35

CROSSBAR SYSTEMS
NO. 3
ORIGINATING REGISTER CIRCUIT
DIAL PULSING AND "TOUCH-TONE®" CALLING

CHANGES

D. Description of Changes

D.1 To add leads LB4 and LB5 from the marker circuit, and LBS4 and LBS5 to the marker connector circuit.

F. Changes in CD Section III

F.1 In 2.02, Relays, change LBO-3 to read LBO-5.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-GFC-

WE DEPT 25820-HAH-GWC-PN

Printed in U.S.A.

CROSSBAR SYSTEMS
NO. 3
ORIGINATING REGISTER CIRCUIT
DIAL PULSING AND "TOUCH-TONE® " CALLING

CHANGES

D. Description of Changes

D.1 To prevent the MUD relay in the marker from momentarily operating on a partial dial time out or abandonment.

D.2 If two or more customers are connected to the dial-tone-first announcement and a time out or abandonment of any one customer will force a register release of all others, a minor change is made to prevent this condition from occurring.

D.3 To prevent the RB relay from being held operated or forced operated by other registers the operate path of the RB relay is changed.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-LCB-

WE DEPT 355-HAH-KLF-DM

CROSSBAR SYSTEMS
NO. 3
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CHANGES

D. Description of Changes

D.1 To operate P2A relay when a 9 is keyed for the A digit in registers not arranged for 4-digit intra-PBX dialing.

D.2 To prevent operation of MST on a dial-tone-first announcement time-out.

D.3 To ground only the A7 lead to the marker on a zero operator call.

D.4 To prevent a possible delay in transmitting translation information to the marker.

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 When a customer originates a call, a marker causes a connection to be established between the customer line and an originating register. The originating register transmits dial tone to the customer and records the called number. The originating register then transfers to the marker the called number information and information of identification of the calling line which it received from the marker. The marker then uses this information for establishing an intraoffice connection between the calling line and the called line or a connection between the calling line and an outgoing trunk to the called office. In the latter case an outgoing sender is used to transmit the called number information over the trunk to the called office.

1.02 The originating register receives from the marker information as to the type of line connected whether individual, 2-party, manual, or coin.

1.03 On 2-party lines the register makes a party identification test and transfers the result to the marker so that the proper party can be charged for the call.

1.04 Coin test is made on all calls whether or not a coin has been deposited at the coin station.

2. GENERAL DESCRIPTION OF OPERATION

2.01 When a customer lifts the receiver to originate a call, the line circuit line relay operates and starts a series of events which results in the establishment of a connection from the calling line through the line, line switch, trunk switch, and an idle originating register. This connection is established under control of the marker and is known as the dial tone connection. Each register has a tip, ring, and sleeve appearance on a trunk frame just as a trunk does and the operation of selecting a register and connecting a calling line to it is much the same as selecting a trunk and connecting a line to it.

2.02 This connection between the calling line and register is called the dial tone connection, and gets its name from the fact that dial tone is supplied to the calling line over this connection when the register is ready to receive dial pulses or TOUCH-TONE® signals.

2.03 While the marker is in the process of establishing this dial tone connection, it determines and transfers certain information concerning the identity of the calling line to memory relays in the register, because the marker, which will be used to set up the originating connection from calling line to trunk, will need this information. The marker causes this information to be passed to the register via the trunk link. This information consists of the class of service of the calling line and location of the customers line on the LL frame.

2.04 When the dial tone connection is being established the marker informs the register if the calling line is coin, 2-party, or manual. In each of these cases the register may be required to take some special action which is described later.

2.05 The class and line identification relays operated as described above will lock to an off-normal relay in the register, which is operated and held by a slow-release relay operated by the marker. When the dial tone connection has been established the marker releases and allows the register line relay to operate over the dial tone connection and customer loop. The line relay operates its auxiliary relay which supplies a circuit for holding the off-normal relays and, thus, the register and the dial tone connection. At this point the register is ready to receive dial pulses or TOUCH-TONE signals and transmits dial tone to the calling customer.

2.06 The customer dials or keys all of the digits required for the identification of the register line or operator trunk and the register engages a marker via the marker connector circuit. The register recognizes when all of the digits have been registered in one of several ways.

2.07 If a zero is dialed for the A digit, counting relays corresponding to a ten will be operated. If the digit zero is keyed for the A digit, translating relays corresponding to a zero will be operated. If the register is not arranged for prefix digit zero a circuit through the counting or translating relays will operate the manual relay which indicates that the zero operator is wanted and no further dialing or keying should be expected.

2.08 If the register is arranged for prefix digit zero, the zero prefix counting relay OP will be operated. The OP relay starts the digit timer to time for further digits to be dialed or keyed. If another digit is dialed or keyed before the timer times out, the register will wait for the remaining digits, and then call for a marker to complete the call. If no further digits are dialed or keyed after the zero prefix, the digit timer operates causing the manual relay to operate indicating that

the zero operator is required and no further dialing or keying should be expected.

2.09 If an X11 service operator is called, all of the relays of the local X11 translator circuit operate because a one has been registered in both the B and C digit, this causes a marker to be engaged.

2.10 The digit steering relays are used to determine when particular digits have been registered. Where all customers are called by dialing or keying the same number of digits a service cross-connection from the appropriate steering relay contacts to the marker start relay winding will cause operation of the marker start relay when this number of digits has been received and, therefore when dialing or keying has been completed and a marker required.

2.11 Where calls to a different customer require a different number of digits, it is necessary to have some distinguishing mark in the called code which will indicate the number of digits for the call being served.

2.12 In cases where all local calls are 7 digits B-digit translation is used to indicate 10-digit foreign area calls. The C-digit zero translation may also be used to detect NNO codes.

2.13 The PBX dialing arrangements may be handled by the register. Intra-PBX calls will be handled on a 4-digit basis, calls to be made outside of the PBX require a directing digit "9" be dialed prior to dialing or keying a number outside of the PBX.

2.14 The register may be arranged to provide private network traffic by use of 1XX tie line codes or 10-digit CCSA routing.

2.15 On calls from 2-party lines the register receives a 2-party class indication and a 2-party identification test is made before dial tone is transmitted and again just before the marker is engaged after dialing or keying has been completed. Two tests are made to reduce the possibility of charging the wrong party, and the results of these two tests are transmitted to the marker. The marker informs the trunk which party should be charged.

2.16 Dial-tone-first coin service is provided in the register. This is basically a loop-start service but provides for ground-start service. Coin test is made on all calls after dialing or keying has been completed.

2.17 On calls from a dial-tone-first coin station, a coin need not be deposited for the following type calls O+, O-, 1+, and X11.

2.18 When the register has determined that all the requied digits have been dialed or keyed, it causes a connection to be established through the marker connector to a marker and transfers to the marker all of the information necessary for the completion of the call. This includes the called number, the identification of the calling line, and certain class marks. The marker translates the code, determines the destination of the call and then sets up the proper trunk connection, after the trunk connection has been established, the marker transmits a release signal to the register to cause its release.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE OF REGISTER

GENERAL

1.01 When a customer, who desires to originate a call, removes the receiver from the switchhook the associated line relay of the line link frame operates and starts a series of events which results in the line being connected to an idle originating register. This connection is established under the direction of the marker and is called the dial tone connection.

1.02 A marker which is serving a call examines the trunk frame for an idle originating register. The marker connects to it, and tests the individual registers to see which are idle. The marker selects one of the idle originating registers and connects to it via contacts of the MG, MH, F, F1A, and F1B relays. By means of this multiple lead connection the marker operates memory relays which records the class of service and line location in terms of line block, line group, line, and line unit. Also, the marker may operate one or more class relays (2P, CN, MAN, or DPO) to indicate the calling line is 2-party coin, manual, or dial pulse only. The dial pulse only class is used to prevent unauthorized use of TOUCH-TONE sets by customers not entitled to this service. The marker also causes operation of one of the off-normal ground supply relays under control of a slow-release relay. These relays hold the operated memory and class relays and supply ground to the sleeve lead to hold the dial tone connection. The slow-release function is required to hold the register from the time the marker releases after setting up the dial tone connection, until the time the line L relay has had an opportunity to operate and take over the supervisory control of the register.

BUSY TEST BY MARKER

1.03 When the register is idle, ground is present through normally closed or break contacts of ON, PD, and MB relays in series to the FT lead. This lead is multipled at the trunk frame to other registers on the trunk frame, and ground on this lead indicates to the marker that at least one register on the trunk frame is idle. The marker makes a busy test of the individual registers by means of the TG and TT leads. Operation of TBK and TG- relay in the marker extends ground to the TG lead through to the TT lead for selection of an idle register. The marker selects an idle register and connects battery to the corresponding TF lead for operating the register F relay which operates the F1A and F1B relays and establishes a multiple lead connection from the marker to the register.

REGISTRATION OF CLASS, LOCATION, ETC

1.04 With relay F1A and F1B operated, circuits are established for recording information concerning the calling line. A group of relays are provided for recording each of the following:

(a) Class of service

(b) Line block

(c) Line group

(d) Line

(e) Line unit

1.05 Additional circuits are provided through contacts of the F relay for the marker to operate the 2P relay on calls from 2-party lines, the CN relay on calls from coin lines, the MAN relay on calls from MAN lines, the MP relay on calls from multiparty ANI lines, and the DP relay on calls from dial pulse only lines.

OPERATION OF OFF-NORMAL RELAY

1.06 Relay S1 is operated through a contact of F relay. Relay S1 operates ON which supplies locking ground for the memory relays and other relays which may operate later.

DIAL TONE CONNECTION ESTABLISHED

1.07 When F operates, it grounds lead JC to the trunk switch and connector circuit to operate a JC- relay. With the JC- relay operated the tip, ring, and sleeve leads through the trunk switch and connector circuit are connected to the marker. The marker sets up the dial tone connection and makes certain test of the tip, ring, and sleeve leads, and if they are satisfactory, will cause release of F and, in turn F1A and F1B of the register and the JC- relay of the trunk switch and connector circuit. The release of JC- of the trunk switch and connector circuit transfers the tip, ring, and sleeve lead of the dial tone connection to the register. The ON relay being operated supplies a holding ground to the sleeve, thereby holding the dial tone connection.

1.08 The L relay operates through a circuit over the tip and ring leads of

the dial tone connection, the customer loop, and the windings of the tone coil in the register. Relay L operates relay SR. Relay SR extends the circuit from the back contact No. 4 of the L relay to the winding of the P1 pulse counting relay, and operates relay ON1. The ON1 supplies grounds for the digit register relays and other relays which may be operated later, closes the dial tone supply to the tertiary winding of the tone coil, thereby causing dial tone to be transmitted to the calling customer, and closes a circuit to hold ON. The circuit to S1 is opened when F releases but S1 is slow-release so that it holds ON until ON1 has operated and established a holding circuit for ON. On calls from 2-party lines, a locking circuit is provided for S1 while the first party identification test is in progress, so that the release time of S1 does not have to include this test interval.

