverter and the second-trial ANI transverter satisfactorily ascertains the calling number and transfers it to the sender, the RLT relay in the sender will operate and cause the TM timer to recycle. If the second-trial ANI transverter also fails on the translation of the calling number, the TR relay operates in the sender and recycles the TM timer. Failure of either the RLT or TR relay to operate within the timed interval of 16.2 seconds nominal will result in one of two operations depending upon the option provided. With option WN provided, the TR relay will be operated by the TIF relay to cause the sender to function the same as for an identification failure call. Without option WN, completion of the time interval will cause operation of the TM relay followed by the TRL relay which operates the RO relay, and a trouble release follows as described in TM Trouble Time-Out.

5.22 After the TM timer has been recycled by the operation of the RLT or TR relays and the release of the STT relay, the timer is again made operational for the calling number outpulsing function of the call. Since the STT relay has released, the timer is now restored to its original 16.2 seconds normal. This timing is in effect until the ON1 relay releases at the end of the call.

5.23 Likewise the TM timer is used to time the outpulsing of the KP signal plus the X information digit in an operator identified, OI, or identification failure, IF call. If these pulses are not sent followed by the release of the ON1 relay within the 16.2 seconds, nominal, time of the timer, a trouble release will result.

TIMING ON IDDD CALLS (LAMA ARRANGEMENT)

5.24 When the sender is seized relay ON1 operates relays TMA, TMB, and TMC to start the TM timer for a 6.3- to 12-second timing interval. When the sender subsequently is ready to request a transverter it will operate relays STT and STT1. Relay STT1 operated prevents the timing circuit from being recycled as a result of other functions the sender is performing while the transverter is attached.

5.25 When the transverter completes its functions, sender relay RLT operates to recycle the timer and when relay STT1 releases the timing circuit starts on the next timing period depending on how far the sender has progressed at the time relay STT1 released. Let us assume that the sender is outpulsing the gateway identification code at the time the transverter completes its functions. The subsequent release of relay STT1 will start the timer on the 12.7- to 24-second timing period for the sender to complete the first stage outpulsing.

5.26 At the end of first stage outpulsing, relay EFP operates to recycle the timer and start the 15- to 28-second timing period for the receipt of the second off-hook. This off-hook is the start of the off-hook wink signal from the gateway office to start the second stage outpulsing.

5.27 When the second off-hook is received relay WK operates to start a transistor timer TOF which in turn times for 65 to 77 milliseconds. This 65- to 77-millisecond timing plus the operate times of relays OF, SOF, and TOF insures that the sender will see a minimum 130-millisecond off-hook wink before it recognizes it as a legitimate off-hook. This timing prevents the sender from starting its second stage outpulsing prematurely on a false on-hook hit signal.

5.28 Relay WK and TOF also recycle the TM timer and start a 7.5- to 14.1-second timing period for the receipt of an on-hook. This checks that the off-hook wink does not persist for more than 7.5 to 14.1 seconds.

5.29 At the end of the off-hook wink the sender will receive a second on-hook signal which operates relay SON. Relay SON recycles the TM timer and starts a timing period of 12.7 to 24 seconds for the sender to complete its second stage outpulsing and for the sender to release.

ACTION ON TM TROUBLE TIME-OUT

5.30 The TM operates on its primary winding through the TM tube to the 130-volt supply, locks on its secondary winding to the 48-volt supply, and opens the operating circuit to reduce the 130-volt current drain. This also prolongs the life of the TM tube since the tube life is inversely proportional to the time of current flow.

5.31 The TM operates TRL, which grounds the stuck sender register lead SS to the plant register circuit, grounds the LP lead to the jack, lamp, and key circuit to light the TO lamp for the sender, grounds the ALM lead to the jack, lamp, and key circuit to start the office timer, and operates the reorder relay RO. Where option WT is provided, and the time out occurs on a test call while the sender is made busy, the MB relay will prevent the TRL relay from grounding the SS lead to the plant register circuit.

5.32 On CL2, class calls, TRL connects the tip and ring leads together to prevent an idle indication on 2-way trunks with loop supervision.

5.33 The RO connects a 226-ohm battery to lead AB to operate the marginal overflow relay of the trunk, transfers LR from the AB lead to ground, and releases the slow-release relay CT. Relay CT disconnects the resistance battery from the AB lead, disconnects ground from the stuck sender register lead, and releases LR. Relay CT also opens the tip and ring leads to allow release of the forward connection except on CL2 class calls.

5.34 If the CTR key is normal, 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 LP and ALM leads to the jack, lamp, and key circuit.

5.35 If the CTR key is operated, ON will be held through TRL to maintain the grounds on leads LP and ALM to the jack, lamp, and key circuit. The ground on lead LP will light the TO lamp while the ground on lead ALM will cause the major alarm to operate with the R-S-TOA indication. If the sender make-busy relay is operated by the insertion of a plug in the make-busy jack, the ground is removed from the ALM lead retiring the alarm. The TO lamp is not extinguished however. In offices equipped with a stuck sender trunk identifier circuit SST1, the operation of the MB relay also puts a 226-ohm battery on the AB lead to the trunk. When the AB leads are scanned by the SSTI circuit, this resistance battery operates a detector relay in the SSTI circuit thus locating the trunk associated with the stuck sender.

5.36 When the CTR key is restored to normal, ON releases allowing release of the operated relays of the sender. The TRL releases from ON1 and extinguishes the TO lamp.

5.37 If some trouble prevents release of ON1 and the sender when the CTR key is normal, the alarm will be brought in as described for the CTR key operated.

5.38 On an international direct distance dialing LAMA call, relay RSA1 which operates during sender recycle between the first and second stage outpulsing periods, cancels the effect of the CTR key during this period. Relay RSA1 operated prevents the sender from sticking on a time out which can occur if an "all-trunks-busy condition" is encountered between the crossbar No. 5 local office and the gateway office. The operation of the IDR key in the master test frame jack, lamp, and key circuit will override the effect of relay RSA1 and permit the sender to stick on a time-out during the sender recycle period.

TRL WITHOUT TM

5.39 If the sender detects a reversed trunk, TRL may be operated directly without waiting for TM to operate. In this case TRL will perform its functions in the same way as on a regular sender time out and it also connects the TM2 discharge resistor across the TM capacitor to prevent operation of TM so as to give a clue to the cause of the trouble.

TIME-OUT DURING LAMA FUNCTIONS

5.40 In order to not cause partial records on the AMA tape, the sender is arranged so that it will not release while connected to a transverter. If a TM time out occurs during the AMA functions, the TM, TRL, RO, CT, and trunk overflow relays operated as described but LR will be held by the operated STT relay to prevent release of the sender. When the transverter transmits a release signal, either regular or trouble, to the sender, AMA releases and STT releases to cause release of LR followed by ON and the operated relay of the sender, if the CTR key is normal.

5.41 If the transverter is unduly delayed after a sender time-out, the major alarm will be brought in.

INTERSENDER TIMING

5.42 The auxiliary ATM timer is used on sender seizure for timing the trunk cover-up interval and the operation of ATM with AV operated causes operation of the KP steering relay. Relay KP closes the tip and ring for trunk test on regular class trunks with class relay CL2 normal and opens the circuit to ATM. The ATM releases and, with KP operated, causes operation of ATC to

restart the timer except on dial coin zone class. The ATM is somewhat slow to release and ATC is somewhat slow to operate to allow sufficient time for the discharge of the ATM capacitor and deionization of the ATM tube. With ATC operated the ATM capacitor charging path is through the ATM5 resistor and this combination of resistance and capacity gives a time delay in the operation of relay ATM of 4.4 seconds, minimum, 5.7 seconds, nominal, and 8.4 seconds, maximum. Under normal operating conditions an incoming register or sender will be attached without delay and the start-pulsing SP relay will operate to open the circuit to ATM before ATM operates. If the connection of an incoming register or sender is delayed, ATM will operate and, with ATC operated, will close a path from the winding of RO to the WA lead to the outgoing sender group release circuit. If the marker finds an all-senders-busy condition, the marker will operate the release relay of the sender group release circuit which in turn will ground the WA lead. If the WA lead is grounded and both ATM and ATC are operated and SP is normal, the reorder RO relay will operate to release the sender. This feature is designed to cause the release of senders which are held because of a shortage of registers or senders at the terminating office when senders are needed for other calls. It prevents an overload condition in one office from causing overload conditions in other offices.

