Intercept Service 945-822

INTERCEPT SERVICE

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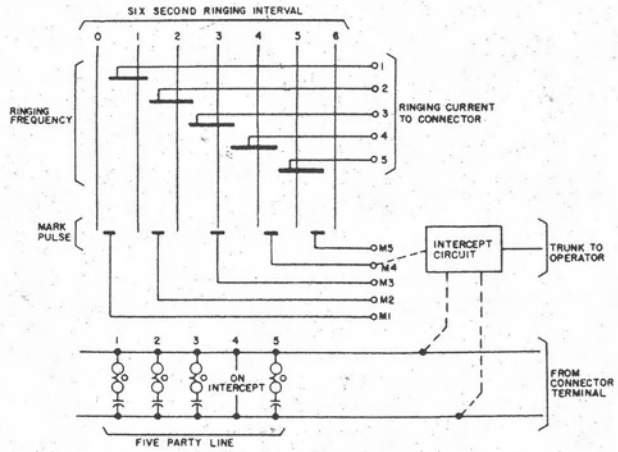

Technical bulletin 945-822

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GENERAL SYSTEM

Subsidiary of

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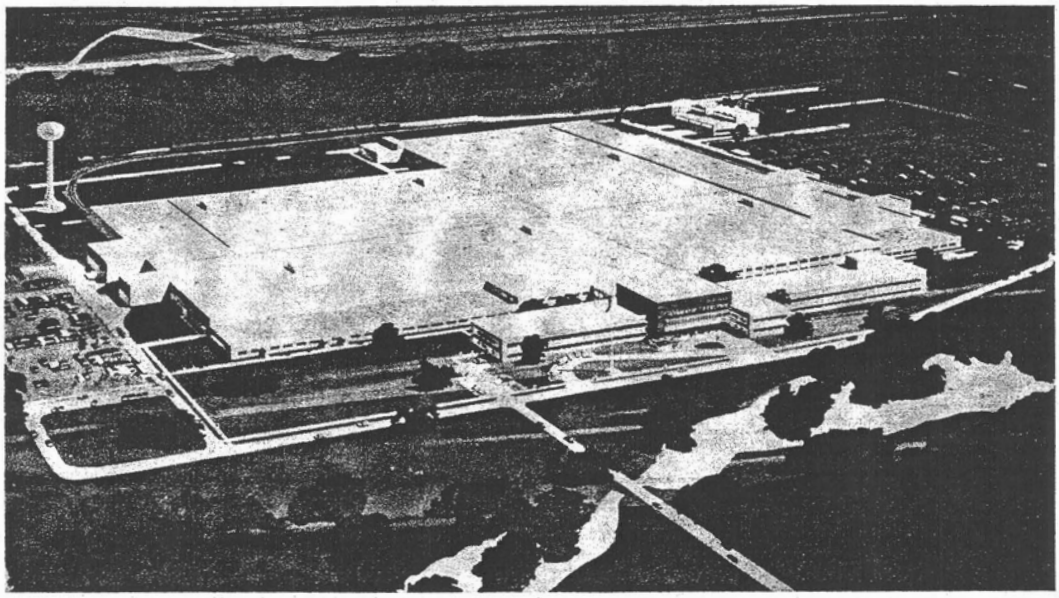

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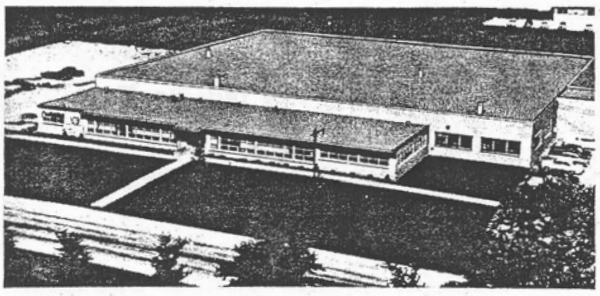

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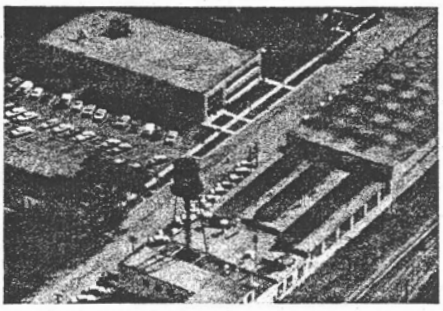

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INTERCEPT SERVICE

1. INTRODUCTION

It is extremely important for a central office participating in the intertoll dialing network to be equipped with adequate intercept facilities. A subscriber placing a toll call that is intercepted, even through a dialing error, must be given helpful information without being charged for a long distance call.

Facilities must be provided at the central office for handling calls made to vacant selector levels, unassigned connector terminals, and stations on private or party lines placed on intercept. Intercept service provides facilities for routing these calls to a recorder announcer or an operator where helpful information will be returned to the calling party.

This technical bulletin presents some of the methods of intercepting calls at selector levels (local or toll), and connector terminals (terminal per line or terminal per station connectors). To present all the intercept circuits and all the intercept schemes possible would be beyond the scope of this bulletin. The basic schemes and circuits presented in this bulletin are for instructional purposes only.

2. APPLICATION

A call can be intercepted at any time during its progress. A vacant selector level or unused connector terminal may appear anywhere in a local or toll switch train. A call in progress that has been intercepted is routed via various intercept circuits, depending upon the switch and type of office, to a recorder announcer or to an operator. The calling party, however, is unaware of the intercept condition until the recorder announcer or the operator is reached. Intercept circuits can be provided for terminal per line and terminal per station connectors, serving private or party lines and for vacant selector levels of local or toll selectors.

In review, intercept service has many and varied applications some of which are:

a. To handle calls made to vacant selector levels.

b. To handle calls made to unassigned connector terminals (terminal per line or terminal per station).

c. To handle calls to unassigned stations on a party line of up to 10 stations with either code, harmonic, or superimposed ringing.

d. To handle number changes or individual line subscribers who have relocated out of the office area, or a party line subscriber who has moved out of the line range or office area.

3. INTERCEPT SCHEMES

The intercept scheme employed in a central office to route and terminate calls intercepted at connector terminals or selector levels will vary with the requirements of the telephone company.

For example, in a small central office all intercepted calls, regardless of where in the switchtrain or why they were intercepted may be routed to a recorder announcer. In another office the practice may be that intercepted calls will be routed to a toll office (attended) via toll trunks, where they will be handled by an operator. Still a third method of handling intercepted calls is to route them to a dual service trunk which can access either one of two termination points, such as a recorder announcer or an operator.

Generally a call made to a vacant selector or an unassigned connector terminal is considered a dialing error on the part of the calling party. The information returned to the calling party is repetitious in nature and can be handled by a recorder announcer. The recorder announcer in returning the mechanically recorded message saves valuable operator call handling time.

A call made to a station placed on intercept, or a call to a station whose directory listing has been changed, is not considered a dialing error. The information returned in this case is not repetitious in nature, and can best be handled by an operator. Also, if the calling party had placed a call to a station whose directory listing has been changed, the calling party would then have to call the operator to obtain the new listing and then place a third call to reach the desired party.

The following paragraphs discuss the above mentioned methods of routing and terminating intercepted calls.

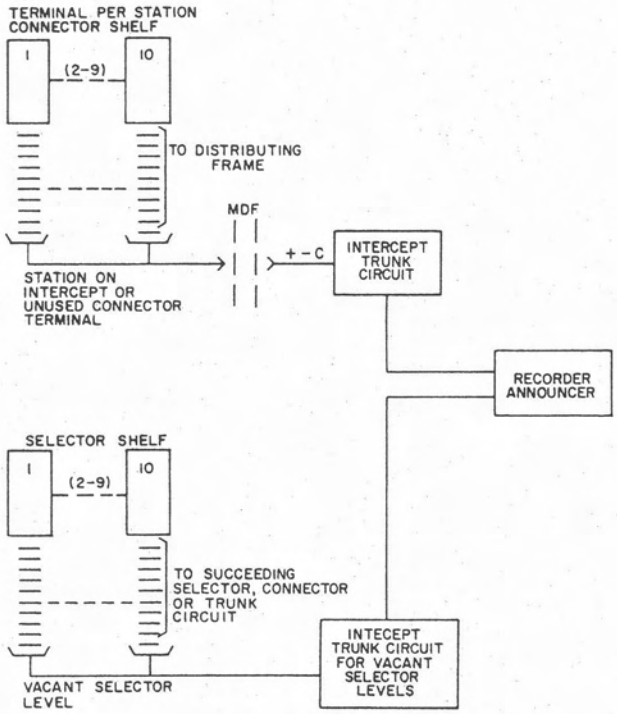

Figure 1. Connector and selector intercept via intercept trunk to a recorder announcer.

3.1 Routing Intercepted Calls to a Recorder Announcer

The method of routing intercepted calls to a recorder announcer is shown in figure 1. When the connector has been dialed to a terminal, or the selector to a level where the call is to be intercepted, the corresponding intercept trunk circuit is seized. When the trunk circuit accessed from the connector has been seized it will trip the ring in the connector without providing answer supervision. If the recorder announcer is idle, the intercept trunk circuit starts the recorder announcer and completes the transmission path between the calling party and the recorder announcer. The recorded message is extended to the subscriber. If the recorder announcer is busy, the intercept trunk circuit will return ringback tone until the recorder announcer becomes idle.

The selector is not a call terminating switch. Therefore the selector level intercept trunk circuit is designed to absorb the remaining dialed digits. Should the recorder announcer be busy, the selector level intercept circuit, after absorbing the dialed digits will return ringback tone to the calling party until the recorder announcer becomes idle.