2. DIAL PULSE COUNTING AND REGISTRATION

GENERAL

2.01 For any digit, a train of pulses consisting of 1 to 10 equally spaced momentary line openings is generated by the calling customer dial. The number of opens correspond to the number dialed, one for the number 1, two for the number 2, etc, and ten for the number 0. These pulses may be at the nominal rate of 10 or 20 per second. Between these trains of pulses there is an interdigital interval during which the line remains closed. The pulsing relay responds to these pulses and the counting circuit counts the number in each digit and, during the interdigital interval, transfers this count to the proper digit register unit. When this transfer is completed the counting relays are released and the counting circuit is ready to count the pulses of the next digit. The end of a digit is recognized by means of a slow-release register advance (RA) relay which operates during the first open pulse and release during the interdigital interval. This relay controls the transfer of the count for each digit to the digit register unit.

PULSING RELAY

2.02 The L relay is a magnetically biased polarized mercury contact relay with three windings. The primary is used as a line winding and is used to operate the relay on a circuit which includes the customer loop. The tertiary is used as a pulse aiding winding and is wired in series with the pulse help capacitor PH to the L front contact No. 1. This contact also is wired to the winding of the slow-release supervisory (SR) relay. When L operates and closes ground to the No. 1 contact, the PH capacitor charges through the tertiary winding and the current is in a direction to hold L operated. This current is reduced to zero as the capacitor becomes charged and the other windings exercise full control. When the circuit to the primary winding is opened, the L releases to open ground from the No. 1 front contact. The PH capacitor then discharges through the winding of the SR relay and the current in the L tertiary winding is in a direction to hold the No. 1 contact open. The tertiary winding and the PH capacitor thus act to insure that once L operates it will remain operated for a definite minimum interval and that once it releases it will remain released for a definite minimum interval. This pulse correcting action makes possible longer maximum loops and higher capacity ringing bridges than would otherwise be possible. The tertiary winding is also used to hold the L through the marker connector when the marker is engaged and is also used for slightly weakening the L relay when operating with ground start coin lines. When the coin (CN) relay operates it closes a circuit to energize the tertiary winding in a direction to aid the primary winding. This is necessary to prevent "showering," a condition which exists when the line circuit relay operates on a loop which will not hold the register L relay. If a leak condition exists on the line, which will cause operation of the line circuit relay, the marker will be called to connect the line to a register. Then if the register relay does not operate the register will release and reconnect the line to the line circuit relay to start the marker action again. To prevent this showering the register L relay is biased to hold on any line which will operate the line circuit relay.

2.03 The secondary winding is used for slightly altering the sensitivity of the L as it operates and releases. This winding is also connected to the No. 1 front contact of L and is so poled that its ampere turns oppose those of the primary winding when L is operated. This has the effect of making L, once it operates, slightly stiffer or easier to release and once it releases, slightly weaker or easier to operate. The value of the LA resistor is chosen to give the optimum benefit from this winding.

2.04 The contacts of the L relay consist of a common armature spring No. 3 making contact with two independent front

contacts numbered 1 and 2, and two independent back contacts numbered 4 and 5.

2.05 The LW capacitor and resistor network connected to the line side of the primary winding of the L is for the purpose of preventing a premature release of L, when working with customer lines which have high-capacity ringing bridges. On each open pulse on these lines the line current momentarily dips and then increases as the bridged capacitor charges in series with the inductive ringer. The LW capacitor holds the L relay over the dip in the line current. This network is also used to prevent a false momentary release of L when a retard coil holding bridge is inserted into the loop after the dialing of each digit at a PBX.

2.06 The winding of the supervisory relay SR is connected to the No. 1 front contact of the L and is energized whenever L is operated. This relay is slow-release and will hold over the momentary opens of the L front contact which occurs during the dialing of a digit. It will release, however, to cause release of the register if the customer abandons the call.

SUPERVISORY CONTROL

2.07 The winding of the RA relay is connected through an ON1 contact to the No. 5 back contact of L and is energized whenever the L is released with ON1 operated. This relay is made slow-release by the action of its secondary winding which is short-circuited whenever the relay is operated. This secondary is a precision winding with a resistance tolerance of only ±3 percent so that the variation in release time of the relay is held within reasonably close limits. Since this winding is open during the operation of the relay, the relay is reasonably fast in operating. Relay RA will operate during the first dial open pulse when L releases and will remain operated until the interdigital interval when L is held operated.

2.08 The auxiliary register advance (RA1) relay is controlled from a back contact on RA and works in reverse to RA, operating when RA releases and releasing when RA operates. The RA1 is a fast-operate and a fast-release relay.

DIAL PULSE COUNTERS

2.09 The dial pulse counting circuit consists of relays P1 to P5 and P2A. Relay P1 and P2 are used in a pulse dividing capacity with each relay functioning from L but at half the speed. These relays are controlled by the No. 4 back contact and the No. 2 front contact of L. When L releases on the first dial open with SR operated, P1 is operated through the back of a continuity contact on P2. Relay P1 locks through this continuity contact on P2, through its own make-contact to ON ground. When L reoperates at the end of the first open pulse, ground through L contacts 3 and 2 and through contacts of P1 operated, operates P2. Relay P2 locks to the ON ground through P1 operated and opens its operating circuit on a continuity contact, transferring the holding circuit for P1 from the ON ground to the ground at the L No. 2 contact. On the next release of L, P1 releases. The P1 in releasing opens the holding circuit to the ON ground for P2, but P2 is held to the ground at the L No. 4 contact. The locking circuit of P2 to a contact of P1, will hold P2 over any stagger that may occur between the opening of the L back contact No. 4. On the next operation of L, P2 releases. This cycle is then repeated with P1 and P2 remaining operated at the end of each odd-numbered pulse and remaining normal at the end of each even-numbered pulse. Relays P3, P4, and P5 are used in various combinations to count and remember the number of operations of P1 and P2. Relay P3 operates when P1 releases at the start of the second open pulse; P4 operates when P2 operates at the end of the third open pulse; and P5 operates when P2 releases at the end of the sixth open pulse. The sequence of operation of these relays is given in the sequence chart on SC22 The following table gives the sequence in tabular form.

TABLE A

Pulse	L	P1	P2	P3	P4	P5	Remaining Operated	Output Leads Grounded
1 BK / MK	R / O	O	O				P1, P2	O,1
2 BK / MK	R / O	R	R	O			P3	O,2
3 BK / MK	R / O	O	O		O		P1, P2, P3, P4	1,2
4 BK / MK	R / O	R	R				P3, P4	O,4
5 BK / MK	R / O	O	O	R			P1, P2, P4	1,4
6 BK / MK	R / O	R	R			O	P4, P5	2,4
7 BK / MK	R / O	O	O				P1, P2, P4, P5	O,7
8 BK / MK	R / O	R	R	O			P3, P4, P5	1,7
9 BK / MK	R / O	O	O		R		P1, P2, P3, P5	2,7
10 BK / MK	R / O	R	R				P3, P5	4,7
11 BK / MK	R / O	O	O	R			P1, P2, P5	O
12 BK / MK	R / O	R	R				P5	O

2.10 Although the number of dial pulses never exceeds 10, the counting circuit is arranged to give a distinctive signal if the count exceeds 10. This distinctive signal is a ground on the single output lead O. This is used under certain conditions to cause a premature time-out and this operation is discussed under Register Time-Out. The auxiliary counting relay P2A is operated at the start of the second pulse when P3 operates. Relay P2A locks on a continuity transfer contact and opens its operating circuit. This relay is used to recognize when the counting circuit counts the first digit greater than one and causes the digit to be transferred to the A-digit register. The reason for excluding ones is covered in the paragraph on the preliminary pulses. Relay P2A opens the dial tone circuit, closes the O and 1 output leads of the counting circuit and opens the operating circuit of the first steering relay AS.

DIGIT STEERING

2.11 The digit steering circuit serves to connect the output of the pulse counters to the digit registers successively as the digits are received. The steering circuit is also used to indicate when dialing is completed. This circuit consists of one relay per digit and its advance is under the control of the RA1 relay.

2.12 The A-digit steering relay AS is operated when ON operates at the start of the call. Relay AS locks through a back contact on BS. When RA1 operates at the end of the first digit with P2A operated, BS operates through a front contact of AS. The BS locks through a back contact of CS and opens its operating circuit on a continuity transfer contact to the RA1 contact so that when RA1 releases at the start of the next digit AS releases. This action repeats for each digit with the steering relay for the next digit operating when RA1 operates at the end of a digit and the steering relay for the digit just registered releasing when RA1 releases at the start of the next digit. The five output leads of the pulse counter are carried through individual transfer contacts on the steering relays and are closed to the digit register associated with the lowest lettered operated relay. For example, with both AS and BS operated the leads are associated with the A-digit register. The transfer from one digit register to the next takes place on the release of the lower lettered relay.

DIGIT REGISTER

2.13 The digit register unit for each digit consists of a dry reed relay, with five independent coils enclosed in a can 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 purpose and a single lead wired to a terminal. One contact of the locking contact pair, one side of the coil, and both contacts of the load contact pair are wired to individual terminals. These terminals extend to both the front and rear of each 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. Ten of these digit register units are provided.

OVERALL OPERATION

2.14 The counting and registration of a digit takes place as follows. The L relay responds to the customer dial and the counting circuit counts the number of pulses. After the last pulse of the digit, L remains operated and RA releases. Relay RA closes an ON ground, connected through an MST1 break-contact, through two separate break-contacts to the translating contacts of the counting relays. This ground emerges through separate break-contacts of RA1 on two of the output leads O, 1, 2, 4, and 7 and is connected by the steering relay to a digit register to cause operation of two of the five digit register relays. Relay RA released also operates RA1 which operates the next steering relay and, with five individual contacts, opens the five output leads of the counting relays. With this type of operation the digit register relays are required to operate during the operate time of RA1. Two other break-contacts on RA1 release the counting relays. The circuit is then ready for the next digit.

REGISTRATION OF A "1" ON THE A-DIGIT REGISTER

2.15 All registers are arranged so that an initial single 1 pulse cannot be registered in the A-digit register. The 1 is used as a prefix indicating an extra-charge call. Prevention of registration is accomplished by the P2A relay which keeps the O and 1 output leads of the counting relays open and the steering relays from advancing until it has operated. A count of two or greater is required to operate the P2A relay.

PREFIX COUNTER

2.16 The register may be cross-connected to recognize a single 1-pulse digit that may be dialed before the other digits as an indication that some special action

is to be taken. Relays 11A and 11B are provided to recognize this prefix digit.