5.43 On dial coin zone calls, the loop closure is not completed to the outgoing trunk until after the attendant has answered the call and is disconnected. The intersender timer is started when the attendant disconnects and functions as for a noncoin zone call.

5.44 On automatic intercept service calls the intersender timing feature is disabled. On calls to an intercept service the marker grounds the CL1 and CL3 leads to cause operation of the CL13 relay. The CL13 relay cancels the operations of the individual CL1 and CL3 relays. A back contact of the CL13 relay opens the WA lead thus preventing operation of the RO relay as a result of an intersender time-out. Under normal loading conditions at the intercept service the shortened sender release time could cause release of some calls before they have been processed.

5.45 If relay RO is operated as a result of the overload condition, a momentary ground is connected to the STR lead to cause operation of the sender timed release traffic register. Since there is only one traffic register per sender group and since more than one sender may be released simultaneously as a result of the marker finding the all-senders-busy condition, the STR traffic register will not necessarily indicate the number of senders released. It will indicate the number of times senders were released as a result of the all-senders-busy condition.

5.46 Relay RO, in operating, operates the overflow relay of the trunk and releases the CT relay to cause release of the sender. On LAMA class calls the release of the sender will await transverter release.

6. LAMA

GENERAL

6.01 In offices arranged for local automatic message accounting, the sender will be equipped with the LAMA memory relays for recording the line identification; type or pattern of the code; number structure or type of number as to whether a possible fifth digit should be recorded as a letter or as a number; message billing index; recorder number to which the trunk is assigned; whether the call is a test or service call, whether or not the call is being observed, and whether or not it is a traffic sample call. In addition, the sender will be equipped with general purpose relays for controlling the AMA functions on the call.

6.02 Provision is made in the sender to provide cross-connections for generating code pattern and number structure marks where U-type markers are employed which do not operate the sender code pattern and number structure relays. The cross-connections required are explained in the cross-connection table.

6.03 On a LAMA class of call, the marker operates the AMA class relay and the LAMA memory relays over leads through the sender connector. These relays lock to ON1. When the sender AV relay is operated by the marker, indicating that the sender has received all its information and that

the link connections are satisfactory, the start transverter STT relay is operated through the operated AMA relay. Relay STT connects ground to the TM lead and battery to the ST and STA leads to the transverter connector. The ground connection to the TM lead starts the transverter timing circuit and the battery connection to the ST lead causes the preference relay for the sender in the transverter connector to operate in its proper turn. This will cause a connection to be established between a transverter and the sender. The STA lead is used as a battery supply for the connector relays. This connection will close leads for the transfer of the information listed above and also the code and numerical digit information.

6.04 When the transverter has completed its functions, it will operate the release transverter RLT relay. This allows release of AMA which opens the ST and TM leads to cause release of the transverter connector; AMA also releases STT.

TRANSVERTER TROUBLE RELEASE

6.05 In the event the transverter encounters a trouble condition it will ground a trouble release lead to the transverter connector. The connector will then release the connection to the transverter and establish a new connection to a transverter, usually a different one. If the second-trial transverter also encounters trouble, the message billing index is scanned and, if the call is scheduled for detailed billing, ground is connected to the trouble release lead to the sender. If the call is not scheduled for detailed billing, the transverter connects ground to the regular release lead and the call is completed by the sender in the usual manner. If the sender receives a trouble release signal, the TR relay operates. Relay TR releases AMA which opens the ST and TM leads to cause release of the transverter. Relay TR also operates RO which connects resistance battery to the AB lead to cause operation of the overflow relay of the trunk and opens the circuit to CT to cause release of the sender except on dial coin zone calls. On dial coin zone calls on which an AMA record is attempted, either an RLT or TR release from the transverter will allow the call to complete.

LAST DIGIT CONTROL

6.06 The sender is arranged on AMA class calls to delay pulsing the last digit until the transverter has completed the initial entry record. This prevents completing the pulsing and signaling the called customer before the sender can cut the trunk through. It also prevents completing the connections on those calls which result in a trouble release by the transverter except on dial coin zone calls as noted above.

6.07 A locking circuit is provided for PG1 through a back contact of LD and a front contact of AMA. The LD will release after the next to last digit has been pulsed and, if the AMA record has not been completed PG1 will be held operated. When the record is completed AMA will release PG1 for transmitting the last digit and the start pulse. In the case of a transverter trouble release TR will operate to prevent release of PG1 so that the last digit will not be transmitted. On dial coin zone calls, the locking circuit of PG1 is extended to include STT. The operation of TR will release AMA which, in turn, will release STT. The release of STT will allow the last digit to be transmitted.

TIMING FOR TRANSVERTER RELEASE

6.08 The TM timing circuit normally allows a fixed interval for completion of each call. On AMA calls, in order to prevent partial records there is a requirement that once a connection is made to a transverter the sender should not release until a release signal is received from the transverter. Under certain traffic and trouble conditions a sender may be prevented from gaining access to a transverter and to prevent tying up the senders for long periods of time while awaiting transverters, the sender timing interval is reduced during the transverter function period. This is accomplished by STT connecting the TM4 timing resistor in parallel with the TM3 timing resistor. When RLT operates to release the transverter connector and transverter, a discharge path is established for the TM capacitor. The STT then releases to open the discharge path and to restore timing circuit for timing a regular interval.

6.09 On calls other than dial coin zone class, if the timer functions during the transverter function period, TM operates and removes the ground originally used for operating STT. If the connection has actually been made to a transverter, STT will be held from ground at the transverter connector. If the connection had not been made to a transverter, STT will release to cause release of the sender which can then accept new calls.

6.10 On dial coin zone calls, if the AMA relay is still operated when the attendant disconnects, the sender timing is started at the LAMA reduced interval. A release of the transverter at this time, either regular or trouble, will recycle the TM timer. A time-out will cause the operation of CTV1 which operates CTM to recycle the TM timer. When TM releases, CTV2 operates to open the ground lead used to operate STT. Operation of CTV2 restarts the TM timer with regular sender timing. It is slow to operate to allow the TM capacitor time to discharge. If the connection has been made to a transverter, the STT will be held by ground through the transverter connector. If the connection has not been made, STT will release to allow the last digit to be sent.

7. INTERNATIONAL DIRECT DISTANCE DIALING

LAMA ARRANGEMENT

A. General

7.01 The interim arrangement for IDDD is provided only in senders arranged for LAMA operation. On an IDDD call, the marker connects the calling line to a tandem trunk and requests an outgoing MF sender.

B. Sender Seizure

7.02 When the marker seizes a sender it registers a Code Pattern 2 (CP0,2) in the sender to indicate that this is an IDDD call. The marker also registers the called number consisting of a country code and a national number (maximum 11 digits) and other information required by the sender on a LAMA call.

7.03 When the marker is arranged for 3-digit code conversion it operates arbitrary digit register relays AR2/5, BR2/5, CR2/5 to register the gateway identification code in the sender. When the marker is not arranged for 3-digit code conversion, the marker registers one arbitrary digit CR2/5 in the sender. The sender then generates the other 2 arbitrary digits AR2/5, and BR2/5 by means of cross-connections between terminals AR2/5, BR2/5 and terminals AGA, AGB, BGA, and BGB. The three arbitrary digits AR2/5, BR2/5, and CR2/5 then form the gateway identification code.

C. Transverter Seizure

7.04 When the marker transmits the advance signal AV the sender seizes a transverter and transmits to it the equipment location of the calling line and all the other information the transverter requires on a LAMA call. The transverter then proceeds to make an entry on the AMA tape.

