SECTION NO. 6

SUBSCRIBER OUTGOING CALLS USING SENDERS

SUBSCRIBER OUTGOING CALLS USING SENDERS

NO. 5 CROSSBAR OFFICES

CONTENTS

PAGE

A. INTRODUCTION

1.01 This text is one of a group which describes the detailed circuit operation of the various types of calls handled by the No. 5 crossbar system with wire spring relays.

1.02 When a subscriber in a No. 5 crossbar office dials a central office code of some other central office, the completing marker must pick a trunk to that office and select a sender which will pulse the telephone number over the trunk. Of course it performs all the other necessary functions required for setting up a connection. This section of the text describes the marker job of establishing a subscriber outgoing trunk connection.

1.03 Before this can occur, certain things must have passed. A dial tone connection has been established, the subscriber has dialed and pre-translation of the dialed central office code has occurred. These three functions are described in Sections 2, 3 and 4 of this text, in that order.

1.04 The subscriber outgoing call begins when an originating register seizes a completing marker after the subscriber has completed dialing. If the student looks at Fig. 40 of Section 1 of this text - General Description - he will see a block diagram of the outgoing call. The originating register passes the dialed number and line location of the dialing subscriber to the completing marker. The marker examines the called central office code, operates a route relay, selects a trunk to the called office, picks a sender, passes information to the sender, establishes the channel, makes the necessary checks and disconnects. The sender pulses the required digits over the trunk and then disconnects itself. What we have left is the calling subscriber connected to the trunk through a channel. A diagram of this talking connection appears as Fig. 35 on Page 24 in the General Description (Section 1 of this text).

B. ESTABLISHING THE OUTGOING TRUNK CONNECTION

1. General

1.01 After the subscriber has completed dialing, the originating register puts out a marker start signal into its originating register marker connector. The seizure of the marker and the operation of the marker connector has been described in Section 5 of this text under the title - Intraoffice Call. The marker seizure, passage of the dialed digits and subscriber's line location is the same in the outgoing call as for the intraoffice call. OS 701-2 shows the circuit for marker seizure.

1.02 When the originating register is connected to the completing marker, it passes information to it. The marker examines the information so that it can determine what it is to do. Before it can start selecting a trunk, it must know the route. Before it can determine the route, it must examine the called office code. It considers the calling subscribers class of service when operating a route relay. The operated route relay gives the marker the directing information for this call. The route relay tells the marker where the outgoing trunks are located, what kind of sender is needed, how many digits must be pulsed, etc.

1.03 Much of the processes and functions in an outgoing call are similar to intraoffice calls. Seizing the trunk link frame, selecting the outgoing trunk, building the channel, etc. won't be repeated in this discussion. The student is encouraged to review these operations in Section 5 - Intraoffice Call.

2. Translating the Called Office Code

2.01 When the originating register connected to the completing marker, it passed the dialed digits to the marker. On sheet 1 of OS 715-1, we see how the A, B and C digits are sent to the marker. The marker also receives a local translator signal (LT relay operates) and an originating register call signal (OR relay operates). The marker examines the called office code and grounds a code point which is numbered to represent the dialed office code.

2.02 The operation of the translator circuits is the same for an intraoffice call. This process is described in Section 5 of this text under the heading Intraoffice Call.

2.03 Several examples of actual code points are shown on OS 715-1. Some of these examples are the code points of the central offices represented on the marker cross connection sketches. For instance, on sheet 1 of OS 716-1 we have some central offices represented as being in the local area and others in a distant area reached through tandem. The central office names appear as code points on both the code point grounding and marker cross connection sketches.

3. Route Relay Operation

3.01 After the marker has translated the A, B and C digits (which are the called central office code) and after it has grounded the associated code point for this office, it is ready to operate the route relay.

3.02 In order to operate the proper route relay and route series relay, the marker considers the calling subscribers class of service. When the originating register is connected to the completing marker, it passes the class of service information of the calling subscriber. On OS 714-1 we can see this operation. It is the same as for an intraoffice call. The marker receives and stores the calling subscriber's class of service and uses the contacts of these relays to ground two terminals which represent the subscriber's class of service. These punchings are cross-connected to screening relays (S-) as shown on sheet 1 of OS 714-1. Each class of service has two screening relays assigned to it but some classes of service share a common relay.