2.17 The detailed operation of the prefix counter is as follows. When RA releases after the first 1-pulse digit is counted a circuit is closed for operating 11A. Relay 11A locks and closes a circuit for operating 11B when P1 releases as a result of the operation of RA1.

REGISTER ARRANGED FOR DIGIT 1 ACCESS CODES

2.18 A single 1-pulse digit preceding the called number is used to provide digit 1 access codes which indicate calls outside the local service area. The 1 is registered on the 11A and 11B relays. The operation of the marker start (MST) relay is under control of cross-connections as described in the section on the determination of the number of digits. Action of the 11B relay, which removes ground from the local translator lead LT and connects it to the P1 lead, informs the marker that a digit 1 access code has been received.

DIRECTING DIGIT FOR PBX CLASS

2.19 When the register is cross-connected for PBX 4-digit dialing, the PBX customer must dial a directing digit 9 in order to make a call to a point outside the PBX group. As the ninth pulse of the directing digit is counted, the DD9 relay is operated. This relay immediately opens the operating path of the 2 and 7 leads to the A-digit register and releases the P2A relay. As the pulse counting relay P3 releases at the end of the digit 9, the DD9A relay operates. The DD9A relay recloses the 2 and 7 leads and the operating path to the P2A relay so that the next digit of 2 or greater will be registered on the A-digit register.

2.20 If a 9 is dialed and not followed by any other digits, a register time-out will occur. Since the P2A relay is released, which, in turn, releases the PD relay, a permanent signal (PS) mark is sent to the marker.

REGISTER ARRANGED FOR PREFIX DIGIT ZERO (O+)

2.21 The register may be arranged for prefix digit zero, relays OP, OP1, and various cross-connect terminals as shown in Section D of the SD are provided for this service. If the first digit dialed is a zero it is stored on these two relays. If further digits are dialed the OP relay releases. A prefix digit zero call is indicated when OP is normal and OP1 is operated. If no further digits are dialed OP and OP1 both remain operated indicating the initial zero meant zero operator.

2.22 The OP relay operates during the tenth open dial pulse through contacts of P3, P5, and AS operated and P1 and P4 normal. Relay OP locks to an ON ground through contacts of P2 and STRA.

2.23 The OP1 relay operates at the end of the digit through contacts of OP operated and P3 normal. Relay OP1 locks to an ON ground.

2.24 If a second digit is dialed the OP relay is released when P2 operates at the end of the first open pulse.

3. "TOUCH-TONE" CALLING DETECTION AND REGISTRATION

GENERAL

3.01 For any digit, a combination of two audio frequencies is generated by the calling customers TOUCH-TONE set. Each combination of frequencies consists of one frequency out of a "high" group of three audio frequencies and one frequency out of a "low" group of four audio frequencies. Twelve such combinations are available with this arrangement. Ten of these are used to represent the digits 0 through 9. The remaining two are unused.

3.02 Associated with each originating register is a TOUCH-TONE calling receiver circuit which detects the presence of TOUCH-TONE keyed digits and causes translating relays to operate corresponding to the frequencies of the keyed digit. Operation of the translating relays transfers the digital information into digit register units. The end of the digit is recognized by the STRA steering relay which operates when a key is depressed at the customer set and remains operated until the key is released. This relay controls the transfer of digital information into the proper digit register.

"TOUCH-TONE" CALLING RECEIVER

3.03 The TOUCH-TONE calling receiver is bridged across the incoming T and R leads of the register circuit. Each keyed digit causes the TT receiver to ground one of the four LG1-4 leads, one of the three HG1-3 leads, and the STR lead. The receiver is arranged to maintain these output grounds for a sufficient length of time to insure that the digit has been registered and the digit register has been advanced. This action prevents a digit from being lost should a customer depress a key for a very short interval.

3.04 The grounded LG- lead operates one of the YO, Y3, Y6, or Y9 translating relays and the grounded HG lead operates

one of the Z1, Z2, or Z3 translating relays. The frequencies received for each digit, the output leads grounded by the TT receiver, and the translating relays operated are as follows. Note that the numerical designation of the operated YO, Y3, Y6, or Y9 and Z1-3 relays may be added to obtain the corresponding digit for digits 1 through 9.

3.05 The receiver is arranged to detect TOUCH-TONE signals and to ignore other signals. It will provide an output of 2-digit signals and the steering signal for each digit received. The TOUCH-TONE receiver acts as a discriminator and will ground two of the digit leads when it detects a digit. In all other cases it will provide no output.

3.06 The MF relay also operates as soon as the first keyed digit is received. The P2A operates also if the first digit is greater than one. The reason for excluding 1s is covered in the paragraph on preliminary pulses. The MF locks to an off-normal ground and informs the register that the call is being originated by a TOUCH-TONE customer. The P2A locks through a continuity transfer contact to an off-normal ground and causes the digit to be registered in the A-digit register unit. The P2A operated also opens the dial tone circuit, closes a ground supply for the output leads of the translating circuit and opens the operating circuit of the AS steering relay.

DIGIT TRANSLATION

3.07 The digit translation circuit consists of the YO, Y3, Y6, Y9, Z1, Z2, and Z3 relays. These relays are under control of the TT calling receiver output leads LG1-4 and HG1-3 and function to translate the 4 by 3 encoded information received from the TT receiver into 2-out-of-5 information required by the digit register units. The outputs of the translating relays appear on the 0, 1, 2, 4, and 7 leads which are connected to the proper digit register unit by the steering relays. The output leads are grounded as indicated in the table.

3.08 If for any reason an unused combination of translating relays should operate, namely, Y9 and Z1 or Y9 and Z3, the TBL punching will be grounded which will cause TBL to operate. The TBL operates RL which will cause the register to release, and the customer will receive overflow tone.

TABLE B

Digit	Frequencies Cycles Per Second		TT Receiver Output Leads Grounded		Translating Relays Operated		Output Leads Grounded
0	1336	941	HG2	LG4	Z2	Y9	4, 7
1	1209	697	HG1	LG1	Z1	YO	0, 1
2	1336	697	HG2	LG1	Z2	YO	0, 2
3	1477	697	HG3	LG1	Z3	YO	1, 2
4	1209	770	HG1	LG2	Z1	Y3	0, 4
5	1336	770	HG2	LG2	Z2	Y3	1, 4
6	1477	770	HG3	LG2	Z3	Y3	2 4
7	1209	852	HG1	LG3	Z1	Y6	0, 7
8	1336	852	HG2	LG3	Z2	Y6	1, 7
9	1477	852	HG3	LG3	Z3	Y6	2, 8

DIGIT STEERING

3.09 The digit steering circuit serves to connect the output of the translating relays to the digit registers successively as the digits are keyed. The steering circuit is also used to indicate when keying is completed. This circuit consists of one relay per digit and the EK relay which grounds the EK lead to the marker if a digit is stored in the K register. The advance of the steering circuit is under control of relay STRA.

3.10 The A-digit steering relay is operated when ON operates at the start of the call. The AS locks through a back contact on BS. The STRA operates at the beginning of the first digit. When P2A operates (if the digit is 2 or greater) BS operates through a front contact of AS. The BS locks through a back contact of CS and opens its operating circuit to the STRA contact on a continuity transfer contact so that when STRA releases at the end of the digit, AS releases. This action repeats for each digit with the steering relay for the next digit operating when STRA operates at the beginning of a digit and the steering relay for the digit being registered, releasing when STRA releases at the end of the digit. The five output leads of the translating relays are carried through individual transfer contacts on the steering relays and are closed to the digit register associated with the lowest lettered operated relay. For example, with both the AS and BS operated, the leads are associated with the A-digit register. The transfer from one digit to the next takes place on the release of the lower lettered relay.

DIGIT REGISTER

3.11 The digit register units are described under dial pulsing.

OVERALL OPERATION

3.12 The translation and registration of a digit takes place as follows. The TT receiver responds to the customer TOUCH-TONE set and furnishes output grounds to operate the translating relays in the translating circuit in accordance with the frequencies of the keyed digit. At the beginning of a digit the TT receiver also causes STR to operate. Off-normal ground, through the contacts of the operated translating relays, appear on two of the 0, 1, 2, 4, and 7 output leads which are connected by the steering relay to a digit register to cause operation of two of the 5-digit register relays. The STR operated also operates STRA which in turn operates the next steering relay. At the end of a digit the output of the TT receiver is removed thereby releasing the translating relays and STR. The STR released releases STRA which in turn releases the steering relay of the digit just registered. The circuit is then ready for the next digit.

REGISTRATION OF A "1" ON THE A-DIGIT REGISTER

3.13 The situation with respect to a 1 on the A-digit register is the same as described for dial pulses.

PREFIX COUNTER

3.14 The register may be cross connected to recognize a single 1 which may be keyed before the other digits as an indication some special action is to be taken. Relays 11A, 11B, and various cross-connect terminals are provided for this purpose. This prefix digit is used for the purpose described in PREFIX COUNTER under 2. DIAL PULSE COUNTING AND REGISTRATION.

3.15 The detailed operation of the prefix counter when a TOUCH-TONE customer keys a single 1 is as follows: When the TT receiver receives the first keyed 1 it causes the translating relays corresponding to a 1 to operate and also operates STR which, in turn operates STRA. When STRA operates a path is closed for operating 11A. The 11A locks and closes a circuit for operating 11B when STRA releases at the end of the digit. Further keying of digits will cause the register to function in the same manner as decribed under dial pulsing.

DIRECTING DIGIT FOR PBX CLASS

3.16 When the register is cross connected for PBX 4-digit dialing a special directing digit 9 must be keyed in order to make a call outside of the PBX.

3.17 When a directing digit 9 is keyed, the directing digit 9 relay, DD9, is operated when STRA and the Z3 and Y6 translating relays operate at the beginning of the digit. The DD9 locks to an off-normal ground and prepares a path to operate DD9A, when STRA operates at the end of the keyed digit.

3.18 The digit 9 will not be registered in the A-digit register since there is no operating path for P2A, and the digit registers are disabled until P2A operates. The P2A relay operates on the next digit of 2 or greater.

3.19 If a 9 is keyed and not followed by additional digits, a register time-out will occur. Since P2A is released, which in turn releases PD, a PS permanent signal mark is sent to the marker.

REGISTER ARRANGED FOR PREFIX DIGIT ZERO (O+)

3.20 The register may be arranged for prefix digit zero relays OP, OP1, and various cross-connect terminals as shown in Section D of the SD are provided for this service. If the first digit keyed is a zero, it is stored on these two relays. If further digits are keyed, OP relay releases. A prefix digit zero call is indicated when OP is normal and OP1 is operated. If no further digits are keyed, OP and OP1 both remain operated indicating that the initial zero meant zero operator.