D. First Stage Outpulsing

7.05 When the tandem office is ready to receive pulses it returns an on-hook to the sender which in turn transmits to the tandem office, the gateway identification code in the form KP, AR2/5, BR2/5, CR2/5, ST. The tandem office then switches the call to the proper gateway office.

E. Sender Recycle

7.06 At the end of the first stage outpulsing, relay EFP operates to release the operated steering relays, the arbitrary digit register relays, and to recycle the sender in preparation for its second stage outpulsing.

F. Second Stage Outpulsing

7.07 When the gateway office is ready to receive pulses, it returns an off-hook wink to the sender. The sender then transmits to the gateway office a maximum of 11 digits in the form KP, country code, national number, and start pulse.

G. Sender Disconnect

7.08 When the sender transmits the start pulse at the end of the second stage outpulsing the end of pulsing EP relay operates to start the sender release.

TRAFFIC SERVICE POSITION SYSTEM ARRANGEMENT

7.09 On this type of call, the marker registers classes 1, 3, 5, and 8 in the sender. The combination of classes 1 and 8 signed the sender that this is an IDDD call being routed through a TSPS No. 1 office. Classes 3 and 5 are the ANI classes which provide the ANI features required to complete this call. The marker also registers the called country code and national number (maximum 12 digits) in the sender plus the line location of the calling number

and other information required by the sender on an ANI call. If the office is equipped to handle a maximum of only 11 digits, all IDDD calls requiring a country code and national number consisting of 12 digits must be handled by the attendant.

7.10 The sender generates a prefix digit 1 by means of the cross connections at terminals AGA, AGB, and the arbitrary digit terminals AR0, 1. The sender then outpulses the called number to the TSPS office in the form:

KP-1-CC-NN-STP

where CC = Country Code, NN = National Number and STP = Special Start Pulse (900, 1700 cycles). The country code plus the national number will consist of a maximum 12 digits.

7.11 The sender then recycles to release the digit registers as described for an ANI call. The sender calls in a transverter and gives it the line location of the calling line. The ANI transverter in turn registers the directory number of the calling line on the digit register relays in the sender. When the TSPS office is ready to receive the calling line number, it returns an off-hook to the sender and the sender outpulses the calling line number in the form:

KP-ID-ABC-XXXX-ST

where ID = Identification Digit (Automatic or Operator Identified, Observed or Non-observed, or Identification Failure). The ABC is the office code and XXXX is the directory number of the calling line. After outpulsing the calling line number, the sender disconnects.

8. AUTOMATIC NUMBER IDENTIFICATION

GENERAL

8.01 In offices arranged for ANI the sender is equipped with many of the same memory relays as used for storing LAMA information to be passed to the local transverter. These relays are used in ANI calls for recording calling line identification information, test or service call, observed or nonobserved, and tip or ring party information. In addition, the sender is equipped with general purpose relays for controlling the ANI functions of the call.

8.02 When functioning with ANI, the sender will first send the called number, with arbitrary or deletion digits as required, in the same way as it outpulses a regular non-AMA call. At the completion of the called number, however, the memory relays containing the called number, along with the deletion or arbitrary digit relays, are released, the sender seizes an ANI transverter and passes the calling line identification information to it. The ANI transverter, via a translator, translates this information into the calling directory number and transfers it back to the sender. This called number is registered in the sender on the memory relays previously containing the called number.

8.03 With 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.

8.04 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. In AI calls, however, in addition to the KP and X, the full calling number is sent followed by a start signal.

8.05 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
3	AI - Service Observed
4	OI - Service Observed
5	IF - Service Observed

AUTOMATICALLY IDENTIFIED CALL

8.06 On all ANI class calls, the marker operates the CL5 relay. On AI calls, the marker also grounds the CL3 lead which causes the AMA relay to operate.

8.07 When the ST pulse of the called number has been outpulsed, since CL5 relay is operated, the R (register reset) relay is operated instead of the EP relay as in a regular non-ANI call. The R relay operates the R1 relay which, in turn, operates the R2 relay. These register reset relays open the locking grounds to all digit registers and miscellaneous relays associated with the called number. In addition, the R relay, in operating, recycles the TM timer for ANI transverter timing.

8.08 The R2 relay, in operating, closes the operate path for operating the STT relay and in addition causes the LD and DCR relays, which had previously been released, to reoperate. The LD relay in operating releases the R relay which restores all locking grounds previously opened. The STT relay connects ground to the TM lead and battery to the ST and STA leads to the ANI transverter connector. The ground connection to the TM lead starts the ANI transverter timing circuit and the battery connection to the ST lead causes the preference relays for the sender in the ANI transverter connector to operate in their proper turn. This will cause a connection to be established between an ANI transverter and the sender. The STA lead is used as a battery supply for the connector relays. The ANI transverter connector will close leads for the transfer of the information listed above in addition to the line identification information of the calling line. The directory number translation of this information is then passed back to the sender through this connection.

8.09 When the ANI transverter has satisfied itself that the calling number has been translated correctly and received by the sender without error it operates the RL relay in the ANI transverter which, in turn, operates the sender RLT relay.

8.10 The RLT relay, in operating, releases the AMA relay followed by the release of the STT relay which releases the ANI transverter. The operation of the RLT relay also recycles the timer. When the RLT relay has operated, the calling number may be outpulsed if, or when, an off-hook signal has been received from the CAMA sender indicating it is ready to receive this number at the distant office. This off-hook signal, when received over the tip and ring leads causes the OF relay in the sender to operate. This relay, in connection with the operation of the LD relay previously operated by the R2 relay, operates the CSR (CAMA sender ready) relay. When the CSR relay, plus the RLT relay, has operated, the KP relay operates to begin pulsing.

8.11 The KP relay releases the R1 relay which removes the circuit around the PG relay and allows the capacitor PG pulsing circuit to again function. The KP relay also operates the CRS (arbitrary digit) relay which connects the X information digit leads to the RR (recapture relays) which operate on a 2-out-of-5 code basis. For a nonobserved call, RR4 and RR7 relays operate, and for an observed call, the RR0 and RR3 relays operate. The CRS relay also releases the R2 relay. With the X information digit stored on the RR recapture relays and the R1 relay released, the pulsing circuit functions and outpulses the KP, X information digit, and ABX X X X X ST. At the completion of the ST pulse, the R7 relay releases and with the CSR relay operated, the EP relay operates. This relay performs the same functions as it does on a non-ANI call, that is, stops the pulsing circuit. A sender release follows.

ANI TRANSVERTER TROUBLE RELEASE - IDENTIFICATION FAILURE

8.12 In the event that the ANI transverter encounters a trouble in ascertaining the calling number or checking the number passed back to the sender, the TRL relay operates in the ANI transverter. This action of the transverter sends ground to the sender over the TR lead and operates the R3 relay in the sender. The R3 relay contacts are in series with the R relay contacts on certain off-normal ground leads. When R3 operates, locking grounds are removed from the register relays associated with the calling number. Also when R3 operates, it sends a ground back to the ANI transverter connector over the TRA lead which operates the TR relay in the connector. This causes the present ANI transverter connector to release, the connection to the ANI transverter and a new connection to be made to

either a different or the same transverter depending on the preference circuit. As the first connector releases, ground is removed from the TR lead to the sender and the R4 relay, which has been shunted down by the ground on the TR lead, operates. The R4 relay recloses all the locking grounds previously opened by the R3 relay and the sender calling number register relays are ready to receive the calling number from the second transverter.

8.13 The second transverter is seized, the line identity information is passed to it, and a translation is made and passed back to the sender. If this number checks satisfactorily, the ANI transverter is released and the number is outpulsed. If the number does not check, the ANI transverter grounds the TR1 lead to the sender which operates the TR relay through the operated R4 relay contact.