3.2 Routing Intercepted Calls to a Toll Office

Figure 2 illustrates the method of routing intercepted calls to a toll office, where they will be handled by a toll operator.

An intercept line equipment circuit, which replaces the normal line equipment, is supplied for the connector terminals to be intercepted. A number of connector terminals can be bunched and connected to a single intercept line equipment. This however is a traffic consideration and will be discussed in further detail in section 5.

When the intercept circuit for vacant selector levels, and the line equipment circuit for unused connector terminals, access the same intercept trunk, they are interconnected by a chain circuit. The purpose of this chain circuit is to allow only one intercept circuit to seize the intercept trunk at a time. When the calling party has dialed a connector terminal or selector level to be intercepted, the corresponding intercept circuit is seized. If the chain circuit is not open, that is, the intercept trunk circuit is idle, the intercept trunk circuit can be seized. The intercept trunk circuit in turn seizes the trunk finder circuit. The chain circuit is now opened and if another connector terminal or selector level to be intercepted is dialed, the corresponding intercept circuit will return ringback tone until the chain circuit is again closed.

The trunk finder accessed via the intercept trunk circuit contains a rotary switch, 10 or 25 point bank, which will hunt self interrupted for an idle trunk to the toll office. When the idle trunk is found, the call proceeds as a CLR (combined line and recording) call to the toll office. The operator, however, upon answering the call, hears a special tone generated at the trunk finder circuit identifying this as an intercepted call.

3.3 Routing Intercepted Calls to a Dual Service Trunk

The block diagram in figure 3 shows how a dual service trunk can be used to terminate calls at a recorder announcer or an operator. Although this is a dual service trunk, only one call at a time can be handled.

As can be seen in the block diagram, Service 1 is used to access the trunk finder circuit and trunks to the toll office, while Service 2 is used to access the recorder announcer. Service 1 and 2 are provided by the way in which the + and - leads are connected to the dual service trunk circuit. To provide Service 1 the + and - leads are connected in the normal manner, that is, the + lead of the preceding circuit to the + terminal of the dual service trunk circuit and the - lead to the - terminal in like manner. To provide Service 2 these leads are reversed, that is, the + lead is connected to the - terminal and the - lead to the + terminal. This reversal can be accomplished at the distributing frame. By reversing the leads to provide Service 2 a

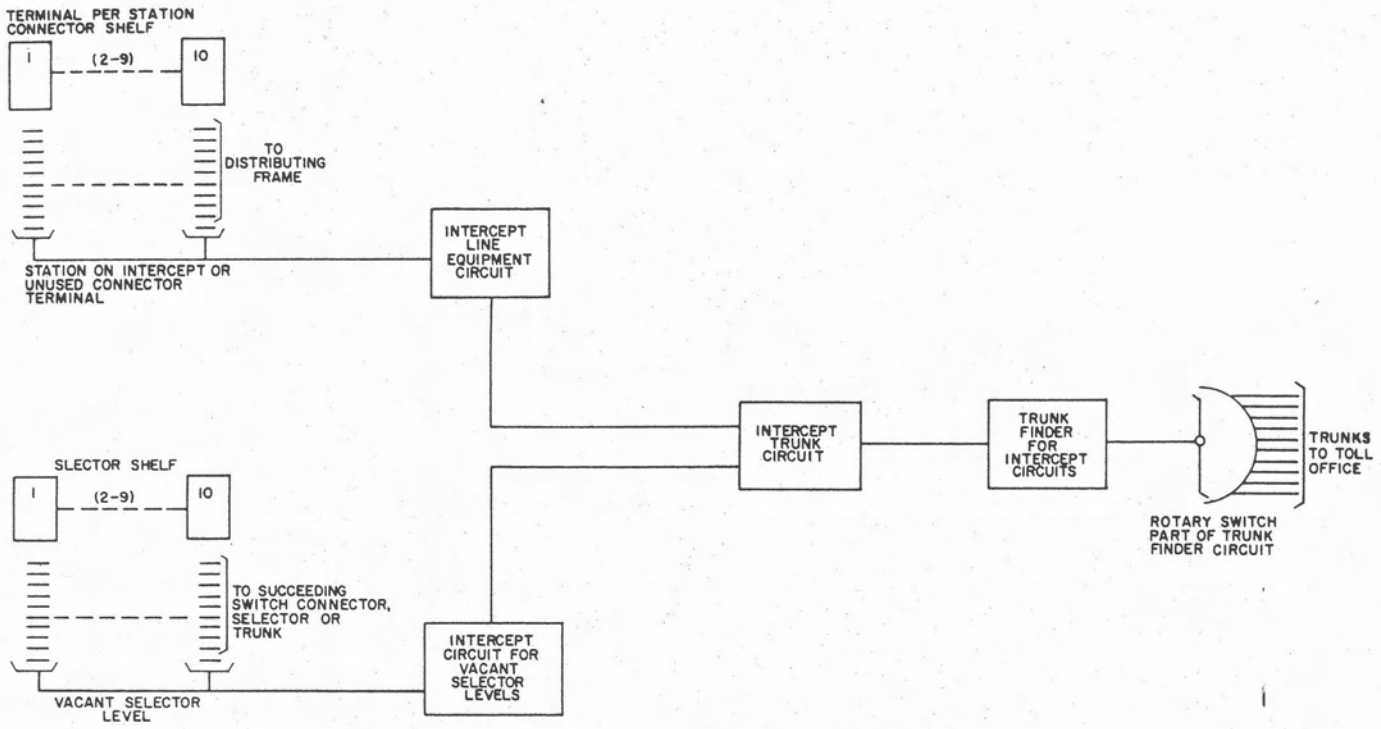

Figure 2. Connector and selector intercept via toll trunk to an operator.

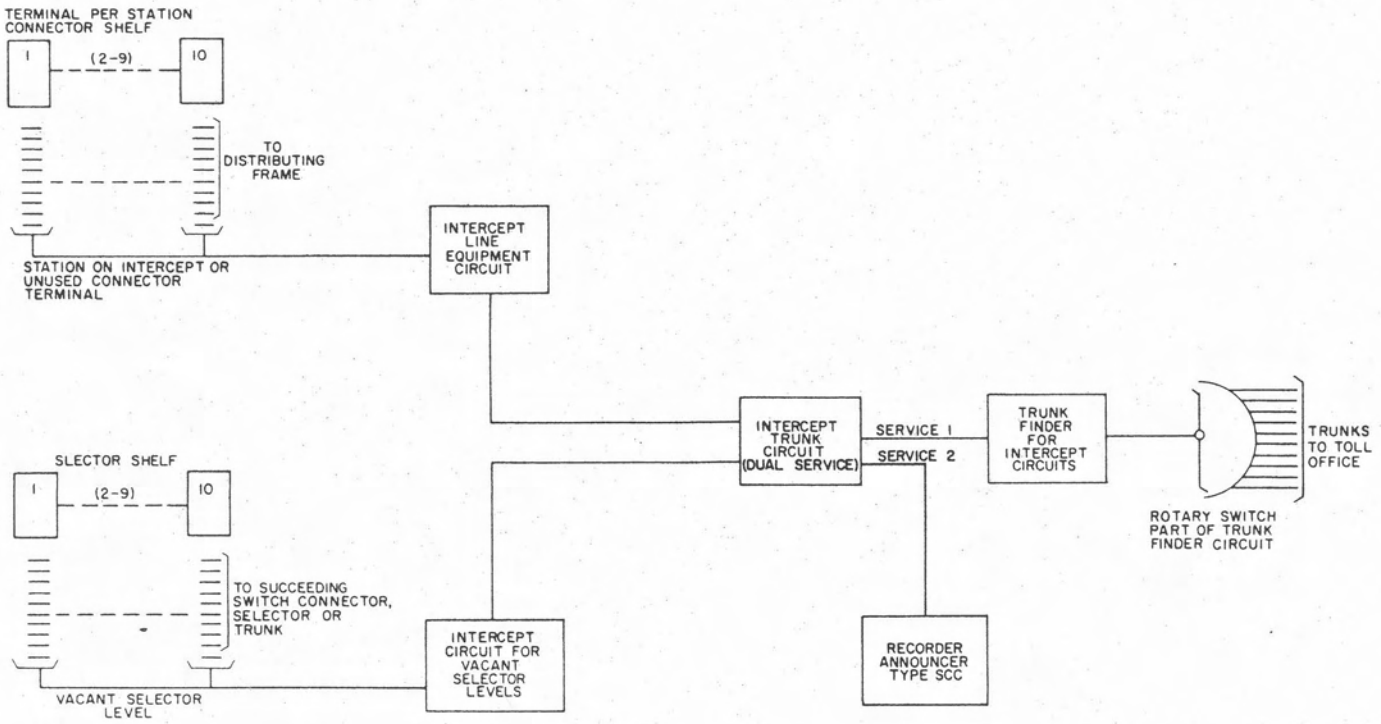

Figure 3. Connector and selector intercept via dual service trunk to operator and recorder announcer.