3.03 In that group of terminals under the heading - SORT 1 - each class of service punching is connected to an individual SW- punching for a screening relay. However, in the circuit under SORT 2, some classes of service share an S- relay and some have an individual relay. The reason for this arrangement is simply that some classes of service not only use the same group of trunks to complete an outgoing route, but also receive the same charge treatment. That is, the route series relay (NCNC or MBS- for instance) is the same. It makes no difference whether our subscriber is a private branch exchange flat rate (PBXF), individual flat rate (IF) or 2-party flat rate (2F).

They all receive the same routing and charge treatment for the various outgoing calls. By using the arrangement under SORT 2, we cut down considerably on our marker cross connections.

3.04 On sheet 2 of OS 714-1, under SORT 2, SWC-0 (PBXF), SWC-1 (IF) and SWC-2 (2F) are all connected to SW28. The contacts of relay S28 will provide the screening paths for these three classes of service for outgoing routes. This arrangement is copied for other classes of service which also get the same routing and charging treatment. If a class of service receives different treatment than the others, it is assigned its own screening relay in SORT 2. For example, look at SWC-3 terminal which represents class of service 03 in Podunk 5 - 4 party flat (4F). Since this class receives a route or charge treatment different than PBXF, IF and 2F, it has its own screening relay. This arrangement is carried on for other classes - coin, for instance.

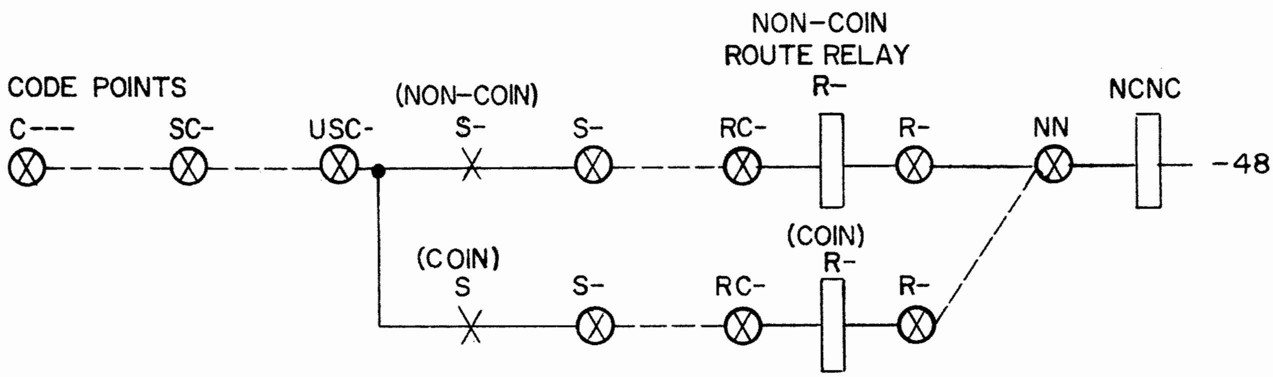
3.05 On sheet 3 of OS 714-1, the marker cross-connection form, this arrangement of grouping classes of service to one S- relay is shown on the lower portion. Screening relay S28 is depicted as serving the first three classes of service columns. These are, of course, PBXF, 2F and IF.

3.06 On OS 716-1 sheet 3, we have the marker cross connections for typical outgoing routes. The code points shown are those represented on sheet 1, the block diagram. The screening relays (S28, S29, etc.) are the same ones that we saw under SORT 2 on OS 714-1, sheet 1.