8.14 The TR relay in operating releases the AMA relay, which leads to the release of the ANI transverter, opens certain calling number register locking grounds, changes the leads which operate the RR- relays for a different X information digit, operates the KP relay to begin pulsing if the CAMA sender is ready to receive the calling number at the distant office as denoted by the operated CSR relay, and recycles the timer in order to time the outpulsing of the X information digit.

8.15 The sender outpulses the KP and the X digit only. When the PG1 relay operates at the end of the X digit, the CRS relay releases and, since there is no information in the A-digit register, the RR- relays release. This causes the operation of the EP relay through the SP relay operated, LD relay released, the RR- relays released. The release of the sender follows.

TIME-OUT IDENTIFICATION FAILURE

8.16 Where option WN is provided, an IF digit will also be transmitted if the TM timer functions before the sender can gain access to or receive an answer from an ANI transverter. Option WN provides a time-out identification failure relay TIF which is operated through front contacts of the CSR and AMA relays. When the CSR relay operates, as the result of off-hook from the distant office, it opens the path normally used to operate the TRL relay on time-outs and transfers this path to the TIF relay. When the TM timer functions, the TIF relay operates and grounds the SS lead to the plant register, recycles the TM timer, and operates the TR relay. Operation of the steering relay CRS, prior to outpulsing of the information digit, releases the TIF relay to restart the TM timer for call completion timing. Operation of the sender continues from this point in the same manner as described in the two preceding paragraphs.

OPERATOR IDENTIFIED CALL

8.17 On Operator Identified (OI) calls, the CL3 lead is not grounded as in an automatically identified call. The AMA relay therefore remains unoperated.

8.18 When the ST pulse of the called number has been outpulsed, the R relay is operated followed by the operation of the R1 and R2 relays. The operation of the R relay recycles the timer and closes the operate path to the OI relay which operates. The OI relay operates the RLT relay.

8.19 In the meantime, relay R2 operates the LD relay and the sender, if it has not already received it, awaits an off-hook signal from the CAMA sender via the trunk to operate the OF relay in the sender. When OF operates, the CSR relay operates which indicates that the CAMA sender is ready to receive the calling number. The CAMA sender at this point is expecting an AI identification of the calling number.

8.20 The combination of the CSR and RLT relays operated, operates the KP relay to prepare for the KP pulse prior to the X information digit. The KP relay operates the CRS (arbitrary digit steering) relay and the OI information digit information is passed to the RR- relays which operate on a 2-out-of-5 code basis. The information leads had previously been grounded as a result of the operation of the OI relay and the operation or release of the OBS1 relay depending on whether the call is service observed or nonobserved. The KP relay, in operating, also releases the R1 relay which had been holding PG pulsing relay released. The PG capacitor timing pulsing circuit now is placed in operation and the KP pulse and X information digit, stored on the operated RR- relays, is outpulsed.

8.21 Since no digits are registered in the A-digit register, the RR- relays remain released after the X digit is outpulsed. Since the LD relay released with the KP relay after the KP pulse was sent, a ground through the LD and RR- 2-out-of-5 relays released, operates the EP relay. The pulsing is ended and the sender release follows.

9. COMBINED ANI-LAMA

GENERAL

9.01 Provision is made for combined ANI-LAMA operation. This feature is available for use in LAMA offices handling PPCS calls routed through a traffic service position. A modified AMA transverter is used for this type of operation. This transverter performs both the LAMA and the ANI functions.

LAMA OPERATION

9.02 In offices arranged for combined ANI-LAMA, the sender will function as described in the paragraphs on regular LAMA operation.

ANI OPERATION

9.03 When the marker grounds the CL3 lead of a sender arranged for combined ANI-LAMA a CL3 relay will operate in the sender in addition to the AMA relay. The CL3 relay grounds the SPL lead to indicate to the transverter connector that it must select a modified AMA transverter and to signal that transverter that it is to perform ANI functions on this call. The CL3 relay also operates the CL3A, B, and C relays which cause the sender to function as if connected to an ANI transverter as described in 8.

10. TRAFFIC SERVICE POSITION (INCLUDING PPCS)

10.01 The sender is arranged on a CL8 class basis to transmit more than one non-digital combination of two frequencies as a start signal. The variable start signal is used where the call class marks are required to identify combined traffic over a common trunk group to a Traffic Service Position System No. 1.

10.02 With Option YK provided, two non-digital frequency combinations are used as call class marks to permit sending 0+ and 1+ coin traffic over a common trunk group to a traffic service position. In this application the CL8 relay is operated from the marker and, when all the digits registered have been transmitted, the RR7 relay will be operated which will cause the frequencies ten and one to be connected to the input of the repeating coil. This 10-1 start pulse combination, in place of the regular 10-7 start combination, indicates a 0+ (person-to-person, collect, special) call.

10.03 With option YJ provided, the CL8 signal is used in combination with the CR arbitrary digit information to determine the start-signal combination to be transmitted after the called number. Four of the five possible start signals are used to indicate coin and noncoin, and 0+ and 1+ traffic. With CR7 and CL8 operated the CR7A relay will operate to cause the required combination of 10-0, 10-1, 10-2, and 10-4 to be connected to the input of the repeating coil through operated contacts of the CR- digit relays. The marker primes the CR- relays with the proper combination of 7-0, 7-1, 7-2, and 7-4 for the output desired. A back contact of the CL8 relay prevents the DCR relay from operating thus preventing the CR- digit from being transmitted in its regular position. The standard 10-7 start pulse will be transmitted with or without the receipt of CL8, but without a CR- digit. The following table shows the start signal transmitted versus the information received.

TABLE A

	TYPE CALL		CLASS CL8 OPERATED	CR DIGIT REGISTRATION RECEIVED	CR DIGIT TRANSMITTED	START PULSE TRANSMITTED AFTER CALLED NUMBER
OPTION YK	TO ANY OFFICE		NO	NONE	NONE	10-7
	TO ANY OFFICE		NO	2/5	2/5	10-7
	OPERATION WITH CROSS-BAR TANDEM TSP	1+	NO	NONE	NONE	10-7
		0+	YES	NONE	NONE	10-1
OPTION YJ	TO ANY OFFICE		NO	NONE	NONE	10-7
	TO ANY OFFICE		NO	2/5	2/5	10-7
	OPERATION WITH TSPS NO. 1	NONCOIN 0+, 0 OR OVERSEAS PPCS	YES	7-0	NONE	10-0
		COIN 0+, 0	YES	7-1	NONE	10-1
		SPARE	YES	7-2	NONE	10-2
		NONCOIN 1+ OR OVERSEAS STATION PAID	YES	7-4	NONE	10-4
		COIN 1+	YES	NONE	NONE	10-7

10.04 The sender, also on a class basis, sends forward either the calling number or an operator identification signal on PPCS zero operator calls to the traffic service position. Classes 3, 5, and 7 cause the sender to send the calling number forward without having sent the called number. Class 5 and 7 cause the sender to send forward an operator identification signal without having first sent the called number.

10.05 When the CL7 relay is operated the locking ground is removed from the steering relays preventing the outpulsing of the called number. With relays CL3 and CL5 operated, in addition to the CL7 relay, the sender will operate as described in the paragraphs on automatically identified calls. If just the CL5 relay is operated in addition to the CL7 relay the sender will operate as described in Operator Identified Calls.

11. ABANDON CALLS

11.01 In case a call is abandoned during the sender functions the sender will immediately release except in cases where the CTR key is operated and trunk test has not been completed or when connected to a transverter on a LAMA class call.

11.02 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. In case the call is abandoned, this ground is disconnected. The LR relay is normally connected to the AB lead and is operated to the ground at the trunk. If the call is abandoned, ground is disconnected from the AB lead at the trunk and LR releases, releasing ON, the sender link hold magnet, and ON1, followed by the release of all other operated relays.

11.03 If STT is operated indicating that a LAMA class call is being handled and that the transverter has not been released, LR will remain operated until a transverter release is received and STT released. With the CTR key for the sender operated, if trunk test has not been satisfactorily completed and if the call is one that requires trunk test, none of the TG1, OF1, EP, or RO relays will be operated and LR will not release. In this case the sender will be held until the TM timing circuit functions to bring in the office alarm.

