CROSSBAR SYSTEMS
NO. 5
INCOMING REGISTER CIRCUIT
MULTIFREQUENCY

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SECTION I - GENERAL DESCRIPTION

1. GENERAL USE

The multifrequency incoming register is used in conjunction with a multifrequency signal receiving circuit to receive information in the form of multifrequency signals transmitted on a two frequencies out of six basis from either a keyset or an outgoing sender. When the entire number has been received, this information is transferred to a completing marker so that a connection can be set up between the incoming trunk and the called line or between the incoming trunk and an outgoing trunk to the called office. The marker then controls the completion of the call directly or with the aid of a sender. A block diagram showing the connections of a multifrequency incoming register on a completing call is shown on the SD in information Note 301 in Fig. 1 and a block diagram showing the connections of a multifrequency incoming register on a tandem connection is shown in Fig. 2.

2. REGISTER LINK CIRCUIT

A group of registers, maximum 10, appears in a single register link circuit. This link circuit, called a link group, has a maximum of 12 horizontal groups of trunks in a wire spring relay link and a maximum of 15 horizontal groups of trunks in a U type relay link. A horizontal group contains one or two 20 vertical crossbar switches and accommodates from 1 to 40 incoming trunks with each trunk requiring one vertical unit. Registers appear on the horizontals of the switches and are multipled to corresponding levels of the switches of all horizontal groups in the link.

For each horizontal trunk group each register has in the link circuit a register preference relay, a register busy relay and other relays to send trunk frame number, class and trunk location information to the register. For each trunk in the link there is a trunk preference relay.

3. GENERAL METHOD OF OPERATION

3.1 Operation with Register Link

When a trunk receives a call it operates in the link its preference relay which closes a start lead to the register preference relay chain. If the preferred register is idle, its register preference relay operates; but if it is busy, its busy relay will be operated advancing the start lead to the succeeding register.

The operation of the register preference relay constitutes seizure of the register. The register preference relay operates in the register an off-normal relay which prepares the register for operation. The register preference relay also operates in the register a register busy relay which causes operation of link register busy relays for this register in all other horizontal groups.

The link sends to the register information consisting of class of trunk, trunk link frame number and trunk location for translation to a trunk number, if required. This information will be used by the completing marker in processing the call. A crosspoint is closed in the link to connect the trunk to the register and the register makes a check for a possible double connection. The trunk cut-off relay is then operated to allow the register sole access to the tip and ring leads. When this connection has been established and all checks satisfactorily completed the control relays of the register link are released. After a timed interval the register takes control of supervision and reverses the polarity of the tip and ring leads to signal that the register is ready to receive pulses.

3.2 Signal Receiver

Permanently associated with each register is a multifrequency signal receiving circuit which receives and translates the signals transmitted over the trunk. Five frequencies are used for the transmission of the digits 0 to 9 on a two-out-of-five basis and a sixth frequency issued in combination with one of the five for enabling the receiver before the start of pulsing of digits and for indicating to the receiver and register that the entire number has been transmitted. The receiver detects the enabling pulse and readies itself for receipt of the digit signals. These are received as two-out-of-five frequencies and the receiver grounds the corresponding two-out-of-five leads to the register to cause operation of relays of the digit register. At the time of

receipt of the digit frequencies the receiver signals the register to prepare to advance to the next digit and the register in this preparation starts a recycle of the receiver. When the digit signals end, the receiver completes its recycle and the register completes its advance to the next digit. Succeeding digits are recorded in a similar manner.

After all the digits are transmitted an additional combination of two frequencies is transmitted as an end signal. The receiver detects this combination and signals the register to prepare to transfer the number to the marker.

3.3 Trunk Cut Through

Before the completing marker can complete the call, the trunk must be changed from its pulsing condition to its transmission condition so that it can assume supervision. When the signal is received from the receiver that all digits have been received, the register causes operation of the trunk cut through relay, checks that it operates and then proceeds to establish a connection to a completing marker.

3.4 Connection to Marker

When the register has checked that the trunk has established its transmission condition and is ready to assume supervision, it connects to a completing marker by means of a marker connector. The register transfers to the marker information consisting of the trunk class, the trunk link frame number, all the registered digits, the digit end signal and, for trunks with appearances on the line link frame, a trunk number which enables the marker to determine the line link location from the number group. The marker then proceeds to establish a connection between the trunk and the called destination. For local trunks and local calls on tandem trunks, this involves establishing a linkage between the trunk link frame appearance of the trunk and the line link appearance of the line. For through calls on tandem and intertoll trunks, this involves establishing a linkage between the line link appearance of the incoming trunk and the trunk link appearance of an outgoing trunk to the desired office. When a call is thus completed or the trunk is set in an overflow condition due to the marker being unable to complete the call, the marker operates a release relay in the register to disconnect the register from the marker. The register then releases the link connection between the trunk and the register. The register is then ready to serve another trunk.

3.5 Prefix Counter

In conjunction with the class relays, the register determines whether any "one" digits received initially should be registered on the prefix counter as a foreign area directing code or on a service code or on the A digit register as part of the called code or number.

3.6 Operator Errors

The register is equipped to detect certain errors by operators and to cause a reorder routing of the call rather than to have the marker block and cause a trouble record. The errors detected consist of too few or too many digits for the particular trunk class.

3.7 Trouble Timers

When the register is seized, two trouble condition timers are started. Those are the link release and the overall timers. The link release timer will detect a trouble condition which prevents the link from completing its functions and indicates this to the marker so that the appropriate action can be taken. The overall timer will detect any condition which prevents completion of the call in the normal manner.

SECTION II - DETAILED DESCRIPTION

1. REGISTER LINK CIRCUIT

1.1 Registers and Trunks in the Link

A maximum of 10 registers and a maximum of 480 trunks in a wire spring link such as SD-26048-01, or a maximum of 600 trunks, in a U type relay link such as SD-25585-01, are associated with a register link circuit. The wire spring link has from 1 to 12 horizontal groups of trunks and the U relay link has from 1 to 15. A horizontal group contains one or two 200 point crossbar switches and accommodates from 1 to 40 incoming trunks with each trunk requiring one vertical unit. Registers appear on the horizontal of the switches and are multipled to corresponding levels of switches for all horizontal groups in the link group. Figure 3, in the SD information Note 302, shows a block schematic indicating the arrangement of trunks and registers on a wire spring incoming register link frame.

1.2 Link Relays

For each horizontal group in the link, each register has a register preference relay, a register busy relay, and other relays to send trunk frame number, class, and trunk location information to the register. Each trunk has in the link a trunk preference relay. The register preference relays and the trunk preference relays are arranged into preference chains that control the operation of the link.

2. SEIZURE

2.1 Preference Relay Operation

When a trunk receives a call it operates in the link its preference relay, which closes a start lead to the register preference relay chain. If the preferred register is idle, its register preference relay operates, if it is busy, its busy relay will be operated, advancing the start lead to the succeeding register.

The operation of the register preference relay constitutes seizure of the register, but if more than one preference relay is operated simultaneously for that register, the trunk in the preferred position gets connected and the less preferred trunk will be advanced to another register by operation of the link register busy relay.

The operation of the register preference relay locks the call in by connecting resistance battery from the register on the "LK" lead, in parallel with that from the trunk over lead "ST", so that any momentary closure on the trunk which is long enough to operate the register preference relay will cause the connection to be locked in until the register takes control of supervision. This is illustrated in the information Note 303 on the SD in Fig. 5 where X represents the horizontal group in which the trunk is to be served, X_1 represents any other horizontal group, Y represents the trunk being served, and Y_1 represents any other trunk in that horizontal group.

As shown in Fig. 6, the register preference relay closes a shunting circuit from lead "LO" to its associated link register busy relay, designated RBX, to prevent it from operating. The register relays RB and RB1 operate to cause operation of the link register busy relays, designated RBX_1 in Fig. 6 for this register in all other horizontal groups to advance the start leads.

The register preference relay also grounds lead "ON" to operate the register off-normal relay ON. The immediate functions of ON are to aid the link in closing the crosspoints and to operate ON1, SR, TM1, and AS to prepare them for future use.

2.2 Trunk Link Frame, Trunk Class, and Trunk Location Information

The register preference relay in the link operates associated relays designated C and CA in the wire spring type relay link or CL, TF, and TN in the U type relay link from ground on lead "TF". These relays close ground to a trunk class lead "OA", "TAN", etc., close grounds to trunk link frame number leads for operation of the FG0, FG1, or FG2 and two of the relays TF0, 1, 2, 4, 7 and close grounds to the trunk location leads, if required, for operation of one of the relays LT0-9 and two of the relays LU0, 1, 2, 4, 7 and one of the

relays REG, REG1, SUP, or SUP1. This trunk location information is required for trunks with appearances on the line link frame and is translated by the register into a trunk number which is later transferred to the marker.

2.21 Trunk Link Frame Number Registration

One of the leads "TF0" to "TF9" to the register link will be grounded on each call when the connecting relay of the register link horizontal group associated with the selected incoming register operates. This ground causes operation of one of the five TF0, 1,2, 4, 7 relays. The TF- relay in operating locks and operates the trunks frame transfer relay which transfers each of the ten incoming "TF" leads for one TF- relay to another TF- relay. The two TF- relays connected to each lead have the numerical suffixes of the two-out-of-five combination for the numerical designation of the lead. For example, a ground on lead "TF2" will initially cause operation of relay TF2. TF2 will operate TFT to connect lead "TF2" to relay TF0.

Each of the operated TF- relays will ground a correspondingly numbered lead to the marker connector.