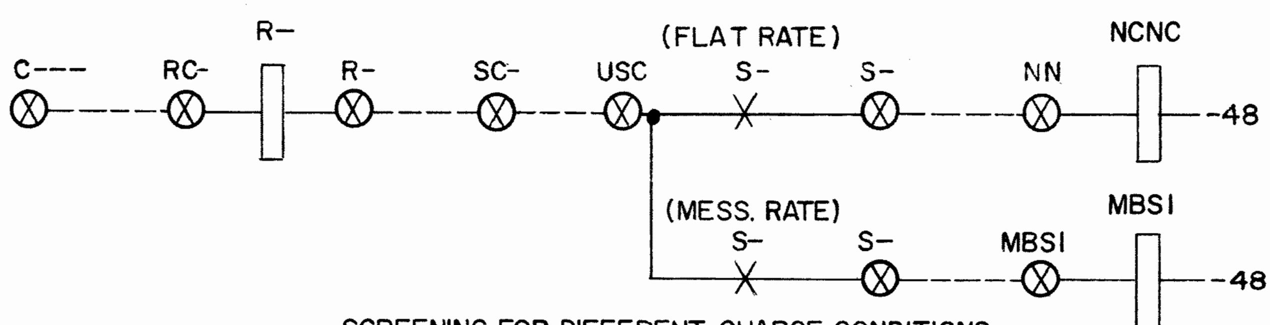
3.07 Let's assume our subscriber making this call is a IF (individual flat rate) in Podunk 5. His class of service number is 01 and on OS 714-1, sheet 1, we see that his associated SWC-1 punching is connected to SW28. This means, of course, his screening relay is S28. If our subscriber has dialed a telephone in the Olympic 3 office, then the 653 code point has been grounded by the marker. This C653 terminal, which appears on sheet 3 of OS 716-1, is connected to SC12 which in turn is connected to USCO for the second group of screening relays (SORT 2).

3.08 If we trace the path of the ground, which the marker placed on the C653 code point we find it connected to SC12. This screening connection terminal is the first one associated with the second set of service relays. SCO to 11 terminals served the screening relays in SORT 1 and SC12 to 23 serve the screening relays in SORT 2. Since our subscriber has individual flat rate service (IF), S28 relay is operated and closes a path through its contacts to its SO terminal and to grouping point SG13. This in turn connects to route relay 30, the Olympic 3 - noncoin route relay, in series with NCNC relay. Our subscriber is allowed this call free. The trunk used for flat rate traffic from PO 6 and PO 6 to OL 3 does not require any class or charge signals from the marker. On this sketch, we can see that the flat rate subscribers are screened to the route relay 30. If our call is made by a coin or message rate subscriber, we operate different route relays. The two coin subscriber classes use route relay 34 and the message rate subscribers use route relay 35. The route series relay in series with route relay 34 is NCCN. This relay stands for noncharge - coin. Actually this is a charge call, but the trunk is designed to charge on all calls so that the marker needn't set a charge signal in the trunk. The route series relay used for message rate classes is MBS1. This is an AMA charge relay. It causes the marker to perform the necessary operations for automatic charging of the call.

3.09 For calls to the Olympic 3 office, the screening relay precedes the route relay. This arrangement is like the one we used on intraoffice screening. However, for the rest of the outgoing routes shown on sheet 3, the route relays precede the screening relays. Fig. 1 is a simple diagram for comparing the two arrangements of screening. If we intend to steer our subscribers over different routes, we place the screening relay before the route relay. When all subscribers use the same route but get different charging treatment, then the screening relay follows the route relay.



SCREENING FOR DIFFERENT ROUTES



SCREENING FOR DIFFERENT CHARGE CONDITIONS

FIG. 1 - SCREENING METHODS

3.10 If we take a look at sheet 1 of OS 716-1 we see that there are two groups of trunks from Podunk 5 and 6 to Olympic 3. One group serves noncoin subscribers in either PO 5 or PO 6 and the other serves coin subscribers.