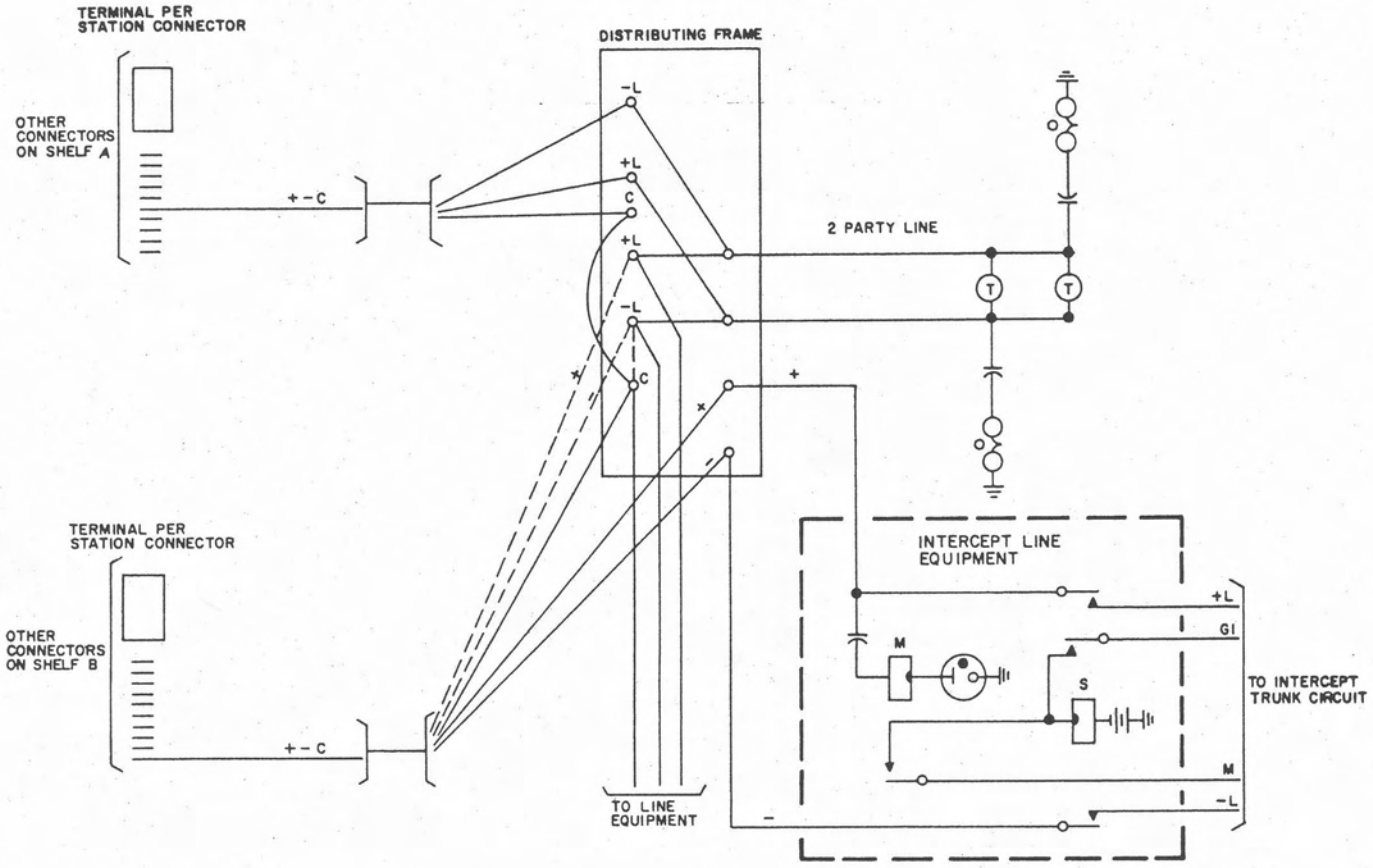

Figure 4. Terminal per station two party line.

special service relay in the dual service trunk circuit will operate in series with the reverse battery relay of the connector, or similar relay in the selector level intercept circuit, (D relay). When the special service relay operates, the transmission path is switched from the Service 1 terminals and outgoing leads to Service 2 terminals and outgoing leads. The chain circuit discussed in the previous paragraph is connected between the dual service trunk circuit, the selector level intercept circuit and the intercept line equipment circuit.

The dual service trunk circuit as shown in figure 3 will access the trunk finder circuit via Service 1 and the recorder announcer via Service 2. The trunk finder circuit accessed via Service 1 will function as stated in paragraph 3.2. The trunk finder searches for an idle trunk to the toll office, and supplies a special tone so that the operator will recognize this as an intercepted call.

The recorder announcer accessed via Service 2, is shown located in the same office. The recorder announcer is started by a relay in the dual service intercept trunk circuit. At the completion of the message cycle the transmission path between the recorder announcer and the calling party is opened.

4. TYPE OF OFFICE

Whether a particular central office is a terminal per station or terminal per line office is the basic factor in determining the type of intercept equipment to be employed. Although both types of offices may use a similar intercept scheme, the particular intercept circuits will differ.

The terminology, terminal per station or terminal per line, used when describing an office, is derived from the type of connector used in the office. When we speak of a terminal per station office we are referring to an office employing terminal per station connectors, and a terminal per line office is one employing terminal per line connectors.

The basic difference in the two types of connectors is as follows:

In a terminal per station connector each station (subscriber) is represented by its own individual termination, that is, each set of connector bank terminals (+, -, and c) serves one station. In a terminal per line connector each set of terminals (+, -, and c) represents a line serving one or several stations, usually a maximum of 10. Also, a terminal per line

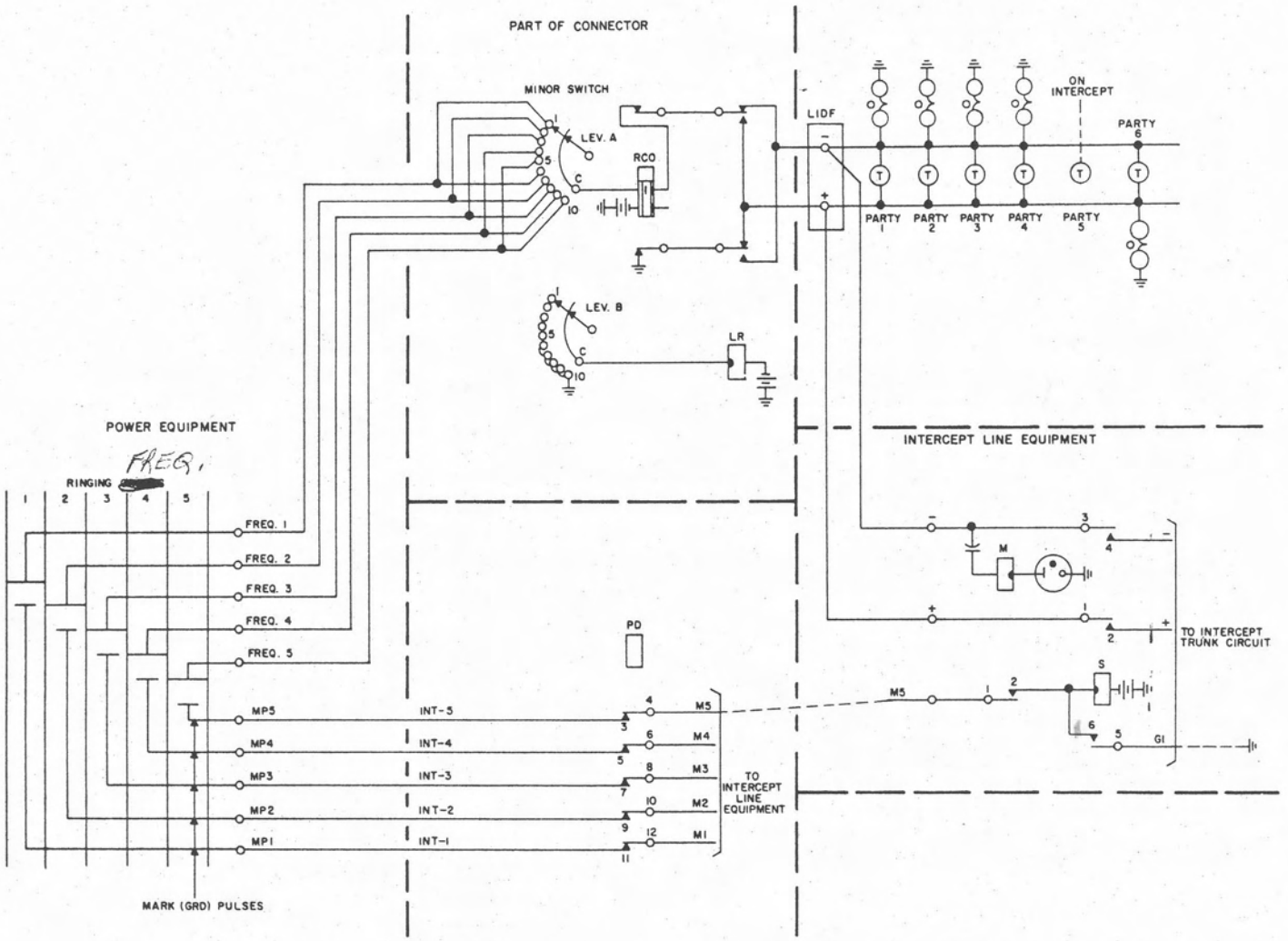

Figure 5. 10 party terminal per line party line.

connector is equipped with a minor switch which is used to apply the code or frequency to the line. This type of connector requires the last three digits in the subscriber's listing.

4.1 Terminal Per Station Office

In a terminal per station office the connector terminal to be intercepted can be disconnected from its associated line equipment. The intercept line equipment can then be connected to the connector terminal, usually at the distributing frame, as shown in figure 4. As can be seen in figure 4; if the station placed on intercept is a 2 party line there is no problem, because the connector terminal can be disconnected from its associated line equipment, and the intercept line equipment can be connected at the distributing frame to the intercepted terminal.

