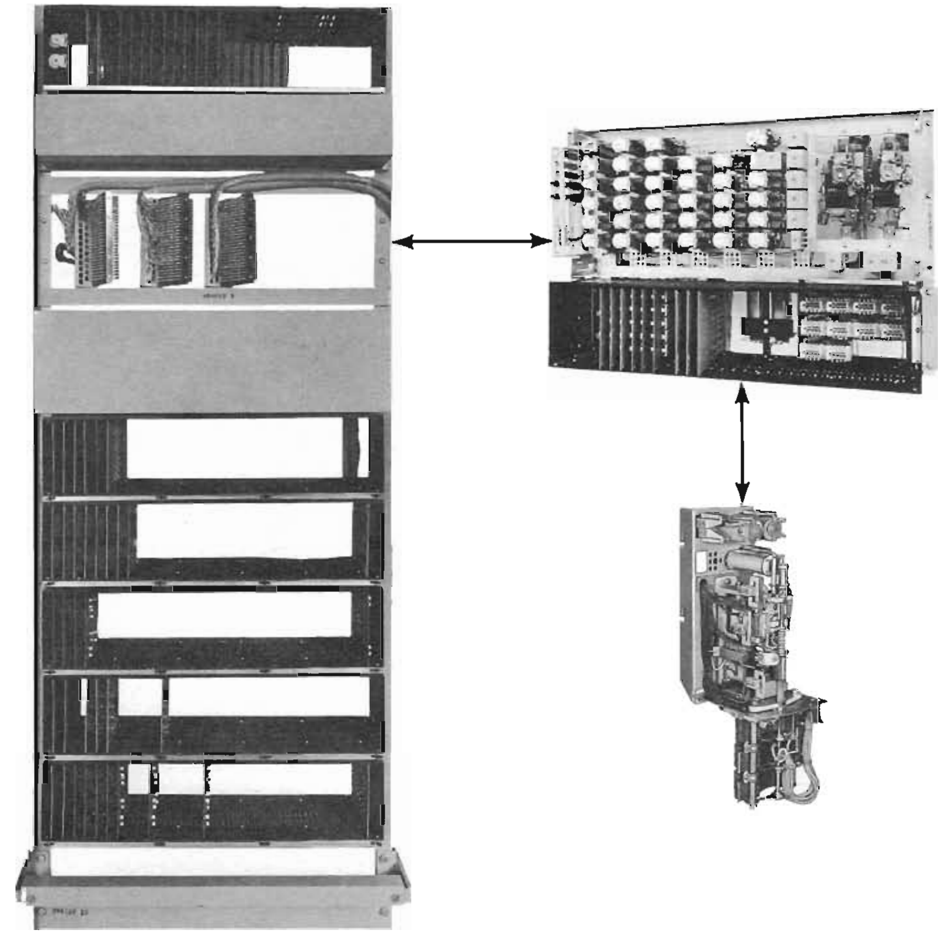
Series 100 Director 200-416

SERIES 100 DIRECTOR

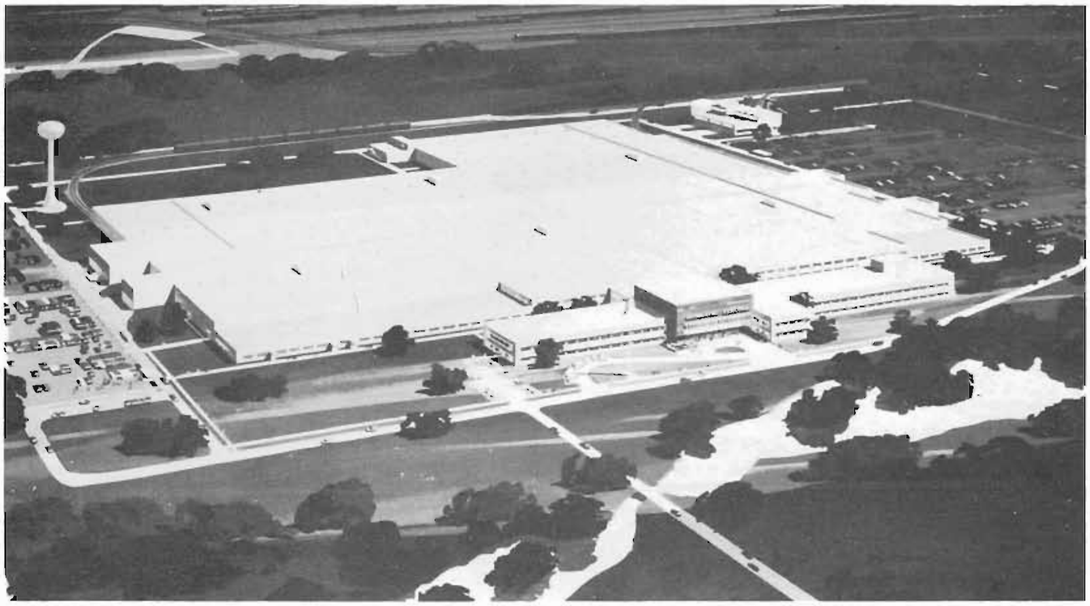


Technical bulletin **200-416**

AUTOMATIC ELECTRIC

GENERAL SYSTEM

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS



Factory, development laboratories, and general office at Northlake, Illinois, U.S.A.

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SERIES 100 DIRECTOR

1. INTRODUCTION

Telephone companies are constantly faced with switching and trunking problems that arise from system growth and modernization. For example, expansion of an extended area service network can often result in complex trunking patterns and lead to inefficient use of existing switches. With this and other similar problems in mind Automatic Electric Company has designed the Series 100 Director to give common control and translation features to step-by-step offices. This system is capable of fulfilling the needs of the local switching network without modification of existing switches or shelves.

The main components of the Series 100 Director system are:

(1) Register-Sender Access Equipment, designed so that the system can be added to existing step-by-step offices both large and small without modification of existing switches.

(2) Electromechanical Register-Sender, that converts dial pulses to codes, presents the codes to the Translator and under control of the Translator converts translated codes to loop pulses, or MF signals, for outpulsing.

(3) The electronic Translator, that contains instructions in the form of routing codes in its logic circuits for completing each type of call that can be offered in the Series 100 Director system. The Translator is easily tailored to each individual office.

1.1 Applications

The Series 100 Director can be applied to meet the needs of offices requiring increased flexibility in numbering plans and trunking arrangements. The Series 100 Director is equally applicable to large or small offices.

Some of the applications are:

a. When an extended area service network is being expanded to include additional offices and uniform directory number dialing is required.

b. When trunk group savings can be realized by translating routing through tandem points.

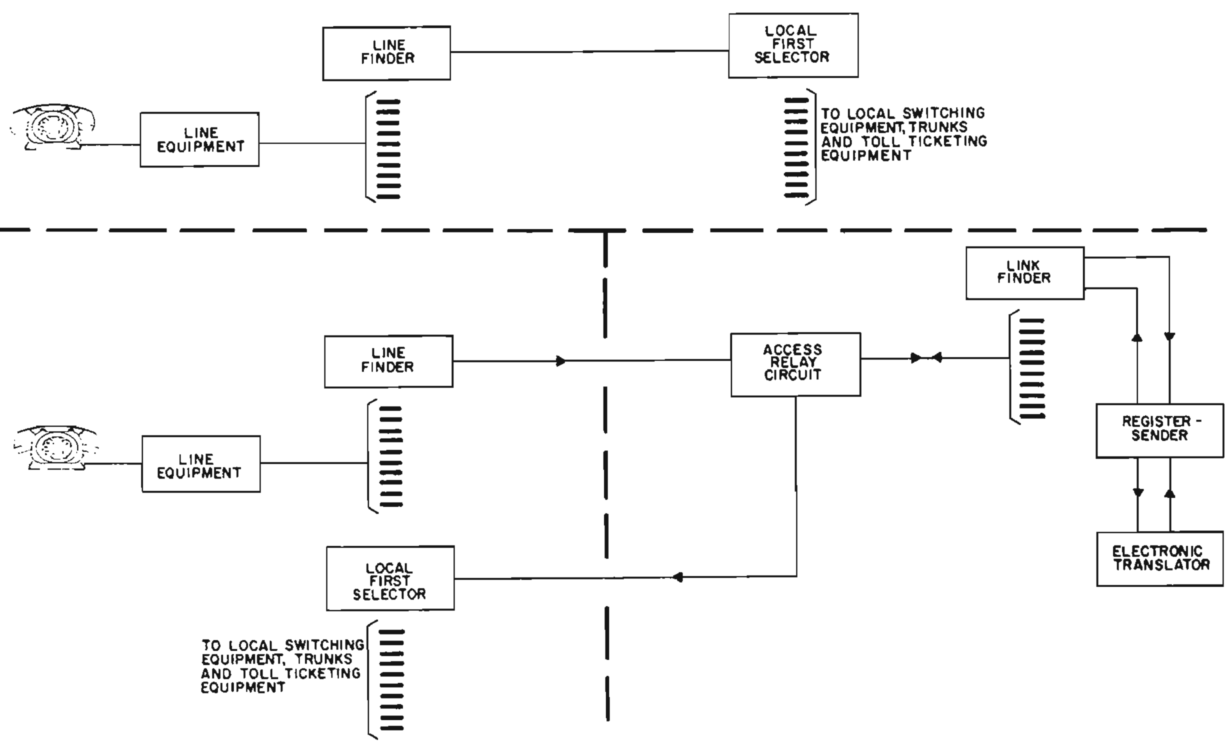


Figure 1. Block diagram of Series 100 Director.

c. When savings in the number of trunks can be realized by using alternate routing to carry overflow traffic.

d. In metropolitan areas when it is required to send a full complement of digits to a connecting office.

e. In offices not arranged for 7 digit customer numbering when it would be necessary to add digit absorbing selectors for this feature.

f. When trunking to common control offices requires MF sending.

g. Flexibility to introduce single digit SATT access codes (1 + station to station and 0 + person to person) and to standardize on special service codes.

h. Provide touch calling facilities.

i. Optional message rate metering or time and zone metering for 1 or 2 party lines.

2. REGISTER-SENDER ACCESS EQUIPMENT

The Register-Sender Access Equipment has been so designed that the Series 100 Director can be added to existing step-by-step offices, both large and small without modification of existing switches or shelves.

As its name implies the Register-Sender Access Equipment is the access point to the common control Series 100 Director equipment. Figure 1 shows where in the switch train the Series 100 Director is accessed.

The main components of the Register-Sender Access Equipment are the access relay circuit (also referred to as the link circuit), the link finder circuit, and the sub-group relays.

2.1 Access Relay Circuit

The access relay circuit consists of two relays, L and CO and can be provided for either message rate service or flat rate service. One access relay circuit is required per linefinder. The access relay circuit as shown in figure 1 is inserted in the switch-train between the linefinder and local first selector.

The access relay circuit extends the customer's +L and -L leads to the link finder, and also the - and + leads from the director to the local selector as shown in figure 2. The access relay circuit splits the connection from the customer to the first selector until after the common equipment releases. The access relay circuit is seized by the linefinder, and in turn provides a start marking to the link finder via the sub-group relays. When seized by the linefinder, the access relay

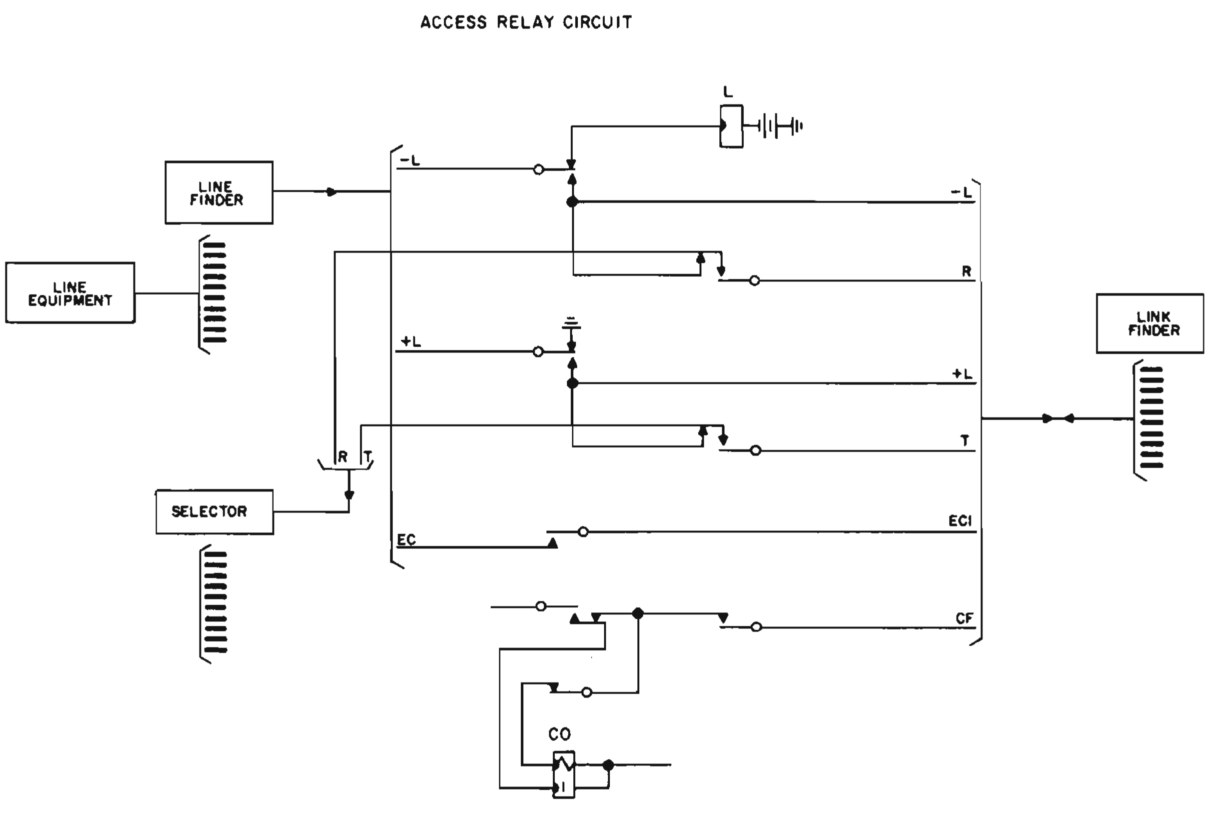


Figure 2. Access relay circuit.

circuit performs similarly to the customer's line equipment. All information dialed by the customer will enter unchanged by this circuit into the common control equipment; also, all information outpulsed from the Register-Sender equipment to the local first selector and the remaining switching equipment is via this circuit. When signaled to do so, this circuit will switch through connecting the linefinder and customer's line equipment to the switchtrain. This is the only circuit of the Series 100 Director held operated for the duration of the call.

2.2 Sub-Group Relays

Sub-group relays are provided in groups of 10 relays each. One group relay (G) is provided for every 10 access relay circuits. The 10 access relay circuits associated with one G relay appear on the same level of the link finder. The group relay G is seized by the access relay circuit and in turn extends the start marking to seize an idle link finder, and marks the vertical bank contact at the level to which the access relay circuit is connected.

The banks of the link finders are slipped so that each group of access relay circuits appears on the first level of at least one link finder. As shown in figure 3 the G relay operated by an access relay circuit seizes the link finder A relay. The G relay closes ground into a preference chain in order to seize the link finder at which its corresponding access relay circuit appears on level one. For example, an access relay circuit that appears on level one of link finder 4 seizes relay G4. Relay G4 in turn closes ground through unoperated contacts of relay E of link finder 4 and seizes the A relay. If link finder 4 is busy the ground is closed through operated contacts of relay E to link finder 3 through unoperated contacts of its E relay, assuming link finder 3 is idle, and seizes the A relay.

2.3 Link Finder Circuit

The link finder circuit functions much like a linefinder and is capable of serving 100 access relay circuits. A G relay of the sub-group relays provides ground on the start lead which causes the link finder to begin vertical stepping. The same G relay also provides the vertical bank marking (ground) which causes the link finder to stop vertical stepping at the marked level. The link finder begins rotary stepping and stops at the contacts marked by the access relay circuit calling for service.

The link finder is equipped with a 600 point bank and when it has its wipers positioned on the bank contact of the access relay circuit calling for service, figure 4, it extends the +L and -L leads from the customer's station apparatus to the Register-Sender. This is the pulsing path into the Register-Sender. It also extends the EC lead to the Register-Sender to provide the class of service mark if required. The T and R leads are also extended from the Register-Sender to the access relay circuit and the first selector for outpulsing into the switchtrain.

Link finders are shelf mounted, 10 link finders per shelf. The banks of the link finders are slipped as shown in figure 5 so that each access relay circuit appears on the first level of at least one link finder.