We have chosen this example of separate groups of trunks for coin and noncoin service to show the student this method of trunking. This trunking plan is used where the coin traffic to an office is enough to warrant a separate group of trunks. Actually we have used three route relays for these trunk groups. Route relay 34 controls the selection of the coin trunks and both route relays 30 and 35 control the selection of the noncoin group. When route relay 30 operates, NCNC operates in series with it and the call is free. This is for flat rate subscribers. When route relay 35 operates, MBS1 operates in series with it. This is a charge call for message rate subscribers. If we consider a call to a Mission 3 subscriber made by a coin telephone subscriber in Podunk 5, we have a different arrangement of trunking. On CS 716-1, sheet 1, we can see that there is only one group of trunks from PO 5 and PO 6 to MI 3. This group of trunks serves coin and noncoin traffic. Our coin subscribers in PO 5 have class of service number 07. Screening relay 31 in SORT 2 is assigned to them. On sheet 3 of OS 716-1 we can see how this works. Code point C643 is grounded by the translator circuit when our subscriber calls Mission 3. S31 screening relay is operated. We have a circuit from C643 through route relay R31, SC13 to USC1 cross connection, operated S31 to winding of DR1. This relay (diverted route No. 1) has a high resistance. It operates but limits the current through R31 so that it won't operate. On the lower right of the sheet we can see how contacts of DR1 operate R13, the coin junctor route relay, in series with NCNC. Because coin junctors only handle coin calls, and because the trunk is designed so that every call is a charge, we don't have to set a coin or charge signal in the trunk. On sheet 3 we have examples of both these methods. Calls to Olympic 3 are screened ahead of the route relay, calls to the other central offices are screened after the route relay.

3.11 Several of the various route series relays, which can be used are shown on sheet 3. For instance if we consider several calls by the various classes of service we run into different route series relays. If a flat rate subscriber in PO 5 (S28 screening relay) calls Mission 3, the route series relay is NCNC. This is a free call for him. However, if a message rate subscriber calls Mission 3, he is routed to MBS1 (message billing index 1) through operated S30 relay. A coin subscriber is routed to DR1 (diverted route No. 1) through his operated S31 screening relay. The operation of the coin call is somewhat different for this example. The operation of coin junctors is discussed in A874.201.11. If we continue to examine the screening of calls to Mission 3 made by subscribers in PO 6 office we get some slightly different results. A flat rate subscriber (S36) is routed to MBS2. This call is a charge call for him. In other words, flat rate subscribers in PO 5 can call Mission 3 for nothing, while flat rate subscribers in PO 6 are charged. On sheet 1 of OS 716-1 it can be reasoned why. The Mission 3 central office is located nearer those subscribers in our marker group who are in the Podunk 5 exchange area. If we look at the relationship between Baring 2 and PO 5, 6, we see just the opposite is true. And upon examining the screening on sheet 3, we see that flat rate subscribers in PO 5 (S28) are charged (MBS2 route series relay) while flat rate subscribers in PO 6 (S36) are not charged (NCNC).

3.12 Another screening condition is shown where a 4-party subscriber in PO 6 dials the Mission 3 code. If we trace this screening path from the C643 code point through operated S37 for the 4F PO 6 customer, we end up at the winding of DRO relay. If we take a call to Baring 2 by a 4-party customer in PO 5, S29 relay also directs the routing to the winding of DRO. In either of these examples the call which the subscriber has attempted to dial is restricted from his use because it is a multiunit charge call. Because the 4-party subscribers can't be charged by the AMA equipment, we divert his call from the original route. In either of these cases, the route relays can't operate because the high resistance of the DRO limits the current flow. DRO does operate, however and causes another route relay to operate which will direct the call to an operator.

3.13 If subscribers should dial either Murdock 6 or Murdock 7 telephone numbers they use a common group of trunks. We see on sheet 3 that both of these code points are connected to winding of route relay 33. This is also shown on sheet 1 - the block diagram. There is one group of trunks from PO 5, 6 to MU 6, 7

3.14 On sheet 3 again, we can trace the results of the screening of calls to MU 6, 7. PBXF, IF and 2F subscribers in PO 5 (screening relay S28) are routed to MBS9 route series relay. Also the message rate subscribers using S30 relay are routed to MBS9. In fact the PBXF, IF, 2F, PBXMR and IMR subscribers of PO 6 are also routed to MBS9 relay. This is another of the automatic message accounting index relays. It is used for multiunit calls when a detailed record of the call is required. Coin and 4-party subscribers calling MI 3 are diverted. Coin reaches the operator through the DR2 (restricted route - coin) and 4-party reaches the operator through DRO (restricted route 4-party). In either case route relay 33 doesn't operate.