3.21 The OP relay operates when zero is keyed as the first digit through contacts of Z2, Y9, and AS operated. The OP locks to an ON ground through contacts of P2 and STRA.

3.22 The OP1 relay operates at the end of the digit through contacts of OP operated and STRA released and locks to an ON ground.

3.23 If a second digit is keyed OP releases at the start of the digit when STRA operates.

4. DETERMINATION OF NUMBER OF DIGITS TO BE RECEIVED

GENERAL

4.01 When all the digits have been received, the register operates the MST and MST1 relays to start seizure of a marker. The steering relays are used to indicate when particular digits have been received. As these relays operate they ground, in turn, terminals B to EK. The ground at these terminals either by direct connection or intermediate control, is used to operate MST. Since the register may not receive the same number of digits on all calls, the operation of MST may be controlled either directly or indirectly by contacts of intermediate relays such as B digit translation relays, C digit translation relays or the prefix counter.

4.02 If PBX service is provided a PBX cross-connection terminal is provided for intra-PBX calls of 4 digits, this PBX terminal is cross-connected to the D terminal for marker start after 4 digits.

B-DIGIT TRANSLATION

4.03 The B-digit translation can be used for translating DDD codes of the NO/1X type. Relays SBO, SB1, SB4, and SB7 are used for this purpose. If a zero is registered for the B digit SB4 and SB7 relays operate, the SB7 relay operated opens the operating path of MST between G- cross connect terminal and MST- cross connect terminal the register will then wait for ten digits before calling for a marker. If a one is registered for the B digit SBO and SB1 relays operate, the SB1 relay operated opens the operating path of MST between G- cross connect terminal and MST- cross connect terminal the register will then wait for ten digits before calling for a marker.

NNO NUMBERING PLAN AREA CODE TRANSLATION

4.04 Numbering plan area codes of the NNO type require a translating circuit in the register detect a zero as the C-digit. The register will wait for ten digits before calling for a marker.

4.05 The C-digit translation is accomplished by relays SC4 and SC7. When a zero is dialed for the C digit both SC4 and SC7 relays are operated. A back contact of SC7 disables the marker start path which would normally operate MST after seven digits have been registered. The register will now wait for registration of ten digits before operating MST.

REVERTIVE STATION DIGIT

4.06 A revertive station digit call is a call to a customer on the same line as the calling customer and requires the calling customer to dial or key an eighth digit after the second dial tone has been transmitted to the calling customer as an indication the register is ready to receive the station digit.

4.07 Operation is as follows: When the seventh digit has been registered a path is closed for operating MST and connection to the marker is made, after the marker has performed its function it will operate the register revertive reorder (RR) relay, followed by operating MRL. With RR and MRL operated RDK operates on its primary and locks on its secondary winding through the winding of RD and its own make-contact to an ON

ground. The RR releases MST1, holds the tip, ring, and sleeve lead to retain the line connection when MRL had operated. The RD releases MST and opens the RP lead to the marker. The second dial tone is now transmitted to the calling customer as an indication to dial or key the station digit. When the station digit has been registered JS relay operates and a path is closed for operating MST for completion of the call.

INTERCHANGEABLE CODES

4.08 The register may be cross connected to handle interchangeable NPA and local codes. Interchangeable codes are codes assigned as both NPA and local codes. The NPA codes require 10 digits, local codes require 7 digits. Since the number of digits required on a particular call are determined from translation of the NPA code or local code, additional means are required for handling the call when a conflicting or interchangeable code is received by the register. Various methods are available in the register for differentiating between 7- and 10-digit calls with the use of prefix zero or one. These methods are described as follows:

(a) Digit timing may be eliminated on all interchangeable codes, or digit timing may be provided on O+ interchangeable calls only.

(b) Where timing is not used on any call, home NPA toll calls require 10 digits (home NPA codes must also be dialed). Where timing is used on O+ traffic, O+ calls within the home NPA can be handled on a 7-digit basis with timing if an interchangeable code is dialed, and without timing on noninterchangeable codes, all 1+ traffic requires ten digits.

(c) Also interchangeable codes may be handled with prefix zero or one with timing after seven digits.

4.09 With the arrangement of dialing prefix zero or one on all 10-digit calls where timing is not used on interchangeable codes, cross-connect terminals OP1, OP2, 11C, and 11D are assigned to contacts of OP1 and 11B relays.

4.10 Where timing is used with dialing of prefix zero or one on interchangeable codes cross-connect terminals OP1-OP3, 11C-11E, and terminal DL are assigned to contacts of OP1 and 11B relays.

DIGIT TIMING

A. Digit Timer

4.11 The digit timer (DT) is a precise low-voltage timing circuit which is used for timing for a second digit following a zero prefix, and for dialing an eighth digit so as to distinguish a local code from an NPA code.

4.12 The transistor timer is designed to provide a timed interval of minimum 3.2 seconds, nominal 3.5 seconds, and maximum 3.8 seconds. In the normal condition timing capacitor DT2 is charged to 48 volts minus the small voltage drop across diode CR1 and resistor R3. Current flows in the base-emitter circuit of transistor Q1 which drives the collector current into saturation. The saturation collector voltage of Q1 is approximately 0.25 volts fixing the base-emitter voltage of transistor Q2 below the nominal turn-on value of about 0.7 volts. In this condition no current flows in the collector circuit of Q2.

4.13 When relay DL is operated to initiate the timing cycle, ground is removed from the charging path of capacitor DT2. The DT2 discharges through the high-impedance circuit of resistors DT5 and R2, and the base-emitter circuit of transistor Q1. At the completion of this discharge delay the voltage drop (approximately 0.5 volts) across didode CR1 will permit conduction in the charging circuit of capacitor DT2. This decreases the base-emitter current of Q1 thus bringing it out of saturation. The collector voltage of Q1 then increases raising the base voltage of Q2 above the 0.7-volt turn-on potential. Current then flows in the collector circuit of Q2 which operates timing relay DT. The values of capacitor DT2 and resistor DT5 are chosen to give a delay of 3.5 + 0.3 seconds from the time relay DL operates to the operation of relay DT.

4.14 When relay DL releases the timing circuit returns to normal by re-establishing ground to the charging circuit of capacitor DT2. Since the charging circuit is of low impedance, DT2 is quickly recharged causing an increased base-emitter current in transistor Q1. This current is sufficient to drive Q1 into saturation and thus return transistor Q2 to its normal cutoff condition.

B. Premature Time-Out of Transistor Digit Timer

4.15 The transistor timer may be prematurely set into operation due to a

defective or dirty DL contact. If this occurs the timer will be timed out while the register is idle.

4.16 When this register is seized to handle a call, relay DT will operate immediately after operation of relay ON1 and release of relay S1 during dial tone marker action. Operation of DT will operate relay MST through a back contact of relay RA1 to seize a marker before any digits are registered or, in case the first digit is quickly keyed or dialed, after registration of this first digit. In either case, unless the single digit is zero, the marker will cause a trouble record and release the register because of insufficient digits. If the single digit received is a zero the marker will proceed with a zero operator call.

LOCAL SERVICE CODES

4.17 Where X11 local service codes are used, the X11 translator consisting of relays SBO, SB1, SCO, and SC1 is provided in the register. All four of these relays are operated if the digit 1 is dialed or keyed for both the B and C digits. Relay SC1 is the last of the four to operate. Translation of the X11 service call takes place in the local translator of the marker.

INFORMATION CODES

4.18 Determination of the number of digits to be received on 1-411 local numbering plan area information calls is as follows. The digits 411 following access digit 1 are translated by the X11 translator as described in 4.17. Operation of relay SC1 of the X11 translator will ground relay MST through relay RA1 operated to initiate marker action.

ZERO OPERATOR CALLS

A. Call Originated by Dial Customer (No Prefix Digit Zero)

4.19 When the register is not cross-connected for prefix digit zero and the customer dials zero for the A digit, ten pulses will be transmitted, and when counting relay P1 releases at the start of the tenth open pulse with P3 and P5 operated, the manual (MAN) relay will operate through AS operated. When RA1 operates at the end of the digit MST will operate. With MAN and DDS operated the A7 lead will be grounded.

B. Call Originated by TOUCH-TONE Customer

4.20 If the customer keys zero for the A digit, the TT receiver will cause the operation of the Y9 and Z2 translating relays and the STR steering relay. These relays operated closes a path to operate MAN. When RA1 operates at the end of the keyed digit, MST will operate. With MAN and DDS operated the A7 leads will be grounded.

C. Register Arranged for Prefix Digit Zero (0+)

4.21 When the register is cross-connected for prefix digit zero, OP and OP1 operate if the first digit is zero. The OP provides ground to operate the DL relay when RA1 operates at the end of the digit. In order to obtain zero operator service the customer must wait for the DT time-out. When DT operates, the MAN relay operates through a front contact of OP to the DT ground. When the MAN relay operates, the A7 lead is grounded and the circuit to operate MST is closed.

MANUAL CALLS

4.22 Certain lines may be equipped for manual calls in which case the register receives no dialing or keying. Instead, it creates an artificial zero for the A digit and connects to a marker.

4.23 The MAN class relay operates from the marker through the F relay. The MAN locks and connects ground to the A7 lead to the marker connector. When the marker has established the dial tone connection, relay F is released allowing operation of L, SR, and ON1. With MAN operated, ON1 operates MST to cause the connection to the marker for setting up the call to the operator. The connection through the ON1 contacts insures that the call is not abandoned and that the dial tone connection has released before the connection is made to the marker for the completing function.

SERVICE CODES REGISTER ARRANGED FOR PBX 4-DIGIT DIALING

A. Telephone Company Service Codes X11

4.24 Where the register is arranged for PBX 4-digit dialing telepnone company service codes are of the X11 type, a directing digit 9 is dialed or keyed intially followed by X11. The operation of the SBO, SB1, SCO, and SC1 relays is as described in 4.17.

B. Digit 1 Access Codes

4.25 Where the register is arranged for PBX 4-digit dialing and digit 1 access codes are used to indicate calls outside the local service area, a directing digit 9 is dialed or keyed initially followed by the digit 1 access code and called number. The operation of the 11A and 11B relays is the same as described previously.

ZERO OPERATOR CALLS WITHIN THE PBX

4.26 With the register arranged for PBX 4-digit dialing service and if a PBX customer dials a O, at the beginning of the ninth pulse the DD9 relay will operate. This momentarily disables the A2 and A7 leads to prevent the 9 from being registered and also releases the P2A relay. However, on the tenth pulse the MAN relay operates. This relay releases the DD9 relay previously operated on the ninth pulse and reoperates the P2A relay. With MAN operated and DD9 normal the A4 and A7 leads will be grounded.