A contact of TFT is placed in the CK relay operating path to insure that TFT is operated before the link release check relay RLK is operated. This insures that a ground has been received on one of the "TF-" leads. If a ground is not present on one of the "TF-" leads, TFT will not operate and the link release timer will function to cause connection to a marker with a link release failure indication. If a trouble record is taken at this time, it will indicate the link groups involved in the call.

If a ground is present on the "TF-" lead and the TFT operates but the second TF- relay does not operate the marker will detect the condition when the marker is summoned after digit registration and the resultant trouble record will indicate the number of the incoming register in which the trouble condition exists.

The FG0, FG1, and FG2 relays are used to indicate the tens number of the trunk link frame on which the trunk appears.

2.22 Trunk Class Registration

On each call information must be recorded as to the class of trunk, incoming, toll or tandem, type of translator to be used by the marker and whether or not the services of a special marker are required.

The six OA, OB, and AB special and non-special class combinations are registered on either one or two relays operated out of four relays. These relays are the OA, OB, and AB which provide the class and translator marks to the marker and CLS which operates whenever a special marker is required.

If the trunk class is OA, OB, or AB the desired relay operates directly from the ground on the class lead connected to the respective OA, OB, or AB terminal.

If the trunk class is one of the other -S combinations, the CLS relay will operate and will in turn operate the CLT relay. CLT then connects the "OAS", "OBS", or "ABS" leads to the corresponding OA, OB, or AB relays to cause operation of the proper relay.

A single class relay is operated directly for each of the nontandem, the toll, the tandem, and the pulse conversion trunk classes.

A summary of the trunk classes is given in the following table:

Terminal Grounded By Register Link	Class Relay Operated	Class Lead To Marker	Class Group "A" or "B" To Marker	Translator Lead To Marker ZN Opt.	Nonarea Code	ZO Opt. Area Code	Area Code -411	Type of Marker
OA	OA	INC	TCA	OA	OA	-	-	
OB	OB	INC	TCA	OB	OB	-	-	
AB	AB	INC	TCA	FVD	FVD	-	-	
OAS	CLS, OA	INC	TCA	OA	OA	-	-	SPL
OBS	CLS, OB	INC	TCA	OB	OB	-	-	SPL
ABS	CLS, AB	INC	TCA	FVD	FVD	-	-	SPL
NTAN	NTAN	INC	TCA	LT	LT	-	-	
TAN	TAN	TAN	TCA	LT or 11	LT or 11	TT	X11	
TAN1	TAN1	TAN or TAN1-4	TCA or TCB	*None or FVD or LT	- FVD LT	- TT -	- X11 -	
TOL	TOL	TOL	TCA or TCB	*FVD or TT	FVD or LT	- TT	- X11	
TOL1-4	TOL1-4	TOL or TAN1-4	TCA or TCB	FVD or TT	FVD or LT	- TT	- X11	
PCD	PCD	PCD	TCA	-	-	-	-	
PCD1	PCD1	PCD1	TCA	-	-	-	-	
PCR	PCR	PCR	TCA	-	-	-	-	
CAMAO	CAMAO	INC	TCB	LT	LT	TT	X11	
CAMA1	CAMA1	PCR	TCB	TT	LT	TT	X11	

*Used for Centrex phase I and II transfer.

2.23 Trunk Number

In order that the marker can determine the location of trunks on the line link frame, each trunk with a line link appearance is assigned a three digit number representing a hundreds, a tens and a units digit. The marker uses a preassigned thousands digit and this three digit number to obtain the desired location from the number group circuit. This three digit number is assigned by cross-connections applied in the register to terminals associated with the trunk location relays. Since the holding time of the register on these trunks is longer than on trunks with local completion, their number is limited and they are confined to two of the maximum three register link frames. Figure 4 in information Note 302 on the SD shows in

block diagram form a two frame register link with trunk number assignments.

The trunk location relays of the register are operated in accordance with the location of the trunk on the register link frame. Link units relays LU0, 1, 2, 4, 7 will be operated corresponding to the position of the trunk in a subgroup of ten located on a left or right half switch. A link tens relay LT0-9 will be operated corresponding to the number of the subgroup of ten or half switch. One of the group relays REG, REG1, SUP, or SUP1 will be operated to give a group indication. On the wire spring register link frame, this group indication is cross-connectible within each frame on a horizontal group basis and any indication can be assigned to any horizontal group.

The register link vertical units number of the trunk is registered on the LU0, 1, 2, 4, 7 relays on a two-out-of-five basis. The ground on one of the ten leads "LU0-9" from the register link will operate one of the LU- relays and the LU- relay will in turn operate the link units transfer relay LUT which transfers each of the ten "LU-" leads to a second LU- relay. Thus, the ground on the "LU-" lead will cause operation of two of the LU0, 1, 2, 4, 7 relays. The two LU- relays connected to each lead have the numerical suffixes of the two-out-of-five combination for the numerical designation of the lead. The LU- relays each have a make contact to ground a correspondingly numbered lead to the marker connector.

The LT0-9 relays are operated on a one-out-of-ten basis over leads of similar designations from the register link. These relays in conjunction with the group relays REG, REG1, SUP, and SUP1 are used to generate the tens and hundreds digits.

There are certain limitations as to the numbers which may be assigned to the trunks identified by the various group marks. On the U- type register link the REG and REG1 marks were used to identify the regular or basic frame switches and the SUP and SUP1 marks were used to identify the extension or supplementary frame switches. On the wire-spring register link these group marks are cross-connectible within each frame and within the basic and supplementary switch divisions on a horizontal group basis and any horizontal group may be assigned to give any of the REG, REG1, SUP, or SUP1 indications. For trunks represented by the REG and SUP group relays, full flexibility as to the hundreds number and the tens number is possible for each subgroup of ten trunks since there are four terminals for each LT- relay for the REG assignment and four terminals for the SUP assignment. The pairs of TA- and TB- terminals for REG assigned trunks and the pairs of ETA- and ETB- terminals for SUP assigned trunks are cross-connected on a two-out-of-five basis to the TT0, 1,2,4,7 terminals to indicate the trunk tens number. The HA- and HB- terminals for REG assigned trunks and the EHA- and EHB- terminals for SUP assigned trunks are cross-connected on a two-out-of-five basis to the HT0, 1, 2, 4,7 terminals to indicate the hundreds number.

If, for example, six is to be assigned as the tens number for the trunks located on the left half switch of horizontal group 0, represented by relay LT0 and assigned to the REG group relay, TA0 and TB0 are cross-connected to TT2 and TT4 respectively. If five is to be assigned as the hundreds number for these trunks HA0 and HB0 are cross-connected to terminals HT1 and HT4, respectively.

For trunks on the register link switches assigned to the REG1 group relay, the tens number assignment for each subgroup of ten trunks has full flexibility but the trunks in the corresponding subgroup of ten trunks, represented by the same LT- relay, assigned to the SUP1 group relay will have this same tens number. The pairs of ATA- and ATB- terminals are cross-connected on a two-out-of-five basis to the TT0, 1,2,4,7 terminals for trunks assigned to the REG1 or SUP1 group relays. For example, by cross-connecting ATA7 and ATB7 to TT0 and TT1, respectively, the tens digit one is assigned for trunks on the right half switch of horizontal group three and represented by relay LT7, assigned in the register link to the REG1 or SUP1 group relays.

All trunks assigned in the register link to the REG1 group relay must be assigned to a particular hundreds number and all trunks assigned in the register link to the SUP1 group relay must be assigned to a particular hundreds number. The ARHA

and ARHB terminals for trunks assigned to group relay REG1, and ASHA and ASHB terminals for trunks assigned to group relay SUP1 are connected on a two-out-of-five basis to the hundreds terminals HTO,1,2,4,7. For example, to assign a two as the hundreds digit for all trunks assigned to group relay REG1, terminals ARHA and ARHB would be cross-connected to HTO and HT2, respectively, and to assign three as the hundreds digit for all trunks assigned to group relay SUP1 terminals ASHA and ASHB would be cross-connected to HT1 and HT2, respectively.

In certain cases it may be desirable to assign trunks on both the basic and the supplementary switches to the same group identifying relay in order to make a more economic use of the numbers available. This is feasible so long as the location marks received from the register link are not duplicated. These marks are REG, REG1, SUP, or SUP1 for the group relay, the LT- mark for the half switch or subgroup of tens and the LU- mark for the vertical unit. As long as each trunk differs in at least one of these marks, an individual trunk number within the limits described above can be assigned.

2.3 Closure of Crosspoints

The register preference relay also operates the select magnet associated with the register, using resistance battery over lead "SM". The select magnet off-normal springs, in conjunction with the trunk preference relay, operate the hold magnet associated with the trunk, using ground on lead "OH" through back contacts of relays H and TRL and a front contact of ON. Closure of the crosspoints connects the ground from lead "OH" to lead "HM" to operate relay H. H connects lead "HM" through the low resistance winding of relay DCK, to the ground which operated the hold magnet and disconnects the ground from lead "OH". This provides a holding circuit for the hold magnet and operates the double connection check relay DCK. DCK locks on its secondary winding to the direct ground from relay ON and connects this ground to the "HM" lead. If a double connection had been set up, another register would have been holding direct ground on lead "HM" shunting relay DCK so that it would not have operated thus preventing operation of the release link relay RLK.

H also grounds lead "CO", operating the cutoff relay CO in the trunk to disconnect the tip and ring leads from the trunk supervisory relay. The operation of the cutoff relay grounds lead "BL" (so designated because it is used for bylink operation with incoming dial registers). This ground passes through front contacts of the frame, class and trunk location relays and the register busy relays and operates check relay CK. CK closes a ground through the front contact of the DCK relay to the release link relay RLK causing it to operate.