3.15 Four examples are shown on the block diagram on sheet 1, of offices which are reached through a tandem switching center. Woodlawn 3, Hubbard 2, Fairview 3 and Main 3 are some distance away. There are no direct trunks from PO 5, 6 to these offices. On sheet 3 we notice that the code points of the first three of these offices are connected to a grouping terminal CG2 (code grouping). This assignment is, of course, arbitrary. It is merely a convenient place for connecting those codes which must ultimately connect to the same point. Likewise we see the other side of route relay 25 is connected to a common grouping point, RG- (route relay grouping). These punchings are assigned and offer a convenient place for grouping the connections from route relay windings when they must connect to a common point - SC15 in this example.

3.16 The various screening arrangements for calls to these three offices are similar to those we have talked about. However, we have one office left, Main 3. This central office a code is intercepted at some distant point. It is a free call for those subscribers who could dial it when it was a working code but coin and 4-party customers are restricted from this route. The route series relay MBSO, is an AMA index. It is a noncharge condition.

3.17 The various examples of route relay arrangements on this sheet are typical. They will agree with the arrangements in working offices to the extent that our fictitious central offices, Podunk 5 and 6, are similar to that office. By studying the various arrangements on this and other route relay sheets in this series, the student can better understand the ones he may encounter in his own office. The assignments used on these sketches are, of course, arbitrary. They are written out on the route relay cross connection sheet on OS 714-1 so that the student can learn how this information is presented and so that the student has a handy record of the relay and terminal assignments used on this sketch.

4. Selecting the Outgoing Sender

4.01 General: After the completing marker has operated the route relay it can select a sender and trunk link frame. The selection and seizure of the trunk link frame and trunk is the same as for an intraoffice call. This process is explained in Section 5 - Intraoffice Call. Before the marker can select a trunk link frame, it must have seized an outgoing sender connector. The marker selects the proper kind of sender and attaches or connects it to the trunk through the outgoing sender link. This part will describe the method of selecting and seizing an outgoing sender.

4.02 On Fig. 40 of the General Description, which is in Section 1 of this text, the completing marker is now in position to do step 2 of the block diagram. The route relay indicates the sender type needed and then the marker seizes an outgoing sender connector.

4.03 All of the outgoing senders are arranged in groups according to type of pulsing. There can be maximum of ten senders in a sender group. A sender group is divided into two subgroups, A and B, having a maximum of five senders each. The two subgroups of an outsender group are assigned to different connectors on the same connector frame. This is done to avoid having all of the senders of a group inaccessible to the markers should an associated connector fail. The connectors are designated with the subgroup indication. There is a connector for subgroups A and another connector for subgroups B. Two outgoing sender connectors are required to serve an outgoing sender group. Subgroups of other outgoing sender groups are assigned to these same connectors, but all senders in the same group must be assigned to the same pair of connectors if there are more than two outgoing sender connectors. For calls requiring senders, the marker gives alternate preference to senders in subgroups A and B. However, if all senders are busy in the preferred subgroup, the marker chooses a sender in the other subgroup connector.

4.04 When more than ten outgoing senders of the same type are needed in a marker group, we can make two or more sender groups of this type. Each of these sender groups is associated with a different group of outgoing trunks. The cross connections on the route relay direct the marker to pick an outgoing trunk (TB-, TG-) which is located on the same switch as the outsender (OS-). When more than ten senders of one kind are needed, the two or more groups of these senders are considered as different kinds as far as the marker is concerned. This is necessarily so because senders in these groups would be located on different switches on the outsender link frame. The marker must pick an outgoing trunk and outsender which appear on the same frame. However, where more than twenty outgoing trunks of the same route are assigned to a trunk link frame, the trunks are subgrouped. The trunks in the subgroups are assigned equally to the two sender groups. In this case, the marker is provided with a two step allotter circuit which selects one of these two trunk subgroups. The selection of the subgroup of trunks identifies the sender group for this call.