4.2 Terminal Per Line Office

In a terminal per line office, when a station is placed on intercept, unlike the terminal per station office the connector terminal cannot be disconnected from the line equipment. This presents a problem in identifying the station on a working line to be placed on intercept. Again, a terminal of a terminal per line connector represents a line (not a single station) serving as many as 10 stations.

The method used to identify a station or stations of a party line that have been placed on intercept, or unassigned stations of a party line in a terminal per line office, is known as the Mark Pulse Method. Figure 5 shows a 10 party divided frequency ringing line with station 5 placed on intercept.

4.2.1 Mark Pulse Method.

The Mark Pulse Method of identifying stations of a party line placed on intercept can be used with bridged or divided ringing party lines, using frequency, coded, or superimposed ringing.

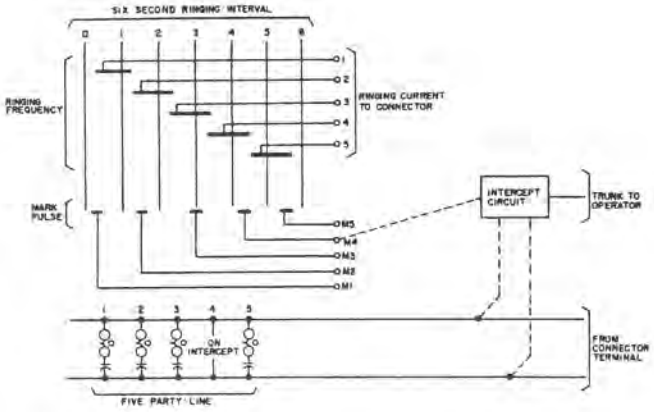

Figure 6. Mark pulse method of intercepting stations on a party line, frequency ringing.

There are different methods of arranging stations to form a party line. One method is to bridge the stations across the line (+ and - leads) and signal them via coded ringing. With this arrangement the ringers of all the stations are sounded when the code is applied to the line. Another method of arranging the stations is to connect parties from the (+) tip side of the line to ground and parties from the (-) ring side of the line to ground and signal them via frequency ringing. In this arrangement five different frequencies of ringing current are applied to either side of the line with the ringer of the subscriber's telephone tuned to respond to one of the five frequencies.

4.2.2 Party line – frequency ringing.

Figure 6 illustrates the Mark Pulse Method of identifying a station placed on intercept on a frequency ringing type five party line. In this case the five parties are bridged across the line.

As can be seen in figure 5, each of the five frequencies is closed at a separate 1.2 second interval. Since each frequency is applied at a different interval a mark pulse can be produced corresponding to each frequency. The mark pulse is actually a ground pulse.

The intercept line equipment circuit, like the stations on the line, is bridged across the line and the mark pulse lead is connected directly to the intercept line equipment circuit. The intercept line equipment consists of two relays, one of which operates on the ringing frequency closing path to operate the other relay via the mark pulse. The relay operating on the mark pulse effects switchthrough to the intercept trunk circuit. The intercept trunk circuit, when seized, trips the ring in the connector without providing answer supervision. Since the intercept line equipment circuit is bridged across the line, the line relay of the intercept line equipment will operate on all frequencies applied to the line, however, the mark pulse must be present to effect switchthrough to the intercept trunk circuit.

4.2.3 Party line – coded ringing.

Figure 7 illustrates the Mark Pulse Method of identifying a station on intercept on a coded ringing party line. The five parties are bridged across the line, therefore, the intercept line equipment will also be bridged across the line. The length of time required to produce the five codes is six seconds. As can be seen in figure 7, there is a period of time when each code, alone, is closed to the line. At this time the mark pulse is also produced. The operation of the intercept line equipment circuit is the same as covered above. With coded ringing, however, as shown in figure 7, the mark pulse appears before the complete code is applied to the line. This would effect switchthrough and cause the code to be clipped before its completion, which could result in sending the wrong code over the line and possibly signaling another station. To prevent code clipping or erroneous codes from being sent, a circuit, which will be discussed in a later section, is inserted between the intercept line equipment circuit and the intercept trunk circuit. When the mark pulse is closed to the M (1-5) lead the intercept line equipment switches the call to the inserted circuit, however, ring trip indication is not returned to the connector and one cycle of code is closed to the line before switchthrough is effected to the intercept trunk circuit.

5. TRAFFIC CONSIDERATIONS

The determining factors in how much intercept equipment should be adequate for a central office are the size and type of office. Size of

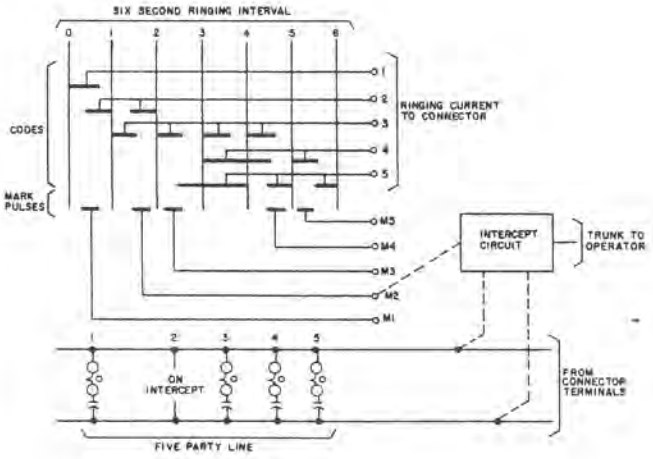

Figure 7. Mark pulse method of intercepting stations on a party line, coded ringing.

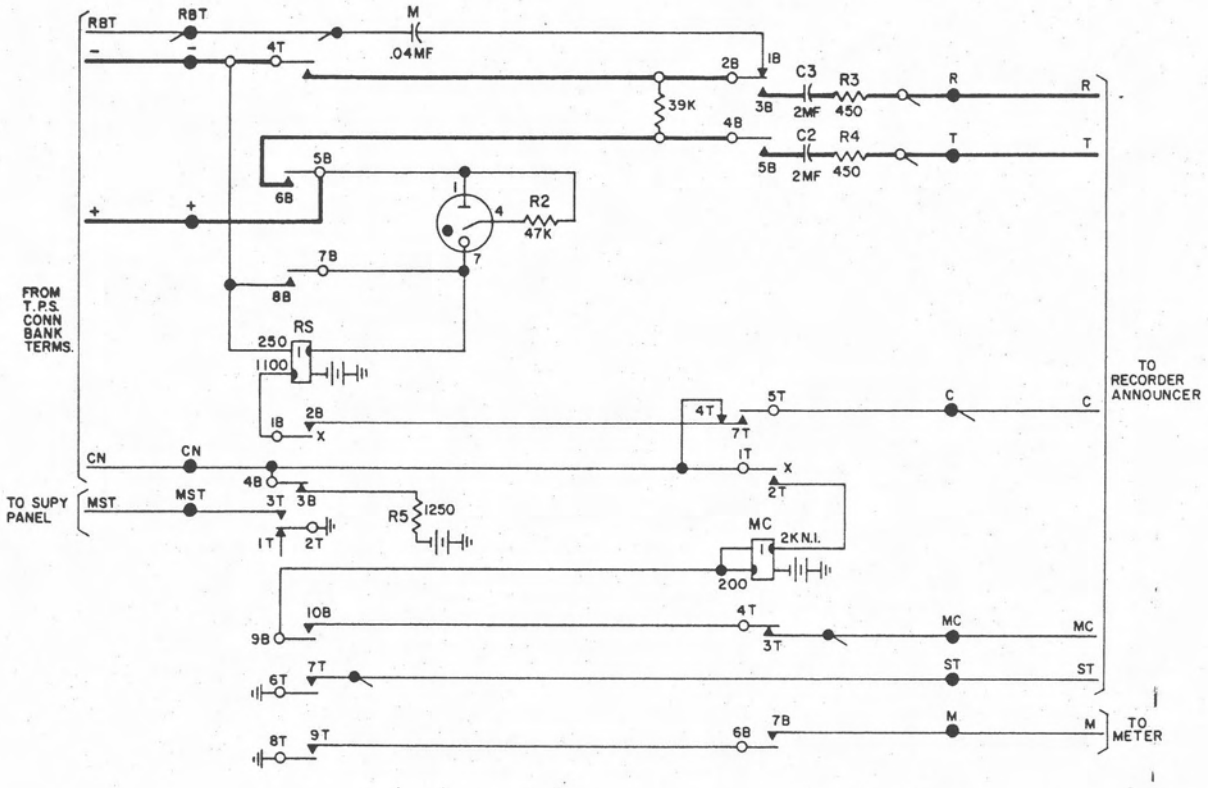

Figure 8. Intercept trunk circuit.

the office is determined by the amount of connector terminals, and type is either terminal per station or terminal per line.

5.1 Terminal Per Station Office

A small terminal per station office is one having less than 500 connector terminals and a large office is one having 500 terminals or more.

In a small terminal per station office one line equipment circuit is used for each 100 connector terminals. In a large terminal per station office one line equipment circuit is used for each 200 connector terminals. When all intercepted calls are routed to a recorder announcer via the intercept trunk circuit in figure 1, one line equipment circuit can be used for each 500 connector terminals.

5.2 Terminal Per Line Office

In a terminal per line office, regardless of size, a line equipment must be provided for each station on a line placed on intercept. If the complete terminal is being intercepted, one line equipment can be used for the terminal.

About 40 to 80 line equipment circuits can be tied to a single intercept circuit.