On tandem and toll class calls, a check is made that the trunk number information has been received from the link, by placing contacts of the REG, REG1, SUP, SUP1, LTO-9, and LUT relays in the operating path of the CK relay. The LUT in operating checks that a ground has been received on one of the "LU-" leads indicating that the register link is functioning satisfactorily. The marker when connected at the completion of digit registration will check for the operation of the second LU- relay.

H also connects the "T1" and "R1" leads, which are connected through the repeating coil windings to the tip and ring lead from the trunk at the signal receiver, to the winding of the supervisory relay A and opens lead "SM" to release the select magnet.

2.4 Release of Link

Operation of the RLK relay opens leads "LK" and "LO", releasing the link trunk preference and register preference relays and permitting the link register busy relay that was shunted down to operate. The register preference relay is also released. This leaves the trunk connected to the register through the crosspoint only, with the register controlling supervision and holding the connection.

3. PREPARATION FOR RECEIPT OF PULSES

3.1 RV Timer

The RV tube has characteristics such that it will not conduct current unless its gas is ionized and the 130 volt potential across the main gap from the anode No. 2 to the cathode No. 4 will not cause ionization. The gas will ionize, however, when a voltage of 72 nominal

is connected across its control gap anode No. 1 and the cathode No. 4. Once the gas is ionized it will conduct current and maintain a voltage drop of 75 nominal across the main gap. Once the gas becomes ionized the control anode loses control and the tube can be restored to its nonconducting state only by opening the circuit or by reducing the voltage below the sustaining value. The voltage across the control gap is equal to that on the timing capacitor RV and this is controlled in time by the value of the capacitor and the value of the charging resistor RV3. The values of resistor RV3 and capacitor RV are chosen to give a time of 140 minimum, 190 nominal, and 290 maximum milliseconds delay in operating the RV relay. With the circuit normal, the capacitor is maintained in a discharged condition by a back contact of RLK.

When RLK operates at the completion of the link functions, it opens the discharge circuit and closes a charging circuit by connecting the primary winding of relay RV, which is grounded by a contact of relay CK, to the capacitor and to the cathode terminal No. 4. After an interval of 190 milliseconds nominal, the gas will ionize and current will pass through the main gap to operate the reversing relay RV. RV locks on its secondary winding and opens its operating circuit on a continuity transfer contact. This opens the circuit to the tube causing it to cease conducting. This is done to conserve tube life since the life of the tube is inversely proportional to the length of time it conducts current. This also conserves the 130 volt battery drain. The RV1 resistor is a protective resistor which prevents any appreciable flow of current across the control gap. The RV1 capacitor is a protective capacitor for absorbing any induced potential changes that might occur on the 130 volt feeder lead so that these cannot affect the time of the circuit.

3.2 Start Pulsing Signal

The operation of relay RV reverses the polarity to the tip and ring leads, thus signaling the operator or outgoing sender that pulsing may be commenced. The register is in readiness by this time because relay ON1, which operated from ON, has connected battery to leads "BAT1" and "BAT2" to the signal receiver and has supplied various off-normal grounds. The digit register has been prepared for registration of digits by operation of the first steering relay AS from ON.

3.3 Supervision

Supervision is maintained in the register by relay SR. This is a slow release relay and will hold over any momentary opens on the line. SR was operated on seizure of the register by ON, but RV opens the operating path and places SR under control of the A relay. The A relay may release during the line reversal but it will immediately reoperate to hold SR unless the call has been abandoned. If SR releases, it will cause operation of MRL to cause release of the register as described in the paragraph on register release. Any seizure of the register will cause a circuit advance up to the operation of RV before a release of SR can be effected.

4. RECEIPT OF PULSES

4.1 General

4.11 Frequencies and Code

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

Digit	Frequency Designations	Actual Frequency Cycles per Second
0	4,7	1300,1500
1	0,1	700, 900
2	0,2	700,1100
3	1,2	900,1100
4	0,4	700,1300
5	1,4	900,1300
6	2,4	1100,1300
7	0,7	700,1500
8	1,7	900,1500
9	2,7	1100,1500
KP	2,10	1100,1700
START	7,10	1500,1700

4.12 Interlocking of Receiver and Register

The receiver is maintained in a disabled condition until it receives the key

pulse or gate opener so that it will not react to unwanted signals that may appear on the line due to inductive pick up or to speech. The KP signal is received entirely by the signal receiver without any effect on the register. Each subsequent digit causes the receiver signal present tube and relay SP to operate. The signal present relay in turn causes operation of receiver relay LK over the leads "J" and "L". LK connects battery to the receiver channel relays and when the channel thyratrons corresponding to the frequencies received operate, the corresponding receiver channel relays operate. The operation of a channel relay grounds the corresponding lead "0", "1", "2", "4", or "7" causing operation of the corresponding digit register relay and also operates the RA relay over lead "S". The operating path of the receiver channel relays includes the winding of the receiver relay CK2 which operates and causes operation of register relay 2CK over lead "H". Operation of RA operates the next digit steering relay and with 2CK operated opens the "J" and "L" leads to the receiver, releasing relay LK. The release of LK releases the channel relays and relay CK2. If by this time the signal is ended, relays 2CK and RA release and allow release of the steering relay for the digit just received. If however, the signal pulse is still present, relays RA and 2CK will be locked to the receiver signal present relay SP over lead "J". These interlocking features are provided to insure that each pulse locks in until it has been recorded and that the register does not advance to the next digit until the end of a pulse.

4.13 Digit Register

The digit register unit consists of a dry reed relay with five independent coils inclosed in a can and with each coil associated with two make contacts, one terminal 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 terminal of the coil and both contacts of the load contact pair are wired to individual terminals. These terminals extend to both front and rear of the relay. For ease of wiring, three sets of terminals are strapped internally. These are the battery side of the coils the locking contact of the relays and one side of the load contacts.

The multifrequency register may be arranged to accommodate five, eight, or eleven digits. The eleven digit register is designed to handle direct distance dialing. The digit registers are designated alphabetically A to H and J to L. Each digit register has an associated digit steering relay.

For the A digit, one of two types of registers is provided. If it is required that a 11 prefix over tandem trunks be recorded, the wire spring relays of Fig. 5 are furnished. Otherwise the reed register unit of Fig. 4 is provided.

4.14 Steering Circuit

The digit steering circuit consists of a single relay per digit. It is advanced by a contact on the register advance relay RA. On the seizure of the register, ON operates and operates AS which locks through series back contacts of all the steering relays. RLK opens the operating circuit of AS. On the first operation of RA, BS operates through front contacts of AS. BS locks through a back contact of CS and opens its operating circuit on one set of continuity transfer contacts. BS, on another set of continuity transfer contacts, transfers the locking circuit of AS from the ON ground to the RA controlled ground so that when RA releases AS will release. The next operation of RA will operate CS through back contacts of

AS and front contacts of BS and the next release of RA will release BS. This action continues with each operation of RA operating the steering relay for the next digit and each release of RA releasing the steering for the digit just registered.

4.2 Registration of the A Digit

The A digit steering relay AS is operated from ON when the register is seized. When the A digit frequencies enter the receiver, the receiver signal present tube and relay SP operate. SP connects ground to lead "J" which is connected through series back contacts on relays MST, TEN, and STS1 or STS depending on the number of digit registers equipped, BS, DS, FS, HS, and KS to lead "L" to the winding of receiver relay LK. The steering relay part of this path is paralleled by a circuit through a back contact of 2CK. LK operates and connects battery to the receiver channel relays and when the channel thyratrons corresponding to the frequencies received, operate, associated channel relays operate to connect ground to corresponding leads to the register. These grounds are carried through the contacts of steering relay AS to operate the corresponding A digit register relays which lock.

When the receiving circuit detects one or more frequencies, the corresponding numerically designated relays of the receiving circuit operate and cause operation of RA over lead "S". When the receiving circuit detects two frequencies and two of the numerically designated relays operate, the receiver CK2 relay operates causing operation of the register 2CK relay. Both RA and 2CK lock to the "J" lead which is controlled by the signal present SP and the CK2 relays of the receiver. RA in operating operates BS which opens one leg of the circuit between the "J" and "L" leads in the register and when 2CK operates the "J" lead is disconnected from the "L" lead allowing release of the LK relay of the receiver. LK in turn releases the receiver CK2 and numerically designated relays. If the signal pulse has ended or when it ends SP will release. With both SP and CK2 released RA and 2CK will release.

RA in releasing completes the steering advance by causing release of AS which recloses one leg of the circuit between the "J" and "L" leads. The release of 2CK relay recloses the other leg of the circuit between the "J" and "L" leads. Either leg being closed enables the relays of the receiver to respond to the next digit signals.

4.3 Registration of the B Digit

The B digit is recorded in the same manner described for the A digit. The frequencies are detected and the receiver SP relay operates. LK operates to enable the receiver channel relays, two of which operate causing operation of CK2. Register relays RA and 2CK operate, the steering relays CS operates to open the "J" and "L" lead circuit to release LK which in turn releases the receiver channel relays and CK2. The B digit register relays operate from the receiver channel relays.

Subsequent digits are received and recorded in a similar manner.

4.4 Pulse Consisting of More Than Two Frequencies

If a trouble condition exists that causes more than two receiver channel relays to operate, the current drawn by the receiver channel relays will exceed the minimum required to operate the receiver relay CK3. Operation of CK3 grounds lead "RO", operating the reorder relay RO to cause the marker to be started with a reorder indication.