11.04 In case the sender is used on a no-digit LAMA class of call in connection with an interoffice trunk, the ON ground is connected to the D lead through a make-contact on AMA to insure that the trunk will not release until the AMA record is complete.

11.05 In case the sender is used on a no-digit AMA class of call in connection with an intraoffice trunk, the trunk has no D relay but does have an auxiliary supervisory relay connected to the AB lead. For this type of call the ON ground is connected to the AB lead through STT and EP operated and SP normal. If the customer abandons the call, the ground on the AB lead holds both the trunk auxiliary supervisory relay and the sender LR relay until sender release.

12. NO PULSING CALLS

12.01 The sender may be used on calls on which no pulsing is required. Trunk test calls are of this type. Also in some cases the sender is used to obtain a path for operating the tandem relay of the trunk. A third type of no-dialing call is the intraoffice LAMA, when the sender is used in connection with the initial entry record.

12.02 For these types of calls the marker primes the sender with the usual digit and AMA information and, in addition, grounds the ND lead. This causes operation of STS1 which, in turn, operates EP. The EP is not operated directly because its slower operating characteristics might delay the marker. The EP closes the discharge circuit to the ATM capacitor so that the trunk test timing will not be completed and the tip and ring will not be closed. The EP prepares for release of the sender by opening one leg of the circuit supplying ground to the CT and trunk D relays. On non-LAMA calls the operation of AV allows release of CT and the trunk D relays. Relay CT is followed by LR, ON, and all the operated relays of the sender. On LAMA calls CT is held by AMA and the operation of AV causes operation of the transverter start STT relay to connect the sender to the transverter. After transverter release, STT and AMA are released; AMA releases CT followed by LR, ON, and all the operated relays of the sender.

12.03 When making trunk test of a tandem AMA trunk, the sender receives the same no-digit indication as it receives when serving an intraoffice AMA call. For the intraoffice call, the sender places ground

on the AB lead to hold the S2 relay of the trunk while for the tandem AMA call, the trunk requires a +130 volts on the AB lead. The sender cannot distinguish between the two calls; however, since the CL2 relay is never operated on intraoffice calls, a back contact of the CL2 relay is used to keep the ground off the AB lead during tandem AMA calls.

13. MAINTENANCE

GENERAL

13.01 Provision is made for the operation of the sender with the automatic monitor, register, and sender test circuit which can be used as a monitor circuit to check the accuracy of pulsing on service calls, as a routine test circuit to check the various functions of the sender, or for the operation of the sender with the sender test circuit which can be used as a routine test circuit.

AUTOMATIC MONITOR

13.02 The automatic monitor, register, and sender test circuit, referred to as the monitor circuit, has provision for functioning with originating registers, incoming registers, and outgoing senders. When used as a monitor circuit it is associated with the various service circuits on a random basis. When connected to a multifrequency outgoing sender, the monitor checks the number outpulsed by the sender with the number transferred to the sender by the marker. The monitor connects a high impedance circuit to the tip and ring leads to make the pulsing check.

13.03 The monitor may also be used as a test circuit for checking the various functions, including pulsing and supervision of the sender.

13.04 On ANI calls, the monitor is used as a test circuit for checking the called number, the X information digit, and calling number. When monitoring senders that are processing an ANI call, only the called number is checked.

13.05 For either a monitor or a test call the marker operates the monitor M relay when it primes the sender with the digit and class information.

13.06 The M relay connects the sender to the monitor over the following leads.

T, R	Are used by the monitor for checking the number pulsed on monitor and test calls.
SG, MOS	Indicates to the monitor, the group and type of sender.
H	Indicates to the monitor that the sender is off-normal and is used by the monitor to hold the sender under certain conditions of failure to check on test calls.
PL	Indicates to the monitor on test calls that the sender has received the start-pulsing signal.
SPE	Indicates to the monitor, on monitor and test calls, that the EP relay has operated to indicate a no-pulsing class or that pulsing has been completed.
SB	Provides a means for the monitor to hold the sender busy.
LK	Provides a means for the monitor to hold the M relay operated.
BS	Provides battery from the monitor for operating the M relay.
FR, CN, S	Provides for sender identification: FR identifies the connector frame; CN identifies the connector number; and S identifies the position in the connector.

SENDER TEST CIRCUIT

13.07 In offices where the automatic monitor, register, and sender test circuit is not provided or is not arranged to function with multifrequency senders, the sender will be tested by the sender test circuit. In this case the marker will prime the sender as on a service call with no indication to the sender that the call is a test call. The outgoing trunk tip and ring leads are connected by the test relay of the trunk to the sender test circuit for supervisory control and checking of the number outpulsed.

13.08 The T lead connection to the jack, lamp, and key circuit is used by the sender test circuit for controlling the outpulsing of digits by the sender.

SENDER MAKE-BUSY

13.09 The sender can be made busy to service calls by the insertion of a No. 322A make-busy plug into the make-busy jack associated with the sender at the jack bay of the master test frame. This causes operation of the MB relay which opens the SIE, SIO, and SP leads so that the sender will test busy to the marker. Under certain

conditions a test call can be set up to override the made-busy condition so that a test can be made of the made-busy sender.

13.10 Where option WT is provided, the MB relay also opens the SS lead to the plant register circuit. This prevents a stuck sender registration at the plant register if the sender encounters trouble trying to complete a test call during the time it is made busy.

14. TRAFFIC USAGE RECORDER CIRCUIT

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

14.02 The sender busy SB lead is connected to make-contacts of the SB and MB relays, and is grounded whenever either of these relays are operated. The SB lead is grounded whenever the register is busy in service, made busy, or under test. The SB lead is open when the circuit is available for use.

14.03 The sender busy for maintenance lead SMB is connected to the winding of the MB relay and is grounded whenever the sender is made busy. Where the office is equipped with the alarm surveillance and control feature, the sender will with option WR provided also ground the SBM lead anytime the sender is held out of service by the interface and control circuit.

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 multi-frequency pulses are transmitted.

TG and OF Relays

Minimum Voltage	45	48.5
Maximum External Circuit Resistance - Ohms	6400	6800
Minimum Insulation Resistance - Ohms	30000	30000

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
4DG	4-Digit Number Structure
5DG	5-Digit Number Structure
A0,1,2,4,7	A digit
AMA	Automatic Message Accounting
AR0,1,2, 4,7	A Arbitrary Digit
ARS	A Arbitrary Digit Steering
AS	A-Digit Steering
ATC	Auxiliary Timer Control
ATM	Auxiliary Timer
AV	Advance
B0,1,2, 4,7	B Digit
BR0,1,2, 4,7	B Arbitrary Digit
BRS	B Arbitrary Digit Steering
BS	B-Digit Steering
C0,1,2, 4,7	C Digit
CL1	Prefix X-X
CL2	Class 2 - 2-Way Trunk
CL3,CL3A, B,C	Class 3 - Automatic Number Identification
CL4	Class 4 - Coin Zone
CL5	Class 5 - ANI
CL6	900-600 Ohm Trunk Impedance Match
CL7	Routing Zero-Operator Calls PPCS
CL8	PPCS Start Pulse
CL13	(Class 1 and Class 3) Cancel Intersender Timing
CP0,1,2, 4,7	Code Pattern
CPA0	Code Pattern
CPB0	Code Pattern
CR0,1,2,4, 7,7A	C Arbitrary Digit
CRS	C Arbitrary Digit Steering
CS	C Digit Steering
CSR	CAMA Sender Ready
CT	Cut Through
CTM	Cancel Timing
CTV1-2	Cancel Transverter Start
D0,1,2,4,7	D Digit
DAR	Dial A Arbitrary Digit
DBR	Dial B Arbitrary Digit
DCR	Dial C Arbitrary Digit
DL1-6	Delete 1-6 Code Digits
DS	D-Digit Steering
E0,1,2,4,7	E Digit
EFP	End of First Stage Pulsing
EP	End of Pulsing
ES	E-Digit Steering