4.05 Between the marker and the outgoing sender there are two channels, a common channel and an individual channel. The common channel (Fig. 2) connects all markers to a sender subgroup. It is established by the operation of the outgoing sender connector relays. The common channel extends the registration (A to L digits) and route information (delete, code pattern, etc.) leads to the selected sender. After this information is transferred to the sender and checked, the marker releases this channel. Then it can be used by other markers connecting to other outgoing senders in the subgroup. Between each marker and each sender there is an individual channel. Fig. 3 shows this arrangement. A marker has five control leads which bridge on contacts of one S- relay for each sender. The other side of the S- relays are wired to their associated senders. On the sender side, the multiple is common to all S- relays for one sender, for all the completing markers. To sum up this point, we can say there is an S- relay for each sender, for each marker in the office. The control leads let the marker retain control of a sender after the common channel is released. The common and individual channel arrangement is used so that a marker ties up the whole sender subgroup (connector) for only a short time. The marker retains control over the sender until it finishes the outgoing call.

4.06 During outpulsing the senders are connected to the outgoing trunks. This is accomplished by having the trunks and the senders appear on crossbar switches of an outgoing sender link frame. The senders appear on horizontals of the switches and outgoing trunks appear on verticals. This provides a flexible means of connecting any trunk to any sender in the group which serves it. When outgoing trunks are not allotted, all the senders of one type have access to all the outgoing trunks which require senders of that type. When outgoing trunks are allotted, all of the outgoing senders in one group (maximum 10 per group) have access to one group of allotted trunks, and all of the outgoing senders of the same type in the other group have access to the other group of allotted trunks.

4.07 On OS 729-1 we have the circuit for operating an OSG- relay. The R- contacts shown, ground a punching OS-. These contacts represent those of any of the various route relays which are associated with the outgoing routes shown on OS 716-1, sheet 3. There is an OS- terminal for each route relay. It is numbered the same as its route relay and is cross-connected to the OSC- terminal which represents the kind of sender (dial pulse, multifrequency, etc.) which is required for pulsing on trunks in this route. Generally we can say that dial pulse senders are used to pulse to step-by-step offices, multifrequency senders to crossbar offices and panel call indicator to manual offices with "B" switchboards. The actual kind of pulsing depends on the central offices in each area.

4.08 The operated OSG- relay represents one group of a maximum of ten groups of senders OSGO to 9. All the senders in a group are the same type, either MF, DP, PCl, etc. While we can have ten groups of senders, there are only five different types of senders which can be used. They are MF, DP, PCl, REV and IMG. There can be ten senders of a type in one group. Each group of senders is divided into two subgroups - A and B. If we have, for instance, three groups of outgoing senders, OSGO, OSG1 and OSG2, then we have six subgroups of senders. All the A subgroups are associated with connector 0 and all the B subgroups with connector 1. In this example there could be thirty senders in the office, fifteen in each connector.

4.09 The operated OSG- relay cuts through test leads from each sender subgroup to the marker. An idle sender in a subgroup grounds a lead common to the subgroup which indicates its idleness to the marker by operating SIA for subgroup A or SIB if it is in subgroup B. If a connector is busy, it signals the marker by operating GBA (group busy A) or GBB (group busy B) relays in the marker. The ground which operates a GBA or GBB relay in a marker, comes from an operated multicontact relay (MA1) in the connector. Of course if this relay is operated in a connector, it means that some other marker is working there. The marker attempts to select an idle connector which has one idle sender of the kind it needs.

4.10 If both connectors are idle (GBA and GBB relays not operated) and both connectors have idle senders of the kind it wants (S1A and S1B operated) then the marker uses its sequence circuit to select a connector. If either connector is busy the sequence circuit is ineffective in the selection process. For example on OS 729-1, if some other marker is working in connector 0, then it would have its associated MA1 relay operated in this connector. This sends a ground to the other markers indicating a busy connector. This ground would operate the GBA relay in our marker. Because all senders in subgroup A are in this busy connector, the operated GBA contacts close a path around the sequence relay contacts in the B subgroup start lead. This allows our marker to seize subgroup B when the sequence circuit says take subgroup A.