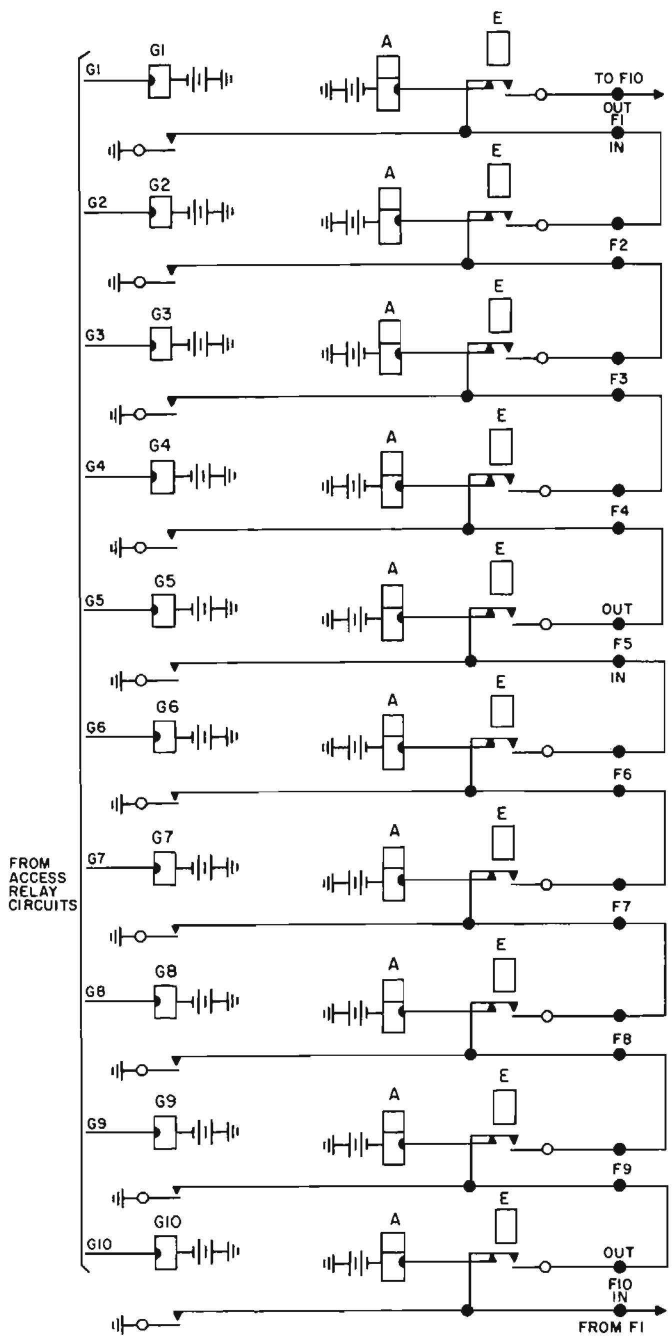


Figure 3. Chain circuit.

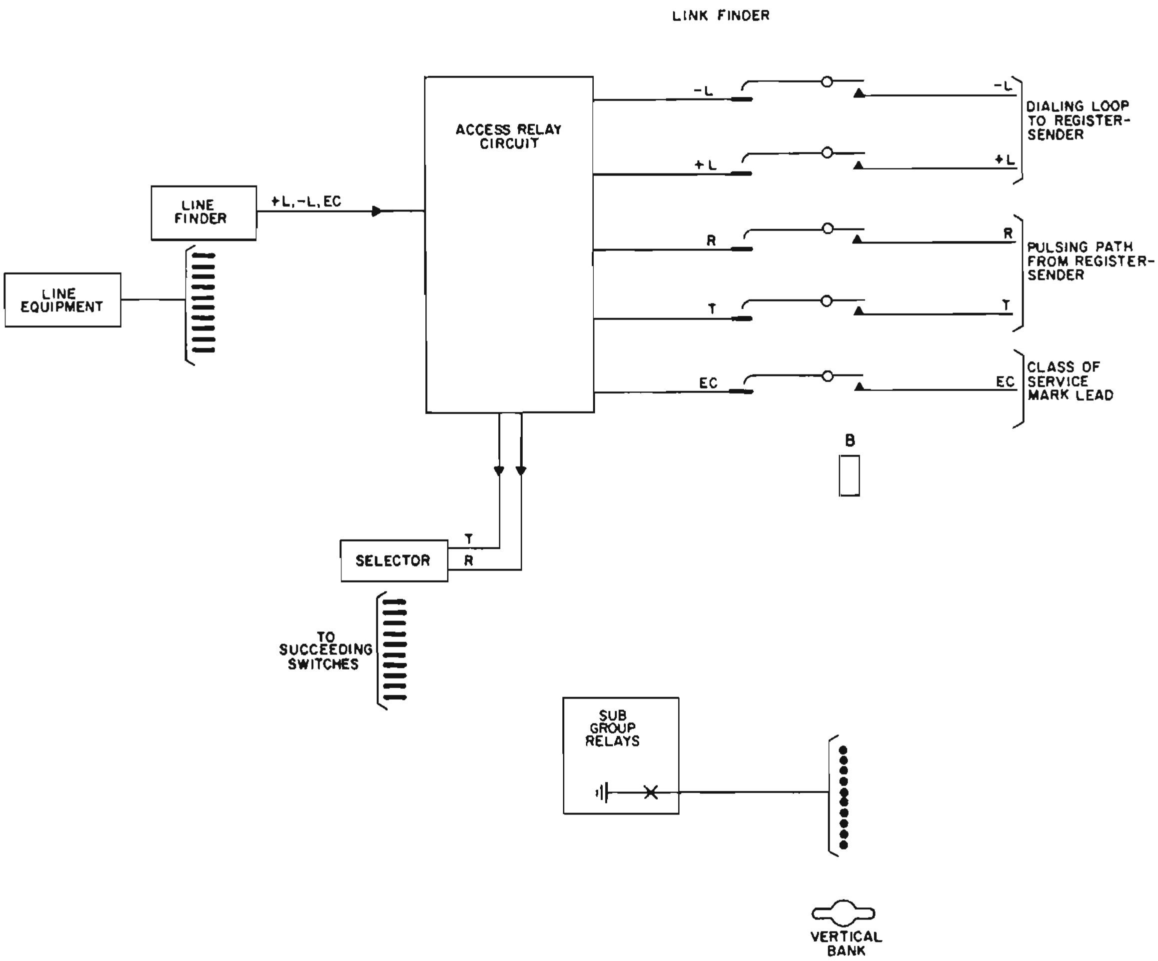


Figure 4. Link finder.

Dial tone is now returned from the Register-Sender not from the first selector. However, the link finder is started at nearly the same time as the linefinder so that the customer receives the tone in approximately the same interval.

2.4 Group Alarm Relays and Alarm Signal Circuit

These relays in conjunction with the alarm signals provide a visual indication during any of the following conditions:

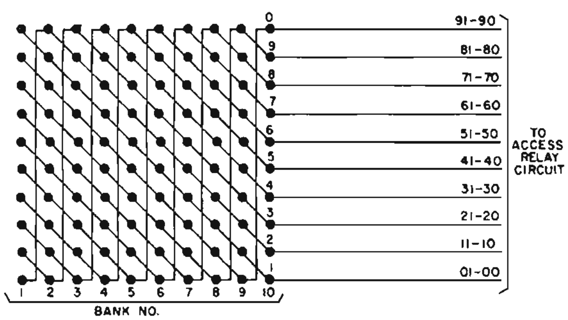


Figure 5. Link finder slipped banks.

a. All trunks busy, which in this case is actually all finders busy.

b. Release alarm. Indicates the link finder has not released and returned to vertical normal.

c. PC Metering. Each time the link finder releases, RLS relay operates giving an indication to the PC meter.

2.5 All Link Finder Busy Circuit

This circuit, consisting of three bar relays, is provided for each shelf of link finders. If an all link finder busy condition occurs, this circuit will return ground through the remaining unoperated access relay circuits, that would access the particular shelf of link finders.

3. REGISTER-SENDER

A Register-Sender, figure 6, is associated with and accessed by a particular link finder. When seized by the link finder, the Register-Sender returns dial tone to the calling party and prepares to receive dialed digits. As the calling party dials, the digits are counted on a high speed correed counting chain. During the interdigital pause the dialed digits are converted from dial pulses to a two-out-of-five code and stored on codelreeds. As the Register-Sender stores each digit it also presents the digit to the Translator.

The Register-Sender is continually presenting the dialed digits to the Translator. Whether the Register-Sender will store all the dialed digits, or drop out after receiving a translation of the first, second, or third dialed digit and allow the subscriber to dial the remaining digits directly into the switchtrain will depend upon the type of call and the information received from the Translator.

As its name implies, the Register-Sender also has the capability of outpulsing (sending) digits by converting them back from a two-out-of-five code into loop pulses. The Register-Sender is capable of outpulsing in either the dial pulse or multifrequency mode. Under control of the Translator, the Register-Sender can shift from the dial pulse mode to the multifrequency mode between the outpulsing of digits.

The Register-Sender is also capable of recognizing three different class of service marks forwarded to it on the EC lead.

When the Register-Sender recognizes that alternate routing is required it goes through an absorb cycle to release any partial switchtrain that has been set up. The Register-Sender then sends new routing instructions. Because the routing can be changed even though sending is in progress; pocketed calls are virtually non-existent. Second alternates can be selected in the same way.

3.1 Register-Sender Without Translator

The Register-Sender presented in this section is used in a Series 100 Director system equipped with a Translator. The Register-Sender, however, can also be used in a system not equipped with a Translator in order to provide customers with touch calling features, but without providing translation facilities. Figure 7 is a block diagram of such a system. In this system the touch calling receiver serves as a tone converter and the Register-Sender as a storage facility and outpulsing source. The touch calling receiver converts the tones from the touch calling telephone to ground marks, which are extended to the Register-Sender. The ground marks are changed to a two-out-of-five code and stored on codelreeds by the Register-Sender. The Register-Sender then converts the two-out-of-five code to loop pulses and extends them to the switchtrain.

3.2 Registering Dialed Digits

When the link finder has found the link calling for service, the link finder switches the link through to the Register-Sender. The A relay of the Register-Sender is now across the dialing loop and will repeat the dial pulses into the

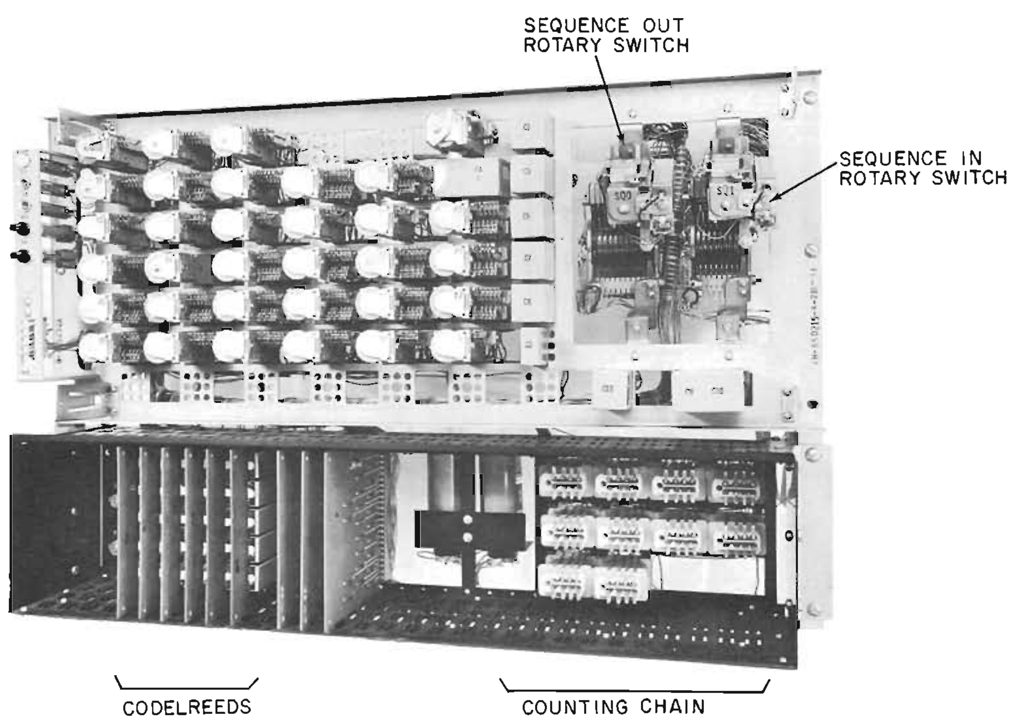


Figure 6. Register-Sender.

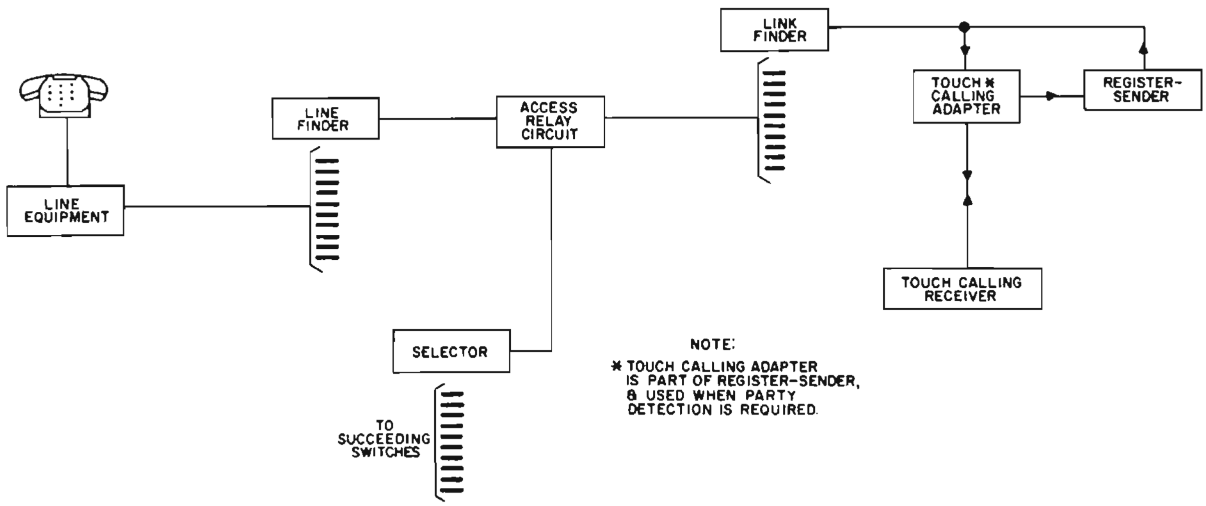


Figure 7. Register-Sender arranged for touch calling without Translator.

Register-Sender as long as the Register-Sender stays with the call, figure 8.

The dialed digits, as they are repeated, are counted via the counting chain, changed to a two-out-of-five code (paragraph 3.2.2) and stored on codelreeds. Between the counting chain and the codelreed is a rotary switch which steps after each dialed digit to distribute the dialed digits to the various codelreeds. The rotary switch also contains a level for each code 0, 1, 2, 4, 7. The proper levels will be grounded by the correeds of the counting chain. For example, when the first digit is dialed, the rotary switch will be on the first position, and if the digit

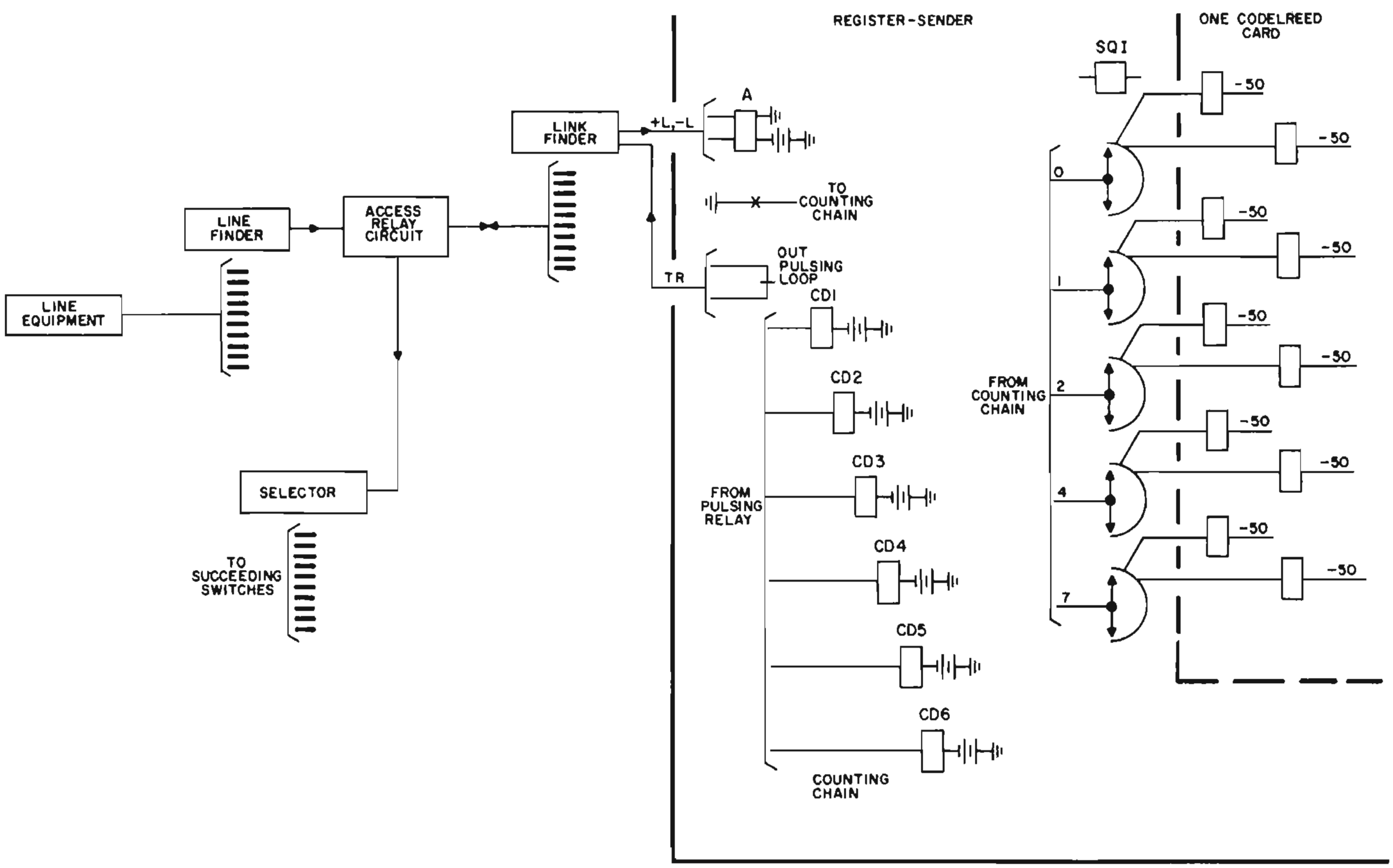


Figure 8. Registering dialed digits.

dialed is 3, levels 1 and 2 will be marked with a ground by the counting chain and the proper codelreeds are operated.