Designation (Cont)	Meaning
F0,1,2,4,7	F Digit
FS	F-Digit Steering
FT0-3	Frame Tens - Line Link
FU0,1,2,4,7	Frame Units - Line Link
G0,1,2,4,7	G Digit
GIC, GICA	Gateway Identification Code
GS	G-Digit Steering
H0,1,2,4,7	H Digit
HG0,1,2,4,7	Horizontal Group - Line Link
HS	H-Digit Steering
ID	International Direct Distance Dialing
J0,1,2,4,7	J Digit
JS	J-Digit Steering
K0,1,2,4,7	K Digit
KP	Keypulse
KS	K-Digit Steering
L0,1,2,4,7	L Digit
L5D	Letter 5 - Digit Number Structure
LD	Last Digit
LR	Line Release
LS	L-Digit Steering
LST	Letter Station Number Structure
M	Monitor or Test
M0,1,2,4,7	M Digit
MB0,1,2,4,7	Message Billing Index
MB	Make-Busy
MS	M-Digit Steering
NOB	Nonobserved
NSP	No Traffic Sampling
OBS	Observed
OBS1	Observed Auxiliary

Designation (Cont)	Meaning
OF, OF1	Off-Hook
OI	Operator Identified
ON, ON1	Off-Normal
PG, PG1	Pulse Generator
R	Reset Register
R1	Reset Register Auxiliary
R2	Reset Register Auxiliary
R3	Reset Register - ANI Transverter Trouble Release
R4	Reset Register - ANI Transverter Trouble Release
RLT	Release Transverter
RN0,1,2,4,7	AMA Recorder Number
RNT0,1,2	AMA Recorder Tens Number
RO	Reorder
RP	Ring Party Calling Line
RR0,1,2,4,7	Recapture Relay
RSA, RSA1	Recycle Sender
SB	Sender Busy
SC	Service Class
SOF	Sender Off-Hook
SON, SONA	Sender On-Hook
SP	Start Pulsing
SPC	Traffic Sampling
ST7	Start or End 7
STS, STS1	Start Digit Steering
STT	Start Transverter
TG, TG1	Trunk Guard
TIF	Time-Out Identification Failure
TM	Time Measure
TMA	Time Measure
TMB	Time Measure
TMC	Time Measure

Designation (Cont)	Meaning
TOF	Timed Off-Hook
TP	Tip Party Calling Line
TR	Transverter Trouble Release
TRL	Trouble Release
TVT	Transverter Test
VR0-4	Vertical File - Line Link
VG0,1,2,4,7,10	Vertical Group - Line Link
WK	Wink Signal

2.02 Tubes

Designation	Meaning
ATM	Auxiliary Timer Measure
TM	Time Measure

3. FUNCTIONS

3.01 To indicate to the marker that the sender is available for use if not engaged on a service or test call or made busy by a plug in the associated make-busy jack.

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

3.03 To register information transferred from the marker, via the outgoing sender connector concerning the code and numerical digits recorded in th originating or incoming register, the arbitrary digits, if any, to be dialed out, the number of code digits to be deleted, the type of trunk, and information pertaining to automatic message accounting.

3.04 The following show the leads and relays used for registering this information, and the purpose of each item of information:

A0,1,2,4,7 to H0,1,2,4,7 and J0,1,2,4,7 to L0,1,2,4,7 — These register relays are used for recording the number which has been recorded in the originating or incoming register and which reaches the sender via the marker. Registers are provided for recording a number composed of a 3-digit toll directing or numbering plan area code, a 3-digit local office code, 4 numerical digits, and a ringing control digit. The number is recorded on a 2-relays-operated-out-of-5 basis using the additive code which is as follows:

Relays Operated	Digit
-0 and -1	1
-0 and -2	2
-1 and -2	3
-0 and -4	4
-1 and -4	5
-2 and -4	6
-0 and -7	7
-1 and -7	8
-2 and -7	9
-4 and -7	0

ST7 — This relay is used to indicate to the transverter the last digit of the called number when a full complement of digits are received. It also permits the marker checking function to be satisfied and, when operated, is used to control the start-pulse multifrequency signal.

AR0,1,2,4,7
BR0,1,2,4,7
CR0,1,2,4,7, 7A — These relays are used for recording up to three arbitrary digits to be pulsed out. A single digit or the last of two or three is recorded on the CR- relays; the first of two or second of three is recorded on the BR- relays, while the first of three arbitrary digits is recorded on the AR- relays. Arbitrary digits are always pulsed first.

CL1 — Prefix XX - This relay is used to cause the sender to outpulse two fixed arbitrary digits.

CL2 — Two-way or Intertoll Trunks - This class relay arranges the sender to function with these types of trunks.

CL3 — Automatically Identified ANI Class - Ground on the CL3 lead operates the CL3 and/or AMA relay to designate an AI call in conjunction with the CL5 relay.

CL4	Dial Coin Zone Class - This class relay arranges the sender to function with dial coin zone trunks or junctors.
CL5	ANI Class - This class relay arranges the sender to function with ANI.
CL6	To switch from 900- to 600-ohm trunk termination.
CL7	PPCS-ANI Class - Used in conjunction with CL3 and CL5 relays to cancel called number transmission and send AI or OI identification.
CL8	To send 10-1 start pulse to tandem office to identify PPCS traffic.
CL13	Class CL1 and CL3 - This class cancels intersender timing on calls to automatic intercept service. It also cancels both the CL1 and CL3 function.
DL1,2,3,4, 5,6	These delete relays are operated on a one-at-a-time basis to cause the sender to delete a number of digits corresponding to the numerical suffix. Deletion starts with the A digit and continues toward F. For example: DL3 would cause the sender to delete the A, B, and C digits. With no DL- relay operated, the sender will dial all the digits registered. Arbitrary digits may be used in conjunction with the DL- relays with the arbitrary digit or digits being pulsed first and then followed by the digit indicated by the DL- relays.
ND	No Digits Transmitted - The ND lead is used to operate the STS1 relay from the marker on calls on which no pulsing is required. Relay STS1 operates the end of pulsing EP relay. This class is used for test calls and on calls where the sender is associated with an intra-office trunk for AMA purposes.
M	This relay is used to indicate that the automatic monitor, register, and sender test circuit is associated with the sender on the call for test or monitor purposes.
AMA	This relay, where LAMA is provided in the office, is used for recording that an AMA record is to be made of the call. This AMA relay, where ANI is provided, is used to indicate an automatically identified ANI call. All the following information is recorded in the sender and transferred to the transverter on AMA calls. the information designated by an asterisk (*) is recorded and transferred to the ANI transverter on ANI calls.
*VG0,1,2,4, 7,10	These relays are used for recording the line link vertical group location of the calling line.
*VF0,1,2,3, 4	These relays are used for recording the line link vertical file location of the calling line.
*HG0,1,2,4, 7	These relays are used for recording the line link horizontal group location of the calling line.
*FT0,1,2,3	These relays are used for recording the line link frame tens location of the calling line.
*FU0,1,2,4, 7	These relays are used for recording the line link frame units location of the calling line.
RN0,1,2,4, 7	These relays are used for recording the recorder number units to which the trunk has been assigned for AMA recording.
RNT0,1,2	These relays are used for recording the recorder number tens indication. These relays are required where more than 10 recorders are provided in a marker group.

MB0,1,2,4, 7	These relays are used for recording the message billing index for the call.
4DG, 5DG LST L5D	These relays are used for recording the number and type of digits in the called office.
CP0,1,2,4, 7	These relays are used for recording the code pattern or the number of digits in the code.
*RP, *TP	These relays are used for recording the identification of the calling lines as to individual or ring, or tip party.
NOB, OBS	These relays are used for recording whether or not the calling line is plugged up for service observing.
SPC, NSP	These relays are used for recording whether or not the call is a traffic sample call.
*SC, *TVT	These relays are used for recording the class of call such as service or transverter test.