4.11 Also we must consider the case when both connectors are idle, but only one of them has idle senders of the kind we want. Suppose on this call that connectors 0 and 1 are not engaged with another marker and connector 0 has no idle senders of the type we need. Neither GBA nor GBB would be operated in our marker. However, S1A would be normal and S1B operated. S1A being normal, opens the path for seizing connector 0. Operated S1B closes the path for seizing connector 1.

4.12 In both sender connector start leads we see normal contacts of the SP relay bridged by the SKA or SKB operated. If the marker runs into a trouble condition before seizing the outgoing sender, the SP (stop progress) operates to prevent its seizing the connector when it can't use it on the call. The SKA or SKB contacts bridge the SP normals so that if the marker runs into trouble after it has seized the connector, it doesn't lose it when the SP operates. In both start leads we have contacts of the FTCK relay. This prevents the marker from seizing a connector if there are no idle outgoing trunks of the route it desires.

4.13 Now that the marker has decided which of the two outsender connectors to seize, it puts out start lead battery which operates its MP- relay in the preference control circuit. The operated MP- relay sends a ground back to the marker operating the SKA (sender connector check) if group A is seized or SKB if group B is selected. The preference control circuit for each outsender connector is the same as the preference control circuit for the trunk link and line link connectors. The student can review this operation in Section 5 - Intraoffice Call. As soon as the SKA or SKB relay operates, the marker can seize a trunk link frame.

5. Trunk Link Frame and Line Link Frame Seizure

5.01 The marker can perform the process of trunk link frame selection as soon as the route relay operates. The TB- and TG- cross connections direct it to the trunks for the outgoing route. However, the marker must wait for an indication that it has seized an outsender connector before it can put out start battery to operate the MP- relay for the trunk link frame.

5.02 The marker has the calling subscriber's line location and uses the frame tens and units information to steer it to his line link frame. Yet it must wait for a signal that it has seized control of a trunk link frame before it can put out the start battery for the line link frame MP-relay. This path is closed by TFK2 relay. TFK2 operates where marker seizes the trunk link connector.

5.03 The marker is designed this way so that equipment is not needlessly tied up when a call can't be completed. For instance, suppose there were no idle senders when our marker attempted to do this SOG job. There would be no good in seizing an outgoing trunk to an office which we couldn't connect to for lack of a sender.

6. Connecting the Marker to the Sender and Sender to the Trunk

6.01 General: The outgoing sender connector has three parts. The preference control circuit (MP, EP, relays) the marker part of the connector (MA1, MA2, etc.) and the sender part (SA1, SA2, etc.). The preference control circuit allows one marker at a time to work the connector. The marker part of the connector is a group of multicontact relays (one set for each marker) which place the marker on the common connector multiple. The sender part is also a group of multicontact relays (one set for each sender) which place the sender on the same common multiple. When these two sets of relays are operated, many leads are closed from the marker to the sender.

6.02 In the marker part of the outsender connector, we have the OSGA0 to 4 in connector 0, and OSGB0 to 4 in connector 1. These relays are assigned to outsender groups by the A- to OSGA0 to 4 cross connection. For instance if OSG0 relay in the marker represents the multifrequency group, then the multifrequency senders in connector 0 (subgroup A) would be assigned to OSGA0 relay. OSGA0 terminal would be cross-connected to the A0 terminal. There is an OSGA0 relay in connector 0 for each completing marker. Generally, we can say that in outgoing sender connector 0 there is one OSGA- relay for each sender group, for each marker. If we have in our office three groups of senders and four completing markers, our OSGA- relays would total fifteen. Of course, in connector 1 we would have fifteen OSGB- relays also. We can have a maximum of five outsender groups in an outsender connector but we are limited to only fifteen senders in a connector. Whatever arrangement of senders in a connector we have is limited by these factors.