6. TERMINAL PER STATION CONNECTOR INTERCEPT

The following paragraphs discuss some of the circuits used in intercepting calls to terminal per station connectors, and routing them to a recorder announcer or an intercept operator.

6.1 Local Connector Intercept

When a connector terminal is unused, or when a station is placed on intercept, the connector terminal is disconnected from the line equipment. During a normal call the subscriber dials the required (7 or 10) digits to reach the desired party. The connector serving the called party tests the line, and if it is idle closes ringing current to the line. At the same time the connector returns ringback tone to the calling subscriber. When the called party answers (lifts the phone off-hook) the ring cutoff relay in the connector operates, removing ringing current from the line. The backbridge relay in the connector also operates to provide battery to the called subscriber and answer supervision.

6.1.1 Dialing an unused connector terminal.

In this example, the intercepted call is routed to a recorder announcer in the same office via the intercept trunk circuit shown in figure 8. When the connector is dialed to the unused

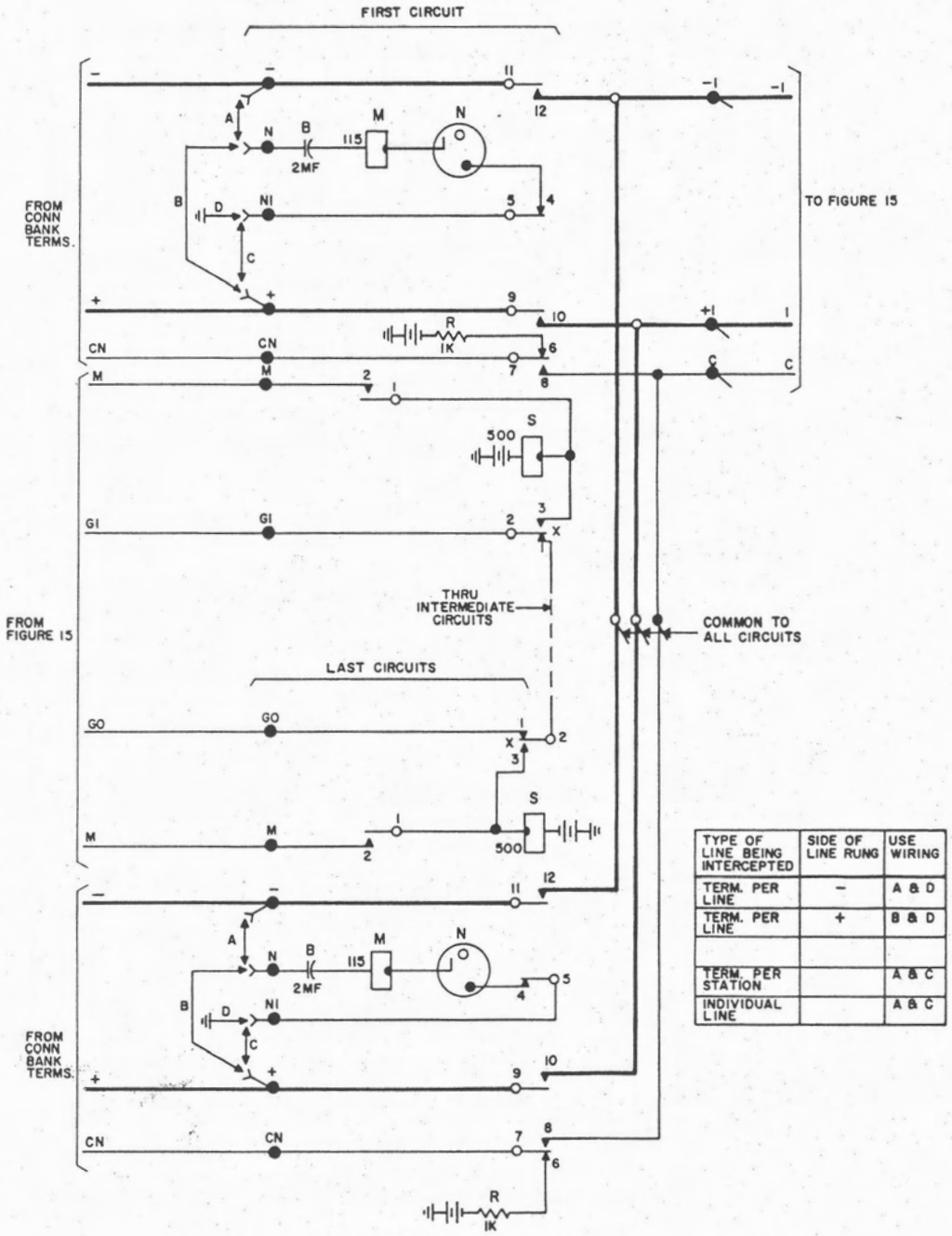

Figure 9. Intercept line equipment circuit.

terminal, the connector tests the line and finding an idle indication (1250-ohm resistance battery on lead CN) closes ringing current to the intercept trunk circuit. Ringing current applied to the line causes tube T to fire and relay RS to operate. Relay RS in operating closes ground at contacts 6T-7T to lead ST to start the recorder announcer. If the recorder announcer is busy this intercept trunk circuit will return ringback tone through make contacts 4T-5T of relay RS to the calling subscriber, until the recorder announcer becomes idle.

When the start relay (ST) of the recorder announcer operates, the drum begins to rotate. As the drum begins to rotate, the cam springs operate, closing ground to lead MC and the intercept trunk circuit. Ground on lead MC through make contacts 9B-10B of relay RS energizes relay MC of the intercept trunk circuit. Relay MC closes its X contacts completing a circuit from ground on lead CN to its No. 1 winding, relay MC operates completely.

Relay MC in operating closes the R and T leads from the recorder announcer to the - and + leads of the connector circuit, thus completing the transmission path to the calling party. At the end of one cycle of message, the recorder announcer cam springs open removing ground

from lead C and opening the holding path to relay RS. Relay RS restores opening the transmission path to the calling party. Relay RS in restoring also removes ground from lead ST.

Relay ST of the recorder announcer releases, the recorder announcer can now accept another call.

When the calling subscriber hangs up, the ground is removed from lead CN causing relay MC to release. This circuit is now at normal. If desired, more than one cycle of message can be returned to the calling subscriber, however, this practice is not recommended. If more than one cycle of message is to be returned, the trunk circuit and recorder announcer are under control of the subscriber. In other words, as long as the subscriber remains on the line, the trunk circuit remains seized and the recorder announcer transmits the message.

It is recommended that one cycle of message be returned as in the example above. That is, when the recorder announcer completes one message cycle it returns to its idle condition. This prevents the subscriber from tying up the trunk circuit and the recorder announcer.

6.1.2 Dialing a station on intercept.

In this example the intercepted call is routed via intercept line equipment, dual service trunk circuit, trunk finder circuit and toll trunks to a toll office for operator handling.

a. The intercept line equipment circuit (figure 9) is connected to the distributing frame or directly to the terminals to be intercepted. When the connector has been dialed to the terminal to be intercepted it seizes the intercept line equipment. The intercept line equipment is marked idle by 1000-ohm resistance battery on lead CN.

   It is possible that more than one connector terminal may be connected to the same line equipment.

   The connector finding the idle condition closes ringing current to the line (-side). Ringing current causes the tube N to fire and relay M to operate. Relay M in operating closes ground from break contacts 3-4 of relay CH of the intercept trunk circuit (figure 15) via lead M to the winding of intercept line equipment relay S. If the intercept trunk circuit is busy (on a previous call), relay CH would be operated, removing ground from lead M, therefore, relay S would not operate. With this condition, the connector will return ringback tone and continue to operate and release relay M, with ringing current, until the trunk circuit becomes idle. All intercept circuits accessing the same intercept trunk circuit are interconnected by chain leads GO and G1, figure 15. Whenever an intercept circuit (line equipment or selector level intercept circuit) has seized the intercept trunk circuit, the chain circuit is opened at contacts of relay S, figure 9.

b. Switchthrough. Ground through the No. 1 winding of relay CH (figure 15) through lead G1, "X" contacts of relay S, figure 9, places relays S and CH in series. Relays S and CH lock operated. Relay CH in operating removes ground from lead M preventing any other intercept line equipments relay from operating. Relay S in operating at contacts 11-12 and 9-10 switches the + and - leads from the connector to the + and - leads of the intercept trunk circuit.

c. Trunk circuit seizure (figure 15). Even though the intercept line equipment switches the call to the intercept trunk a ring trip indication is not returned until relay RA or RB operates. Ringing current closed to the line, (-side), fires tube T1 and causes relay RA to operate. For this example Service 1 is being used, therefore, the + and - leads at the distributing frame are jumpered straight, that is, not reversed. If Service 2 is used the + and - terminals would be reversed when jumpered at the distributing frame.

   Relay RA in operating at its contacts 5-6 also short-circuits its No. 1 winding, placing a bridge across the line and returning ring trip condition to the connector. Relay RA in operating closes a circuit from ground at contacts 1T-2T of relay CS to the winding of relay TS. Relay TS operates and locks to ground on lead C from the connector via the intercept line equipment circuit. Relay TS at contacts 8B-9B closes ground to the winding of relay CS. Relay TS at contacts 6B-7B also closes ground to the No. 2 winding of relay RA to lock it operated. Relay CS is energized, and operates, returning ringback tone through its make contacts 6T-7T to the calling party (-side of line). Relay CS closes a path from ground at contacts 5T-6T of relay TS to lead L. Ground on lead L is closed to relay L of the trunk finder circuit (figure 10). Relay CS also at its make contacts 9B-10B completes a path from ground on lead MC (HC) to the winding of relay HC. Relay HC is energized and operates.

d. Trunk finder seizure. Ground on lead L, energizes relay L of the trunk finder circuit figure 10. Relay L operates and at contacts 3-4 closes ground to lead ST. Ground on lead ST is closed to the winding

of relay SO, relay SO is energized and operates. Relay SO in operating closes ground from level A of rotary switch MM via lead CS, through break contacts 1-2 of relay SW through a pair of its own make contacts 6-7 to lead M1, through INT springs 1-2 of MM and the motor magnet coil. The rotary switch is energized, opens its interrupter springs is de-energized and steps its wipers to the first bank contacts.