SUMMARY OF SPECIAL CODES, SERVICE CODES, AND PBX DIALING OR KEYING

4.27 The X refers to any number O to 9; N refers to any number 2 to 9.

TABLE C

	Type of Code	Code Dialed or Keyed	Translation Marks	Marker Receives Digits A B C D E F G H J K
FROM PBX CUSTOMERS	PBX Extensions	TH H T U	PX	TH H T U
		O	PX	O
		1 X X X X X X	PX1	X X X X X X
		1 N O/1 X X X X X X X X	PX1	N O/1 X X X X X X X X
FROM PBX OR REGULAR TELEPHONE CUSTOMERS (PBX LINES REQUIRE PREFIX 9)	Digit 1 Access	1 N N X X X X X	P1	N N X X X X X
		1 N O/1 X N N X X X X X		
	Prefix Digit Zero	O N N X X X X X	P1	N O/1 X N N X X X X X
		O N O/1 X N N X X X X X	PO	N N X X X X X
	Telephone Co	N N X X X X X	PO	N O/1 X N N X X X X X
	Customer Codes	N O/1 X N N X X X X X	LT	N N X X X X X
	Telephone Co	N 1 1	LT	N O/1 X N N X X X X X
	Service Codes Incl Local Info		LT	N 1 1
	Local NPA Info	1 4 1 1	P1	4 1 1
	Zero Operator	O	ZO	7

5. SELECTION OF MARKER FOR COMPLETING FUNCTION RELEASE OF REGISTER

GENERAL

5.01 A connection is made to a marker by means of a marker connector when all the digits for the call have been registered or as a result of a permanent signal or partial dial time-out. In some cases a 2-party test or a coin test is made before the connection is established. The register transfer to the marker information concerning the locations and class of service of the calling line and the called code and number. The marker then proceeds with setting up the connection between the calling line and the trunk, followed by operation of MRL relay of the register, causing the connection between the marker and register to be released, and the register to be restored to normal.

SEIZURE OF MARKER

5.02 When all the digits of the call have been registered, ground will be connected to the lead associated with terminal MST, the MST relay will operate but this will be preceded by coin test from dial-tone-first coin lines or by the second 2-party test on calls from 2-party lines.

5.03 Relay MST releases TMB to recycle the TM timer and starts the connection to the marker by connecting ground to lead TM to start the marker connector timer and battery to the connector battery supply (CBS) lead and the start lead. The battery on the ST lead causes the connector to establish a multiple lead connection between the register and the marker.

5.04 Relay MST also closes a circuit to RA1 to prevent any further release of RA1 due to additional dialing or keying and operates the auxiliary relay MST1. The MST1:

(a) Opens the path from the front contact of L to the counting relays to prevent any further registration due to additional dialing.

(b) Opens the circuit to STRA to prevent any further operation of STRA due to additional keyed digits.

(c) Disconnects the ground from the translating contacts of the P- relays.

(d) Disconnects the ground from the translating contacts of the Y- and Z- relays.

(e) Open the circuit to release the partial dial (PD) relay.

(f) Grounds through the steering relay chain the single lead 7 for the digit 1 beyond the last registered digit.

The MST1 also prepares a circuit for operating release relay from a contact of TM so that a time out will cause operation of RL and release of the register.

5.05 The MST1 will operate prior to MST on calls from 2-party lines, when it operates at the start of the second party test and, on dial-tone-first coin lines, when it operates at the start of coin test. In these cases MST1 operates to prevent any further dailing or keying from being registered.

RELEASE

5.06 When the marker is ready to set up the connection between the calling line and the trunk the marker will operate release L (RLL) relay over lead RLL. The RLL operates RLA which locks to an ON ground. The RLL shorts the tip and ring leads enabling the marker to perform a ground test of the channel tip and ring. Shortly after seizure of the marker connector, the ground on lead TM was returned on lead L to hold the L relay which in turn holds SR to prevent release of the register.

5.07 If the ground test of the tip and ring leads is satisfactory, or if the marker is unable to set up the call to the proper trunk, the marker will operate relay MRL over lead MRL. The MRL locks under control of MST, opens the tip, ring, and sleeve leads to release the dial tone connection, opens the TM lead to start release of L, and opens the ST lead to release the connector and the marker. The L releases, releasing SR and, in turn, ON1 and ON which opens the off-normal ground leads, releasing all of the relays of the register. In some cases several relays release in cascade; for example, ON will release a digit steering relay which releases MST, which releases MRL. The register is now ready for another call, and indicates it is idle by closing its TT and and TG leads.

6. TWO-PARTY IDENTIFICATION TEST

GENERAL

6.01 On calls from 2-party message rate lines, or 2-party flat rate lines, a party identification test is made before dial tone is transmitted and another test is made after dialing or keying has been completed but before the marker is engaged. Two tests are made to reduce the possibility of a false identification. The register informs the marker of the results of the two tests and the marker then indicates to the trunk, by way of the sender, which party to charge. If the results of the two tests do not agree, the marker blocks and causes a trouble record.

6.02 The distinction between the parties is that the switchhook contacts of the tip party subset connect ground through the ringer winding to the tip wire when the receiver is off the hook, whereas no direct current ground is connected at the ring party station. The register tests for the presence of this ground are made by applying 48 volts through a relay winding to both tip and ring wires at the central office.

FIRST-PARTY TEST

6.03 Since the tip party station ground may be a reasonably high resistance, the test relay must be quite sensitive and for this reason a polarized relay with an electrical bias is used. This relay is of the mercury contact type requiring no mechanical adjustments. Operation of the relay depends on the balance of the ampere turns in the two windings. The secondary winding is connected in a direction to hold the relay unoperated

while the primary winding is connected in a direction to cause the relay to operate. The resistor, in series with the secondary or bias winding, is such that the primary winding will cause operation of the relay when it is connected to a line which has a 3640-ohm ± 10-percent ringer connected to ground at a customer station. Since the TP relay is quite sensitive it may falsely operate initially when connected to the line through the capacitor in the ringing bridge of the ring party station. For this reason the test is made in two stages. First the TP is connected to the line and then, after a timed interval during which TP may operate and release if the ring station is originating the call, the contacts are enabled, and, if the TP is operated, its auxiliary relay TP1 is operated and locked as an indication that the tip party station originated the call.

6.04 When the register has been selected by a marker on a call from a 2-party line, the marker will operate relay 2P by ground over the 2P lead through a contact of MD2 relay and a contact of the F relay. The 2P locks to an ON ground. The 2-party test (TPA) relay operates through a contact on 2P and a contact of F, and locks under control of TPT. The TPD is operated through contacts of F and 2P. The TPD operates TPT. When the dial tone connection has been established the F relay is released to cause release of the JC- relay of the trunk switch and connector circuit to connect the tip and ring of the calling line to the primary winding of the TP relay. The F also opens the circuit to the winding of relay TPD. The TPD is made slow-release by the shunting resistor TPD and allows time for TP to falsely operate on a capacitor surge and to release. When TPD releases, ground is closed to the armature contact of TP and if TP is operated the auxiliary relay TP1 will operate and lock indicating that a tip party station originated the call. The TPD in releasing opens the circuit to the winding of TPT. The TPT is made slow-release by its short-circuited secondary winding to allow time for operating TP1, if TP is operated. The release of TPT releases TPA to disconnect the tip and ring leads from the TP relay and to connect these leads to the tone coil and the L relay. The L relay will operate over the loop and will operate SR and ON1 to transmit dial tone and to take over supervision of the register. The TPA releases S1 to allow L and SR to assume supervision. The TPA which, in turn, operates TPT to prepare these relays for the second-party test.

6.05 If TP1 operates during the test it connects ground through a winding of the tone coil to the tip and ring leads of the line to reduce the current in the tip party ringer so that when the current is interrupted by disconnection of the TP relay, the self-induced voltage will not be high enough to cause bell tapping at the ring party station.

SECOND-PARTY TEST

6.06 The circuit for operating the MST relay is wired through transfer contacts on the 2P relay so that on non-2-party calls the operation of the MST relay is not interfered with, but on 2-party calls the TPB relay is operated instead of MST when dialing or keying has been completed. The TPB operates MST1 to prevent further digit registration and to cause ground to be connected to the proper -7 lead as a digit-end signal, and transfers the front contact of the TP relay from the winding of the TP1 relay to the winding of the TP2 relay. The TPB closes ground through the HL2 resistor to hold the L relay in local circuit and operates TPA to disconnect the L and tone coil from the ring and tip leads and to connect these leads to the primary winding of the TP relay. The TPA opens the circuit to TPD which is slow-release to allow TP to falsely operate on a line surge and to release. When TPD releases, it connects ground to the armature of TP to cause operation of TP2 if TP remains operated to the tip station ground and opens the circuit to TPT. The TPT is slow-release to allow time for the operation of TP2. When TPT releases, it operates TPC to connect the ground which operates TPB to the MST winding causing MST to operate and start the connection to the marker. The TPC releases TPA to disconnect the TP from the tip and ring leads and to reconnect these leads to the tone coil and L relay. The TPA, in releasing, reoperated TPD to disconnect the local circuit holding path of the L relay to again place L under control of the customer line. The TPD also reoperates TPT. If TP2 operates, it duplicates the functions described for TP1.

TWO-PARTY INDICATIONS

6.07 The marker will be informed of the results of the two test by means of

the TP and RP leads. If both tests indicate that the tip party is calling, lead TP will be grounded and RP open. If both tests indicate that the ring party is calling, lead RP will be grounded and TP open. If the tests do not match, both leads will be grounded and the marker will not complete the call but will cause a trouble record instead.

TESTS OF TP RELAY

6.08 In order to make sure that the TP relay retains its adjustment, an operate test and an open circuit release test of the relay is made on all calls from 2-party lines. The locking path of ON1 is closed through front contacts of 2P and back contacts of TP2 and TP1 so that if 2P is operated either TP1 or TP2 must operate to allow release of ON1. If neither of these relays has operated during the call, an operate current flow test is applied to TP before the release of the register to cause operation of TP1 or TP2.

7. DIAL-TONE-FIRST LOOP START COIN LINES

7.01 When the register is seized for coin service, relay CN operates followed by operation of the CNT2 and subsequently CNT3 relays. The CNT2 is held operated over its operate path and a lock path controlled by the CNT1 relay. The CNT3 is held operated under control of the CNT2 relay. The primary function of relays CNT2 and CNT3 is to release in sequence, after the called number has been dialed and before the marker is called, thereby timing the coin test interval. Relays CN and CNT3 operated, prepare the register for coin test by transferring the normal operate path of marker start relay to CNT relay. At the end of dialing, CNT operates over this path. The function of CNT is to hold the L relay operated and then start the coin test cycle. The hold on L is needed to prevent its release during coin test. The CNT operated also locks relay RA1 and operates relay MST1. This action disables the digit counting and registration circuits. In addition CNT operates CNT1. With both of these relays operated, CNT2 begins to release. The CNT1 operated, transfers the tip lead to ground test relay GT; opens the ring lead to prevent ground on L from backing up through the loop to the GT relay; and recycles the TM timing circuit.