4.5 Single Frequency Pulse

If a trouble or test condition exists that causes only one channel relay to operate, receiver relay CK2 will not operate because there will be insufficient current flow. As a result, 2CK relay in the register will remain normal, leaving relay RA under direct control of one of the 0, 1, 2, 4 or 7 channel relays over the "S" lead. The channel relay also operates the corresponding digit register relay. The steering relay for the next digit operates from RA, as usual. LK, however, is held operated over the "J" and "L" leads through a back contact of 2CK and releases only after the pulse is terminated and relay SP releases. LK released, releases the 0, 1, 2, 4 or 7 channel relay which in turn releases RA. RA releases the steering relay for the digit just registered. The register and the receiver are now ready for the next digit.

The single frequency pulse condition is handled in this manner to allow register steering on one frequency so that the marker can be called in a normal manner. The marker then has a chance to detect the condition as a one-out-of-five registration. If the steering circuit did not advance, the next digit would be recorded in the same digit register and the start pulse would ultimately appear in the wrong position and the no operator error relay NOE usually would not operate. Accordingly, the marker would be given a reorder indication and would never check for a false registration.

4.6 Last Digit and Marker Start

Two start pulse or end steering relays STS and STS1 are provided in the positions beyond the last equipped digit steering relay. The STS and STS1 relays serve to recycle the receiver after the last digit and to provide the end seven signal to the marker in case the register receives a full complement of digits.

If a full complement of digits is received before the start signal, the STS relay will be operated in preparation for the start pulse when the last digit is recorded. Assume, for example, that five digit registers A to E are provided, then STS will be wired to operate in place of FS and will operate when the E digit is recorded. When the start signal consisting of the frequencies 7 and 10 is received in the sixth or F position, the receiver grounds leads "7" and "10". The "7" lead is not used in this case but the TEN relay will operate from the ground on the "10" lead. Receiver relay CK2 operates with the receiver channel relays and operates relays 2CK and RA. RA in turn operates STS1 which opens the "J" and "L" leads to release the receiver channel relays. When the start signal ends, RA releases, releasing STS and causing the operation the marker start relay MST. The release of STS grounds the "F7" lead to the marker.

If the start pulse is received in the position of the last equipped digit register, the STS relay functions only to open the "J" and "L" leads. Assume that the start signal is received in the fifth or E position in a five digit register. The ground on the "10" lead will operate the TEN relay and the ground on the "7" lead will operate E7 relay, which grounds the "E7" lead to the marker. Ground on lead "H" from the receiver operates 2CK and ground from the receiver on the "S" lead operates RA which in turn operates STS. Operation of STS opens the "J" and "L" leads to cause release of the receiver channel relays. RA releases causing the marker to be started. Since STS is operated, the "F7" lead is not grounded.

If the start signal is received ahead of the last equipped digit position, the operation is as described except that STS does not operate. In this case the steering relay in position one beyond the last digit registered will operate, its only function being to open the "J" and "L" leads.

5. OPERATOR ERRORS

5.1 No Operator Error Relay

A no operator error relay NOE is provided so that the circuit can check the number of digits registered against the number required on each class of trunk. This provision is made so that all possible calls with an inoperative number of digits due to an operator adding or deleting digits in error will be detected in the register and cause a reorder request from the marker rather than have the marker detect the trouble and cause a trouble record to be made. NOE can be arranged to operate when exact numbers of digits followed by a start pulse are registered or when minimum numbers of digits are registered. The marker start relay MST circuit is wired through a transfer contact of the NOE relay so that with NOE normal, the reorder relay RO will operate in place of MST. When NOE operates, the operate path of RO is opened and MST will operate after operation of TEN and the release of RA. The call thus proceeds in a normal manner. If NOE fails to operate, RO will operate after the operation of relay TEN and the release of relay RA. RO operating will call in the marker with a reorder indication.

5.2 Four and Five Digit and NTAN Classes

5.21 Exact Number of Digits

A cross-connection between terminal OE and terminal XCT arranges the register to receive pulses from a four or five digit

class of trunk on an exact number of digits basis. With this arrangement, relay NOE operates when the exact number of digits and a start pulse are recorded.

The four digit trunk class relays OA, OB, and PCR are wired so that the start pulse must be in the fifth or E position for the NOE relay to operate. Assuming an OA class of call, NOE will operate from contacts of the operated relays TEN, OA, ES, RA, and CK whenever the start pulse occurs in the fifth position. NOE locks and when RA releases at the end of the start pulse MST operates.

If the start pulse is transmitted before or after the fifth position, NOE will not operate and the release of RA after the start pulse is received will cause the operation of RO instead of MST.

For the AB and ABS trunk classes, terminal 5DG is cross-connected to terminal FS or to terminal STS so that the start pulse must be received in the sixth position for NOE to operate.

The NTAN class will be connected for five, six or seven digits depending on the number of digits of the office code.

A cross-connection between terminals NED and RO will arrange the register to connect to a marker immediately with a reorder indication if more digits than the register is equipped to handle are received. This connection connects the 0, 1, 2 and 4 leads to the RO relay winding so that if any signal other than the 7 is received in the start pulse STS digit position RO will operate. RO causes operation of MST.

For example, assume the register is equipped for five digits. When the fifth digit is received STS operates. Then at the end of the digit RA releases to release ES. If another digit is received a ground will appear on one of the leads "0", "1", "2", or "4" to cause operation of RO.

5.22 Station Digit Permitted

Some subscribers in a manual office may be assigned numbers which include a station digit. Where a cutover to a No. 5 crossbar office eliminates the station digit, these subscribers are assigned new numbers having no station digit.

In these cases it may be desirable during the period following cutover to permit anyone dialing the old number to reach an intercept operator and be informed as to the new number rather than be routed to reorder by the operator error features.

This is accomplished by permitting the marker to be connected to in the usual manner even though an extra digit is registered. For this use the terminal OE is cross-connected to terminal MIN so that NOE will operate on a minimum number of digits basis.

This situation also requires the terminal RO to be connected to the one extra digit terminal OED to take care of cases where the extra digit would be in a position one beyond the last equipped digit register position.

The station digit is recorded, if the register is equipped to handle at least one more than the expected number of digits. If the register is not so equipped, the station digit is not recorded.

For example, assume an AB class of call with terminal STS cross-connected to terminal 5DG in a register equipped to handle only five digits. Then, after the fifth digit is recorded and RA has operated, STS operates. With OE connected to MIN, NOE operates from contacts of the relays AB, STS, RA and CK operated. With RO connected to OED, RO will not operate on the station digit output leads since STS1 is not operated.

When the station digit is received, it is not recorded. The receiver recycles when STS1 operates, opening the "J" and "L" leads. The subsequent release of STS closes the "J" and "L" leads and the register is ready to receive the start pulse.

When the start pulse is received, relay TEN operates to open the "J" and "L" leads. At the end of the receiver cycle, RA releases. MST then operates from contacts of the relays RA and CK2 released and relays TEN and NOE operated. The operation of MST results in a connection to the marker.

5.3 Variable Digit Classes

5.31 PCD and PCD1 Classes

For the PCD or PCD1 class the NOE relay can be arranged to operate when an

exact number of digits and a start signal are received or when a minimum number of digits is received.

If the NOE relay is to operate when an exact number of digits and a start pulse are received, the XCT terminal is connected by the operated PCD or PCD1 relay to the -S terminal associated with the steering relay one beyond the steering relay for the last digit. If we assume a PCD class call, transmitting exactly six digits, we would cross-connect terminal PD2 to XCT and terminal PD1 to GS. When the start pulse is received in the seventh or G position NOE will operate through front contacts of TEN, PCD, GS, RA and CK.

If the NOE relay is to operate when a minimum number of digits and a start pulse are received, the MIN punching is connected by the operated PCD or PCD1 relay to the -S terminal associated with the steering relay one beyond the steering relay for the last digit of the call with the minimum number of digits. If, for example, NOE is required to operate when a minimum of six digits are received on a PCD class call, terminal PD2 would be connected to MIN and terminal PD1 to GS. With this connection NOE will operate through front contacts of PCD, GS, RA and CK when the seventh, either a digit or a start pulse is received.

5.32 TOL1-4, TAN, TAN1, CAMAO, and CAMA1 Classes

For the TOL, TAN, and CAMA trunks classes provision has been made so that for a given class, NOE can be required to operate when any one of as many as three exact number of digits followed by a start pulse is required. If two or less exact number of digits are used as a condition for operating NOE, then a minimum number can also be used. The exact number of digits must always be lower than the minimum number of digits because once the minimum number is reached NOE is operated closing the path for MST.

Assume, for example that there are TOL class trunks over which three, four, seven or ten digits are transmitted. The TOL relay is provided with three contacts which can be cross-connected on one side to the terminals associated with the steering relays and on the other side to the XCT or MIN terminals. In this case, since there are four possible numbers of digits and since only three exact numbers can be accommodated, cross-connections would be made for two exact numbers, three and four, and a minimum number seven. These would be as follows:

For the 3 Digit Call	TL1 connects to DS TL2 connects to XCT
For the 4 Digit Call	TL3 connects to ES TL4 connects to XCT
For the 7 Digit Call	TL5 connects to HS TL6 connects to MIN

Thus NOE would be arranged to operate when exactly three digits followed by a start pulse, exactly four digits followed by a start pulse or a minimum of seven digits and a start pulse are received.

If either three digits and a start pulse or four digits and a start pulse were registered, relay NOE would be operated through front contacts of relays TEN, TAN, DS or ES, RA, and CK. If a signal, either a digit or a start pulse, is received in the eighth position NOE would be operated through front contacts of TAN, HS, RA, and CK.