If the trunk tied to the first set of terminals, (position 1) is busy, terminal G1 will be grounded. This ground follows the same path over lead CS and steps the motor magnet to the next terminal. If the next terminal is idle, that is, no ground on lead C2, relay SW will operate in series with rotary switch MM (from ground on lead ST, to battery at the coil of MM) however, MM will not operate in series with relay SW.

Relay SW in operating closes ground from lead ST, through its make contacts 4-5 to relay TO, and at its break contacts 1-2 opens the stepping circuit to the motor magnet. Relay TO is energized and operates, opening the holding circuit to relay SO.

When relay L operated on seizure, it closed ground from its make contacts 7-8 to winding B of shunt field relay SF. With MM positioned on the idle trunk, winding A of relay SF is across the + and - leads. Winding A across the + and - leads acts as a loop, seizing the trunk circuit to the toll office. The windings of the shunt field relay SF are now opposing, therefore, relay SF will not operate. When the trunk is seized ground is returned via the C lead to hold relay SW operated. The line lamp at the operator's position is lighted.

e. Operator answer. When the operator answers, intercept tone on lead G, through contacts 1-2 of relay L, to lead C, contacts 5-6 of relay TO operated, contacts 3-4 of relay SO, restored, contacts 9-10 of relay TO, contacts 2-3 of relay SW operated through level C of MM to the trunk circuit, identifies this call as an intercepted call. The operator, upon answering, causes a battery reversal in the trunk circuit, which is returned to this circuit and winding A of the shunt field relay SF. Windings A and B are now aiding, causing relay SF to operate. Relay SF in operating closes ground from contacts 7-8 of relay L through the winding of relay CL to lead C and the intercept trunk circuit, figure 15, through unoperated contacts 7T-8T of relay SS, 3-4 of relay TBL, operated contacts 3-4 of relay HC to relay CL. Relay CL operates, closing ground to the winding of relay CLS.

Relay CLS operates, completing the transmission path from the connector, through the intercept line equipment circuit, intercept trunk circuit, trunk finder circuit, to the trunk circuit and the operator.

6.2 Toll Connector Intercept

When a toll call is extended through a toll board by an operator, it will access a toll switch train. For this example we will assume the toll switch train consists of a toll transmission selector, an intermediate selector, and a toll connector. In some cases the connector may be a combination local and toll connector.

When a toll connector is seized, its ring cutoff relay is operated by ground on the EC lead from the intermediate selector. The reverse battery relay in the connector operates returning answer supervision to the operator. The operator closes the ring key, removing ground from the EC lead, which causes the ring cutoff relay to restore and ringing current to be closed to the line.

6.2.1 Intercepting a toll call.

When the toll operator seizes the toll switch train, as mentioned above, upon seizing the toll connector and receiving answer supervision, the operator closes the ring key. This causes the ring cutoff relay in the connector to restore and close ringing current into the intercept line equipment circuit. The intercept line equipment circuit will seize the intercept trunk circuit. The intercept trunk circuit will return ringback tone and seize the trunk finder circuit. The operation of the various intercept circuits will be the same as intercepting local calls. When the intercept operator answers, a high resistance bridge is placed across the line to prevent the transmission battery feed relays from operating, thus preventing an answer indication.

7. SELECTOR LEVEL INTERCEPT

The intercept circuit for vacant selector levels is tied to the bank contact of the selector level to be intercepted. Should there be several vacant selector levels, it is possible to multiple them to a single intercept circuit. This is strictly a traffic problem in determining how many levels can be multipled to an intercept circuit. The intercept circuit is usually connected to the first set of terminals on the vacant level. The remainder of the terminals are busied out (grounded) so that if the intercept circuit is busy the selector will step to the 11th bank contact and return busy tone to the calling party. This again is a traffic consideration, if the traffic (amount of calls) to a

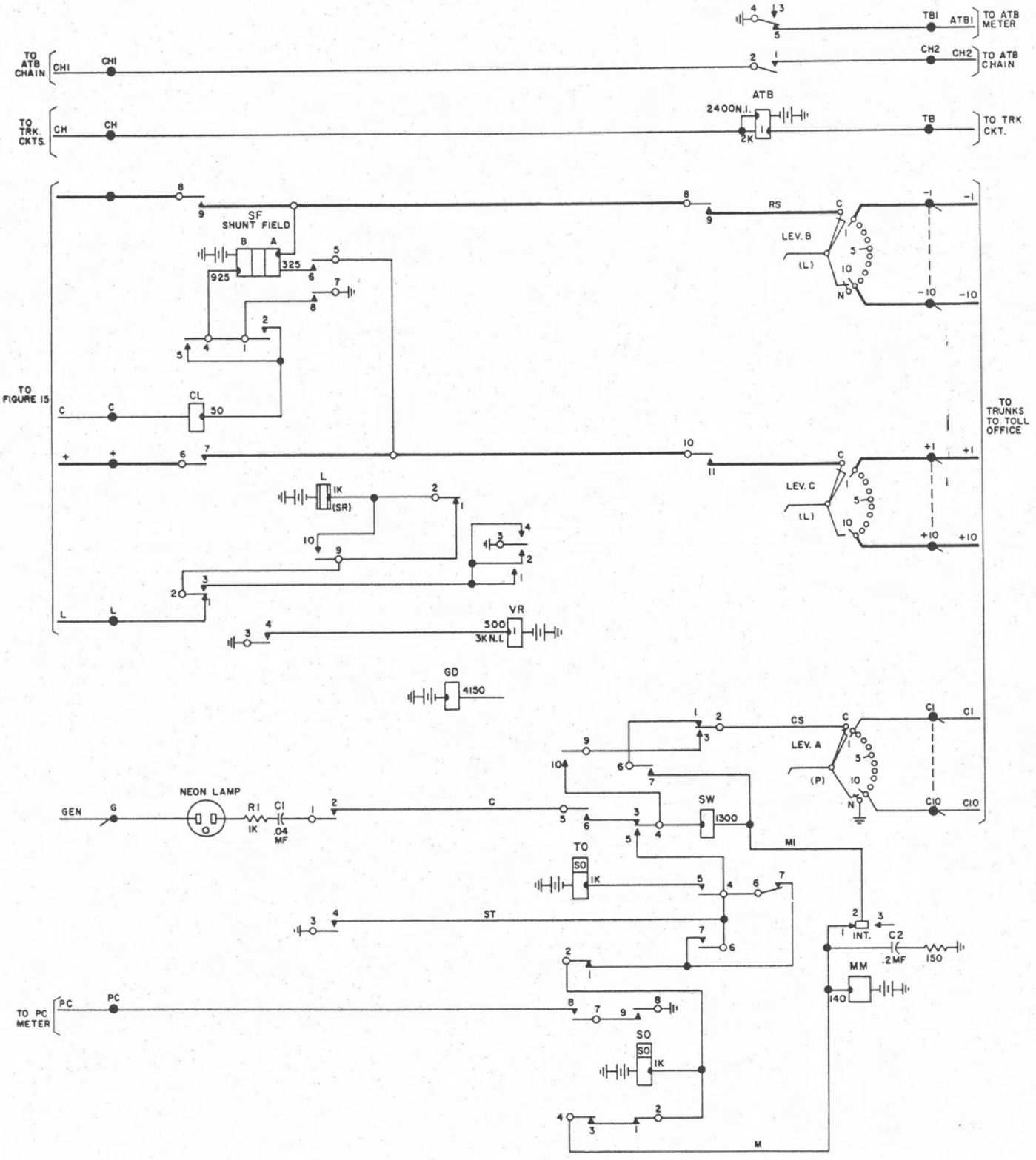

Figure 10. Trunk finder circuit.

particular level is heavy enough, more than one intercept circuit may be tied to a vacant level.

7.1 Local or Toll Selector Intercept – Call Routed to Recorder Announcer

The intercept trunk circuit shown in figure 11 is used when the call intercepted at a vacant selector level is routed to a recorder announcer in the same office. When the selector has been dialed to the vacant level, it will begin rotary hunting. The intercept trunk circuit is marked idle by 500-ohm resistance battery on lead C. Upon finding this resistance battery, the selector stops rotary hunting and closes the + and - leads to the intercept trunk circuit. When the + and - leads are closed, the loop is completed to relay BF. Relay BF operates, closing ground at its make contacts 2-3 to the winding of relay BFS, relay BFS is energized and operates. Relay BFS in operating, at contacts 5-6 closes ground to lead ST to start the recorder announcer.