7.02 When GT is initially connected to the external tip circuit, it may falsely operate due to line surge. If a coin has been deposited at the coin station, grounding the tip lead, GT will operate or remain operated if it has falsely operated. If a coin has not been deposited GT will not operate or will soon release if falsely operated. Since the final state of GT (operated or nonoperated) at the end of the coin test cycle determines if a coin is present or not present. The slow-release of CNT2 covers the period during which GT may falsely operate and release. Relay GT1 records the final state of GT during the slow-release interval provided by CNT3. The operation of GT1 is under control of both GT and CNT2, once operated, GT1 locks. When CNT3 releases, it establishes the marker start circuit. If a coin has been deposited operation of MST will be through GT1 operated and break-contacts of MRL and RL. If a coin has not been deposited, and the call is of the 1+, X11, O-, or O+ type of operation of MST will be through a break-contact of GT1 and a make-contact of 11A for 1+, SC1 for X11, MAN for O-, or OP1 for O+.

7.03 Where the dial-tone-first recorded announcement is provided and the call is not of the 1+, X11, O-, or O+ type, and a coin has not been deposited ground through break-contacts of GT1, 11A, SC1, MAN, OP1, and cross-connect terminals DTF to ANN will cause operation of announcement (ANN) relay which will connect the T and R leads to the recorded announcement circuit.

7.04 If the recorded announcement is not provided the cross-connection will be from DTF terminal to NANN terminal. Ground at these terminals will cause operation of TBL relay and in turn RL causing the register to release. The line drops to a locked out condition.

(a) An operate test of the GT relay is made before the register releases to check that GT is capable of operating under service conditions. This test is made on all coin calls when L releases and MRL or RL operates. The register will remain off-normal if GT does not operate. The locking path of ON1 is closed through a front contact of CN and a back contact of GT1 so that if GT and GT1 fail to operate, ON1 will remain operated and the register TM timing circuit functions to cause an alarm.

GROUND-START COIN LINES

7.05 This circuit is arranged to function with ground-start coin lines. The

operation with ground-start coin lines which have more sensitive line circuit relays requires that the L relay be made more sensitive so as to operate on a lower value of line current and thus prevent showering. The CN relay closes ground through series resistors LB and LC to provide a limited number of ampere turns in the tertiary of the L relay in a direction to aid the operation of L. A coin test cycle is made on these lines just as it is made on the loop-start lines.

8. RELEASE OF REGISTER BY CUSTOMER

MARKER NOT ATTACHED

8.01 If the customer abandons the call and replaces the receiver on the switchhook the closure on the tip and ring conductors is opened. If this occurs before the marker has completed the dial tone connection L will not operate to operate SR and ON1 and when S1 releases after the release of F, ON will release to release the connection on a 2-party line the first party test will be made before S1 and ON release. If the abandonment occurs after L, SR, and ON1 have operated, L and SR will release. Release of SR will operate RL causing release of the register.

8.02 The RL opens the tip and ring leads to avoid breaking current at the cross-points of the switches and opens the sleeve lead to release the dial tone connection. The RL locks to an ON ground and opens one part of the circuit for holding ON1. On 2-party calls an auxiliary circuit is closed through front contacts of the 2P relay and back contacts of the TP2 and TP1 relays. One of the relays TP1 or TP2 must be operated on each 2-party call and this operation is described in the paragraph on the test of the TP relay.

8.03 The ON1 releases ON to cause release of all the relays of the register and causes the register idle indications.

MARKER ATTACHED

8.04 If the marker has been engaged before the customer disconnects, the L relay will be held over the L lead to the connector where it is connected to the TM lead which is connected to ground through front contacts of MST. The connection to the trunk will be set up in the usual manner but, since the customer loop is open, the trunk connection will immediately release.

9. REGISTER TIME-OUT

GENERAL

9.01 The register TM timing circuit consists of a three transistor timing circuit, the timing relay TM, the auxiliary relay TM1, and the control relays TMA, TMB, and TMC. This circuit times for various functions of the register to be completed, and if they are completed within this time, recycles itself for timing the next function. If the function is not completed the timer times out and causes the action indicated in the following table.

TABLE D ORIGINATING REGISTER TIMER (TM)

TIMES FOR	TIME ALLOWED (SECONDS) MIN	NOM	MAX	ACTION TAKEN
Dialing or Keying of First Digit (Permanent Signal	10.8	12.5	13.7	Engage Marker for Permanent Signal Test for Trouble Ground or ROH Routing
Dialing or Keying of Digits Other Than First (Partial Dial)				Engage Marker Overflow Tone is Returned
Release of Register After Operation of MST Relay. (Stuck Register)				Release Register Except for Condition Where TP Fails to Operate or Release in Which Case Register Will be Held. (See Tests of TP Relay.)

DESCRIPTION OF TIMER OPERATION

9.02 The TM timer is started by operation of control relay TMA which removes ground from the charging circuit of timing capacitor TM and connects the grounded relay TM to the transistor circuit.

9.03 The timer is recycled by the release of TMA which connects ground to the charging circuit of the timing capacitor TM.

9.04 The TMA and TMB relays control the recycle. The TMA operates from an ON ground on its primary winding and locks on its secondary winding through contacts of a number of control relays. The locking ground operates the TMB relay. The TMB opens the primary winding operating circuit of TMA. In order to recycle the timer one of the control relays opens the TMA locking circuit. This causes the release of TMA and TMB. The TMB is a slow-release relay and allows time for TMA to release and to charge the TM capacitor before releasing to reclose the operating path for TMA. When TMB releases TMA reoperates to start a new timing cycle.

9.05 For TOUCH-TONE operation the TMC relay is inserted in this sequence. If the keyed digit is of short duration, relay TMB may not release in time, but TMC is fast-release and insures that the timer is recycled during the digit.

9.06 If a time-out occurs the auxiliary relay TM operates and locks and, in most cases, causes a recycle of the timer.

PERMANENT SIGNAL TIMING

9.07 The timer is started on the seizure of the register by the operation of TMA from relay ON, TMC is also operated at this time and locks under control of STRA. The TMA operates TMB. The TMB at this time is under control of a back contact of P2A and a front contact of RA1.

9.08 During a dialed call, RA1 is released while a digit is being dialed. When a digit of two or greater is counted by the dial pulse counting circuit, P2A operates.

9.09 During a keyed call, MF is operated at the beginning of the first keyed digit which transfers control of TMB from the front contact of RA1 to a front contact of TMC. While a digit is being keyed, STRA is operated which releases TMC. When a digit of two or greater is keyed and recognized by the translating relays, P2A operates.

9.10 When P2A operates under either of the two conditions described above, TMA and TMB release to recycle the timer for partial dial functions. The P2A also operates PD.

9.11 If the timer functions before PD operates, TM operates to operate TM1 which locks. The TM1 causes operation of MST. Operation of MST opens the locking circuit of TMA releasing TMA and TMB to recycle the timer. With MST operated the TMB operating circuit remains open and no further recycle is made. Release of TMA releases TM to operate MST1 to prevent any registration. With TM1 operated and PD normal the PS lead to the marker is grounded, the PS relay operates and transfers the T and R to the marker where the marker performs a permanent signal test as described in the marker CD.

PARTIAL DIAL TIMING

A. Dial Pulse Operation

9.12 With P2A operated, the locking winding of TMA and the operating curcuit of TMB is under control of RA1. At the end of each digit RA1 operates to operate TMB and at the start of each digit RA1 releases to release TMA and TMB to recycle the timer.

9.13 If the customer fails to dial a sufficient number of digits to cause operation of MST, the timer will function to cause operation of TM. The TM operates TM1 which, in turn, operates MST to cause a marker to be engaged. The TM1 will close a locking circuit to PD to prevent its release when MST1 operates. With PD operated the marker receives a ground on lead PD.

9.14 Under certain dialing interrupter test conditions where the interdigital interval is short, the TMB relay may not have sufficient time to operatre so as to cause a recycle of the timer at the start of each digit. Due to this limitation, it may not be possible to test the register during periods of office overload conditions and using a large number of digits with each digit a high number. Under these conditions the TM timer may function before the entire number is dialed.

9.15 The TM1 relay is locked to a contact on PD so that a peg count can be made on abandoned partial dial calls. This is described in the section on traffic registers.

9.16 If all digits are dialed, MST1 operates to allow the release of PD. Operation of MST1 and releae of PD changes the condition from partial dial timing to stuck register timing.

B. TOUCH-TONE Operation

9.17 With P2A and MF operated, the locking winding of TMA and the operating circuit of TMB are under control of TMC. At the end of each digit STRA releases to operate TMC and, in turn, TMB. At the start of each digit STRA operates to release TMC which, in turn, releases TMA and TMB to recycle the timer. Subsequent circuit action is the same as described in A. Dial Pulse Operation.

STUCK REGISTER TIMING

9.18 Timing for release of the register is usually started by the operation of MST although in some cases the actual time required to dial or key the last digit is included in the timer period. When RA1 or TMC operates at the end of the last digit it closes the circuit for locking TMA and operating TMB. If a second party test is made on a 2-party line; or if the MST operation is a result of the time-out of the digit timer, TMB will operate. If MST operates directly from RA1, TMB will not have time to operate and in this case MST cannot recycle the timer and the time required to dial or key the last digit will be included in the stuck register timing period. If a dial-tone-first coin line is connected to the register, the timer will be recycled at the start of the coin test by the operation of CNT1.

9.19 If the register does not release as a result of the marker action or some trouble prevents the register from gaining access to a marker, the timer will function to cause operation of relay TM. The TM operating, with MST1 operated, operates RL. The RL opens the tip and ring leads to release the L relay and the sleeve lead to release the dial tone connection. The L releases SR which, in turn, releases ON1 and ON to cause release of the register. On 2-party lines either TP1 or TP2 must be operated before ON1 is released. This is described in the section on 2-party lines.

LINE TROUBLE TIME-OUT

9.20 If the customer line becomes crossed with a power line or ringing feeder the counting circuit may count more than ten pulses for the A digit. The counting circuit is arranged so that, if a count of 11 or more is made, the only lead enabled to the A register is the zero lead. Consequently, if an interdigital interval occurs after 11 or more pulses the release of RA will connect ground to the zero lead and through contacts of the MAN or OP and OP1 relays to operate TM1.