5.4 Second Key Pulse Signal

If a second key pulse signal consisting of the frequencies two and ten is received, the TEN relay will be operated from ground on the "10" lead and the ground on the "2" lead will cause operation of the RO relay provided NOE had already been operated. If NOE had not been operated, the operation of TEN will cause operation of RO. RO causes the marker to be started with a reorder indication.

5.5 Simultaneous Operation of Two Keys

Simultaneous operation of two keyset keys at the switchboard results in the operation of three or four or no receiver channel relays. If no channel relays are operated, the error may be detected as any insufficient digit error.

Three or more channel relays in operating cause operation of receiver relay CK3. CK3 ground lead "RO" to operate relay RO which causes a marker to be started for reorder routing.

6. CODE TREATMENTS

6.1 NPA and Nonarea Codes on TOL, TAN, and CAMA Trunks

Registers arranged to handle traffic over CAMAO, 1, TAN, 1, TOL, and NTAN trunk classes can also be arranged to serve numbering plan area (NPA) codes in which NXX codes may be used for both NPA and nonarea codes, and the code NPA-411 is detected as an area information code.

6.11 NPA Codes

Codes having ten digits with a start signal in the eleventh position and where the A digit is other than 0 or 1, are considered NPA codes. When such a code is received, relay ST11 operates after the start signal is detected and shifts the translation lead to the marker from LT to TT to request area code translation.

6.12 NPA Information Code

When the code NPA-411 is registered in the A-F digit positions, respectively, and a start signal is received in the G position, relay A411 operates and shifts ground from the "LT" to "X11" translation lead. The marker recognizes this signal as a request for translation of an area information code.

A series arrangement of contacts of the D, E, and F registers are included in the operate path of A411. These contacts D0, 4, E0, 1, and F0, 1, are isolated from ground by front contacts of the MSTA relay. When the digits 4-1-1 are received in those registers and relay TEN operates from the start signal in the G position, a path is completed to operate the A411 relay. Following the marker start, relay MSTA operates from TC1 and breaks the series connection between the D, E, and F registers. MSTA also grounds one side of the D-, E-, and F- contacts to allow transfer of these digits to the marker.

6.13 Nonarea Codes

Codes with a 0 or 1 in the A position are considered nonarea codes. Relays SA0 and SA1 are used to detect such codes. Both relays operate when the digit 4, 5, 7, or 8 is received as the A digit, and both remain normal when the A digit is 2, 3, 6, or 9. SA0 operates when A is 0 and SA1 operates when A is 1. If either relay operates alone, the operate circuits of the A411 and ST11 relays are opened. With both A411 and ST11 unoperated, ground is connected to lead "LT" regardless of the number of digits. If SA0 and SA1 both operate or both remain normal, the operate paths of A411 and ST11 are not opened and one or the other can operate as previously described.

SA0 and SA1 are both prevented from operating when the digit 2, 3, 6, or 9 is received in the A position since the receipt of frequency 2 in these digits operates relay A2 which grounds the resistance battery to SA0 and SA1.

6.2 One-One Prefix Codes

6.21 A Digit Register

The A digit register of Fig. 5 is provided when tandem trunks receive one-one area directing codes or one-one service codes. The register is arranged so that the locking circuit of the A0 and A1 relays is through a front contact of one of the A2, A4, or A7 relays or through a back contact of the tandem class relay. This prevents an initial "one" from being recorded as the A digit on a tandem class call. When one-one prefix codes are not used, Fig. 4 with a reed type A digit register is provided.

6.22 Prefix Counter

Fig. 5 is provided with a prefix counter, consisting of relays 11A and 11B, to record the one-one of the area directing code or of the service code on tandem class calls. When the receiver detects an initial digit of "one", the A0 and A1 relays operate over their respective leads but do not lock since TAN is operated and A2, A4, and A7 are not operated. Relay 11A operates through make contacts of A0, A1, TAN and RA to the ON relay ground. 11A locks around the A0 and A1 contacts so that, when these relays release, 11A will hold directly to RA. 11A also locks through a back contact of 11B to insure the operation of 11B. 11A operates 11B which locks and switches the translator lead from LT to 11 so that the marker will use the translator for one-one prefix codes. 11A also opens the J and L leads to release receiver relay LK which in turn releases CK2 and the channel relays. Release of the

channel relays releases A0 and A1. At the end of the pulse RA releases to release 11A. 11A recloses the J and L lead and the receiver is ready for the next digit.

A second or subsequent one will operate 11A in a similar manner and its operation will serve to recycle the receiver.

The first digit received other than a "one" will be locked through front contacts of A2, A4, or 7 and the register will operate the B digit steering relay through front contacts of A2, A4, or A7, TAN and RA to the ON relay ground.

6.23 Initial Digit "One" as the A Digit

If Fig. 5 is provided and the register serves a trunk other than a tandem class, relay TAN will be normal and any digit can be registered in the A position. If an initial digit "one" is received, relay A0 and A1 will operate and lock through back contacts of TAN. Steering relay BS will also operate through a back contact of TAN.

6.3 Special Codes

Since the multifrequency register always receives a start signal after the last digit, it needs no other facilities for determining when to operate the marker start relay. This being the case, any type of code (or number) may be used over any class of trunk with the exception of the following.

On toll trunks, various codes may be used such as 1X1 for toll service codes, 11X(X) (X) for TX, 1XX and OXX for toll tributary codes and X1X or XOX for area codes. Therefore, the 11 prefix cannot be used as an area directing code on toll trunks.

On five digit tandem trunks wired for the FVD translator, one-one prefix codes cannot be used because the single code digit may be a one.

7. TRUNK CUT-THROUGH

When the start pulse has been recorded, the marker start relay MST operates. However, before the marker can be seized it is necessary to transfer supervision back to the trunk in order to provide a holding circuit for the line link and trunk link switches which the marker will operate. Therefore, relay MST opens the tip and ring leads and signals the trunk over lead "D" to take supervisory control. A differential relay TC1 is used in the "D" lead to permit operating a trunk relay and then checking that it operates, over a single lead.

Lead "D" is connected in the trunk through the winding of trunk relay D to battery and in the register through the secondary winding of relay TC1 to battery. To operate the trunk relay, ground is connected from a front contact of relay MST through the low resistance primary winding of TC1 to the "D" lead. The trunk relay operates but the TC1 does not operate because its two windings are energized in opposite directions. When the trunk relay operates, the trunk supervisory relay A operates over the trunk conductors, and in turn connects ground to the "D" lead. This ground holds the D relay and short-circuits the low resistance winding of TC1 allowing the secondary winding to become effective so that TC1 operates. TC1 operates relay TC2 which locks and starts a connection to the marker.

8. CONNECTION WITH MARKER

8.1 Marker Start

The operation of relay TC2 connects battery to the start lead "ST" and the connector battery supply lead "CBS" to the incoming register marker connector circuit. It also grounds timing lead TM to start the connector timer. The connector responds by connecting the register to an idle marker by about 100 leads.

8.2 General

Information transferred to the marker consists of class of trunk, trunk link frame number, trunk number (if any), all digits which were received, and an end signal consisting of a ground on the 7 lead of the next digit beyond the last digit received. The marker expects grounds on two of the five leads for each digit registered and a single ground on the -7 lead off the next digit. This permits the marker to check that no digits were missed entirely. The marker will use this information to set up the call either directly through the trunk link and line link frames to a subscriber, or through the line link and trunk link frames to an outgoing trunk with control by an outgoing sender, or, on a pulse conversion call, through the pulse conversion trunk with control by a dial pulse or revertive pulse sender. The number recorded on the digit registers and the trunk number are transferred to the marker on a two-out-of-five basis.

8.3 Trunk Class Information

One lead between the link and the register is used per class of trunk, but this lead is required to convey three items of information. These are class of call, translator to be used in the marker to interpret the received digits correctly and the type of marker to be used. This information is outlined on following page.

8.31 Class of Call

On the older vintage markers up to seven classes of call were used as follows:

INC Incoming or terminating only, with the trunk appearing on the trunk link frame only.

TAN Tandem: With trunk appearing on both trunk link and line link frame: local service treatment of certain codes.

TAN1 Tandem: With trunk appearing on both trunk link and line link frames with local service treatment of codes but on which screening and restricting of certain codes are to be applied by the marker.

TOL Toll: With trunk appearing on both trunk link and line link frames; toll service treatment of certain codes.

PCD Pulse conversion dial: Informs the marker that an outgoing dial pulse sender of the first group, if more than one group is provided, must be selected.

PCD1 Pulse conversion dial: Informs the marker that an outgoing dial pulse sender in a second group of senders must be selected.

PCR Pulse conversion revertive: Informs the marker that an outgoing revertive sender must be selected.

On later markers three additional tandem leads TAN2-4 were added making a total of ten class leads. These were then increased to twenty by adding the TCA and TCB multipliers.

With the increase in the number of class leads the flexibility was also expanded so that the leads could be used for purposes other than those described above.

8.32 Translator to Be Used

OA or OB Office A or Office B. No code transmitted: four numerical digits for subscribers in office A or office B respectively.

FVD Five Digit. Indicates that a certain one-digit translator is to be used. On INC class, the one-digit may be used to distinguish between the various divisions of numbers in a numbers series. On TAN class, it indicates that only one digit of two or three digit local area office codes is transmitted over the trunk.

LT Local Translator. With "ZN" option this lead indicates that the full code translator for the home area is to be used with "ZO" option this translator lead indicates a nonarea code.

11 One-One. When one-one foreign area directing codes are used and a 11 prefix is received on a tandem trunk the translator indicator is changed from LT to 11 as an indication that the call is to be directed to the foreign numbering area.