Through operated contacts of the codelreeds, timed battery is extended to the Translator during this Register-Sender's time slot. The timed battery is extended over leads grouped in such a way that the stored digit is presented to the Translator as a two-out-of-five code. As each digit is stored on codelreeds, the number of digits presented to the Translator increases.

3.2.1 Codelreed storage.

Digits dialed into the Register-Sender are stored on codelreeds. A codelreed is constructed by winding two coils directly on a reed capsule and then encapsulating two such units with a permanent magnet between them. Five such assemblies are then mounted on a printed wiring card, figure 9. The strength of the permanent magnet is such that it will not cause the operation of the reed contacts but will hold them operated when current is applied through the winding. Once the codelreed is operated, it will remain operated. In order to restore the codelreed, the windings must be energized in opposition. Since this system uses a two-out-of-five code, five codelreeds provide storage for one digit. Each printed wiring card contains ten codelreeds, therefore, two digits can be stored per card.

3.2.2 Two-out-of-five code.

The Register-Sender uses a two-out-of-five code in storing digits. Digital information

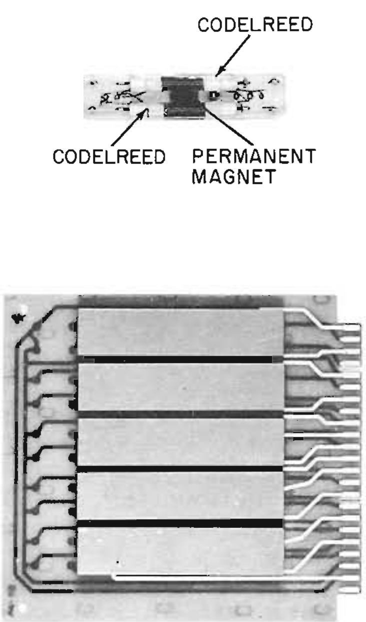


Figure 9. Codelreeds.

transmitted between the Register-Sender and Translator is also in a two-out-of-five code. By using a two-out-of-five code, only five codelreeds, instead of ten are required to store any digit from one to ten dialed by the customer. The five codes are 0, 1, 2, 4, 7. Each digit from one to ten is represented by a combination of two-out-of-five codes. For example the code for the digit 1 is 0-1; the code for the digit 2 is 0-2. Table A lists the complete coding.

Table A

Digit	Code
1	0-1
2	0-2
3	1-2
4	0-4
5	1-4
6	2-4
7	0-7
8	1-7
9	2-7
10	4-7

The two-out-of-five coding also provides a parity check in that two codelreeds must be operated to indicate a valid digit has been stored. If one or three or more codelreeds have operated it is not a valid digit.

3.3 Sending

As the information stored on the codelreeds is extended to the Translator, the Translator will furnish instructions to the Register-Sender to control outpulsing and holding of the switchtrain during switching of a call.

3.3.1 Receiving information from the Translator.

Translated routing digits are received from the Translator in a two- or three-out-of-five code. The two- or three-out-of-five code is sent in the form of a timed battery. The timed battery is received at the banks of a rotary switch as shown in figure 10. The levels of rotary switch SQO are arranged to receive the two-out-of-five code, 0, 1, 2, 4, 7. The timed battery is extended from the bank contacts to the T relays, TO, T1, T2, T4, and T7. The T relays operated will depend upon the code received from the Translator. The different combinations of operated T relays will cause the Register-Sender to perform various functions such as repeat the next dialed digit, absorb the dialed digit, etc.

The bank contacts of rotary switch SQO are lettered instead of the usual numbering scheme. As information is received from the Translator, rotary switch SQO advances a position,

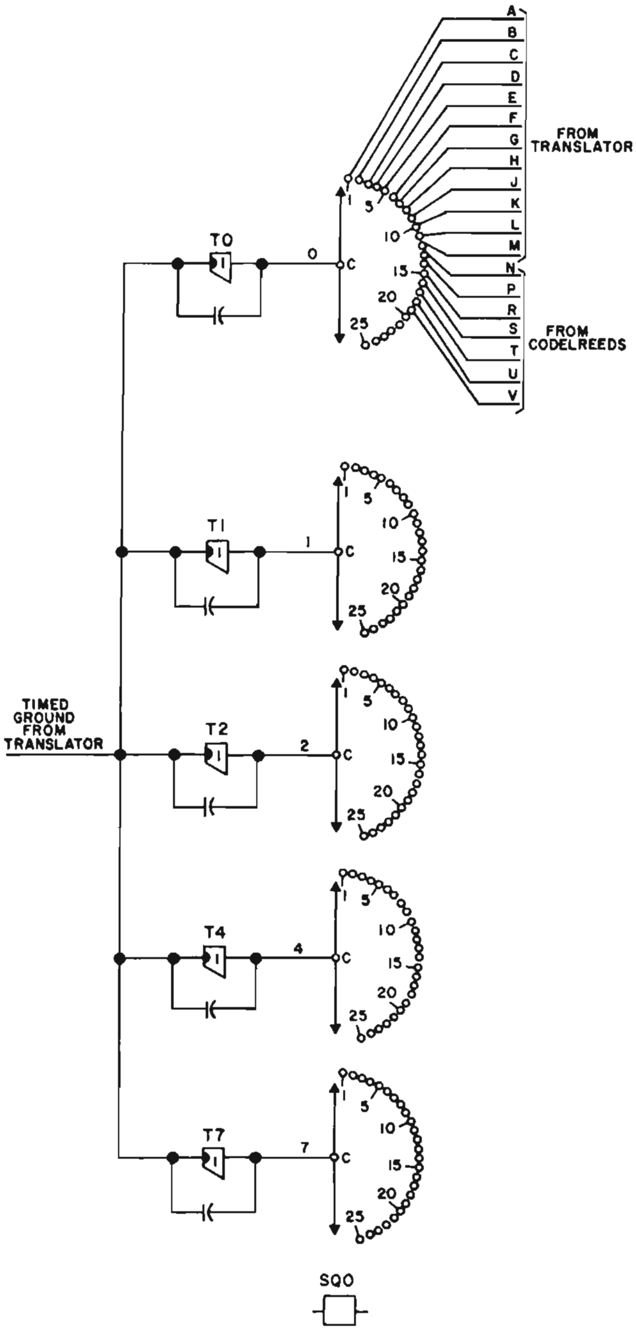


Figure 10. Receiving timed battery and ground from Translator.

or more depending on the information received. The bank contacts A through M, (letter I is not used) are connected to the Translator via the route commons. Bank contacts N, P, R, S, T, U, and V (letter O is not used) are connected to the codelreeds so the information stored on the codelreeds can be read out.

3.3.2 Repeating dialed digits.

The first digit dialed into the Register-Sender can be repeated to the first selector. This is a strapping option in the Register-Sender. Repeating the second or subsequent dialed digits is under control of the Translator. When the Register-Sender is seized the loop to the first selector is closed, and is indirectly controlled by the pulse repeating relay of this circuit. If a second or subsequent digit is to be outpulsed the Translator controls opening the loop to the first selector.

3.3.3 Absorbing dialed digits.

When the digit repeated to the selector does not result in code permitting early release the Register-Sender is signaled by the Translator to provide 600 ms open loop to the selector. The 600 ms open loop is enough time to allow the selector to release, absorbing the digit. The length of the open loop can be extended to 700 ms through optional wiring. The standard inter-digital pause is used for timing this interval.

3.3.4 Stop dial.

During outpulsing a shunt field relay has one winding placed across the loop to the selector, and the other winding energized in opposition. If a stop dial condition (battery reversal) is received from the first selector via the outpulsing loop the windings of the shunt field relay are now aiding magnetically, causing it to operate. The shunt field relay in operating opens the circuit from the readout relays. When the stop dial condition is removed the normal polarity is restored on the outpulsing loop. The windings of the shunt field relay are now opposing, causing it to restore. With the shunt field relay restored, the circuit to the readout relays is closed and outpulsing continues.

3.3.5 Alternate routing.

Trunk routes for which alternates are provided are monitored by an ATB relay in the Register-Sender. The Register-Sender is arranged to detect when a selector fails to switch through indicating an ATB has been encountered. No modification of selector or tone circuits is required for this feature.

When the Register-Sender recognizes that alternate routing is required, it goes through an absorb cycle to release any partial switch-train that has been set up. The Register-Sender then sends new routing instructions.

For example, assume the Register-Sender has positioned the local first selector to level 2 and the outgoing second selector to level 1, figure 11. In hunting for an idle trunk to city A, the outgoing second selector finds all trunks are busy and steps to the eleventh rotary position. The Register-Sender recognizes the ATB condition and drops the switch-train. The Register-Sender will re-send, this time positioning the local first selector to level

2 and the outgoing second selector to level 2.

It is possible to assign one more alternate route, possibly off level 3 of the outgoing second selector.

3.4 Class-of-Service

A class-of-service mark can be included as a condition for a particular translation. There are two methods that can be employed to determine the class of the calling line.

3.4.1 Method 1.

An EC lead through the link finder banks can be arranged to furnish three different classes. This can be done on the basis of treating an entire linefinder group as a single class, of grouping by levels via shaft springs on the linefinders, or by marking from the line equipment over a fourth wire through the linefinder banks. The required markings are received on the relays shown in figure 12. The mark is forwarded to the Translator in synchronism with digital information from the codelreeds.

The class of the calling line provides one of three conditions on the EC lead: Class 1, No connection; Class 2, 2000 ohm ground; Class 3, direct ground.

As can be seen in figure 12, when no potential is applied to lead EC, neither relay SA or SB will operate. Lead TB will therefore be closed to lead CSA. The potential closed to lead TB through unoperated contacts of relays SA and SB to lead CSA indicates class-of-service 1.

When 2000 ohm ground is closed to lead EC, relay SA will operate and close lead TB to lead CSB. The potential closed to lead CSB indicates class-of-service 2.

When direct ground is closed to lead EC, relays SA and SB operate in series and close the potential on lead TB to lead CSC. The potential on lead CSC indicates class-of-service 3.

3.4.2 Method 2.

A standard feature is returning positive 50-volt pulses from the Register-Sender to the C lead of the calling line equipment. These pulses are in synchronism with the signal that connects the Register-Sender to the Translator. The C lead of each line requiring a special class is equipped with an isolating gate, through which lines of the same class are grouped. The outputs of these gates are applied to code gates in the Translator. This method does not require any storage of the class mark, and provides for as many classes as required. The growth is then on an as needed basis.

3.5 Touch Calling Adapter

When any line in a linefinder group is equipped with touch calling, the touch calling adapter must be provided. A touch calling receiver

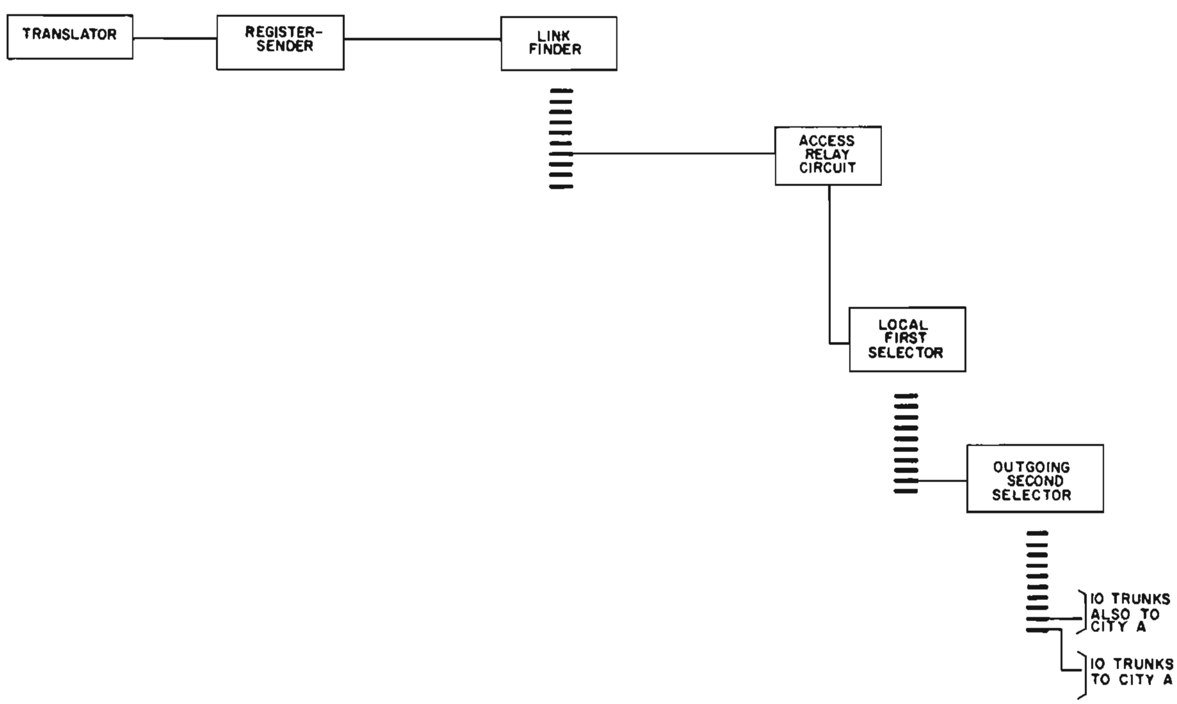


Figure 11. Alternate routing.

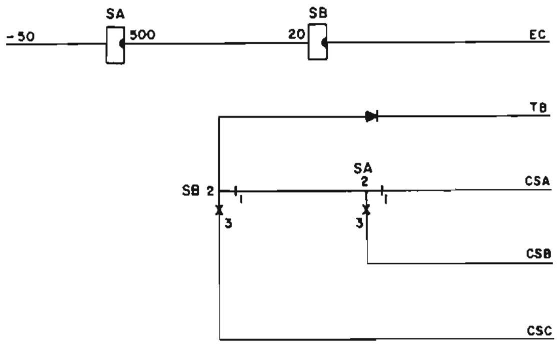


Figure 12. Class of service markings.

and possibly the touch calling receiver link circuit must also be provided. The touch calling adapter and receiver are placed between the link finder and the Register-Sender. The A relay of the Register-Sender is normally across the dialing loop and repeats the dial pulses as ground pulses to the counting chain. When touch calling is used, the tones are converted to ground which in turn marks the levels of rotary switch SQ1 for storage on codelreeds. The A relay is not used to repeat the pulses, but to hold the preceding switch-train operated. One touch calling adapter is required per Register-Sender. Touch calling is discussed in further detail in paragraph 5.2.

4. TRANSLATOR

The Translator, figure 13, is a high speed electronic circuit that uses time division access which enables it to serve up to 100 Register-Senders. The Translator can receive a maximum of six digits for translation and provide routing information within a 100 microsecond time interval.

Since a single Translator can efficiently serve 100 Register-Senders it is desirable to provide a duplicate or partial duplicate Translator as standby equipment. There are two options in providing standby Translator equipment:

a. Option 1 provides for a single full code Translator with a partial Translator for home office codes and one or two important codes.

b. Option 2 provides for a full duplicate Translator with automatic transfer.