Since the selector is not a call terminating switch, the trunk circuit is designed to absorb the remaining dialed digits. Relay BF follows the dial pulses, alternately energizing relays BFS and C. Relay C in operating, at contacts 6-7 opens the holding circuit to relay MC. When the last digit has been dialed relay BF and relay BFS remain operated. Relay BF, in remaining operated, at contacts 1-2 opens the operating path to relay C. At the beginning of the next message cycle, ground on lead MC is closed through make contacts 9-10 of relay BFS, break contacts 8-9 of relay MC, break contacts 3-4 of relay CO, to the winding of relay MC. Relay MC operates its X contacts (1-2) and locks through break contacts 6-7 of relay C and contacts 6-7 of relay CO to ground at contacts 7-8 of relay BFS. Relay MC in operating at contacts 6-7, and 11-12, closes the transmission path between the calling party and the recorder announcer.

Should the recorder announcer be in the process of returning a message, this circuit is arranged

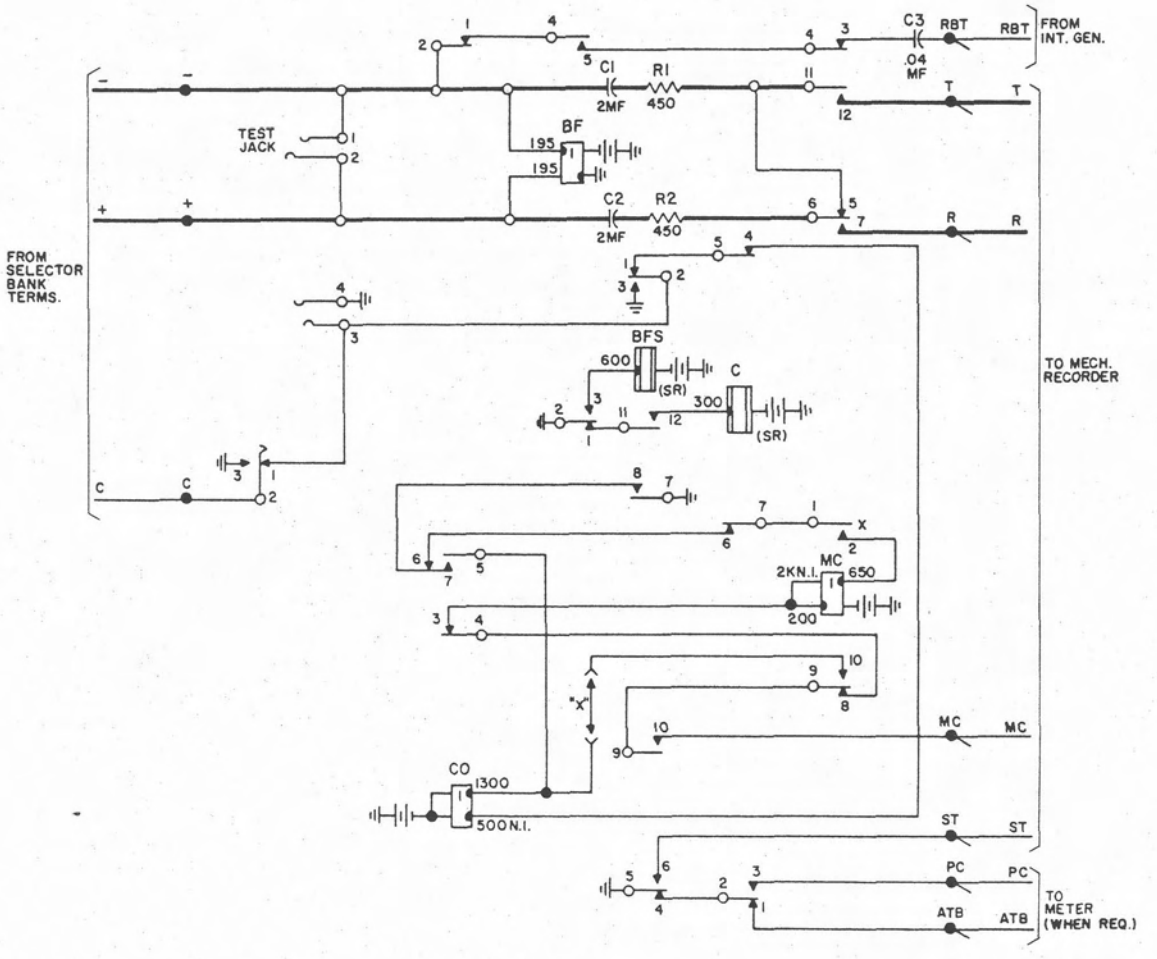

Figure 11. Selector level trunk intercept circuit.

to return ringback tone, after all the digits have been absorbed, until the recorder announcer becomes idle.

At the end of one message cycle ground at the recorder announcer is again closed to lead MC, through make contacts 9-10 of relays BFS and MC, to the winding of relay CO. Relay CO is energized and operates, opening the holding path, at contacts 6-7, to relay MC. Relay MC restores opening the transmission path to the calling party. If only one cycle of message is to be returned, the X strap is connected. If more than one cycle of message is to be returned, the X strap is removed.

The calling party holds relays BF, BFS, and CO operated while remaining in the off-hook condition. When the calling party hangs up, loop to relay BF is opened. Relay BF restores, and at contacts 1-2 removes ground from the winding of relay BFS. Relay BFS restores, removing ground at contacts 7-8 from the winding of relay CO. Relay CO is de-energized and restores.

7.2 Local or Toll Selector Intercept – Call Routed to Toll Office

The intercept circuit for unused selector levels shown in figure 12 is used when intercepted calls are routed to a toll office.

a. Seizure.

This circuit will be marked idle on lead C by 500-ohm resistance battery through the non-inductive winding of relay CS.

When the selector has been dialed to the vacant level, and begins rotary hunting, it will stop on the terminals tied to the selector level intercept circuit (assuming the selector level intercept circuit is idle). The loop is closed to relay BF. Relay BF operates, and at contacts 2-3 closes ground to the winding of relay BFS. Relay BFS operates and at contacts 3-4 closes ground to the winding of relay C, and the No. 1 winding of relay D. Relay BFS also closes ground to lead C to mark this circuit busy. Relay C in operating at contacts 11-12 closes interrupted ground from lead IPM to the winding of relay P. Relay P begins to pulse at 60 IPM. Relay P at contacts 1-2 closes interrupted ground from contacts 1-2 of relay D to rotary switch TS. With relay P pulsing at 60 IPM, the rotary switch steps its wipers once every second. Again, since the selector is not a call terminating switch, this circuit is designed to absorb the remaining dialed digits. As the rotary switch begins to step its wipers relay BF following the dialed pulses at contacts 1-2 closes ground through break contacts 1T-2T of relay CS, and 7-8 of relay ECA, through make contacts 5-6 of relay BFS to the winding of relay CD. Relay CD is energized and operates.

Relay CD in operating at contacts 2-3 closes ground through the rotary switch off-normal contacts 3-4 and interrupter springs 1-2 to the winding of TS. Rotary switch TS steps self interrupted to the home position. If the calling party is still dialing, the stepping circuit is again closed to TS from contacts 1-2 of relay P.

When dialing is completed (no more pulses to relay BF) and rotary switch TS steps to the 5th bank contact, ground is closed from make contacts 7-8 of relay C, through break contacts 4-5 of relay CD restored, through level A of rotary switch TS, break contacts 1-2 of EC, unoperated, to the No. 1 winding of relay CS. Relay CS operates closing ringback tone to the calling party. Relay CS on operating at break contacts 1B-2B opens the operating path to relay P. Relay CS also completes a circuit from ground on lead M of the intercept trunk circuit (figure 15) through break contacts 3-4 of relay CO, make contacts 7-8 of relay D, and 6B-7B of relay CS to the winding of relay L. Relay L operates and opens the chain circuit, leads G1 and GO. Ground on lead G1 is closed to the winding of relay CO.

b. Trunk circuit seizure.

Relay CO in operating closes ringing current to the intercept trunk circuit, figure 15, via the - side of the line. Relay RA operates on the ringing current completing a d-c loop from battery at terminal RB of the selector level intercept circuit, figure 10, through the No. 1 winding of relay F, operated, contacts 3-4 of relay D, unoperated contacts 8-9 of relay F, operated contacts 5-6 of relay CO, + side of the line, operated contacts 5-6 of relay RA, tube T1, - lead, operated contacts 7-8 of relay CO, unoperated contacts 5-6 of relay F, operated contacts 5-6 of relay D to ground at terminal RG1. Relay F operates on this d-c loop, removing ringing current from the line. The operation of the trunk circuit is as covered in paragraph 6.1.2-c, and the trunk finder circuit as covered in paragraph 6.1.2-d.

8. TERMINAL PER LINE CONNECTOR INTERCEPT

The following paragraphs discuss intercepting a call at a terminal per line connector terminal. The Mark Pulse method of identifying stations on a party line placed on intercept is also discussed.