TT With "ZN" option this lead indicates that a toll translator was to be used. With "ZO" option this lead indicates that the code is an area code.

X11 Indicates that an NPA-411 information code has been received in the register.

8.33 Marker to Be Used

SPL Indicates that a special marker must be used to handle the no-test, no-hunt or test desk requirements of the trunk. This signal has no counterpart for nonspecial trunks; the signal is present for special trunks and absent for nonspecial trunks.

The above information is summarized in the paragraph on Trunk Class Registration.

8.4 Trunk Link Frame

The trunk link frame number is transferred to the marker on a tens and units basis. The tens digit is on a one-out-of-two basis and the units digit is on a two-out-of-five basis.

8.5 Marker Release

When the marker completes its functions it grounds the marker release lead "MRL", operating relay MRL. If the marker encounters trouble, it sends a trouble release signal to the connector, which disconnects from that marker and selects a second marker, usually a different one, in an effort to complete the call. If the second marker also fails, it grounds lead "BT" (so called because it is used to tell originating registers to give busy tone to the calling party). The ground on lead "BT" operates the register trouble release relay TRL.

9. RELEASE OF REGISTER

The operation of relay MRL or TRL is a signal that the register should release. Relay MRL or TRL locks to relay TC2 and opens leads "ST" and "TM" to the connector. This releases the connector and the marker. MRL or TRL closes a local holding circuit for relays RB and RB1 and releases relay ON. ON releases the register link hold magnet and relays H, DCK, and ON1. ON1 releases the trunk frame number, class, and trunk number relays and relay CK, which releases relay TEN, and this releases relay MST. When CK and MST have released, relay TC2 releases to release relays MRL or TRL, RB and RB1 and the link circuit register busy relays in turn, thereby making the register available for reselection. The release of ON and ON1 opens the various off-normal ground leads, releasing all other operated relays.

10. LINK TIMING

Since the link circuit contains no timing feature and since a link failure would block calls from numerous incoming trunks, the register is arranged to time for completion of link functions and to cause a marker connection and release of the register if they are not completed within 325 milliseconds nominal. Timing is accomplished with the link release tube LR, relay LR and the associated capacitor-resistor network.

The LR tube has characteristics such that no current will pass between terminals No. 2 and No. 4 unless the gas is ionized and the 130 volt potential across these terminals is insufficient to cause ionization. The gas will ionize if 72 volts nominal is connected across terminals No. 1 and No. 4. When ionization occurs, current will flow between terminals No. 2 and No. 4 with a voltage drop of approximately 75 volts. The voltage across terminals No. 1 and No. 4 is equal to that of the capacitor LR and this is controlled in time by the size of the charging resistor LR3 and the size of the capacitor LR. These are chosen to give a time of 245 minimum, 325 nominal and 500 maximum milliseconds for operation of relay LR. Capacitor LR is normally discharged by the connection of the LR2 resistor shunt through back contacts of ON. When ON operates at the start of the link functions, this shunt is removed and the grounded winding of relay LR is connected to the capacitor and to terminal No. 4. The capacitor starts to charge through resistor LR3 to the 130 volt source. If the link functions are completed satisfactorily, RLK operates to reconnect the discharge path to prevent further charging and consequent operation of the timer.

If some trouble prevents the completion of the link functions, RLK will not operate and the capacitor LR will charge sufficiently to cause the gas to ionize and cause operation of relay LR on a circuit from the 130 volt source, through tube terminals 2 and 4, front contact of ON and the winding of relay LR to ground. LR locks to 130 volts through resistor LR4 which is low enough in resistance to reduce the voltage on the tube below the sustaining value, thus deionizing the tube to conserve its life. LR also operates MST and grounds lead D toward the trunk. This operates relay TC1 and simultaneously operates the cut-through relay D in the trunk, if the crosspoints have been closed. Relay TC1 operates TC2 which calls in the marker.

LR grounds the "LR" lead to the marker connector so that the marker can take appropriate action. The DCK relay, if operated, indicating that a link crosspoint has been closed and that no double connection exists, grounds the "DCK" lead to the marker connector. If the marker receives the DCK ground and the LR ground, it will attempt to condition the trunk for reorder. When the marker has made the proper disposition of the call, it usually operates the register trouble release relay

TRL although in some cases it may operate the regular release relay MRL. The operation of either TRL or MRL will release the marker and the ON relay followed by the release of all operated relays. RLK is operated by either TRL or MRL to simulate a release check so as to free the link. TRL opens the link select magnet path and the link held magnet path to cause the early release of these magnets on the majority of the calls when TRL operates. If the trunk cut-through relay D has operated from lead "D" over the cross-points, the trunk will hold until the call is abandoned. If the D relay could not operate because of the trouble, the trunk will again start for a register.

11. REGISTER TIMING

A period of 25 seconds nominal is allowed for all digits to be recorded. If relay MST does not operate within this interval, after register seizure, the register will time out and call in a marker for a reorder connection. Once MST has operated, a second period of 25 seconds nominal is allowed for completion of the marker functions and register release. If the register does not release within this interval, an abandoned call is simulated in an attemp to release the register. In case the register fails to release, the office alarm is brought in.

The overall timing in the register is accomplished by relay TM, tube TM and the associated resistor-capacitor network. Tube TM has characteristics such that no current will pass between terminals No. 2 and 4 unless the gas is ionized and the 130 volt potential across these terminals is insufficient to cause ionization. The gas will ionize, however, if 72 volts nominal, is applied across the No. 1 and No. 4 terminals, and current will then flow between terminals No. 2 and No. 4 with a voltage drop of 75 nominal. The voltage across the No. 1 and No. 4 terminals is equal to that across the TM capacitor and this is controlled in time by the value of the capacitor and the value of the charging resistor TM3. These are chosen to give a time of 19.6 minimum, 25 nominal and 37 maximum seconds delay in the operation of relay TM.

Capacitor TM is normally discharged by a circuit through resistor TM 2 and a back contact of relay ON. When ON operates at the beginning of a call, it opens the capacitor discharge path and substitutes a charging path from 130 volt source through resistor TM3, capacitor TM, front contact of relay ON, back contact of MST and the winding of the TM relay to ground. This circuit will charge the capacitor to 72 volts in about 25 seconds and since the capacitor is connected across the tube control gap, terminals No. 1 and No. 4, this voltage causes the gas to ionize. This causes operation of TM from the 130 volt source, through tube terminals No. 2 and No. 4, front contact of ON, back contact of MST and winding of TM to ground. The TM1 resistor is provided for preventing an excessive amount of current in the control gap.

The timer is recycled when relay MST operates. When MST operates, the TM relay winding is disconnected from the capacitor and the discharge circuit is connected across the capacitor through a front contact of relay TM1 which was operated at the beginning of the call by the ON relay. TM1 is released when MST operates, but is sufficiently slow release to allow time to discharge capacitor TM. When TM1 releases, it opens the discharge circuit and reconnects the TM relay winding for another timing cycle.

If the timer operates before relay MST operates, it operates relay TM. TM grounds lead "LP" to light the time-out lamp for the register at the master test frame, grounds lead ALM to start an office alarm timing circuit, locks through resistor TM4, which is low enough in resistance to shunt and extinguish the tube, and operates reorder relay RO. RO locks and operates marker start relay MST. MST grounds lead "D" to the trunk through a winding of relay TC1. The trunk relay D operates and connects direct ground to lead "D", operating relay TC1. TC1 operates relay TC2, calling in a marker. Since relay RO is operated, the marker finds ground on lead "RO" and no ground on the class of translator leads; therefore it sets the trunk in the reorder or overflow position. The operation of MST also releases relays TM and TM1 and recycles the timer.

If the TM timer operates after relay MST has operated, relay TM operates. With MST operated, TM opens the circuit to the supervisory relay SR, allowing it to release to cause operation of MRL to effect the release of the register.

12. ABANDONED CALLS

The calling party may release the register at any time after the start pulsing tip and ring polarity reversal has been transmitted by the register. Supervision is under control of relay SR which in turn is controlled by relays A and TC1. An abandoned call is recognized by the release of relay SR, which may occur at various times as described in the following paragraphs.

When the register is seized, relay SR operates on a circuit through back contacts of relays TM and RV to ground at relay ON. When RV operates to reverse the polarity on the tip and ring leads it opens this circuit, but relay A should operate to establish a parallel holding circuit for SR. Should the calling party disconnect, relay A will not operate or will release if operated, causing the release of relay SR.

When relay MST operates, it releases relay A. However, MST also operates the cut-through relay in the trunk over the "D" lead. This relay connects the trunk supervisory relay to the tip and ring leads causing it to operate and this grounds lead "D", operating TC1. TC1 closes a new holding circuit for SR through a back contact of TM. In order to prevent SR from releasing before TC1 operates, a path is provided to hold SR through series front contacts of relays TM1 and MST. The operation of MST releases TM1 which is sufficiently slow release to hold relay SR until TC1 operates. If the calling party abandons after this stage, the trunk supervisory relay will release, releasing relay TC1 which will release relay SR.

When SR releases from any of the above causes, it operates MRL from ground on a front contact of relay RV. MRL releases the register.

13. TRUNK TEST CALLS

When the trunk test circuit is connected to an incoming trunk by means of the test jack, special tests may be made on which the register is required to connect to a marker without waiting for any digits to be keyed. The signal for this condition is ground through the sleeve of the test jack in the trunk circuit and over lead "D" to the register. The register TC1 and TC2 relays operate, causing a marker to be called. Lead "TST" is grounded toward the marker by back contacts of relay MST as an indication that the call is a test call.