4.1 Time Division Access to Translator

The Register-Senders accessing the same Translator are individually connected to it in sequence over a common highway. A Register-Sender accesses the common highway during a period of time called a time slot. If the maximum 100 Register-Senders are supplied, the Translator will provide 100 time slots, each 100 microseconds in length. The Translator circuitry continuously closes each Register-Sender in turn to the highway. This means that the Register-Sender does not need to determine when a dialed code requires translation since the Translator is continuously scanning the entire system. Translated information will be returned as soon as the dialed code has been registered, whether that code consists of one or up to six digits. The amount of Register-Senders a Translator must serve does not change the length of the time slot, however, it does change the cycle time between time slots. In the time slot of a particular Register-Sender that is accessing the Translator, negative battery is closed to the Translator over the common highway leads to the translator commons. The leads on which the negative battery appears correspond to the operated codelreeds in the Register-Sender. (The negative battery is also referred to as timed battery.) For example in figure 14, leads 0 and 2 are closed to send the digit 2.

4.2 Translator Logic Circuits

The Translator logic circuits consist of trans-

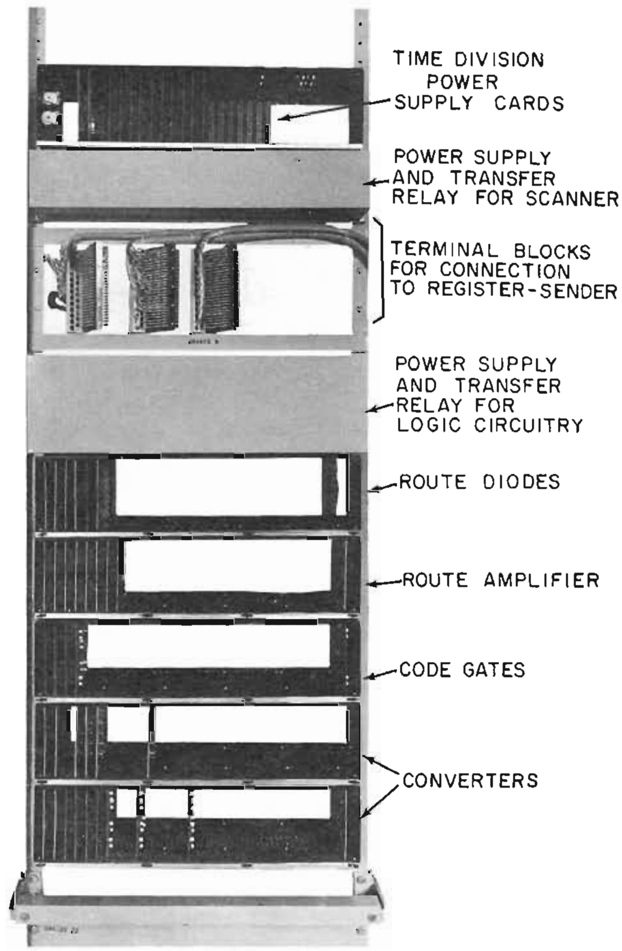


Figure 13. Translator.

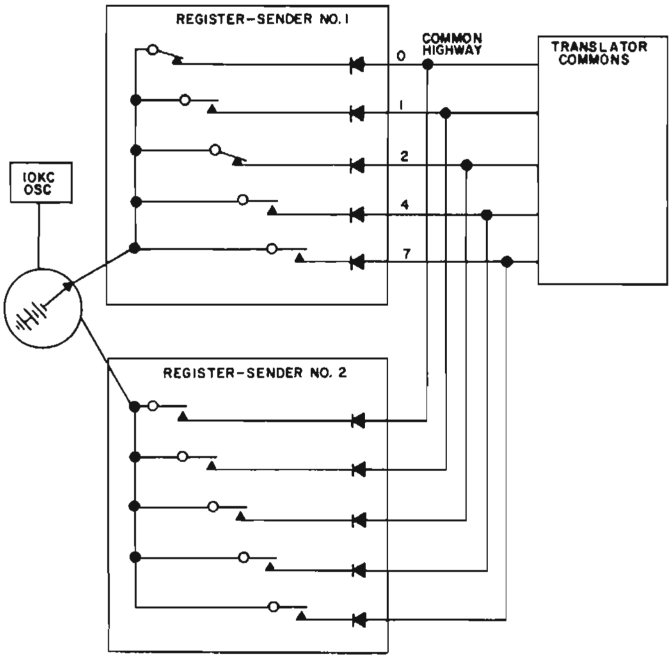


Figure 14. Time division access to Translator.

lator commons, converters (AND gate, inverter combination), code circuits (AND gate and possible diode OR gate), route amplifiers, and route diodes.

4.2.1 Translator commons.

The leads over which the digital information is extended from the Register-Sender terminates at the translator commons. The translator commons, figure 15, consists of a clamping diode and a resistor for each lead. Negative battery is extended from the Register-Sender through the forward biased diode to the converter AND gate. The resistor clamps the leads in the idle state. Ten resistor-diode circuits are mounted on a single card.

The translator commons are shown in figure 15 in groups of five leads each; in keeping with the two-out-of-five code extended from the Register-Sender. The number of translator commons required is determined by the number of digits to be translated. If the Translator is required to translate a maximum of four digits, four translator commons must be provided. Translator commons are also used to terminate leads such as DPM - indicates dial pulse call and TCM - indicates touch call. Figure 15 shows the translator commons arrangement for translating four digits with provisions for DPM and TCM leads.

The digital information received through the four translator commons will be referred to in this bulletin as the N, P, R, and S digits. The N digit will be received first, then the P, R, S, if required. Depending on the codelreeds

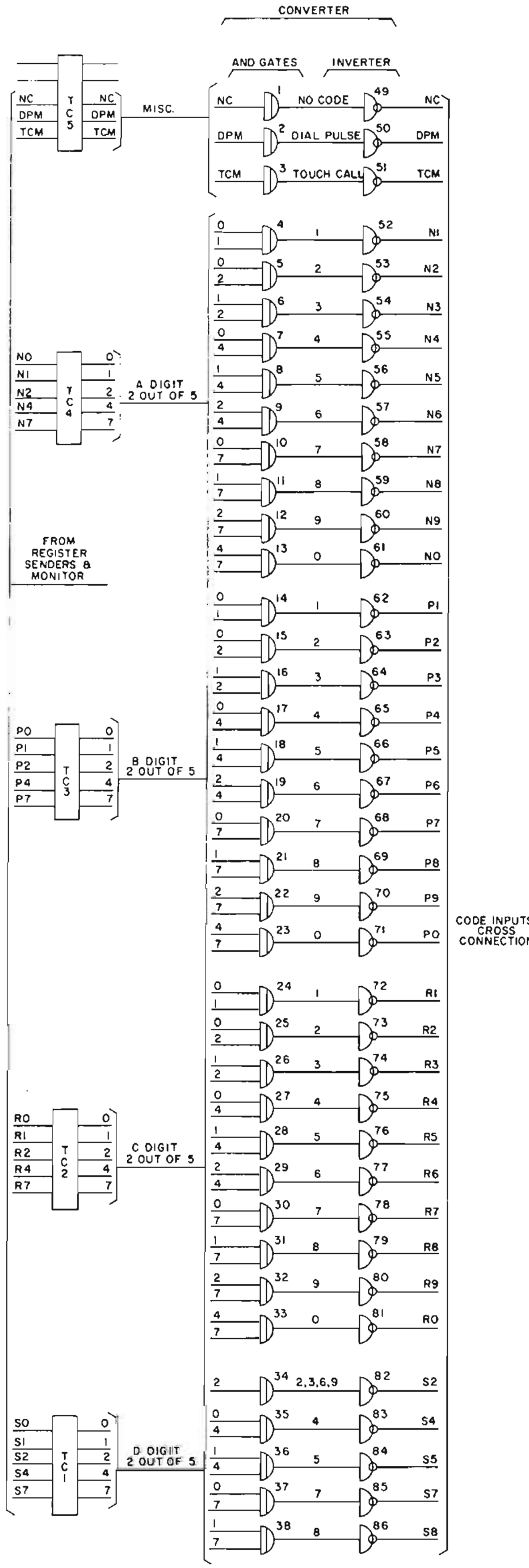


Figure 15. Translator commons, converter AND gates, and inverters.

operated in the Register-Sender, negative battery will be received via two of the leads at the translator commons. This is illustrated in figure 14. In the time slot of Register-Sender No. 1, negative battery is closed through operated codelreeds contacts and extended to the Translator via the translator commons to the code converters.

4.2.2 Code converter.

A code converter consists of a single or two input AND gate with its output connected to an inverter. As shown in figure 15 the leads from the translator commons are connected to the various AND gate inputs, corresponding to the two-out-of-five code. The AND gate inverter combination converts the two-out-of-five code input (negative voltage) to a single decimal output (also negative voltage).

The two input AND gate must have negative battery at both inputs in order to exhibit a positive output to the inverter. The leads from the translator commons are connected to the AND gate inputs in such a way that for any two-out-of-five digit code only one AND gate will have negative battery on both inputs. For example, if the digit 2 is extended, the translator commons leads 0 and 2 will contain negative battery. Leads 0 and 2 both appear only at AND gate 5. AND gate 5 therefore exhibits a positive output.

The output (positive voltage) of AND gate 5 is extended to its associated inverter which is 53. With a positive voltage on its input; inverter 53 exhibits a negative voltage on its output. The original two-out-of-five (negative battery) code input has been converted to a single decimal (negative battery) output and will be extended to the code circuits.

4.2.3 Code circuits.

A code circuit consists of an AND gate and in some cases a diode OR gate. The interconnections between the converters and the code circuits will vary from installation to installation. This is due to the variance between local office codes and area codes.

The AND gate of the code circuit can vary in size from a single input gate to a six input gate. The input size of the AND gate is determined by the number of digits to be translated. Also if class-of-service is a requirement for a specific translation the class-of-service mark is extended to the code AND gate.

As shown in figure 16 when a one digit code requires translation, such as the digit 1, which in this case is extended from inverter 52 via lead N1 to code AND gate 93, a single input AND gate is used. When the code 1-1 requires translation, which in this case is extended from inverters 52 and 62 via leads N1 and P1 a two input AND gate is required such as code AND gate 94. As the number of digits in the code to be translated increases, and with the possible addition of a class-of-service mark, the AND gate input size increases.

Through the use of diode OR gates several outputs of the inverters pertaining to the same routing can be bunched. For example if 33, 34, or 35 are the first two digits dialed and require the same routing, the second digits 3, 4, and 5 as they appear at the outputs of the inverters can be connected to the same diode OR gate as shown in figure 17. The first digit 3 is extended directly from the output of the inverter to the code AND gate. The diode OR gate will exhibit an output when any of its inputs contains a negative voltage.

4.2.4 Route amplifiers, route diodes and route commons.

The output of the code AND gate (positive voltage) is extended to a route amplifier. The route amplifier amplifies the signal (now a negative voltage) and extends it via a route diode to the route commons. The signal must be amplified in order to operate relays in the Register-Sender.

The output of the route amplifier is extended to a route diode. The route diode is an OR gate and therefore extends on all its outputs the potential that appears on its input from the route amplifier. The leads connecting the outputs of the route diodes to the Register-Sender are called the route commons. The route commons are part of the common highway that serves all the Register-Senders accessing the same Translator. The connections at the Register-Sender will also vary between installations. The route commons will usually have a letter designation and a two or three digit code. The letter designation is the bank position of the rotary switch (SQO) in the Register-Sender and the two or three digit code indicates the levels marked.

4.3 Fault Detector

The fault detector is required with the translator monitor when a partial duplicate Translator is provided. The fault detector, consisting of a Type 45 rotary switch (figure 18), is inserted between the route amplifier and the route diodes, figure 19. The C level of the fault detector is arranged in such a way that when the rotary switch is in the home position the RT leads from the route amplifiers are connected to the route diodes. This is accomplished through the break contact type design

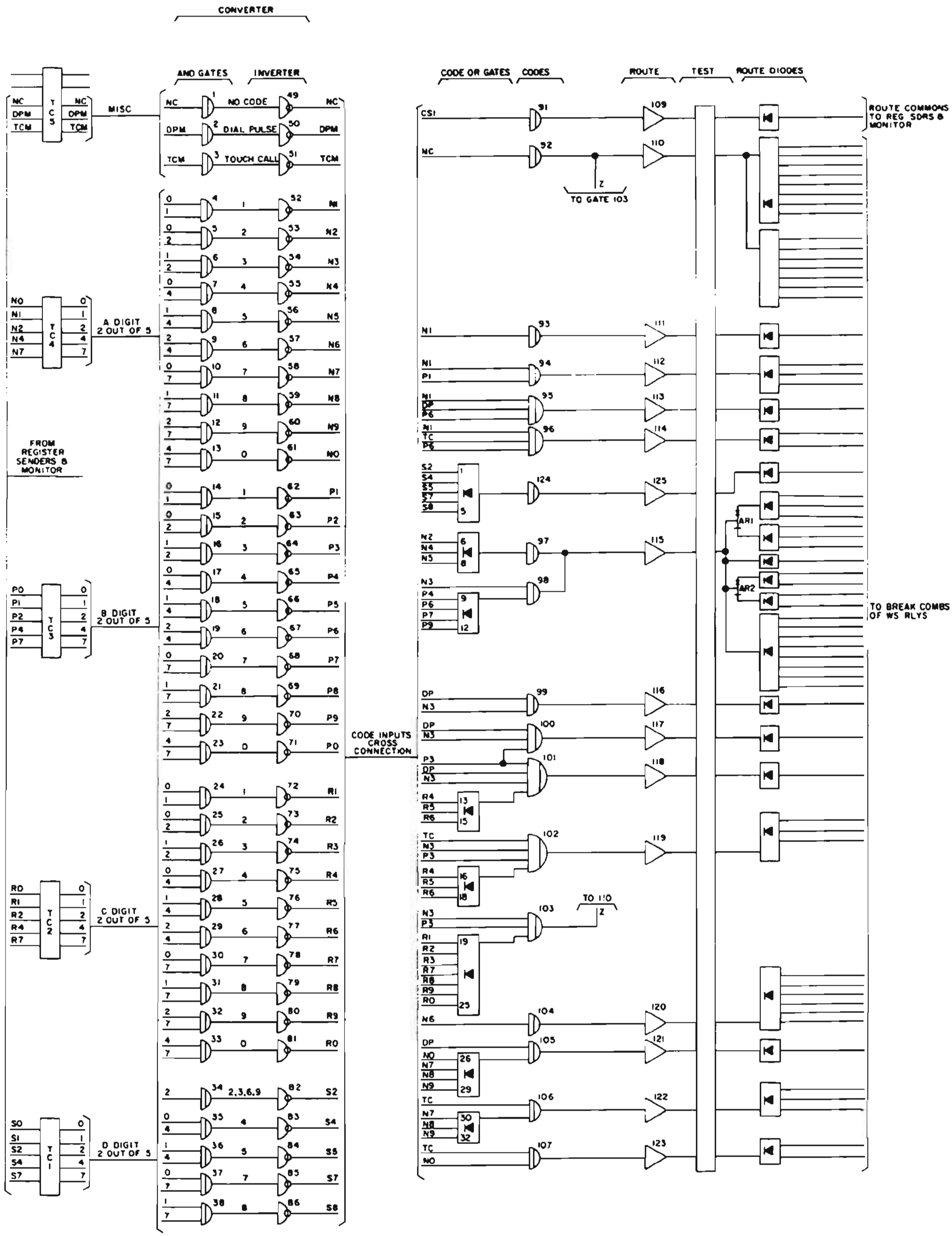


Figure 16. Code circuits.

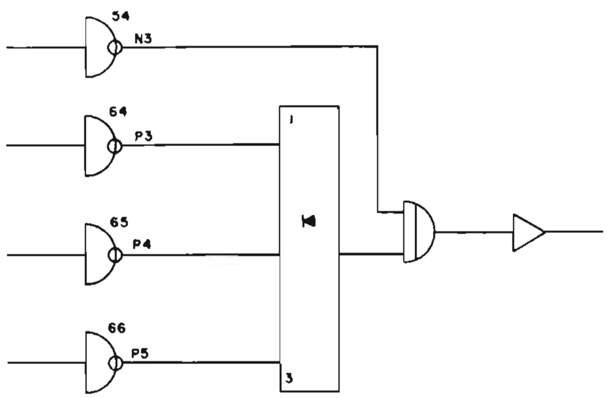


Figure 17. Use of diode OR gate.

of the C level. Contact 1A of level C is connected to contact 1B of level C when the rotary switch is in the home position. This holds true for the remaining 24 bank contacts on level C. When the rotary switch steps off the home position, to the first position, the wiper of level C opens the contacts in position 1, (1A and 1B) therefore lead RT1 is no longer directly connected to RO1. Instead lead RT1 is extended to level A and the translator monitor and lead RO1 is extended via level B to the translator monitor. As the rotary switch steps the RO and RT leads are extended one at a time to the translator monitor. The reason for extending these leads to the translator monitor is discussed in further detail in paragraph 5.1.

4.4 Transfer Circuit

When a complete standby Translator is provided, the transfer circuit consists of one wire spring relay per each 34 Register-Senders, figure 18. Each wire spring relay consists of 34 transfer (break-make) combinations.

Both the primary and standby Translators are continuously running, however, the condition of the transfer relay, operated or restored, determines which Translator is connected to the route commons. The transfer circuit is also provided when a partial Translator is used for standby.

The time division power supplies are provided in duplicate. The transfer relay shown in figure 20 determines which time division power supply is supplying power to the system.