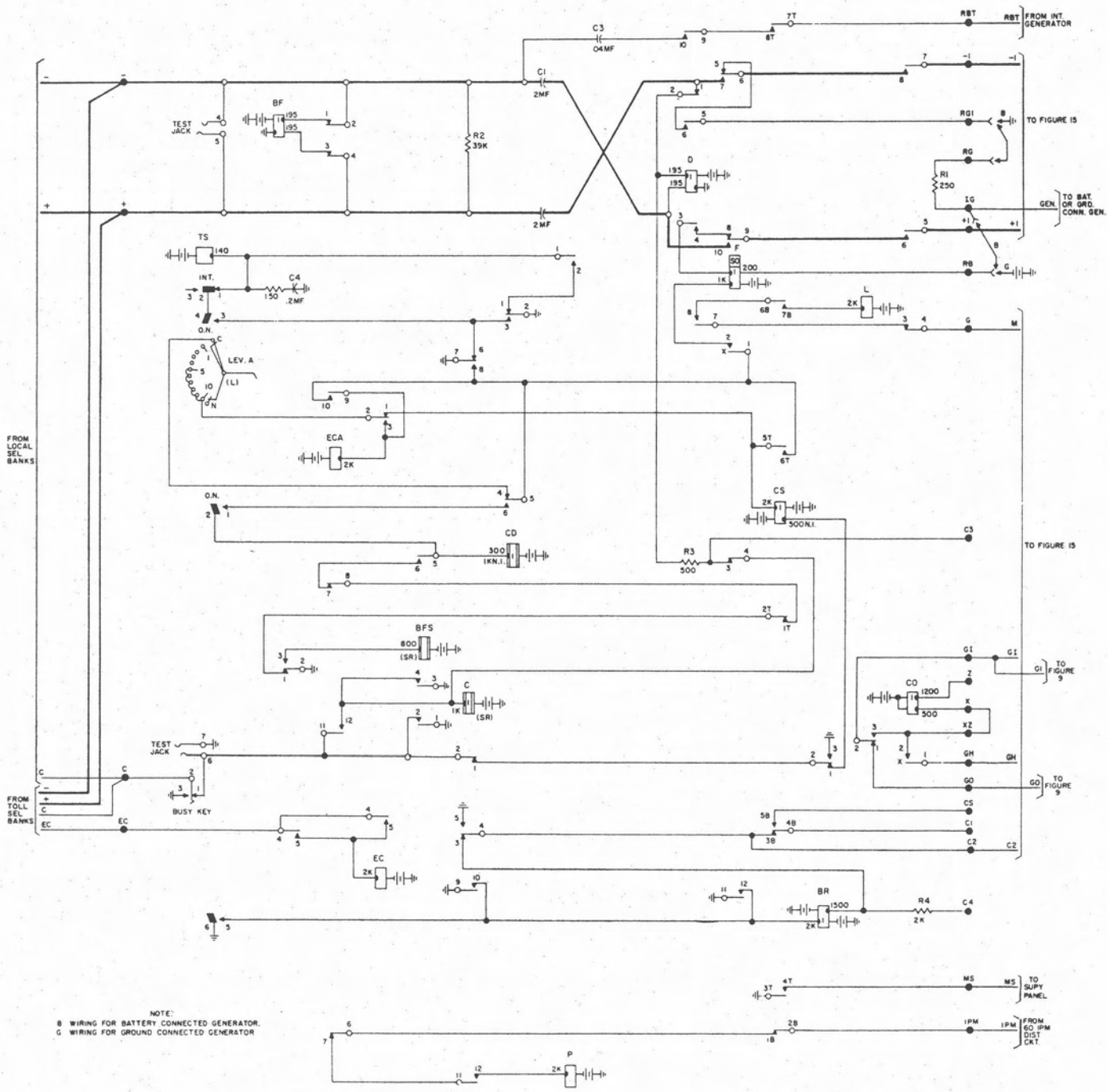

Figure 12. Selector level intercept to toll office.

8.1 Private Lines and Unassigned Connector Terminals

If a terminal of a terminal per line connector is unassigned, it can be treated like a terminal of a terminal per station connector. This also holds true for private lines of a terminal per line system. The connector terminal can be disconnected from the line equipment. The intercept line equipment can then be bridged across the line.

8.2 Party Lines – Frequency Ringing

Figure 5 illustrates how a station, station number 5, of a divided ringing ten party line is placed on intercept. The intercept line equipment circuit (figure 9), used in the discussion on terminal per station connectors is also used for terminal per line connector intercept. For this example, however, the M relay of the intercept line equipment circuit is shown connected for divided ringing, - (ring)

side of the line to ground figure 5. An additional circuit, figure 13, is required for terminal per line connectors serving party lines with frequency ringing.

The additional circuit is called the PD relay circuit. Figure 5 illustrates how the line equipment is connected to the line at the distributing frame and also how the M lead is connected to the PD relay circuit.

With the connector dialed and the minor switch positioned to apply the proper frequency, relay M operates. Relay M of the intercept line equipment circuit will operate whenever a ringing frequency is applied to the - (ring) side of the line, however the mark ground pulse must be present to affect switchthrough to the intercept trunk circuit. The mark ground pulse is closed from the interrupter to lead INT 1-5, through break contacts of PD, to lead M (1-5) of the intercept line equipment circuit, energizing relay S. Relay S operates, switching the + and - leads to the intercept trunk circuit, figure 15. Relay S locks operated to ground on lead G1 (assuming the intercept trunk circuit is idle), from the intercept trunk circuit. Relay S also opens the chain circuit lead G1-GO, preventing any other line equipment from seizing the intercept trunk. Relay S of the intercept line equipment circuit is operated, in series with the No. 1 winding of relay CH of the intercept trunk circuit. Relay CH operates its X contacts and locks operated to ground on its No. 2 winding. Relay CH in operating closes ground from its make contacts 1-5 to lead M1 and relay PD. Relay PD operates, removing ground from lead M.

Relay S in switching the + and - leads to the intercept trunk circuit, closes ringing current to the intercept trunk circuit. Ringing current over these leads causes tube T1 to operate and relay RA to operate. Relay RA in operating short circuits its number 1 winding and returns a ring trip indication to the connector via the

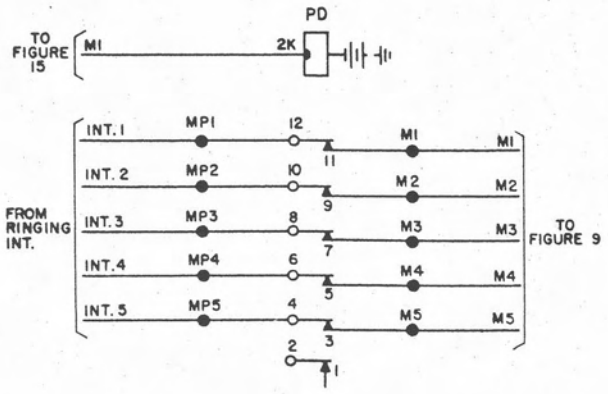

Figure 13. Mark pulse circuit (PD relay).

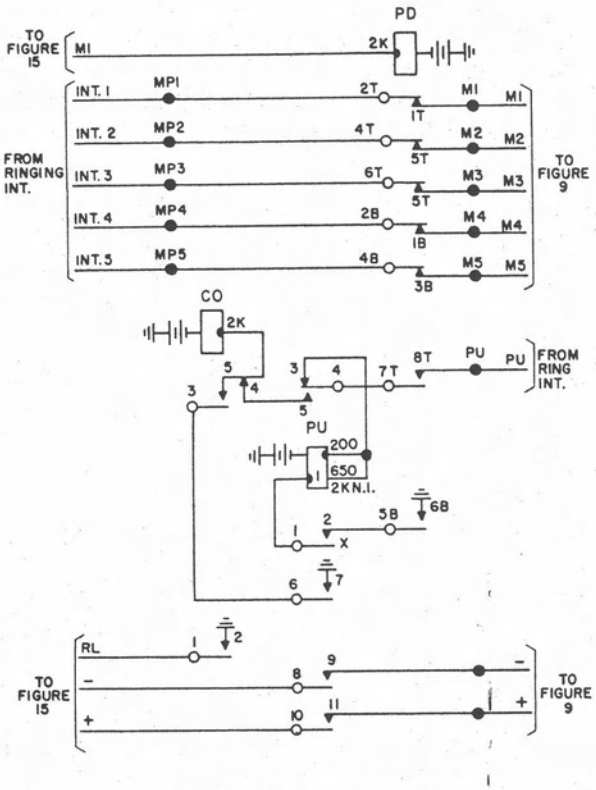

Figure 14. Coded ringing relay circuit.

intercept line equipment circuit. The connector cuts off ringing current. The operation of the intercept trunk circuit is as covered in paragraph 6.1.2-c.

8.3 Party Lines – Coded Ringing

When coded ringing is used on party lines, figure 14 must be provided. The operation of the line equipment is as discussed in paragraph 8.2, up to switchthrough of the + and - leads by relay S. When figure 14 is provided relay S no longer connects the + and - leads from the connector to the trunk circuit. Relay S instead switches the + and - leads to figure 14.

When the connector has been dialed and the minor switch positioned to apply the proper code, ground on the mark pulse lead is closed to the winding of relay M, figure 9. Relay M operates and if the intercept trunk circuit is idle, closes ground from lead M to the winding of relay S. If the intercept trunk circuit is busy, that is the CH relay of the intercept trunk circuit is operated, figure 15, there will be no ground on lead M and relay S will not operate. Relay S of the intercept line equipment circuit locks operated in series with relay CH via lead G1 of the intercept trunk circuit. Relay CH in operating, at contacts 4-5 closes ground via lead M1 to relay PD of figure 14. Relay PD is energized and operated and at contacts 7T-8T closes the circuit from lead PU to the winding of relay PU after one complete cycle of ringing. Ground on lead PU

energizes the No. 1 winding of relay PU. Relay PU operates its "X" contacts and short circuits its No. 1 winding. When ground is removed from lead PU, relay PU operates completely.

Relay PU, operating, closes the + and - leads from the intercept line equipment circuit to the intercept trunk circuit. Relay RA or RB of the intercept trunk circuit operates on ringing current and returns a ring trip indication to the connector. The ring cut-off relay in the connector operates. Ringback tone will now be supplied by the intercept trunk circuit.

The operation of the intercept trunk is the same as discussed in paragraph 6.1.2-c.

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