9.21 If the zero prefix counter is not provided the MAN relay operates when the tenth pulse is counted. The TM1 is then operated through a contact of MAN at the interdigital interval.

9.22 If the zero prefix counter is provided the OP relay operates when the tenth pulse is counted and locks through a contact of P5 to an ON ground. After TM1 operates through OP at the interdigital interval the MAN relay is operated through contacts of TM1 and OP to an ON ground.

9.23 In either case MAN operated opens the circuit to the PD relay so that the marker will receive a permanent signal indication. The TM1 operated operates MST for connection to a marker and MST operates MST1 to prevent any further registration. The marker will receive a PS indication and grounds on leads A0 and A7. Under this condition a trouble record card may or may not be provided depending on the number of lines with permanent signal conditions in the office and the position of the PS record control key at the maintenance center.

REGISTER ALARMS

9.24 Whenever TM is operated it grounds the alarm lead to the ALM circuit. The ALM lead is common to all registers and a ground on this lead will start a common timing circuit. In most cases the ground on the ALM lead is of short duration since TM, in operating, starts a chain of events which eventually results in the release of TM. However, if some trouble prevents TM from accomplishing its usual function and TM remains operated, the common timing circuit will function to cause the office alarm to operate. The maintenance force will be directed to the register by the lighted lamp at the test frame.

9.25 The alarm may be silenced by making the register busy. This causes operation of the MB relay which disconnects the ground from the ALM lead, thus cutting off the alarm from this particular register, but leaving the lamp lighted.

10. SERVICE CALLS

CODES X11

10.01 The X11 translator consists of relays SBO, SB1, SCO, and SC1 which are associated with the output leads of the B- and C-digit registers. Relays SBO and SB1 will operate if the BO and B1 leads, respectively, are grounded. With SBO and SB1 operated, SCO will operate if the CO lead is grounded. Operation of SCO will then allow SC1 to operate when lead C1 is grounded. Thus, SC1 operates only if a digit 1 is present in both the B- and C-digit registers.

10.02 With SC1 and RA1 operated, a ground is connected to the MST terminal. This will cause operation of MST for noncoin individual lines; operation of TPB for 2-party lines for the second party test. After the appropriate action, the marker will be engaged.

DIGIT 1 ACCESS CODES

10.03 The 11A and 11B relays are used to register an initial 1.

10.04 For dial pulse calls, if the counting relays count a single pulse, initially, P2A will not operate and when RA releases at the end of the digit 1, ground is connected to the 1 lead through a back contact of P2A to operate 11A. The 11A locks and when P1 releases as the result of the operation of RA1, 11B is operated and locked. Where digit 1 access codes are used the operation of the 11B relay removes ground from the LT translator lead and grounds the P1 translator lead to the marker.

10.05 For TOUCH-TONE calls, if the translating relays, corresponding to the digit 1, are operated initially, P2A will not operate and ground is connected to lead 11A through a back contact of P2A to operate 11A. The 11A locks and when STRA releases at the end of the digit 1, 11B is operated and locked.

LOCAL NPA INFORMATION CODE 1-411

10.06 Access digit 1 preceding the information code 411 is used to indicate an information call outside the local area but within the same NPA.

10.07 As the access digit 1 is dialed or keyed, it is registered on relays 11A and 11B. Contacts of 11B transfer ground from the LT lead of the marker connector to lead P1.

10.08 The 411 digits are translated by relays SBO, SB1, SCO, and SC1. If one is dialed or keyed for both the B and C digits, all four of these relays will be operated. When RA1 operates at the end of the final digit 1 and SC1 is operated, ground will be placed on terminal MST to initiate marker action.

11. ZERO OPERATOR CALLS (NO PREFIX DIGIT ZERO)

11.01 When the register is not cross-connected for operation with zero prefix counter and a customer with a dial set dials zero as the initial digit, the P3 and P5 counting relays will be operated and the P1 and P4 counting relays will be normal during the tenth open pulse.

11.02 If a TOUCH-TONE customer keys a zero as the initial digit the Y9 and Z2 translating relays will be operated.

11.03 For either of these two conditions, MAN will operate through the operated AS. When the zero digit is registered and RA1 operates, a ground is closed through the MAN contacts to cause operation of MST on noncoin individual lines or operation of TPB for 2-party lines for the second party test. After the appropriate action the marker will be engaged.

11.04 If a customer dials a 1 when the register is cross connected for prefix digit one followed by a zero the 11A and MAN relays will be operated. When the zero is registered and RA1 operates, a ground is closed for operating TBL which operates RL causing the register to release.

11.05 Where the register is cross-connected for operation with prefix digit zero, OP and OP1 operate if the A digit is zero. The OP provides ground to operate the DL relay when RA1 operates at the end of the digit. In order to obtain zero operator service, the customer must wait for the DT time-out. When DT operates, MAN operates through a front contact of OP to the DT ground. When MAN operates, the A7 lead is grounded and the circuit to operate MST is closed.

12. MANUAL CALLS

12.01 Lines which have manual originating and dial terminating service are in the manual class. They may be either coin or noncoin. When such a line originates a call, the marker recognizes from the class number that it is a manual line and operates the MAN class relay. The MAN locks,

opens the dial tone circuit, and grounds the A7 lead to the marker connector so that the marker will function as if a zero were dialed as the A digit. The MAN also prepares a circuit for operating MST as soon as the marker has completed the dial tone connection and releases the F relay to allow operation of L, SR, and ON1. The ON1 insures that the dial tone connection will have released before the connection is made to the marker for the completing function.

13. PREFIX DIGIT ZERO (O+)

13.01 Where prefix digit zero calling is provided the dialing or keying of zero for the first digit indicates that the customer desires one of two services, the zero operator or O+. In order to determine which service is desired an interval is timed by the digit timer and:

(a) If no further digits are dialed or keyed it is assumed that the zero operator is requested and connection to a marker is made.

(b) If additional digits are dialed it is assumed that the call is a prefix digit zero (O+).

13.02 In order to determine whether an initial zero is prefixing an O+ call or whether zero operator service is desired the zero prefix counter is provided. Operation of the zero prefix counter is explained in "Zero Prefix Counter," "TOUCH-TONE Operation," and "Zero Prefix Counter - Dial Pulse Operation."

13.03 When an initial zero is dialed OP operates on the tenth open pulse. The OP operated, opens the 4 and 7 leads to the A-digit register to prevent registering zero, releases P2A to prevent the steering relays from advancing at the end of the digit, opens the dial tone supply, and starts the digit timer.

13.04 When the initial zero is keyed from a TOUCH-TONE set OP is operated. Zero is not registered on the A-digit register because the P2A relay is not operated by the Y9 and Z2A translating relays. With P2A normal the steering relays will not advance at the end of the digit.

13.05 At the end of the initial digit zero, relay OP1 operates to reclose the operate path of P2A.

13.06 If further digits are not dialed or keyed after the initial digit the digit timer will time out to operate DT. The DT provides a path to operate MAN through a front contact of OP. The MAN operated, grounds the A7 lead in the digit register and operates MST (after necessary coin 2-party tests). A back contact of OP prevents the DT ground from also operating MST and, thus, short-circuiting the coin functions.

13.07 If the customer wishes O+ service the next digit must be started before the time-out occurs. When the next digit is started OP releases on the first pulse when P2 operates from dial sets or when STRA operates if the digit is keyed from a TOUCH-TONE set.

13.08 When OP releases at the start of the next digit, this releasing DL to stop the digit timer, relay DT will also release. This action takes place before relay RA1 reoperates at the completion of the digit. Since both DT operated and RA1 operated are required for operation of MST, a premature marker start cannot occur.

13.09 If the second digit is a zero MAN operates. When RA1 operates at the end of the digit a path is closed to operate TBL and in turn RL causing the register to release.

13.10 If the second digit is a 1, the 11A relay will operate. The register will release as described in 13.09. If the second digit is 2-9, it will be stored on the A-digit register and a marker will be engaged as a result of cross-connections.

13.11 Where the register is arranged for PBX 4-digit dialing the circuit to OP is wired through a front contact of a DD9A tranfer. If the PBX customer does not dial or key a directing digit "9" the MAN relay will operate on an initial zero and cause connection to the PBX attendant.

14. TROUBLE RELEASE

14.01 If the marker is unable to complete a connection because it has encountered a trouble, it will operate the TRL relay under certain circumstances in order to free itself. The TRL operates and locks to MST and opens the ST lead to release the connector and marker. The TRL in operating operates the RL which opens the TM lead to start release of L and, opens the tip, ring, and sleeve leads to release the dial tone connection. The L releases, releasing

SR, and, in turn ON1 and ON which opens the off-normal ground leads, releasing all of the relays of the register.

15. MAKE BUSY

15.01 The register is made busy by operation of the associated ORMB key at the test frame. Operation of the key grounds lead MB and operates the register MB relay through a break-contact of ON1. The MB opens the TT and TG so the register appears busy. The register may also be made busy by other means as described in the test circuit CD.

15.02 The MB also removes ground from the ALM lead so that the alarm may be silenced if it has been operated by the register.

16. TRAFFIC REGISTERS

ABANDONED PARTIAL DIAL REGISTER

16.01 If a call is abandoned after at least one digit has been dialed or keyed but before dialing or keying has been completed, the ON relay will release as usual. Under these conditions relay PD will still be operated and TM1 unoperated, and a circuit will be closed from ground through a break-contact of ON, make of PD, and break of TM1 to lead APD for operating a peg count register connected to this lead. The release of ON releases P2A and PD. The PD is made slow in releasing, so that it will not open the operating circuit of the peg count register until it has had sufficient time to operate. The PD keeps the TT and TG leads open so that the register appears busy until PD releases.

16.02 If a partial dial time-out occurs, both PD and TM1 will be operated when ON releases, and the APD lead will not be grounded. The TM1 locks to a contact of PD so that TM1 cannot close the APD lead.

PARTIAL DIAL TIME-OUT

16.03 If the customer dials or keys only nine digits on a DDD call but does not abandon, a partial dial time-out will result. The operation of TMA at the start of the ninth digit will start the TM timer to function. The time-out will cause the operation of the TM relay which operates TM1, which locks under control of the slow-release relay PD. The TM1 also closes a locking path for PD. This circuit arrangement makes sure that TM1 will remain operated as long as PD is operated. The TM1 operates the MST relay which starts the marker. With TM1 and PD operated, the marker is informed that this call should receive partial dial treatment. The marker performs its functions, and transmits a release signal to the register to cause its release.

17. TRAFFIC USAGE RECORDER CONNECTIONS

17.01 The register-busy for maintenance (RBM) lead to the traffic usage recorder is grounded whenever the MB relay is operated electrically and is used for indicating that the register had been made busy.