Under normal conditions, or when the No. 1 time division power supply is in use the WS relay(s) is unoperated. In its unoperated condition the WS relay closes the outputs of the No. 1 time division power supply to the route amplifiers. The wire spring relay is under control of the translator monitor circuit. It can be either relay or key operated. When operated, the wire spring relay opens the path from the No.1 time division power supply to the route amplifiers and closes the path from the No. 2 time division power supply to the route amplifiers.

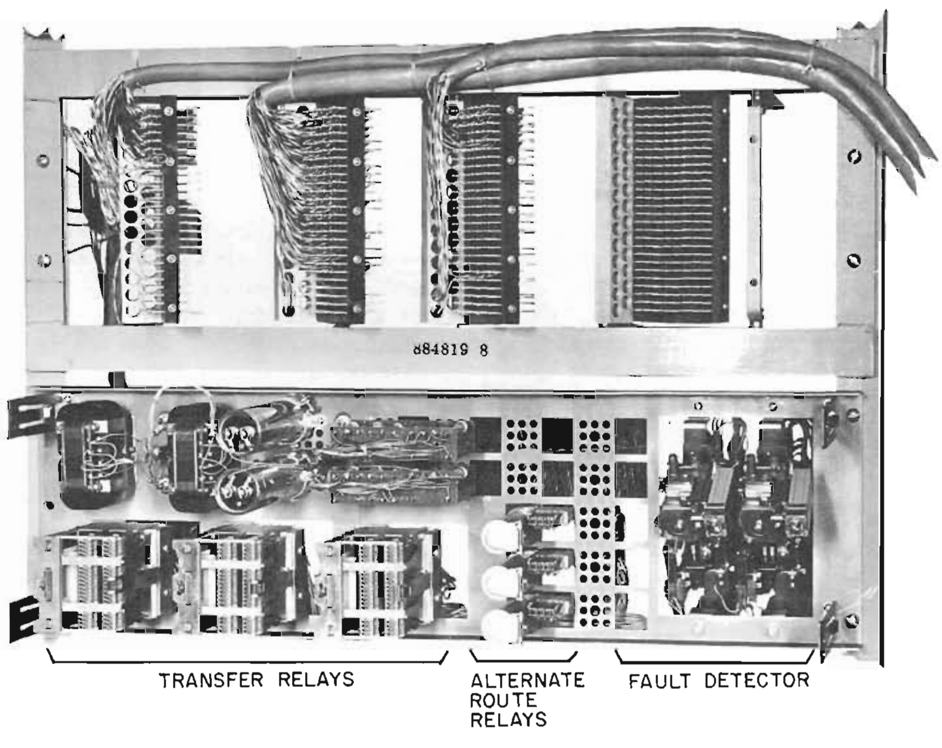


Figure 18. Translator (partial).

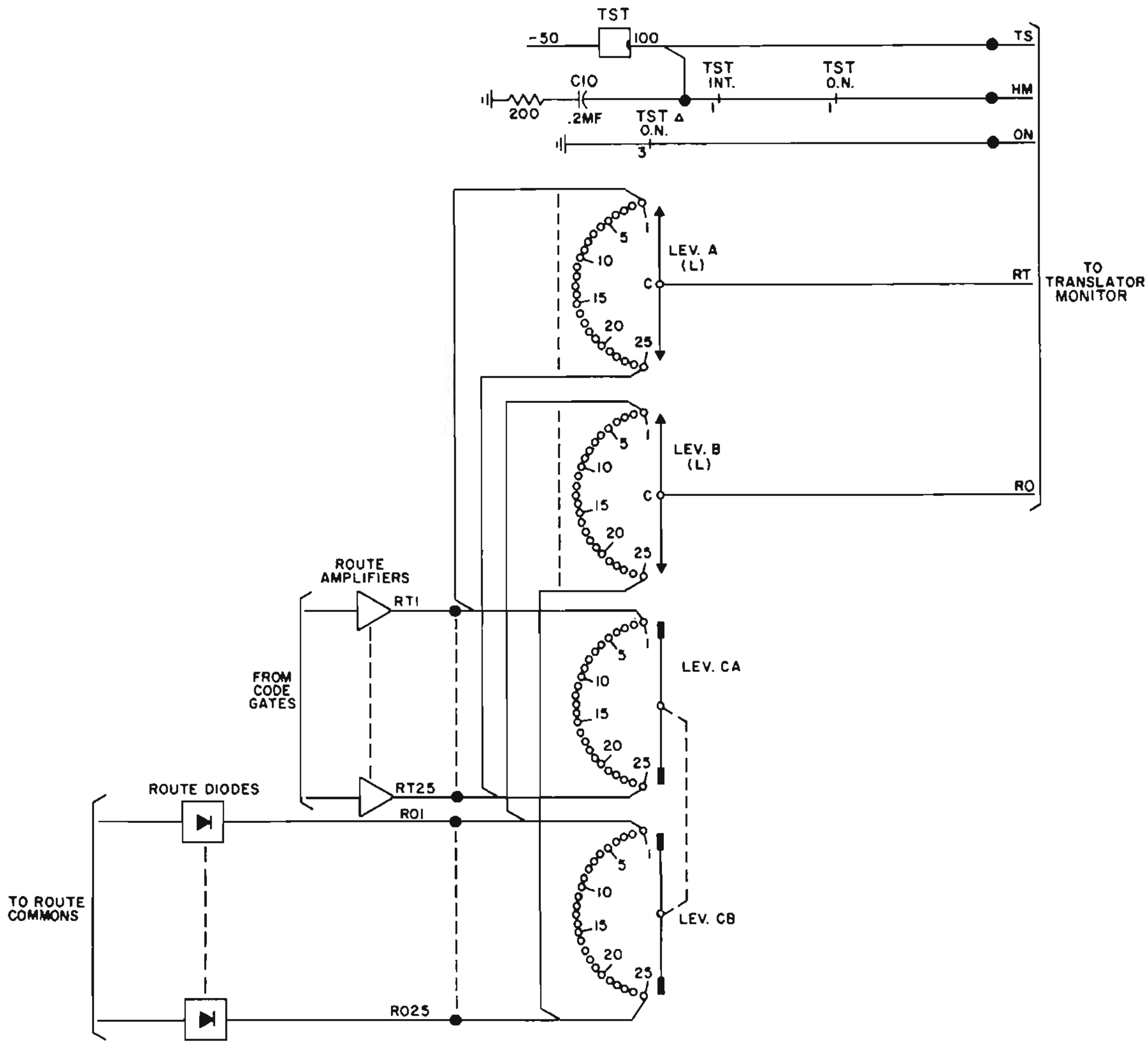


Figure 19. Fault detector.

4.5 Time Division Power Supply

The equipment comprising the time division power supply for the Register-Senders accessing the same Translator is shown in figure 20 and in block diagram form in figure 21. The Translator is provided with two time division power supplies as shown, however, through contacts of wire spring relay WS only one is supplying power to the Register-Senders. Relay WS is under control of the monitor. Should the monitor detect trouble in time division power supply No. 1, it will operate relay WS to transfer to time division power supply No. 2.

4.5.1 Power supply equipment.

As shown in figure 21, a single time division filter and power supply feeds both time division power supply 1 and 2. An oscillator and reset circuit is provided for each power supply. Two ring counter and reset circuits are provided for each Register-Sender, one in each time division power supply. An amplifier is provided for each Register-Sender.

Two ring counter circuits, one a part of the primary power supply the other a part of the standby power supply, plus their associated amplifier are mounted on a single card.

4.5.2 Operation.

Each ring counter circuit will be "turned on" individually by the oscillator and reset circuit. As each ring counter is turned on, it conditions the next ring counter.

As shown in figure 21, the C lead is the control lead over which the ring counter circuit is turned on while the R lead is the lead over which the ring counter is reset. The CT-IN lead interconnection between ring counter circuits is the lead over which the next ring counter is conditioned for turn on. The output of the ring counter is amplified and extended to the Register-Sender by its associated amplifier. Two outputs are available from the amplifier, negative time battery (TB) and positive timed ground (TG).

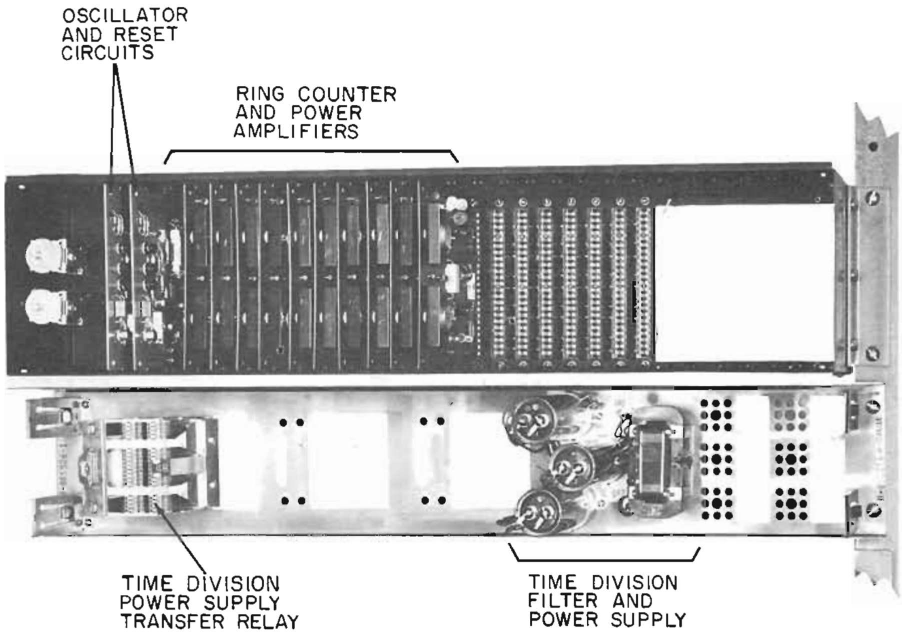


Figure 20. Translator (partial).

5. AUXILIARY EQUIPMENT

5.1 Monitor Circuit

The monitor, figure 22, is designed to continuously test the Translator circuits. The monitor circuit simulates the operation of the Register-Sender by putting information into the Translator and checking that the output from the Translator is correct for that input.

Input codes to the Translator are assigned by strapping arrangements at rotary switch bank contacts as shown in figure 23. Leads from the rotary switch bank contacts are then extended to the translator commons. Routing digits and

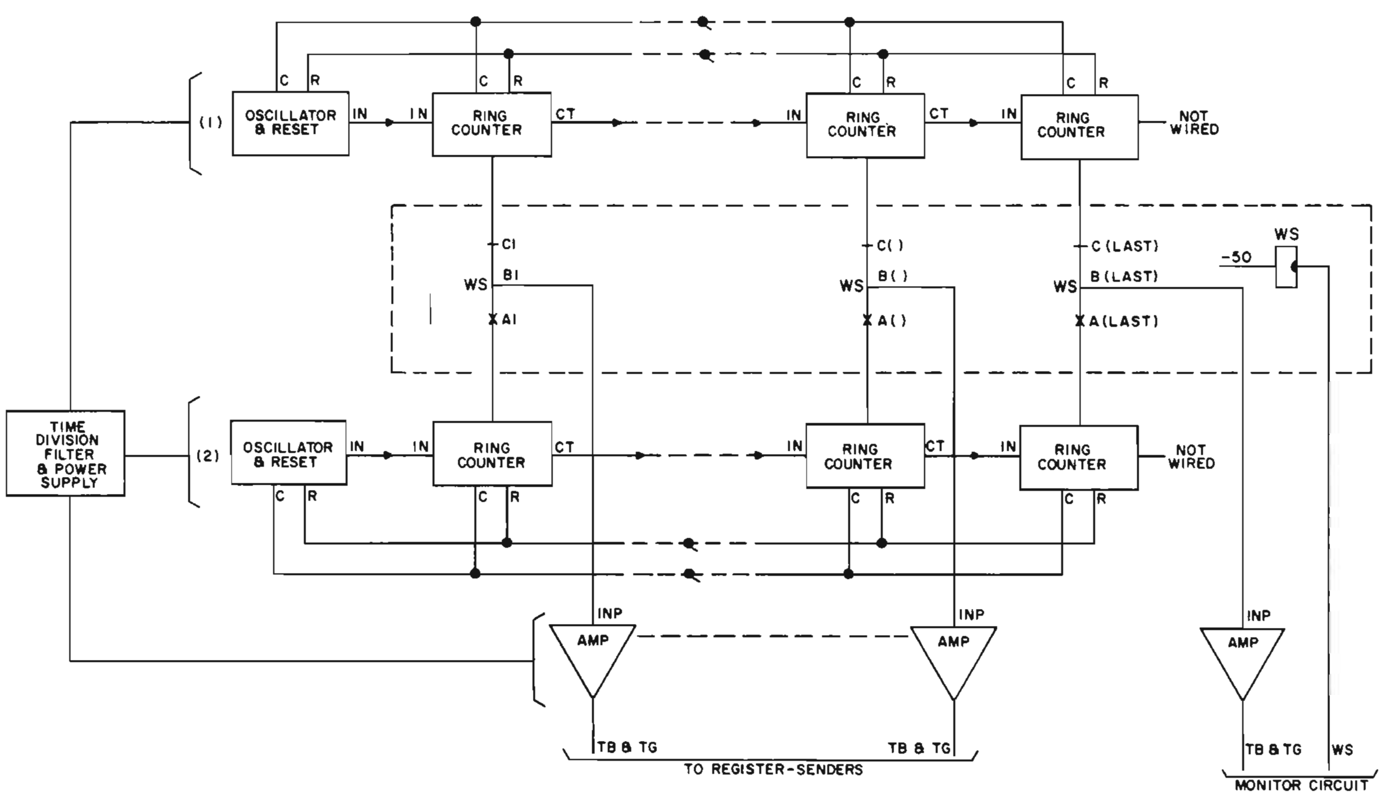
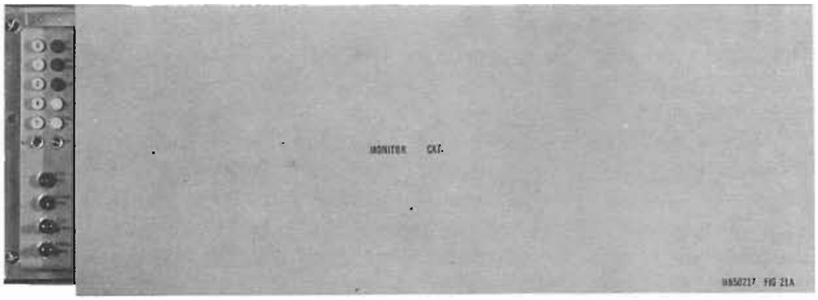
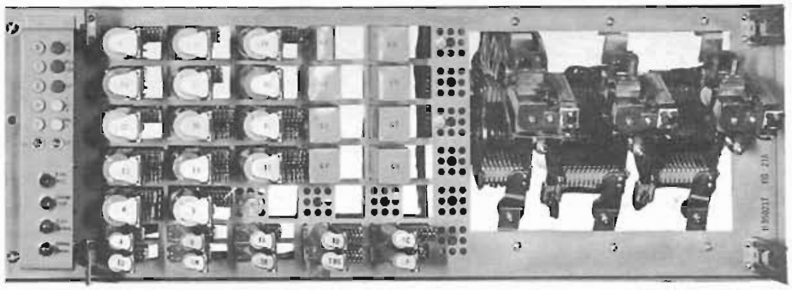


Figure 21. Time division power supply.



COVER IN PLACE



COVER REMOVED

Figure 22. Translator monitor.

other control digits from route commons are compared one at a time with information strapping on the banks. After every digit the route commons are checked for foreign potentials that could cause system malfunctions. When all routing information for a particular code is checked and if the code is correct; the input switch is advanced one step to check the next code.

If an irregularity is detected, the testing sequence is stopped, an alarm signal is activated, and the nature of the trouble indicated by display lamps. Failure of the time division power supply will also be detected in the monitor circuit and automatic transfer to duplicate equipment is controlled by this circuit.

5.1.1 Code checking.

The monitor is assigned the last time slot in the system and is extended timed battery and ground as are the Register-Senders. Through the banks of a Type 45 rotary switch the monitor is capable of sending a maximum of 25 different codes to the Translator. Additional type 45 rotary switches may be provided on an optional basis to test a maximum of 100 codes.

The translations are read from the banks of a second rotary switch. The banks of this rotary switch are arranged to receive the two- or three-out-of-five code similar to the banks of the sequence out rotary (SQO) switch in the Register-Sender. The timed battery extended from the Translator via the rotary switch bank contacts will operate two or three T relays. The T relays (T0, T1, T2, T4 and T7) in operating cause a visual display of the translated code.

The T relays also cause the bank contacts of a third rotary switch to be marked. The bank contacts of this rotary switch are strapped corresponding to the information the Translator is required to return for a particular input code. As long as the correct code is received from the Translator, the proper T relays will operate grounding the bank contacts which allows the monitor to continue to cycle. When the proper T relays do not operate, the cycle stops because the bank contact is not grounded and an alarm is sounded.