14. TRAFFIC REGISTERS

The group busy lead "GB" to the traffic register circuit is grounded whenever all registers of a group are busy. This lead is controlled by a chain circuit through series front contacts of the register RB relays for all registers in the group.

On TOL class calls, a signal is transmitted to the traffic register circuit whenever the register timer TM times out before the marker start relay is operated. If the AS steering relay is operated, indicating a permanent signal condition, ground will be momentarily connected to the "PS" lead. If the AS steering relay is released, indicating that some digits have been registered, ground will momentarily be connected to the "PD" lead.

The TM1, TOL, and AS relays are operated when the register is seized. If the TM relay operates before pulsing starts, the ground is connected through front contacts of these relays to the "PS" lead as a toll call permanent signal indication to the traffic register circuit. The operation of the TM relay will also cause the RO relay to operate, which in turn will cause the MST relay to operate. Operation of the MST relay will cause the TM relay to release so that ground will be supplied on the "PS" lead during the operating time of the RO and MST relays and the release time of the TM relay.

After the first digit has been received, the TM1 and TOL relays remain operated but the AS relay will release. The operation of the TM relay under this condition will connect a ground through the front contacts of the TM1 and TOL relays and the back contact of the AS relay to the "PD" lead, as a toll call partial dial signal to the traffic register circuit. Ground will be applied to the "PD" lead during the operating time of RO and MST and the release time of TM.

After a complete registration has been received, the MST relay is operated, causing the TM1 relay to release.

Consequently, should the TM relay operate after pulsing is completed, neither the "PS" nor the "PD" lead will be grounded since the TM1 relay opens this circuit.

15. TEST AND MONITOR CALLS

15.1 Register Test Circuit

If the register functions with an incoming register test circuit, the M relay of Fig. 9 will be provided. This is a low cost test circuit and is used for testing the register and associated receiver. The M relay is operated over lead "M" by ground from the register test circuit. M locks to lead "ML". The operation of M relay makes the register busy to service calls by operating the relay MB and connects the following leads through to the incoming register test circuit.

H — Indicates to the register test circuit that the register is off-normal.

MON — Indicates to the marker that the call is a test call.

N — Permits the test circuit to increase the sensitivity of the MF signal receiver on certain tests.

RP — Permits the register test circuit access to the register link so that it may originate a call through a test trunk.

15.2 Automatic Monitor Register and Sender Test Circuit

If the register functions with an automatic monitor register and sender test circuit, abbreviated monitor, the M relay of Fig. 10 will be provided. This circuit provides for monitoring on service calls and for originating test calls to check the operations of the register and associated receiver. The M relay is operated by battery on the "BS" lead and ground on the "M" lead from the monitor. Operation of the M relay connects the following leads through to the monitor circuit.

T — Connect the monitor circuit to the tip and ring leads of the register so that a check of the number pulsed can be made on monitored calls.

RG, FR, CN — Are used for indicating the position of the register in its marker connector, the frame on which the marker connector is located and the position of the marker connector on that frame respectively.

MON — For indicating to the marker that the call is a monitored or test call.

TAN — Indicates to the monitor circuit that the call is of a tandem class for the LT translator.

MST — Indicates to the monitor circuit that the register is selecting a marker.

H — Indicates to the monitor circuit that the register is off-normal and also used by the monitor to hold the register under certain conditions of failure to check.

N — Permits the monitor circuit to increase the sensitivity of the signal receiver on certain tests.

MB — Enables the monitor circuit to make the register appear busy to service calls.

15.3 Sender Test Circuit

In offices where a sender test circuit is used for testing multifrequency senders and where, for reasons of economy, no separate multifrequency signal receiver is provided for use with this test circuit, the receiver permanently associated with one of the register circuits in the office can be borrowed. The register associated with the receiver that can be borrowed is wired with option "S", so that, when a multifrequency sender test is to be made, the sender test circuit makes the register busy by operating relay MB and gives itself sole access to the receiver by opening leads "H", "RO", "L", "S", and "10".

16. TRAFFIC USAGE RECORDER CONNECTIONS

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

The register busy lead "RB" is connected to the winding of the RB relay and is grounded whenever the register is busy in service, by test, or made busy.

The register busy for maintenance lead "RBM" is connected to the winding of the MB relay and is grounded whenever the register is made busy. This lead is also grounded whenever the circuit is being monitored or tested.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.1 A Relay - AJ8

Maximum External Circuit Loop	6400 ohms 45V 6800 ohms 48V
Minimum Insulation Resistance	30,000 ohms 45V 30,000 ohms 48V

1.2 Battery Voltages

-45 to -50
+125 to +135

1.3 Maximum Resistance in the "D" lead from incoming register to incoming trunk - 10 ohms.

2. FUNCTIONAL DESIGNATIONS

The functional meanings of the designations of the operating elements of the register are given in the following list.

RELAYS

11A, 11B	ONE ONE Prefix (Foreign Area Directing Code)
2CK	TWO CHECK
A	LINE SUPERVISORY Relay
A411	Numbering Plan Area - Information
A 2/5	4 DIGIT REGISTER
AB	(Trunk Completing to) A and B OFFICES
AS	A DIGIT STEERING
B 2/5	B DIGIT REGISTER
BS	B DIGIT STEERING
C 2/5	C DIGIT REGISTER
CK	CLASS CHECK
CLS	CLASS - SPECIAL MARKER
CLT	CLASS TRANSFER
CS	C DIGIT STEERING

RELAYS

D 2/5	D DIGIT REGISTER
DCK	DOUBLE CONNECTION CHECK
DS	D DIGIT STEERING
E 2/5	E DIGIT REGISTER
ES	E DIGIT STEERING
F 2/5	F DIGIT REGISTER
FGO, 1	FRAME GROUP (tens)
FS	F DIGIT STEERING
G 2/5	G DIGIT REGISTER
GS	G DIGIT STEERING
H	HOLD MAGNET
H 2/5	H DIGIT REGISTER
HS	H DIGIT STEERING
J 2/5	J DIGIT REGISTER
JS	J DIGIT STEERING
K 2/5	K DIGIT REGISTER
KS	K DIGIT STEERING
L 2/5	L DIGIT REGISTER
LR	LINK RELEASE (Trouble)
LS	L DIGIT STEERING
LTO-9	LINK TENS DIGIT (Indicates Trunk Location on Register Link)
LU 2/5	LINK UNITS DIGIT (Indicates Trunk Location on Register Link)
LUT	LINK UNITS TRANSFER
M	MONITOR or TEST
MB	MAKE BUSY
MRL	MARKER RELEASE
MST, MSTA	MARKER START

RELAYS

NOE	NO OPERATOR ERROR
NTAN	NON TANDEM
OA	(Trunk Completing to) OFFICE A
OB	(Trunk Completing to) OFFICE B
ON, ON1	OFF NORMAL
PCD, PCD1	PULSE CONVERSION DIAL
PCR	PULSE CONVERSION REVERTIVE
RA	REGISTER ADVANCE
RB, RB1	REGISTER BUSY
REG, REG1	REGULAR or BASIC (Register Link Switch Group)
RLK	RELEASE LINK CHECK
RO	REORDER
RV	REVERSAL (of Tip and Ring polarity)
SA0, SA1	SERVICE (treatment for) A DIGIT
SR	SLOW RELEASE (Supervisory)
ST11	START PULSE ELEMENT POSITION
STS, STS1	START PULSE STEERING
SUP, SUP1	SUPPLEMENTARY (Register Link Switch Group)
TAN, TAN1	TANDEM
TC1, TC2	TRUNK CUT-THROUGH
TEN	TEN Frequency
TF 2/5	TRUNK LINK FRAME (Units Digit)
TFT	TRUNK FRAME TRANSFER
TM, TM1	TIME MEASURE
TOL	TOLL
TRL	TROUBLE RELEASE

TUBES

LR	LINK RELEASE (Trouble)
RV	REVERSAL (of Tip and Ring Polarity)
TM	TIME MEASURE

3. FUNCTIONS

3.01 To operate register busy relays in the Register Link Circuit whenever the register is either plugged busy or is busy in service.

3.02 To supply battery for operating the select magnet and ground for operating the hold magnet in the Register Link Circuit.

3.03 To recognize closure of a crosspoint in the link.

3.04 To release the select magnet in the link.

3.05 To check for a double connection in the link and then provide direct ground for locking the hold magnet.

3.06 To operate the cut-off relay in the incoming trunk circuit and to check that it operates.

3.07 To receive from the register link the class of incoming trunk, the number of the trunk link frame on which the trunk appears, and also, for trunks with appearance on the line link frame, the location of the trunk on the register link frame.

3.08 To supply supervisory battery and ground to the tip and ring conductors of the incoming trunk in one direction for a timed interval and then to reverse the polarity as a signal that pulsing may begin.

3.09 To accept control of supervision after the link functions have been completed and the polarity of the tip and ring has been reversed as a start pulsing signal.

3.10 When a register is seized, to prevent advancing the start lead

at the active appearance of the register in the link, but to advance the start leads at all other appearances of the register.

3.11 When a register is first seized, to lock in the connection until all link functions have been completed.

3.12 When all link functions have been completed, to allow the last register busy relay in the link to operate and to unlock the connection so that the register will be held under control of supervision.

3.13 To time for all link functions to be completed; if they are not completed within a given interval, to call in the marker and indicate the nature of the trouble to the marker.

3.14 To supply battery to the multifrequency signal receiving circuit.

3.15 To record digits received by the multifrequency signal receiver locking in those received for each digit.

3.16 On calls over tandem trunks to recognize an initial digit "one", to disregard any number of immediately succeeding "ones" and to refrain from locking in a "one" on the A digit register.