17.02 The register-busy (RB) lead to the traffic usage recorder is grounded whenever the ON relay is operated indicating that the register is being used; also used to indicate made-busy registers so that it will truly indicate "not-available-for-service" conditions.

18. PBX TOLL DIVERSION

18.01 The register is arranged for blocking of PBX toll calls dialed by restricted stations over the same dial "9" trunk group used for toll completion by PBX operators and certain nonrestricted stations. Marker screening is used to detect specific calls which should invoke toll diversion, on a per customer group basis. Where the marker desires to invoke toll diversion, it passes a diversion signal to the register operating reversal relay RV1. The RV1 operated, reverses the tip and ring connection to the calling PBX trunk. The RV1 operates RV2 to transfer the holding circuit from the L relay to the SR relay. This prevents release of the L relay during the reversal and subsequent current buildup.

18.02 Operation of the trunk diversion relay depends on the calling extension remaining off-hook to provide an operate path for the diverting relay which is in series with the line. This makes it necessary to guard against flashing by the calling station which could mask the reversal interval, thereby preventing operation of the diverting relay. Relay ABN serves this purpose. Relay ABN is placed in series with a break-contact of L and make-contacts of SR and RV1. If L releases before the marker operates MRL ABN operates and causes operation of RL and release of the register.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Lines and Trunks

TABLE E - CUSTOMER LINES AND PBX TRUNKS

	DIALING			COIN TEST	2-PTY TEST
	7-15 PPS DIALS CUST LINES INCL COIN AND 2-PTY MR	PBX EXT LINES	7-21 PPS DIALS PBX ATT TRKS		(SEE NOTE B)
Ckt Volt Limits	45-50	45-50	45-50	45-50	45-50
Max Ext Ckt Loop Res	2000	2000	1650	2000	2000
Max Line or Trk Cond Res	1800	1800	1550	1800	
Min Ins Res	10,000	10,000	15,000	10,000	15,000
Allowable Rated Bridged Capacity at Subsets	2μF (See Note A)	3μF	None		
Allowable Capacity to Grd on Either Side of Line	2.5μF				
Max Earth Potential	±10V			±10V	±10V

Notes:

A. Allowable bridged capacity for side tone coin collector with antiside tone subset is 3 microfarad.

B. The maximum allowable resistance of the ringer in the tip party subset is 4000 ohms.

1.02 Voltage Limits

Voltage	Min	Max
-48	-45	-50

1.03 Resistance Limits

(a) TOUCH-TONE receiver

(1) The lead resistance from terminal 9 of the F socket to ground shall not exceed 0.62 ohms.

(2) The lead resistance from terminal 15 of the F socket to battery shall not exceed 0.62 ohms.

2. FUNCTIONAL DESIGNATIONS

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

2.02 Relays

Designation	Meaning
11A,B	1 Prefix Counter
2P	2-Party
A2/5	A-Digit Register
ABN	Abandon

Designation	Meaning
ANN	Anouncement
AS	A-Digit Steering
B2/5	B-Digit Register
BS	B-Digit Steering
C2/5	C-Digit Register
CGA,B	Class Group
CN	Coin
CNT, CNT1-3	Coin Test
CS	C-Digit Steering
CSO-7	Class of Service
D2/5	D-Digit Register
DD9, DD9A	Directing Digit 9
DL	Delay (Digit Timing)
DP	Dial Pulse
DS	D-Digit Steering
DT	Digit Timing
E2/5	E-Digit Register
ES	E-Digit Steering
EK	End Check 10 Digits
F, F1A-B	Frame (Cut-In)
F2/5	F-Digit Register
FS	F-Digit Steering
G2/5	G-Digit Register
GS	G-Digit Steering
GT, GT1	Ground Test (Coin Line)
H2/5	H-Digit Register
HS	H-Digit Steering
J2/5	J-Digit Register
JS	J-Digit Steering
K2/5	K-Digit Register
KS	K-Digit Steering
LOO-19	Line
LBO-3	Line Block

Designation	Meaning
LGO-4	Line Group
LUO-1	Line Unit
MAN, MAN1	Manual (Operator)
MB	Make Busy
MB-LOO	Make Busy
MB-LBO	Make Busy
MB-LGO	Make Busy
MF, MF1	Multifrequency (TT Call)
MG, MH	Marker Connector
MRL	Marker Release
MST, MST1	Marker Start
ON, ON1, ON2	Off-Normal
OP, OP1	Zero Prefix Counter
P1-5	Pulse Counting
P2A	Pulse Counting Auxiliary
PD	Partial Dial
PS	Permanent Signal
RA, RA1	Register Advance
RB	Register Busy
RD	Revertive Digit
RDK	
RL	Release
RLA	
RLL	
RR	Revertive Reorder
RV1, RV2	Toll Diversion (Reversal)
S1	Supervisory on Seizure
SBO,1,4,7	B-Digit Translator
SCO,1, 4,7	C-Digit Translator
SR	Supervisory
STR, STRA	Steering
TBL	Trouble

Designation	Meaning
TM	Time Measure
TM1,A,B,C	Time Measure
TP	Tip Party - Line Test
TP1,2	Tip Party Test Auxiliary
TPA-D	Tip Party Test Control
TPT	Two-Party Test Timing
YO,3,6,9	TOUCH-TONE Translation
Z1-3	TOUCH-TONE Translation

3. FUNCTIONS

3.01 This register is designed to perform the following functions, some of which may be omitted if not required.

3.02 To make itself busy under any of the following conditions:

(a) Register engaged on a service call.

(b) Register made busy by means of a make-busy key at the test circuit.

(c) Register under test by test circuit.

(d) Failure in the 2-party test.

3.03 When seized by a marker or a dial tone connection, to register the class number, location of the line of the calling party. This information is transmitted to the marker via the marker connector after dialing or keying has been completed.

3.04 To record information received from the marker that the call is from a coin line, a 2-party line, a manual line, or dial pulse only.

3.05 To provide for holding the register by means of a slow-release relay from the time that the marker has completed the dial tone connection and disengaged itself, until the register line relay and its associated relays have been operated under control of the customer loop and switchhook.

3.06 To hold the dial tone connection by means of a ground on the sleeve lead under control of the customer switchhook, and to hold this connection during dialing or keying by means of a slow-release supervisory relay.

3.07 To transmit dial tone to the calling station when the register has been connected to the line and is ready to receive dial pulses or TOUCH-TONE signals. A 2-party identification test or a coin test may be made before dial tone is transmitted.

3.08 To disconnect dial tone after the second pulse of the first digit greater than 1 has been received during a dial pulse call, or after the first digit greater than 1 has been received on a TOUCH-TONE call.

3.09 To count the number of dial pulses in each dialed digit.

3.10 To receive the frequencies representing digits keyed during TOUCH-TONE call.

3.11 To register the dialed or keyed digits on a group of five register relays per digit on a 2-out-of-5 basis.

3.12 To steer registration of each digit to the group of five register relays corresponding to the digit received.

3.13 To register a prefix 1 on the prefix counter and not on the regular digit registers.

3.14 If operation with the prefix counter is to be omitted, to discard any digits, discard digit 1 until the digit 2 or greater has been registered on the A-digit register.

3.15 To determine by means of cross-connections in the register how many digits are expected on the call, and to cancel further registration when this number of digits has been received.

(a) To recognize that only 1 digit is to be received on calls to zero operator by operating the manual relay when zero is received for the A digit.

(b) To recognize that 3 digits are to be registered on calls to X11 operators (toll, information, etc) by means of the relays of the X11 translator which operate if one is registered in both B and C digits.

(c) To recognize from the A digit, the B digit, or the C digit how many digits are expected before canceling further registration.

(d) To determine the number of digits to be registered when an interchangeable NPA or local code is keyed or dialed.

3.16 To select a marker when dialing or keying has been completed. As described below, a 2-party identification test or a coin test may be made between the end of dialing and the selection of a marker.

3.17 To transfer to the marker the following information:

(a) Class of service of the calling line.

(b) Location of the calling line, line block, line group, and line.

(c) All digits dialed or keyed by the calling customer.

(d) Ground on lead LT, PO, P1, PX, PX1, or ZO to indicate a local call, a prefix digit zero call, a prefix digit one call, a PBX 4-digit call, a 1XX call, or CCSA call or, zero operator.

(e) All digits dialed or keyed by the calling customer.

(f) Grounds lead 7 of the digit 1 beyond the last to provide a means for the completing marker to check that the entire called number has been transferred.

(g) Grounds lead PS or PD to indicate a permanent signal or partial dial.

(h) Grounds lead RP or TP to indicate that the ring or tip party of a 2-party line is calling. Lead RP is also grounded on calls from lines other than 2-party.

3.18 To open the tip, ring, and sleeve toward the calling customer upon a signal via the MRL lead from the marker. This releases the dial tone connection and permits the marker to establish a connection from the calling line to a trunk.

3.19 To hold the register via the L lead to the marker connector, so that the calling customer cannot release the connection while the marker is engaged, and so that the release of the dial tone connection will not release the register.

3.20 To disconnect from the marker when the marker grounds the MRL lead and to return to normal.

3.21 To recognize an abandoned call by the customer at any time before a marker is engaged, and to restore the register and dial tone connection to normal.

3.22 To make a 2-party identification test on two party lines before dial tone is transmitted and again after dialing or keying has been completed. After the second test has been completed, to engage a marker and transmit to it the results of both tests. If the test results do not match, both TP and RP leads will be grounded, and the marker will cause a trouble record to be made.

3.23 To test the TP relay on its test operate current at the end of every call from a ring party on a 2-party class, and to test the TP relay for release on open circuit at the end of every call from a 2-party class. If the TP relay fails to operate or release the register will not restore to normal and a time-out alarm will be given.

3.24 To measure time (12.5 seconds nominal) while waiting for the first digit to be registered. If the digit is dialed or keyed the timer is recycled and the call proceeds. If the digit is not dialed or keyed, a marker is engaged and the line is connected to a permanent signal holding trunk.

3.25 To measure time between digits (12.5 seconds nominal). If the customer is too slow in dialing or keying, a marker is engaged and the line is connected to a partial dial trunk.

3.26 To measure time from the completion of dialing or keying (or PS or PD time-out) until the register restores to normal. This interval is 12.5 seconds nominal. If the register does not restore in this time, the timer circuit attempts to restore the register. If the timer is successful in this action, the calling line will originate a new call and receive dial tone from a new register. If the register does not release, a lamp will be lighted at the maintenance center to indicate the stuck register and a common timer will be started, which, after an interval, will cause an alarm.

3.27 To recognize a manual originating line signal from the marker while it is setting up the dial tone connection, to open the dial tone lead, and to treat the call as if the customer had dialed or keyed zero. On noncoin calls the marker will be engaged immediately and zero will be transmitted for the A digit.