For example, assume rotary switch SB is strapped to send the code 1 in position 1. Leads N0 and N1 are marked with timed battery in the monitor's time slot. As shown in figure 23 the code 1 input to the Translator results in the translated code 0, 1, 4. This code is extended to rotary switch RS and via leads 0, 1, 4 of this rotary switch, relays T0, T1, and T4 operate. Relays T0, T1, and T4 in operating cause lamps 0, 1, and 4 to light.

Relays T0, T1, and T4 also mark the first position of rotary switch SA. This ground indicates the correct translation has been received and allows the monitor to send the next code in its next time slot. If the correct translation is not received the rotary switch bank contact is not marked. An alarm lamp

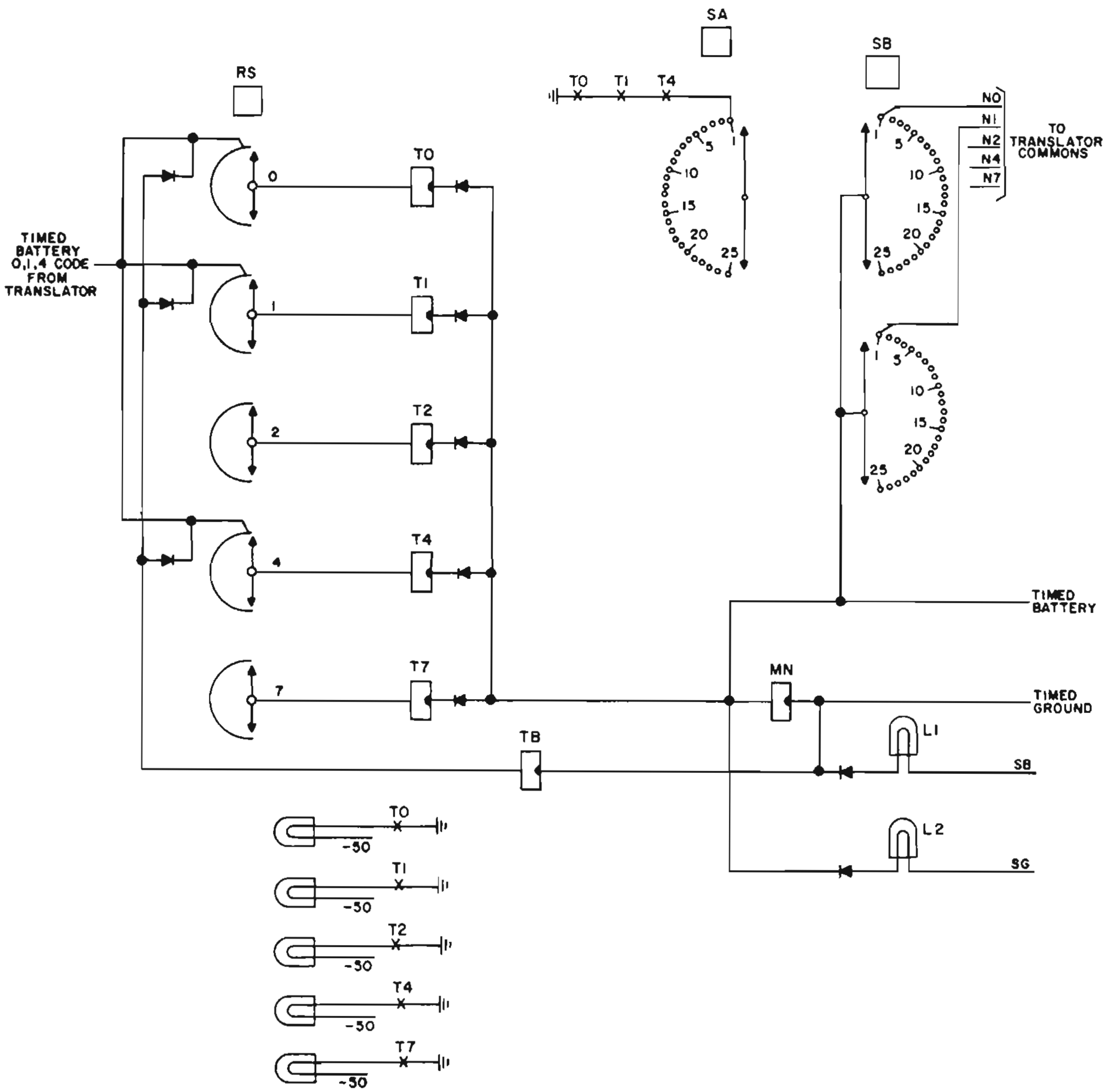


Figure 23. Translator monitor schematic.

is lit, and transfer to a standby Translator initiated.

5.1.2 Checking for foreign potentials.

The leads over which the translated codes are extended are also checked for foreign potentials. If a foreign potential is present, the fault detector is used to open the path between the route amplifier and route diodes. The OPEN CODE lamp is lit.

5.1.3 Time division transfer.

As shown in figure 21 a standby time division power supply is supplied. Relay MN in the monitor circuit is bridged across the Timed Battery and Timed Ground leads. This relay is normally operated unless a failure occurs in the time division power supply. When the relay restores, relay WS operates and the standby power supply is now providing the timed battery and ground.

5.2 Touch Calling Equipment

5.2.1 Touch calling adapter.

The touch calling adapter which is part of the Register-Sender must be provided when the Register-Sender is serving touch calling telephones. The touch calling adapter is inserted between the link finder and the Register-Sender, figure 24. The touch calling adapter can be equipped for two party detection.

If a Series 100 Director is serving touch calling lines, it must be so indicated to the Translator. The reason is that for certain calls the Translator may direct the Register-Sender to release before all the digits have been dialed. This cannot be done on touch calling calls because the Register-Sender must stay with the call until all the tones from the touch calling telephone have been converted to ground marks. A relay in this circuit will indicate to the Translator on lead DPM (dial pulse) or TCM (touch calling) the type of call.

The touch calling adapter extends the dialing loop to the Register-Sender. The touch calling adapter will be in the dialing path for both dial pulse and touch calling calls. This circuit also extends the +L and -L leads to the touch calling receiver link circuit. With a dial pulse call the dial pulses are repeated as ground pulses into the Register-Sender by the Register-Sender "A" relay. With a touch calling call the tones from the touch calling telephone are extended to the touch calling receiver via the touch calling receiver link circuit. At the touch calling receiver the tones are connected to ground marks and are returned to the touch calling adapter and the Register-Sender. There is no counting done by the Register-Sender, since the ground is extended directly to the levels of the rotary switch for storage on codelreeds. The digits are stored in the two-out-of-five code.

When the touch calling adapter recognizes a call which is or may be a touch call it asks for connection via the by-link to an idle touch calling receiver link circuit. If the by-link is idle, connection is made to the receiver link circuit and dial tone is returned to the calling party. When the by-link is established the rotary switch begins hunting for the touch calling adapter calling for service. When the rotary switch finds the touch calling adapter the by-link connection is released.

5.2.2. Touch calling receiver link circuit.

The touch calling receiver link circuit is capable of connecting a maximum of 25 touch calling adapters, one at a time, to a single tone converter. The calling receiver link circuit uses a 25 point rotary switch to extend the + and - leads to the tone converter. The rotary switch is seized by ground extended from the touch calling adapter. The rotary switch hunts for the touch calling adapter circuit calling for service. Upon finding it, the + and - leads from the touch calling adapter are extended to the tone converter. There are also six other leads extended from the touch calling adapter to the touch calling tone converter.

It is over these leads that the ground marks will be extended from the touch calling tone converter to the touch calling adapter and the Register-Sender.

5.2.3. Touch calling tone converter circuit.

The touch calling tone converter circuit converts the two-out-of-five tones that represent a single digit into one or two ground marks which are returned to the Register-Sender. The ground marks are extended to levels of rotary switch SQ1 for storage on codelreeds. There is no counting performed by the counting chain.

5.3 Multifrequency Control Circuit

When MF sending is required each Register-Sender must be equipped with an MF control circuit. When a code that will require MF sending is recognized by the Translator it instructs the Register-Sender to delay sending until all digits are dialed and stored. After the last digit has been stored, the Register-Sender will loop pulse the switch-train, probably consisting of a local first and outgoing second selector, and when a trunk is seized; the Translator will transfer the Register-Sender to the MF mode for the remaining digits.

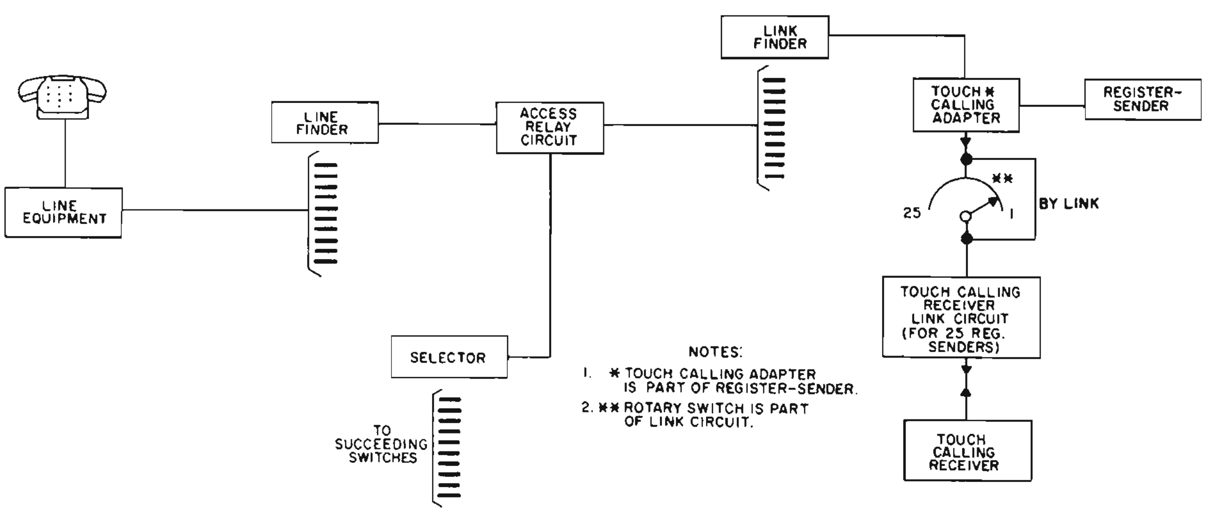
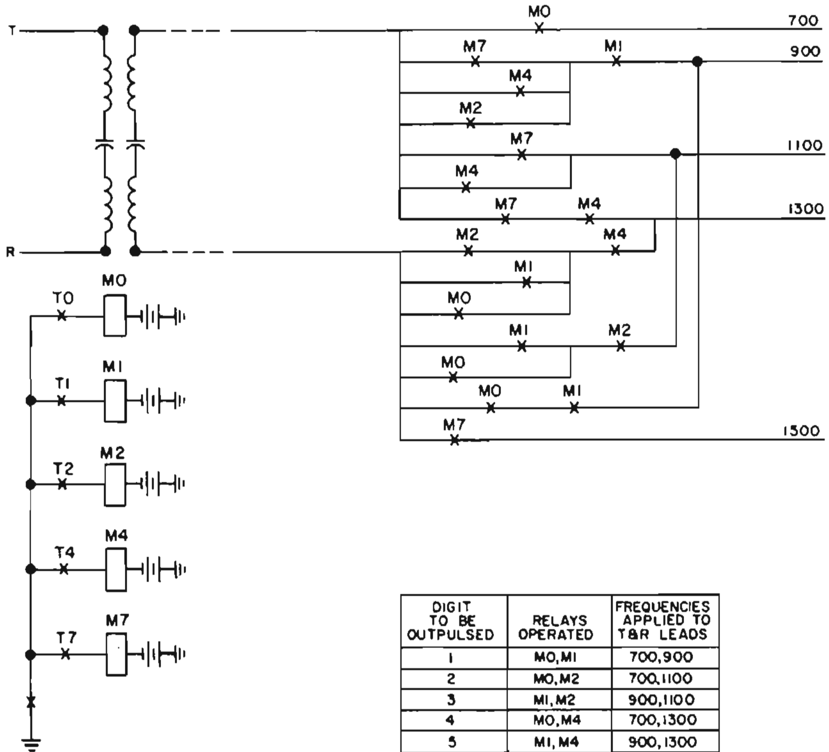


Figure 24. Touch calling arrangement.



DIGIT TO BE OUTPULSED	RELAYS OPERATED	FREQUENCIES APPLIED TO T&R LEADS
1	M0,M1	700,900
2	M0,M2	700,1100
3	M1,M2	900,1100
4	M0,M4	700,1300
5	M1,M4	900,1300
6	M2,M4	1100,1300
7	M0,M7	700,1500
8	M1,M7	900,1500
9	M2,M7	1100,1500
0	M4,M7	1300,1500

Figure 25. Multifrequency control circuit.

When the digits that have been stored are to be outpulsed from the Register-Sender as loop pulses, they are read out of storage one at a time via levels of rotary switch SQO and in turn operate T relays. T relays T0, T1, T2, T4, or T7 are operated depending on the digits stored. The Register-Sender under control of these relays outpulses the loop pulse equivalent of the stored digit with its own pulse generator.

When the digits stored are to be outpulsed in the MF mode, the MF relay in the Register-Sender is operated by the Translator. The digits are read from storage in the same manner, however, the operated T relays now operate relays M0, M1, M2, M4, or M7, figure 25, of the MF control circuit. The operation of two of the M relays closes the frequency equivalent of the stored digit to be outpulsed from the Register-Sender.

6. SYSTEM OPERATION

In this section various types of calls such as local, EAS, and SATT are traced through the Series 100 Director. Figures 28 and 29 show the Translator logic circuit interconnections and an office trunking diagram, and are for example only. These two drawings will vary for possibly every office. Additional types of calls can be processed by the system and more translations made than are presented in this section. The calls presented are the most common.

6.1 Register-Sender Access Equipment Operation

The operation of the Register-Sender Access Equipment will not vary with the type of call and therefore is covered only once in this section.

6.1.1 Line equipment and linefinder operation.

The calling party lifts the handset off hook. Relay L of the calling party's line equipment is operated via the loop closed through the hookswitch. Relay L in operating grounds the start lead which marks the vertical bank and operates a C relay in the group relays, figure 26. The linefinder begins vertical stepping, and stops on the marked vertical bank contact. The linefinder hunts rotary for the marked bank contact. When the marked bank contact is found the linefinder has found the line calling for service and the line equipment CO relay is operated. The + and - leads are switched through to the access relay circuit.

6.1.2 Access relay circuit operation.

As soon as the local linefinder is started the loop is closed to the L relay of the access relay circuit causing it to operate. The L relay in operating closes ground to lead G to operate the G relay of the sub-group relays. Relay L also marks its C bank contact at the link finder with resistance battery.

6.1.3 Sub-group relay operation.

The G relay closes ground into the preference chain (paragraph 2.1) marking the proper vertical bank contact and operating the A relay of the link finder to start vertical stepping.

6.1.4 Link finder operation.

The link finder begins vertical stepping and stops at the marked vertical bank contact, and then hunts rotary for the marked C bank contact. When the marked C bank contact is found the link finder stops rotary stepping. The link finder has now found the access relay circuit calling for service. Ground from the Register-Sender causes the dialing loop to be switched through to the A relay, figure 26.

6.2 Local Calls

In the original switchtrain of this office, local calls were made by dialing the office code 334, 335, or 336, plus the four terminal digits. The path through the switchtrain was as follows. The first two digits 3-3, were absorbed in the local selector, the third digit, 4, 5, or 6, positioned the local selector to the corresponding level and the remaining four digits positioned the fourth selector, the fifth selector, and the connector. The following paragraphs 6.2.1 through 6.2.3 describe how a local call is handled with the Series 100 Director equipment.

6.2.1 First translation.

The first dialed digit (3) is counted by the chain and stored on codelreeds in the Register-Sender, figure 27. In the Register-Sender's time slot, timed battery is closed through operated contacts of the codelreeds and extended to the Translator via the translator commons. Timed battery appears on translator commons N1 and N2, figure 29. AND gate 6 therefore has the timed battery on both inputs causing it to exhibit an output to inverter 54. The inverter extends its output on lead N3 to (AND) gate 99. For this example we will assume this is a dial pulse call as opposed to a touch calling call. Gate 99 therefore has a potential on both inputs causing it to exhibit an output to route amplifier 116. Route amplifier 116 amplifies the signal and extends it through the connected route diode to the A position on levels 0, 2, 4, of rotary switch SQO, figure 30. The routing code 0, 2, 4, in this office means "drop the first selector" thus absorbing the digit. The timed battery extended to the rotary switch causes relays T0, T2, and T4 to operate. These relays along with other relays of the Register-Sender cause the AB relay to operate (figure 30) which in turn opens the outpulsing loop for about 600 milliseconds. The local selector releases and the digit is absorbed. Rotary switch SQO steps to position B.