3.17 To steer from digit to digit under control of the multifrequency signal receiver, not completing a step until the end of a multifrequency pulse.

3.18 In case the multifrequency receiver signals that it has received more than two frequencies simultaneously to call in the marker and ask for reorder.

3.19 To request a reorder routing by the marker when:

3.1901 A second key pulse signal is received.

3.1902 More or less than four digits followed by start signal are received on any four digit trunk class call with terminals OE and XCT cross-connected.

3.1903 More or less than five digits followed by start signal are received on any five digit trunk class call with terminals OE and XCT cross-connected.

3.1904 More or less than a predetermined number of digits followed by a start signal are received on a non-tandem class trunk with terminals OE and XCT cross-connected.

3.1905 Less than four digits followed by a start signal are received on any four digit class trunk with terminals OE and MIN cross-connected.

3.1906 Less than five digits followed by a start signal are received on any five digit class trunk with terminals OE and MIN cross-connected.

3.1907 Less than a predetermined number of digits followed by a start signal are received on a non-tandem class trunk with terminals OE and MIN cross-connected.

3.1908 Less than, or more or less than a predetermined number of digits followed by a start signal are received on pulse conversion dial class trunks.

3.1909 More or less than two predetermined numbers of digits followed by a start signal are received on CAMA tandem or toll class trunks.

3.1910 Less than a predetermined number of digits followed by a start signal are received on CAMA tandem, or toll class trunks.

3.20 To operate the trunk cut-through relay before calling for a marker.

3.21 To check that the trunk cut-through relay operates.

3.22 To transmit to the marker the class of trunk, the number of the trunk link frame where the trunk appears, the trunk number, all digits received over the trunk, and an end signal.

3.23 To release when the marker operates the marker release relay MRL.

3.24 To release when the marker operates the trouble release relay TRL.

3.25 To release if the call is abandoned before the trunk cut-through relay has been operated.

3.26 To release if the call is abandoned after the trunk cut-through relay has been operated.

3.27 To hold the register busy relays of the link circuit operated until the MRL and TRL relays have released.

3.28 To call for a marker and ask for reorder if relay MST has not operated within a measured time after register seizure.

3.29 To release if normal release has not occurred within a measured time after relay MST operates.

3.30 To light a lamp and start a common alarm timing circuit if the register fails to release.

3.31 To prevent starting the common alarm timing circuit when the register is plugged busy.

3.32 To call for a special marker on calls from special trunks, i.e., no test or no hunt trunks or trunks from the test desk.

3.33 With Fig. 10, to connect to the automatic monitor, register and sender test circuit.

3.34 With Fig. 9, to connect to the register test circuit.

3.35 To transmit a group busy signal to the traffic register circuit whenever all registers of a group are busy because of either make-busy plugs or service calls.

3.36 On a TOL class call, to transmit a permanent signal indication to the traffic register circuit whenever the register times out before any digits are recorded.

3.37 On a TOL class call, to transmit a partial dial signal to the traffic register circuit whenever the register times out after receiving the A digit but before marker start.

3.38 To permit the signal receiving circuit associated with the register to be used with the sender test circuit.

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

3.40 To cause steering advance when only a single frequency digit indication is received from the signal receiving circuit.

3.41 To provide an indication of marker seizure on test calls over a path for 1700 cycle tone for office provided with an Office Test Frame.

3.42 To permit the use of NXX codes for both local and numbering plan areas.

3.421 To detect the code NPA-411 as an area information code.

3.422 To recognize all codes having a 0 or 1 in the A position as Non Area codes.

3.423 To recognize all codes having other than 0 or 1 in the A position and having a start in the eleventh position as a numbering plan area code.

4. CONNECTING CIRCUITS

When this circuit is listed on a keysheet, the connecting information thereon is to be followed. This circuit will function with the following crossbar system circuits.

4.01 SD-95536-01 - Signal Receiving Circuit.

4.02 SD-26048-01) - Incoming Register
SD-25585-01) Link Circuit.

4.03 SD-26025-01 - Incoming Register Marker Connector - Marker Part.
SD-26026-01 - Incoming Register Marker Connector - Register Part.
SD-26029-01 - Preference Control Circuit for Marker Connectors.
SD-25586-01 - Marker Connector.

4.04 SD-25805-01 - Master Test Frame Connector Circuit.

4.05 SD-25680-01 - Automatic Monitor, Register and Sender Test Circuit.

4.06 SD-25988-01 - Incoming Register Test Circuit.

4.07 SD-25675-01 - Sender Test Circuit.

4.08 SD-25762-01 - Master Test Frame, Jack, Lamp, and Key Circuit.

4.09 SD-25892-01 - Traffic Register Circuit.

4.10 SD-26070-01) - (Typical) Incoming
SD-25583-01) Trunk Circuit.

4.11 SD-26051-01) - (Typical) Outgoing
SD-25580-01) Sender Circuit.

4.12 SD-26002-01) - Completing Marker
SD-25550-01) Circuit.

4.13 SD-95738-01 - Traffic Usage Recorder Circuit.

4.14 SD-27633-01 - Office Test Frame Circuit.

5. MANUFACTURING TEST REQUIREMENTS

5.1 The multifrequency incoming register shall be capable of performing all the service functions specified in this circuit description and meeting all the requirements of the circuit requirements table.

6. TAKING EQUIPMENT OUT OF SERVICE

6.1 Method of Taking Equipment Out of Service

In order to take the register circuit or any of its associated apparatus out of service, insert a No. 322A (make busy) plug in the associated incoming register make busy jack, IRMB at the jack bay of the master test frame.

6.2 General Precautions When Working on the Apparatus

When working on the apparatus, make the register busy by inserting a No. 322A (make busy) plug in the associated IRMB - jack at the master test frame. When working on the apparatus of a register whose signal receiver is associated with the sender test circuit, the sender test circuit should not be operated. No further precautions are necessary unless otherwise specified in the circuit requirement tables.

7. ALARM INFORMATION

7.1 Time Out Alarm

7.11 Condition

If a multifrequency incoming register encounters a delay in the progress of a call, the register timing circuit will function and attempt to release the register as described in section 10 of the Detailed Description.

7.12 Indication

If the register releases satisfactorily, the only indication of the condition will be the momentary lighting of the time out lamp TO on the master test frame. If the register is unable to release, the TO lamp will remain lighted and the common alarm timing circuit will begin to function and, after a time interval of 10 to 15 seconds, operate the major alarm and light the register and sender time out alarm lamp, R-S-TOA.

7.13 Action Required

If, in response to a major alarm, a lighted TO lamp is found, insert a No. 322A (make busy) plug in the IRMB jack associated with the TO lamp to silence the alarm and to remove the register from service.

7.14 Link Release Timeout

In addition to the timeout feature covered under Alarm Information, there is also a link release and double connection check feature provided to check that the link functions are completed in the allotted time and that there is no double connection in the link path. The operation of this feature causes seizure of the marker for appropriate action which may result in a trouble recorder alarm. The procedure to be followed in response to trouble recorder alarms is covered in Trouble Recorder Alarm Routine No. 5 Crossbar Office.

7.2 Fuse Alarm

If in response to a major alarm an FA lamp is lighted at an incoming register frame, it is an indication that a fuse has been operated at the associated frame.

Replace the operated fuse to restore the alarm and extinguish the FA lamp.

SECTION IV - REASONS FOR REISSUE

CHANGES

B. Changes in Apparatus

B.1 Superseded

TEN Relay - AF519 - Option "ZK" - Fig. 2

TC1 Resistor - 18KE - Option "ZK" Fig. 1

Superseded By

TEN Relay - AJ512 - Option "ZL" Fig. 2

TC1 Resistor - 19AAR - Option "ZL" - Fig. 1

B.2 Added

SA0, SA1 Relays - AK24 - Option "Z0" Fig. 6

MSTA Relay - AJ15 - Option "Z0" Fig. 6

A411 Relay - AJ512 - Option "Z0" - Fig. 6

ST11 Relay - AJ512 - Option "Z0" - Fig. 6

(5) Networks - 185A - Option "Z0" - Fig. 6

D. Description of Circuit Changes

D.1 The changes listed in paragraphs B.1 and B.2 provide for using NXX codes for both local and numbering plan areas and for detecting NPA-411 as an information code.

The marker will be informed whether the code is local, NPA, or NPA-411. Local or nonarea codes will ground the "LT" lead, NPA codes will ground the "TT" lead, and NPA-411 codes will ground the "X11" lead, provided with this feature. All codes beginning with 0 or 1 are considered non-area codes. Codes considered NPA are those having a start signal in the eleventh position where the A digit is other than 0 or 1, or where the D, E, and F digits are 411 respectively, the A digit is other than 0 or 1, and the start signal is received in the seventh position.

D.2 The feature Note 102 is modified to indicate that Fig. 7 and 8 are required only for phase I and II centrex trunks, circuit Note 111 is revised to indicate the option "ZD" is required only for phase I and II centrex trunks, and circuit Note 108 is revised to indicate that where the marker serves phase I and II centrex trunks, option "G" must be provided.

D.3 Resistor codes KS-13490-92 and KS-19150-52 respectively, are similar but use of the latter codes is preferred and is being shown in all No. 5 crossbar circuits. Since the resistors are physically similar and the code is not marked on the apparatus, apparatus figures 1, 2, and 11 are revised to indicate the KS-19150-52 codes in place of the KS-13490-92 codes on a no record basis. This involves a code change of resistors RV1, RV2, LK1, G8, G9, LR1, LR2, TM1, and TM2.

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