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

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

3.07 To provide for operation of the line release LR relay 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.

3.08 To provide for operating the trunk overflow relay over lead AB through the sender link circuit on those calls where it is necessary to return an overflow signal to the calling customer.

3.09 On a tandem class call, to pass information from the marker to the tandem trunk over the TM lead through the sender link to cause operation of the trunk tandem class relay. The TM lead through the sender link is used for trunk identification control by the transverter on LAMA class calls.

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 pulsed 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.

3.12 To provide for sufficient delay in closing the tip and ring leads to the trunk, when one-way nonintertoll 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 is 600 milliseconds nominal, measured from seizure of the trunk.

3.13 When ZR option is provided, to close the loop immediately on seizure but to delay the test for trunk polarity for sufficient time to allow the return of the seizure signal from the terminating office on calls over 2-way trunks or one-way intertoll trunks.

3.14 When ZS option is provided, to close the loop and test for polarity immediately upon sender seizure, and to expect a reversal from off-hook to on-hook as a start pulsing signal on calls over 2-way trunks.

3.15 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.

3.16 To delay outpulsing until a start pulsing polarity reversal has been received on all calls, option ZS.

3.17 To delay outpulsing on CL2 class trunks until the supervision becomes on-hook, option ZR.

3.18 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 for the sender is operated.

3.19 To cause the pulse generator to start pulsing after a trunk test has been completed satisfactorily and to transmit a keypulse signal of approximately 100 milliseconds duration and then to change the timing so as to transmit digits at the rate of approximately 7.2 digits per second.

3.20 To associate a group of five recapture relays with the digit register for the digit to be outpulsed and to control the frequencies connected to the tip and ring leads by contacts on the recapture relays.

3.21 To maintain a standing test on the tip and ring leads after recording the start pulsing signal and to translate any reversal received prior to the transmission of the last digit as a reversed trunk.

3.22 To end the pulsing of digits and to send an end-of-pulsing or start signal when the steering relays advance to a digit register on which no digit is recorded.

3.23 To cause trunk cut-through after all digits and the start pulse have been transmitted.

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

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

3.26 To restore all apparatus to normal on sender release.

3.27 To allow a time interval of 16.2 seconds, nominal from sender seizure on non-LAMA or non-ANI calls for completion of the call.

3.28 To allow a time interval of 8.1 seconds nominal, from closure of battery to the start lead to the transverter connector on LAMA calls for completion of the transverter functions and an interval of 16.2 seconds nominal from transverter release for completion of the call.

3.29 To cause operation of the trunk overflow relay in case of a sender time-out.

3.30 To cause the sender and trunk to be held under control of the cancel timed release CTR key at the master test frame jack, lamp, and key circuit in case of a sender time-out or in case the sender detects a trunk with its tip and ring leads reversed.

3.31 To connect ground to the lamp and alarm leads to the master test frame jack, lamp, and key circuit during the time the sender is in a timed-out condition.

3.32 To connect a momentary ground to the stuck sender SS lead to the master test frame plant register circuit in case of a sender time-out.

3.33 To provide for opening the alarm lead in case the sender is made busy by a plug in the make-busy jack.

3.34 To provide on LAMA calls for immediate release of the sender in case of a time-out where a connection has not been made to a transverter.

3.35 To measure an interval of 5.7 seconds nominal from the start of trunk test to the receipt of the start-pulsing polarity. If the start-pulsing signal is not received within this interval, to close a circuit through which the marker, if it finds an all-senders-busy condition, can cause release of the sender. The timer is disabled when the start-pulsing signal is received.

3.36 To connect a momentary ground to the STR lead to the master test frame traffic register circuit in case of release by the marker as a result of an all-sender-busy condition and a time-out of the auxiliary timer.

3.37 To recognize a ground closure on the WA lead from the outgoing sender group release circuit as an indication that the marker has found an all-senders-busy condition and to release if the auxiliary timer has functioned indicating that the sender is awaiting a connection to an incoming register or sender at the terminating office.

3.38 To provide on LAMA calls for awaiting a release signal from the transverter before release of the sender where a sender time-out occurs during the transverter functions.

3.39 To provide for accepting a reorder signal from the marker over the RO lead; to cause operation of the trunk overflow relay and to release and sender.

3.40 To provide means for adjusting the register network associated with the multifrequency pulse generator so that pulses of the proper speed and percent break can be obtained.

3.41 To provide a 900-ohm termination for most nonintertoll trunks and by the operation of the CL6 relay switch this termination to 600-ohm for most intertoll trunks.

3.42 To provide an indication to the sender group busy alarm circuit so that an all-senders-busy condition can be identified.

3.43 To provide contact protection for various contacts.

3.44 To provide for calling a transverter on LAMA-class calls when the marker operates the AV relay to indicate that the connection to the trunk has been established.

3.45 To provide for transferring to the transverter through the transverter connector information necessary for making an initial entry record of the call.

3.46 To provide for accepting a regular release signal from the transverter when the transverter has completed its functions.

3.47 To provide for accepting a trouble release signal from the transverter in case the transverter encounters certain types of trouble conditions and, if received, to cause the call to be set for reorder.

3.48 To prevent release of a sender while connected to a transverter.

3.49 To delay pulsing of the last digit until a regular release has been received from the transverter.

3.50 To provide means of associating the sender with the automatic monitor, register, and sender test circuit on service calls for monitor purposes and on test calls for test purposes.

3.51 To set the call for reorder in case the signal current supply for the sender is transferred from one generator to another and grounds the TR lead during pulsing.

3.52 To maintain a compromise termination on the tip and ring leads for the signal-on and signal-off conditions.

3.53 To connect a ground to the TG lead to the marker when the sender is seized and to disconnect this ground when the trunk conductors are found to be continuous.

3.54 To check that two of the five recapture relays are operated for each digit before transmitting the digit.

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

3.56 To provide for generating frequencies of 700, 900, 1100, 1300, 1500, and 1700 +0.7 -0.3 percent cycles per second by means of transistor oscillators.

3.57 To arrange the sender to function with dial coin-zone trunks and junctors and to provide the following features:

(a) To provide a nominal time of 32.4 seconds for the coin attendant to answer. To close a path for an all-senders-busy release if this time is exceeded and to dimly light the T0 lamp for the sender at the jack bay of the master test frame.

(b) To cancel timing while the attendant has control of the circuit.

(c) To delay start of intersender timing until the attendant disconnects.

(d) To allow regular sender timing for the call to complete after the attendant disconnects.

(e) When LAMA features are used, to delay the LAMA short time interval until after the attendant disconnects. Operation of the timer will remove the bid for the transverter and recycle the timer for the trouble interval.

(f) To allow the call to complete on either a regular or trouble release from the transverter.

(g) To connect a momentary ground to the CZSR lead to the plant register circuit if a marker finds an all-senders-busy condition and releases the sender after it had timed out waiting for the attendant to answer, and

(h) To disconnect ground from the TG lead to the marker without making a trunk test.

3.58 To arrange the sender to function with automatic number identified class calls and to provide the following features:

(a) To reset all digit registers and miscellaneous information relays following the outpulsing of the called number.

(b) To recycle the TM timer after the outpulsing of the called number.

(c) To seize an ANI transverter and, after priming it with the calling number line identification information, to register the calling number received from the ANI transverter on previously reset register relays.

(d) To recognize an off-hook signal which denotes that the CAMA sender is ready to receive the calling number.

(e) To allow a timed interval of 16.2 seconds nominal for pulsing out the calling number or, in the case of operator identified or identification failure calls, for outpulsing the X information digit.

(f) To allow a timed interval of 8.1 seconds nominal from closure of battery to the start lead to the ANI transverter connector (on ANI automatically identified calls) to the completion of the ANI transverter functions. Following the release of the ANI transverter, to allow 16.2 seconds nominal for the outpulsing of the calling number.

(g) To make up the X information digit.