6.2.2 Second translation.

When the calling party dials the second digit (3) it is stored on codelreeds and in this Register-Sender time slot the two digits (3-3) are sent to the Translator. Timed battery is closed through contacts of the operated codelreeds to translator commons on leads N1, N2, and P1, P2 to the code converters. AND gates 6 and 16 have timed battery on both inputs causing them to exhibit an output to their associated inverters. The output of inverter 54 is extended to lead N3 and the output of inverter 64 is extended to lead P3. These leads are in turn extended to code AND gate 100, along with the DP indication (paragraph 5.2.1). AND gate 100 extends the potential to amplifier 117. Route amplifier 117 extends the potential to the route diodes and the route commons marking levels 0, 1, 4 of rotary switch SQO.

Route code 0, 1, 4 indicates "repeat next dialed digit to selector". The battery on levels 0, 1, 4 operates relays T0, T1 and T4 which in turn operate relay DS, figure 30. The operation of relay DS will cause the next dialed digit to be repeated to the selector through contacts of relay PR. Rotary switch SQO steps to position C.

6.2.3 Third translation.

The calling party dials the third digit which on a local call is either 4, 5, or 6. For this example we will assume the digit dialed is 4. The digit 4 is counted and stored on the codelreeds and in this Register-Sender's time slot the digits 3, 3, 4 will be sent to the Translator. Timed battery is extended through contacts of the operated codelreeds to the translator commons N1, N2, P1, P2, R0, and R4. Code converter AND gates 6, 16, and 27 have the timed battery potential on both inputs. The outputs of these gates are extended to their associated inverters, 54, 64, and 75. The outputs of these inverters are extended over leads N3, P3, and R4 to gate 101 along with the DP class mark.

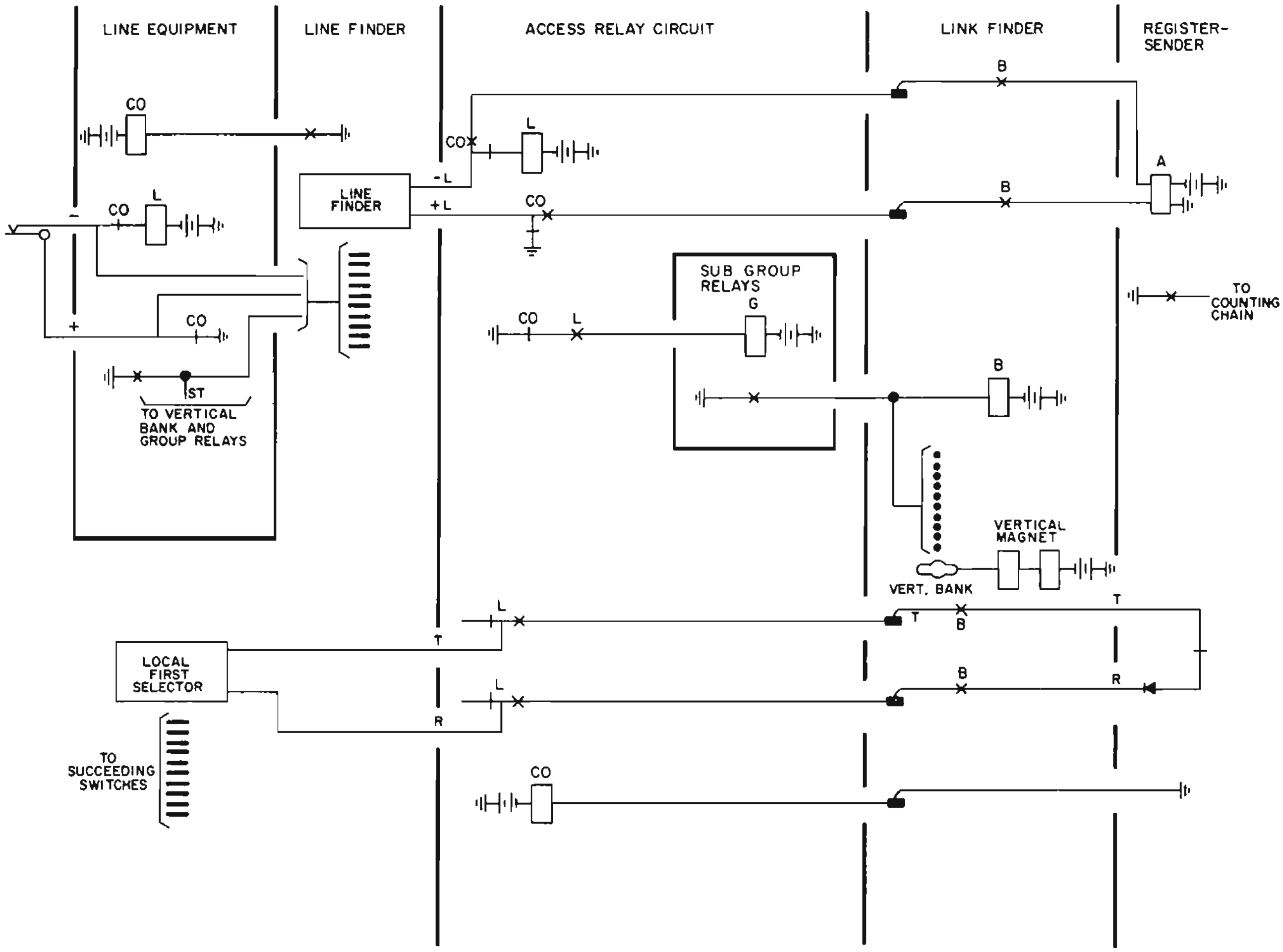


Figure 26. Calling party loop switched through the Register-Sender.

The output of AND gate 101 is extended to route amplifier 118 which extends negative battery via the route diodes and route commons to levels 0, 1, 2 of rotary switch SQO, figure 30. Route code 0, 1, 2 indicates "release the Register-Sender". Relays T0, T1, and T2 operate and the SQO rotary switch steps its wipers to bank contact 20. Ground is closed through level A of SQO to the winding of relay RL. Relay RL operates and initiates the release of the Register-Sender.

The third digit, the digit 4 in this case, was also repeated to the local first selector stepping it to the fourth level. The Register-Sender releases and the calling party dials the remaining four digits into the switchtrain.

6.3 SATT Calls

With the original trunking plan SATT calls were handled in the following manner, when the SATT access code 1-6 was dialed. The digit 1 positioned the local selector to the first level where the special second selector is seized. The digit 6 positioned the special second selector to level 6 where it hunts rotary for an idle SATT trunk. In this example there are no ticketing facilities in the office.

The following paragraphs, 6.3.1 and 6.3.2, trace the same call through the Series 100 Director and switchtrain.

6.3.1 First translation.

With the dialing loop closed to the Register-Sender as shown in figure 26 the calling party receives dial tone and dials the digit 1. The digit 1 is counted by the counting chain and stored on codelreeds. In this Register-Sender's time slot, timed battery is extended from the Translator to the Register-Sender through contacts of the operated codelreeds to the translator commons, figure 27. Since the digit 1 has been stored the timed battery is extended on N1 and N0. With timed battery on N1 and N0, gate 4 has a potential on both inputs causing it to exhibit an output to its associated inverter, figure 29. The two-out-of-five code has now been converted to a single potential and extended by inverter 52 to code gate 93. The output of gate 93 is extended to route amplifier 111. Route amplifier 111 extends the battery to the route diode and route commons and levels 0, 1, and 4 of rotary switch SQO, position A. Relays T0, T1, and T4 are operated and in turn operate relay DS.

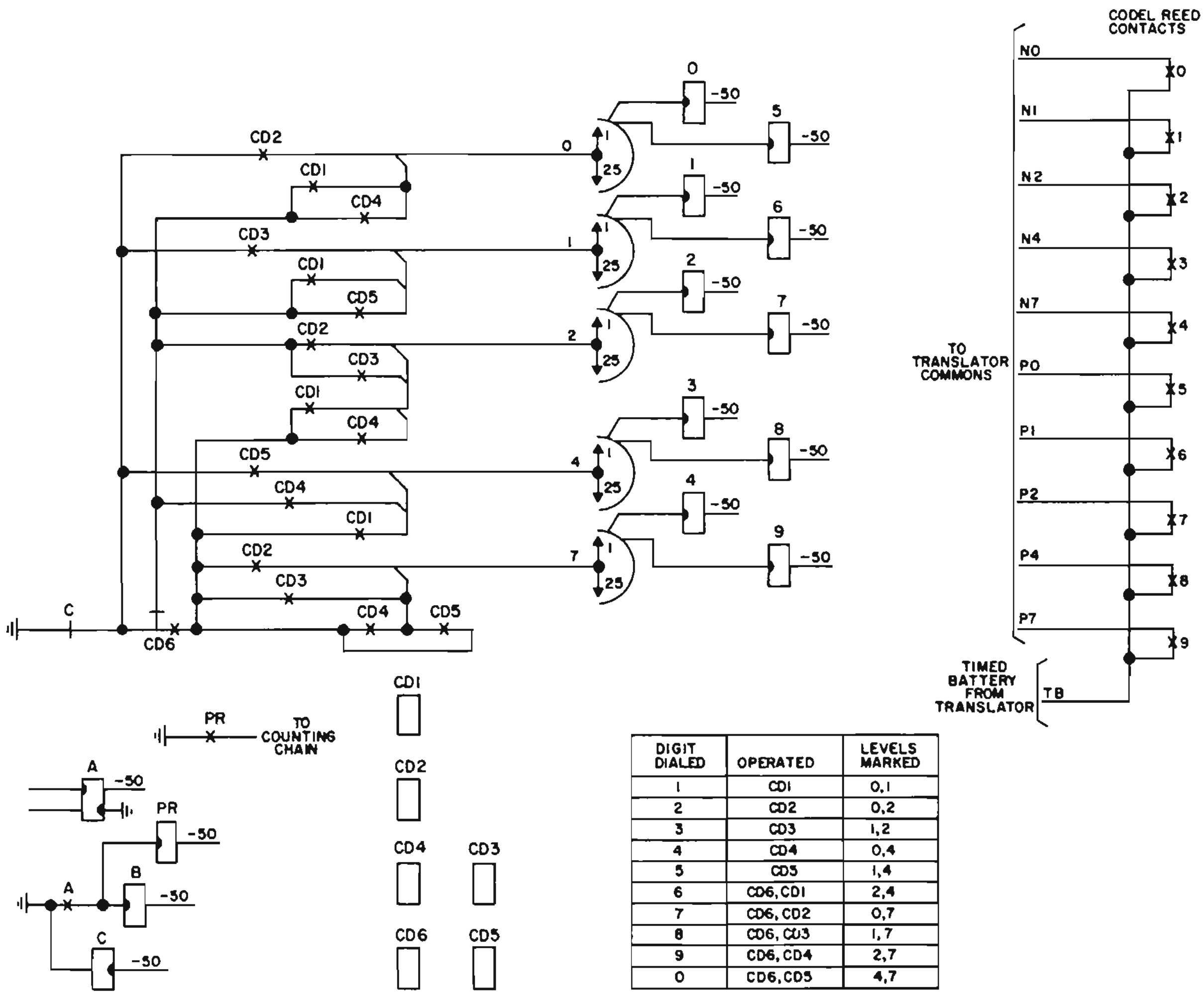
Routing code 0, 1, 4 indicates "repeat next dialed digit to selector". This will be accomplished through contacts of relay PR. With the strapping option in the Register-Sender the first digit 1 was repeated to the selector causing it to be stepped to level 1. Rotary switch SQO steps to position B.

6.3.2 Second translation.

The second digit dialed by the calling party, in this case 6, is stored on codelreeds. In this Register-Sender's time slot, timed battery is extended from the Translator through operated contacts of the codelreeds. The digits 1 and 6 are now extended to the Translator. The digit 1 is extended on leads N1 and N0, the digit 6 is extended on leads P2 and P4, figure 29. The two-out-of-five codes (negative battery) are converted by gates 4 and 19 to single positive outputs and extended to their associated inverters. The negative output of the inverter is extended on leads N1 and P6 to code gate 95. For this example we will assume this is a dial pulse call so there will also be negative battery on lead DP. Gate 95 therefore extends a positive output to route amplifier 113. Route amplifier 113 extends the potential, now negative battery, to the route diode and route commons. The negative battery is extended to levels 0, 1, 2 at position B of rotary switch SQO. Routing code 0, 1, 2 indicates "release the Register-Sender".

The previous code indicated to the Register-Sender to repeat the next dialed digit, therefore, digit 6 was repeated to the special second selector. This selector then is positioned to the sixth level and hunts for an idle SATT trunk.

The timed battery on levels 0, 1, and 2 of the rotary switch operates relays T0, T2, and T1, figure 30, which in turn close a path to relay RL. Relay RL initiates the release of the



DIGIT DIALED	OPERATED	LEVELS MARKED
1	CD1	0,1
2	CD2	0,2
3	CD3	1,2
4	CD4	0,4
5	CD5	1,4
6	CD6, CD1	2,4
7	CD6, CD2	0,7
8	CD6, CD3	1,7
9	CD6, CD4	2,7
0	CD6, CD5	4,7

Figure 27. Receiving and extending dialed digits.

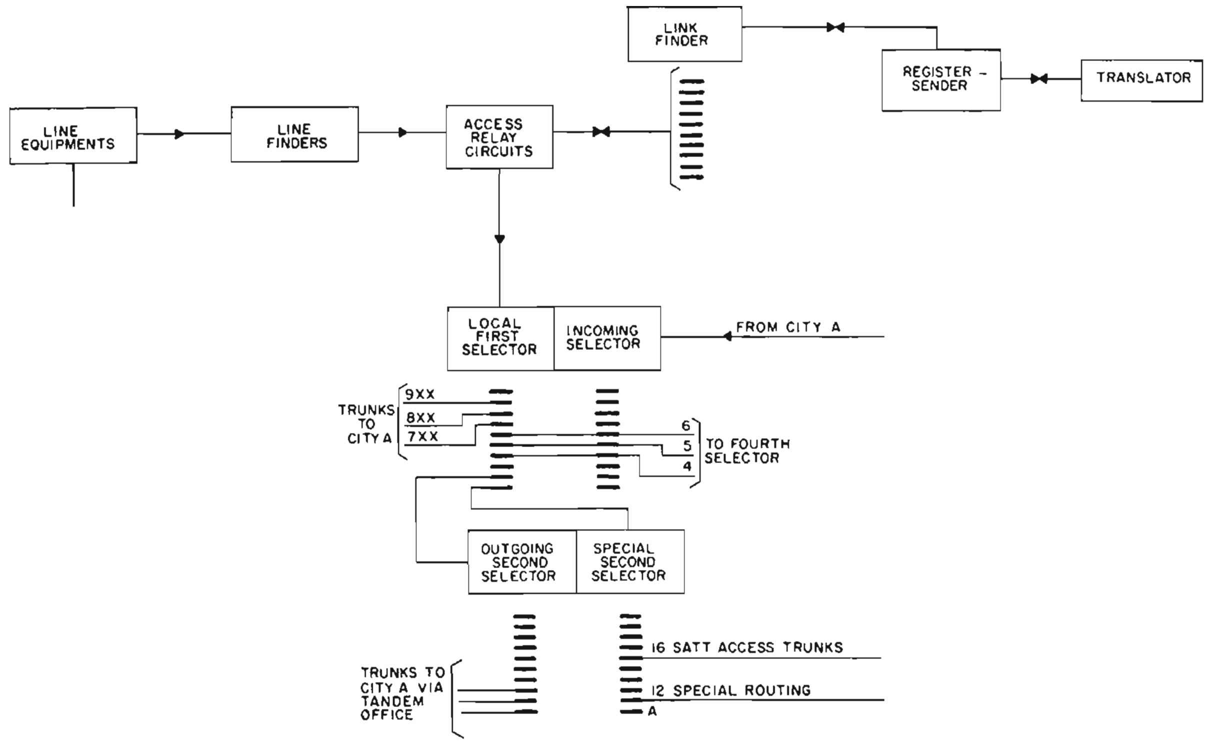


Figure 28. Trunking diagram.

Register-Sender. The calling party dials the remaining digits into the switchtrain.

6.4 EAS Calls - Direct Trunking

With the trunking plan shown in figure 28 there are two arrangements for handling EAS calls. From levels 7, 8, and 9 of the local first selector direct trunks to city A can be seized. The second arrangement provides trunks from levels 1, 2, and 3 of the outgoing second selector to tandem office B which in turn provides trunks that access office A.

The calling party dials the digit 7, 8, or 9 to seize a direct trunk to city A. For this example we will assume the digit 7 is the first digit dialed.

With the dialing loop of the calling party switched into the Register-Sender, figure 26, dial tone is returned and the calling party dials the digit 7. The digit 7 is counted by the counting chain and stored on the codelreeds. In the Register-Sender time slot, timed battery is extended from the Translator through operated codelreed contact. The timed battery is extended to leads N0 and N7 and appears as a two-out-of-five code at the translator commons, figure 29. Code converter AND gate 10 with negative battery on both inputs extends a positive output to inverter 58. Inverter 58 with a positive input exhibits a negative output. The two-out-of-five code has been converted to a single potential on lead N7, and extended to the diode OR gate. The output of the diode OR gate is extended to AND gate 105. Assuming this is a dial pulse call, gate 105 contains a negative voltage on both inputs and exhibits a positive output to route amplifier 121. Route amplifier 121 extends negative battery to position A, levels 0, 1, 2 of rotary switch SQO. Route code 0, 1, 2 indicates "release the Register-Sender". The first digit 7 is repeated to the local selector, the Register-Sender releases and the calling party dials the remaining digits into the switchtrain.

6.5 EAS Calls Tandem Switching

If the digit 2, 4, or 5 is dialed, the call will be switched to city A via the tandem office. For this example we will assume the digit 2 is dialed, and six digits must be outpulsed to the tandem office. The operation of the alternate route relays will also be explained.

6.5.1 Primary route.

With the calling party switched through to the Register-Sender, figure 26, dial tone is returned. The calling party dials the digit 2. The digit 2 is counted by the counting chain and stored on codelreeds, figure 27. During this Register-Sender's time slot, timed battery is extended to the Register-Sender from the Translator. The timed battery is closed through contacts of the operated codelreeds to the translator commons. The timed battery

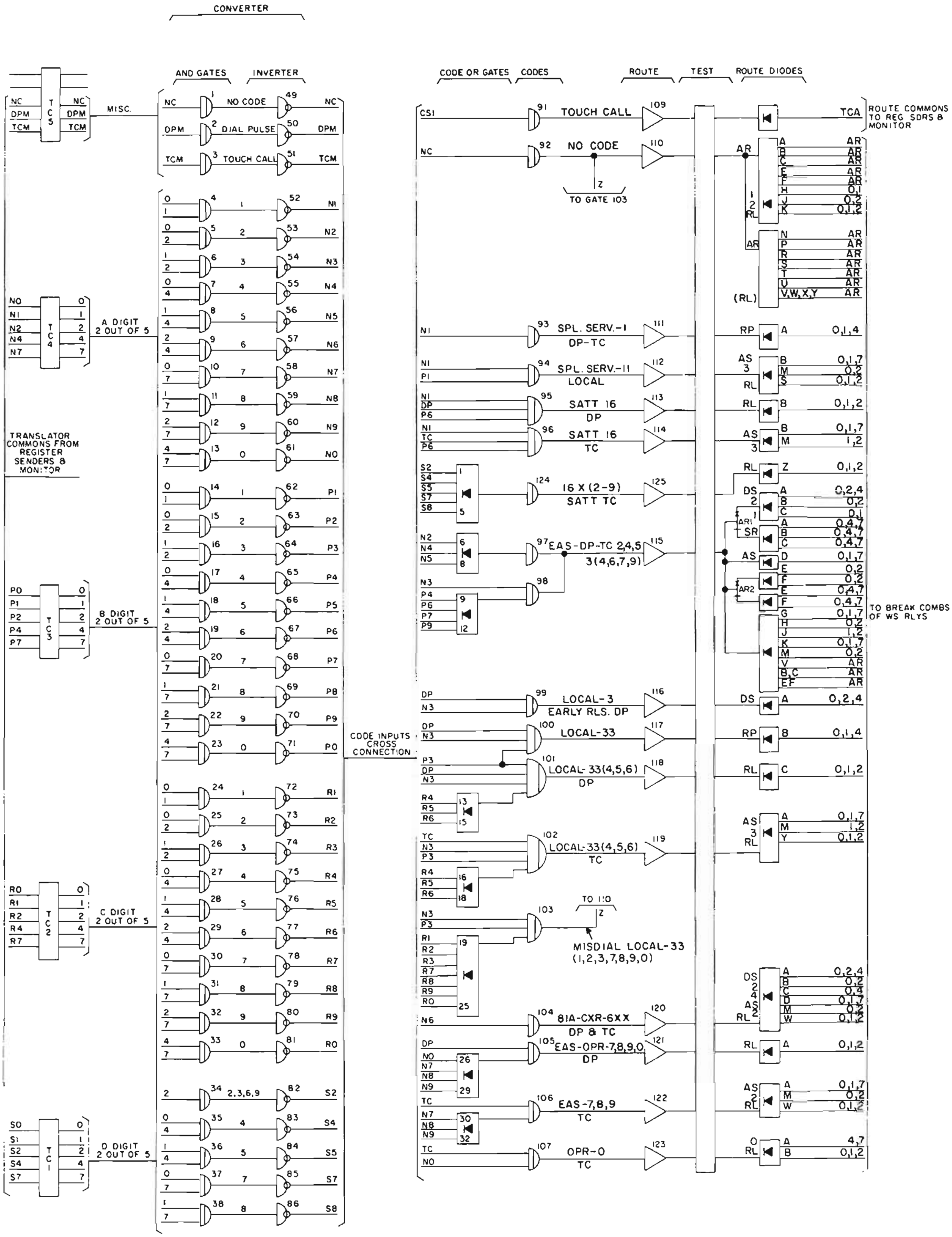


Figure 29. Translator interconnections.

in this case is closed to leads N0 and N2, figure 29. AND gate 5 therefore has negative battery on both inputs and exhibits a positive output to its inverter. With a positive voltage on its input, inverter 53 extends negative battery on lead N2 to the diode OR gate associated with code AND gate 97. Gate 97 exhibits a positive voltage output to route amplifier 115. The negative battery output of route amplifier 115 is extended through normally operated contacts of relay AR1 to the A position levels 0, 2, 4, of rotary switch SQO. The routing code 0, 2, 4 indicates "drop selector", thus, absorbing the digit. The timed battery on leads 0, 2, 4, operates relay T0, T2, and T4 which close a path to the AB relay, figure 30. Operation of the AB relay opens the outpulsing loop for about 600 milliseconds. Rotary switch SQO steps to position B. As can be seen in figure 29, negative battery is extended from the route diode to position B, levels 0 and 2. The two-out-of-five code marking 0, 2, causes the Register-Sender to outpulse the digit 2, stepping the local first selector to the second level. Rotary switch SQO steps to the position C. In the Register-Sender's next time slot negative battery is extended from the route diodes to levels 0 and 1 at position C of rotary switch SQO. This causes relay T0 and T1 to operate and the digit 1 is outpulsed from the Register-Sender. The digit 1 outpulsed from the Register-Sender steps the outgoing second selector to level 1. The outgoing second selector hunts for and seizes a trunk to the tandem office. Rotary switch SQO steps to position D. The Translator extends negative battery to levels 0, 1, 7. The code 0, 1, 7 indicates "routing completed, step to position M".

When rotary switch SQO is in position M the Translator extends the code 0, 2, which indicates "skip the first dialed digit".

As shown in figure 30, terminals N, P, R, S, T, and U of rotary switch SQO levels 0, 1, 2, 4, 7, in this office are connected to the codelreed card terminals. When the timed battery is extended from the Translator through the operated codelreed contacts, the digits are extended one at a time through the operated codelreeds' contacts to the various levels of rotary switch SQO. As each digit is outpulsed rotary switch SQO steps to the next position. In position U the sixth digit is outpulsed and rotary switch SQO steps to position V. In the Register-Sender's time slot the Translator extends negative battery to level AR, at position V, figure 29. Negative battery extended to level AR operates relays L and AR (relay MP already operated), which in turn operate relay RL, figure 30. Relay RL initiates the release of the Register-Sender.

6.5.2 First alternate.

As shown in figure 29, the output of route amplifier 115, when extended to position A, B, and C, of rotary switch SQO, is closed to the route commons through normally operated contacts of relay AR1. Relay AR1 is normally operated and remains operated as long as a trunk in the primary group is idle. The primary trunk group in this office consists of the trunks accessed from level 1 of the outgoing second selector. If all the trunks in the primary route are busy, relay AR1 releases. For this example we will assume the calling party dials the digit 4, and that relay AR1 is restored.

6.5.3 Alternate route translation.

The calling party is switched through to the Register-Sender and receives dial tone, figure 26. The calling party dials the digit 4 which is counted by the correed counting chain and stored on codelreeds, figure 27. In this Register-Sender's time slot, timed battery is extended from the Translator through contacts of the operated codelreeds to the translator commons on leads N0 and N4. Code converter 7, figure 29, has a negative battery on both inputs causing it to exhibit a positive output to inverter 55 which in turn exhibits a negative output. The output of inverter 55 is extended to lead N4 and the code OR gate to code AND gate 97. Code gate 97 extends a positive output to route amplifier 115. With positive battery on its input, route amplifier 115 extends a negative battery at its output through unoperated contacts of relay AR1 to levels 0, 4, 7, position A of rotary switch SQO. Relays T0, T4, and T7 and also the AR relay in the Register-Sender operate. Rotary switch SQO steps to position E from ground through level B.

The Translator marks position E with the code 0, 2. The Register-Sender outpulses the digit 2 causing the local first selector to step to level 2. The rotary switch, still under control of the AR relay, steps to position F. The Translator marks position F with the code 0, 2. This causes the Register-Sender to outpulse digit 2, which, causes the outgoing second selector to step to level 2. On the primary route the outgoing second selector was stepped to level 1, since the trunks accessed from level 1 are all busy, the alternate route instructions from the Translator have caused the Register-Sender to step the outgoing second selector to level 2.

Rotary switch SQO steps to position G and is once again under control of the T relays. The Translator marks position G with the code 0, 1, 7. Relays T0, T1, and T7 operate, rotary switch SQO steps to position M. The Translator marks position M with the code 0, 2 which means skip the first dialed digit. The

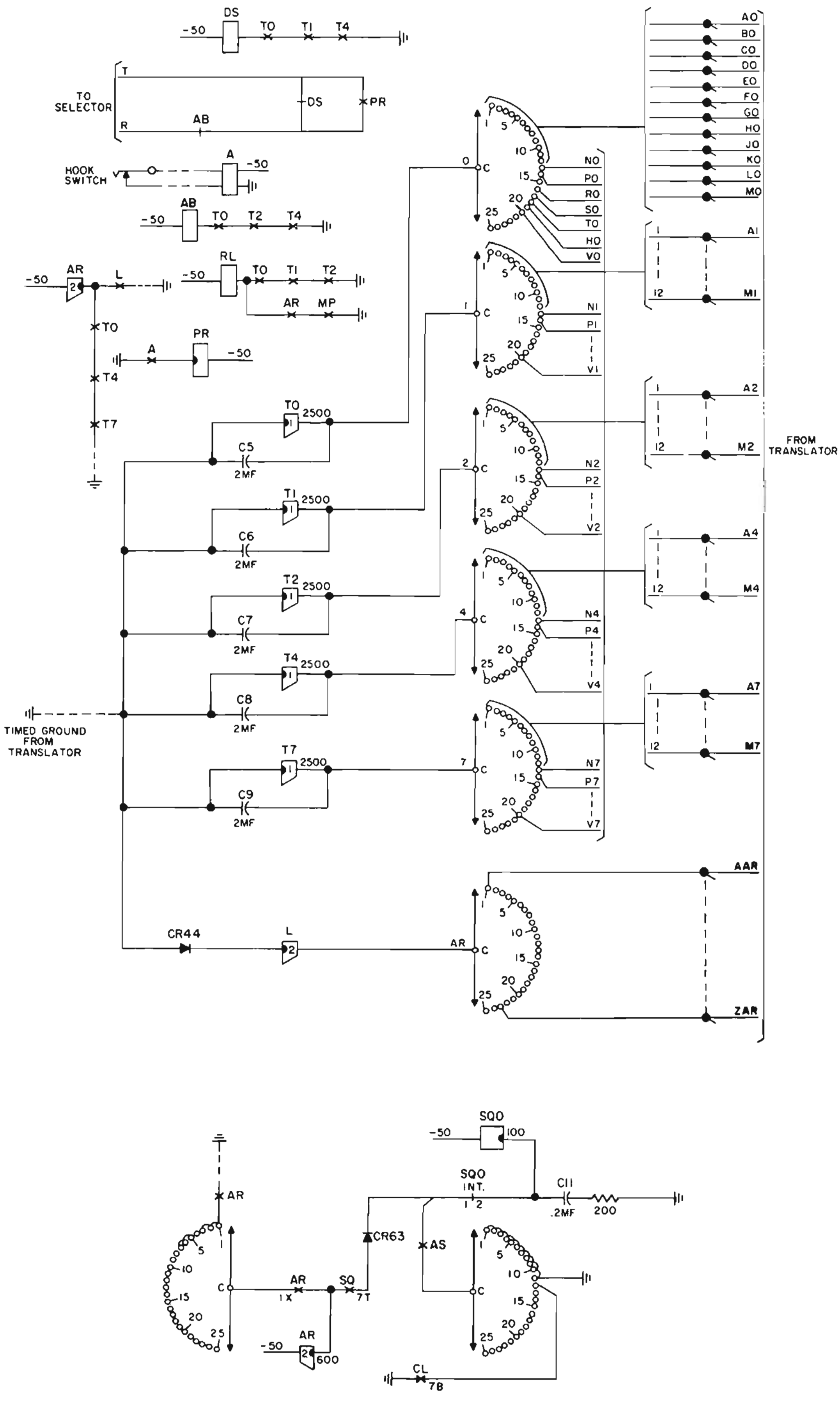


Figure 30. Receiving translated digits.

rotary switch SQO steps past position N. Beginning with position P the last six customer dialed digits are read from codelreed storage and outpulsed over the loop provided via the local first and outgoing second selectors to the trunk circuit and the tandem office (paragraph 6.5.1).

6.5.4 Second alternate.

In this office, trunks have been provided from the third level, as well as the first and second levels, therefore second alternate routing is possible.

If the primary route and the first alternate route trunks are busy, normally operated relays AR1 and AR2 will be restored. These two relays are normally operated as long as at least 1 trunk in the primary or 1 trunk in the first alternate route trunk groups is idle.

6.5.5 Second alternate route translation.

When the calling party is switched through to the Register-Sender, dial tone is returned, figure 26. For this example we will assume the party dials the digit 2. The digit 2 is counted on the counting chain and stored on codelreeds, figure 27. In this Register-Sender's time slot, timed battery is extended from the Translator and closed through contacts of the operated codelreeds. Timed battery, on leads N0 and N2, is extended through the translator commons to converter AND gate 5, figure 29. The positive output of gate 5 is extended to inverter 53. Inverter 53 therefore extends a negative output to lead N2 and code AND gate 97 via the OR gate. With negative potential on its input gate 97 extends a positive output to route amplifier 115. Route amplifier 115 extends negative battery through unoperated contacts of relay AR1 to position A of rotary switch SQO levels 0, 4, 7. Relays T0, T4, and T7 operate, rotary switch SQO steps to position B.

The alternate route relay AR in the Register-Sender operates and rotary switch SQO is stepped to position H.

The Translator marks position H with the code 0, 2, which causes the Register-Sender to outpulse the digit 2 and the local first selector to be stepped to the second level. Rotary switch SQO steps to position J. The Translator marks position J with the code 1, 2, which causes the Register-Sender to outpulse the digit 3 and step the outgoing second selector to the third level. The selector hunts for and seizes an idle trunk to the tandem office. Rotary switch SQO steps to position K.

The Translator marks position K with the code 0, 1, 7, which operates relay T0, T1 and T7. Rotary switch SQO is stepped to position M. The Translator marks position M with the code 0, 2, which indicates skip the first dialed digit. Rotary switch SQO now steps to position P and begins outpulsing the last six dialed digits stored on the codelreeds (paragraph 6.5.1). When the sixth digit has been outpulsed, rotary switch SQO is at position V. The Translator marks the AR level at position V. Relays L and AR operate (relay MP already operated) and in turn operate relay RL which initiates release of the Register-Sender.

6.6 Mis-dialed Calls

When placing a local call the calling party in this particular office must dial one of three codes 334, 335, or 336. We will assume the calling party mis-dials the office code by dialing 337.

The registering and translation of the first two digits is as covered in paragraphs 6.2.1 and 6.2.3. When the calling party dials the third digit, 7, timed battery is extended from the Translator through operated contacts of the codelreeds to leads N1, N2, P1, P2, R0, and R7. Negative battery is extended to both inputs of converters 6, 16, and 30. These three AND gates extend positive outputs to their associated inverters 54, 64, and 78. The negative outputs of these inverters are extended to leads N3, P3, and R7. Leads N3 and P3 appear as inputs to AND gate 103 while lead R7 terminates at the OR gate. The output of the OR gate is then extended to AND gate 103. AND gate 103 now has a negative potential on all its inputs and therefore extends a positive output to route amplifier 110.

Since this would be the third translation, rotary switch SQO is in position C. Route amplifier 110 marks the AR level position C of rotary switch SQO. The L and AR relays in the Register-Sender operate and step SQO to position H. The Translator marks position H with the code 0, 1. This causes the Register-Sender to outpulse the digit 1 which steps the local first selector to level 1.

Rotary switch SQO steps to position J. The Translator marks position J with the code 0, 2. This causes the special second selector to be stepped to level 2. From level 2 busy tone can be returned or the call can reach a recorder announcer (this depends upon the particular central-office policy). Rotary switch SQO steps to position K.

The Translator marks position K with the code 0, 1, 2, which means release the Register-Sender.

It is important to remember that although the calling party mis-dialed, the digit dialed, in this case, 7, was repeated to the local first selector. This is explained in paragraph 6.2.1. However, when the AR level of rotary switch SQO is marked by the Translator and the call is handled as an alternate route call, the established switchtrain is released in order to re-route the call to the special second selector.

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