(h) To provide for seizing an ANI transverter on a second trial basis if the first trial fails, and

(i) Where option WN is provided, to transmit an IF digit if the TM timer functions before the sender can gain access to or receive an answer from an ANI transverter.

3.59 To provide for taking tandem AMA records on common control switching arrangement traffic.

3.60 Provision is made to allow the sender to function with stuck sender tracing.

3.61 To arrange the sender to handle IDDD-LAMA calls and provide the following features:

(a) To outpulse a keypulse signal, the gateway identification code and a start pulse to the tandem office on the first stage outpulsing.

(b) To recycle the sender and await an off-hook wink signal before starting on its second stage outpulsing.

(c) To outpulse a keypulse signal, the country code, the national code, and a start pulse signal to the gateway office on its second stage outpulsing.

3.62 To arrange the sender to handle IDDD-TSPS calls and provide the following features:

(a) To outpulse a keypulse, a prefix digit, the country code, the national number and a start pulse to the TSPS office.

(b) The country code and national number shall consist of maximum 12 digits.

(c) To recycle and then outpulse a keypulse signal, a calling line identification digit, the calling line directory number and a start signal to the TSPS office.

3.63 To provide the CP1 and CP3 leads to the sender group busy alarm circuit for operation with the Alarm Surveillance and Control (ASC) feature which will function either with CSACS or with the Telecommunication Alarm Surveillance and Control System (TASC).

4. CONNECTING CIRCUITS

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

(a) Outgoing Sender Connector Circuit - Sender Part - SD-26057-01

(b) Outgoing Sender Connector Circuit - Marker Part - SD-26059-01

(c) Preference Control Circuit for Sender Connector Circuit - SD-26039-01

(d) Outgoing Sender Connector Circuit - SD-25587-01

(e) Outgoing Sender Link Circuit - SD-25734-01

(f) Completing Marker Circuit - SD-26002-01

(g) Marker Circuit - SD-25550-01

(h) Outgoing Trunk Circuit (Typical) - SD-26085-01, SD-25694-01

(i) Two-way Intertoll Trunk Circuit - (Typical) - SD-25842-01

(j) Transverter Connector Circuit - SD-25592-01, SD26021-01

(k) Automatic Monitor, Register and Sender Test Circuit - SD-25680-01

(ℓ) Sender Test Circuit - SD-25675-01

(m) Master Test Frame Connector Circuit - SD-25805-01

(n) Master Test Frame Jack, Lamp, and Key Circuit - SD-26175-01, SD-25762-01

(o) Plant Register Circuit - SD-25793-01

(p) Traffic Register Circuit - SD-25892-01

(q) Sender Group Busy Alarm Circuit - SD-25500-01

(r) Multifrequency Current Supply Circuit - SD-95391-01

(s) Outgoing Sender Group Release Circuit - SD-26055-01

(t) Traffic Usage Recorder Circuit - SD-95738-01

(u) Outgoing Trunk Circuit or Junctor Circuit for Dial Coin-Zone Service - SD-26078-01

(v) Transverter Circuit - ANI - SD-26161-01

(w) ANI Transverter Connector Circuit - SD-26162-01

(x) Office Test Frame Test Circuit - SD-27633-01

(y) Signaling Receiver Circuit - SD-95536-01

(z) Stuck Sender Trunk Identifier Circuit - SD-27839-01

(aa) Office Test Frame Trouble Indicator and Connector Circuit - SD-27634-01

5. MANUFACTURING TEST REQUIREMENTS

5.01 The sender shall be capable of performing all 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 a multifrequency sender encounters an extended delay in the progress of a call the sender timing TM circuit will function.

6.02 With the sender timed out and with the cancel timed release CTR key at the jack bay of the master test frame normal (pushed in), the sender circuit will attempt to release. If the sender releases, the only indication will be a momentary lighting of the associated (TO) Time-Out lamp at the jack bay of the master test frame.

6.03 With the sender timed out and with the Cancel Timed Release (CTR) key operated (pulled out), or if the CTR key is normal but the sender does not release, the sender will stick and the TO lamp will remain lighted. After a period of 10 to 15 seconds the major alarm will function and the R-S-TOA lamp will light at the jack bay of the marker test frame.

6.04 If, in response to a major alarm a lighted R-S-TOA lamp is found, the alarm may be silenced and the R-S-TOA lamp extinguished by the insertion of a No. 322A make-busy plug in the MG jack associated with the lighted TO lamp. This also makes the sender busy to service but allows the associated TO lamp to remain lighted.

6.05 The trouble conditions and their resultant indications are described in SECTION II, Part 5.

6.06 The sender can be restored to normal by releasing (pushing in) the CTR key.

6.07 If a sender encounters a delay due to the unavailability of incoming registers or senders at the terminating office, the auxiliary intersender ATM timer will function, but will cause no indication to be given at the master test frame.

FUSE ALARM

6.08 If, in response to a major alarm, an FA lamp is found lighted at a sender frame, it is an indication that a fuse has operated at the associated timer.

6.09 Replace the fuse to retire the alarm and extinguish the lamp.

7. TAKING EQUIPMENT OUT OF SERVICE

SENDER CIRCUIT OR ANY OF ITS ASSOCIATED APPARATUS

7.01 In order to take the sender, or any of its associated apparatus, out of service insert a No. 322A make-busy plug into the associated make-busy MB jack at the jack bay of the master test frame.

GENERAL PRECAUTIONS TO BE FOLLOWED WHEN WORKING ON THE APPARATUS

7.02 When working the apparatus, the sender should be made busy by inserting a No. 322A make-busy plug into the associated make-busy MB jack at the jack bay of the master test frame. No further precautions are necessary other than those listed in the circuit requirements table.

SECTION IV - REASONS FOR REISSUE

B. Changes in Apparatus

B.01 Added

LP,SB,SBM Diodes - 533F - Fig. 1 - Option WR

B.02 Superseded	Superseded By
MB Relay - AF63 - Fig. 1 - Option WS	MB Relay - AJ83 - Fig. 1 - Option WT

D. Description of Changes

D.01 A change is made to permit a sender in an office equipped with the alarm surveillance and control feature to give the traffic usage recorder circuit a maintenance busy indication anytime the sender is held out of service by the interface and control circuit. Previously, when the stuck sender holding feature of the interface and control circuit was activated, any stuck senders held for any length of time would distort the Traffic Usage Recorder (TUR) data since the sender indicated only traffic busy while held. This change allows the sender to ground the Sender Busy for Maintenance (SBM) lead while it is being held, thus resulting in more realistic traffic data. This involves the addition of the apparatus listed in B.01 which is designated Option WR rated Feature Standard.

D.02 A change is made to eliminate Stuck Sender (SS) registrations during the time that the sender is made busy from the master test frame. This will eliminate the SS peg counts that previously occurred when the sender encountered a trouble condition during the time that the made busy relay MB was operated. The peg counts are eliminated by opening the ground path to the SS lead whenever the MB relay is operated. This involves the apparatus listed in B.02. The new relay is designated Option WT which is rated after-date Standard.

D.03 On Issue 22D the sender was arranged to function with automatic intercept service on a line link basis. The change consisted of the addition of the CL13 relay (App Fig. 8) rated Feature Standard. On AIS calls the marker operates the CL13 relay by grounding the CL1 and CL3 leads to this circuit. Operation of this relay prevents the sender from going into 5.7 seconds (nominal) overload timing, thus allowing 16.2 seconds (nominal) to complete all AIS calls. This 16.2-second timing period was provided because the requirements for AIS/LLP indicated that some AIS calls would require a sender holding time of more than ten seconds. Present information, however, indicates that the AIS machine will not cause the sender holding time to exceed 5.7 seconds. The CL13 relay (App Fig. 8) and associated wiring (Option YU) is therefore rerated from Feature Standard to A&M Only. Where the CL13 relay is already being used and it is desired to reestablish the overload timing on AIS calls, the marker class cross connects should be changed so that the marker grounds no class leads to the sender on AIS calls.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5243-EHH-ABVL-KAP