6.03 The OSGA- or OSGB- relay which is operated, is common to our marker and to our sender subgroup. It operates the multicontact relays in the connector which are associated with our marker. This operation connects the marker to the common multiple between all completing markers and this one outsender connector. OS 730-1 shows the operation of the connector relays MA1, MA2, MB1, MB2, MC1, MC2. There is a set of these relays for each completing marker in each connector. Also on this drawing we can see how the marker selects one sender of a subgroup. If our marker has seized connector 1 we can trace the circuit for operating a particular OS- relay. We have said there can be five outsenders in a subgroup. The marker has five OS relays for picking a sender in a subgroup. The operated OSGB- relay for the sender subgroup, for our marker, closes through leads from the windings of the OS0 to 4 relays to the five senders in a subgroup. If any sender in the subgroup is idle, it grounds its lead which operates its representative OS- relay in the marker circuit. The marker uses its sequence circuit to select an operated OS- when two or more are operated. This selection circuit works on the same principle as the trunk selection circuit. The sequence circuit rotates the preference. The OSE (outsender selection end) relay operates when any one OS- operates. It acts as a gate - it opens the selecting leads from the marker to the connector as soon as one OS- operates. Any operated OS- relay operates OSE1 on OS 730-1. OSE1 operates OSK (outsender check) which in turn operates FKA. Now we have a path for operating the S- relay for our selected sender. There is an S- relay for each sender, for each completing marker. They are numbered S0 to S14 and correspond to the S0 to S14 punches on the trouble card. The operated S- relay closes the individual channel between our marker and the selected sender. The marker uses this channel for control leads. It will keep this connection closed until it disconnects at the end of the subscriber outgoing job. The operated S- relay operates associated connector relays which put the selected sender on the connector common multiple. These are the SA1, SA2, SB1, SB2, SC1, SC2 multicontact relays. Now there are a lot of leads cut through from the marker to the sender. The marker uses these leads to pass to the sender all the information required for the call. The S- relay also operates the ON1 on OS 731-1 and the ON1 operates the SB. The operated SB makes this sender appear busy to all markers from now on until it releases when its job is done.

6.04 The marker must now connect the selected **sender** to the selected outgoing trunk. Its particular problem is to close the proper crosspoints on one of the outsender link switches so that the trunk and sender will be connected. Senders are connected to horizontals of outsender link frame switches and trunks are connected to the verticals. The switches have twenty verticals. All the verticals of a particular switch are associated with a trunk link frame. One or more switches, as required, are assigned to a trunk link frame. For instance, if in a particular office, there are sixty trunks on each trunk link frame which require pulsing, then three switches would nearly accommodate them. Of course in practice we must allow for growth. However, for the purposes of instruction we can assume each trunk link frame would have three outsender link switches. The first three switches on OSL0 would be assigned to trunk link frame 00, the next three switches would be assigned to trunk link frame 01 and so on. See Fig. 4 for a diagram of this arrangement. The senders are assigned to the horizontals of the switches. All the senders of a type are grouped on one switch. Therefore all those trunks of a trunk link frame which require multifrequency pulsing must be assigned the verticals of only one of the switches for that trunk link frame and they must be assigned to that particular switch which has the multifrequency senders on its horizontals. Now we can say about a particular outsender link switch that it belongs to a certain trunk link frame, and is used for a certain kind of pulsing.

6.05 This arrangement of trunks and senders simplifies our markers problem of finding the proper select and hold magnets for the sender and trunk it has picked. On OS 731-1, sheet 1, we see an arrangement where each trunk link frame is assigned two outsender link switches. Switches 0 and 1 are MF and DP and are associated with trunks on TL00. Switches 2 and 3 are MF and DP for TL01 and so on. The two verticals shown (zero left and nine right) represent the twenty verticals on the switches. Two levels are shown which represent the ten levels of the switch. The capacity of switch 0 is ten multifrequency senders and twenty trunks requiring multifrequency pulsing. All twenty trunks are assigned to TL00. We can see that the paths for operating SS0 to 4 (select magnets) are through contacts of OS0 to 4 and SSA (sender subgroup A) relays. The paths for SS5 to 9 are through OS0 to 4 and SSB (sender subgroup B). This implies that those senders on levels zero to four are in subgroup A and senders on levels five to nine are in subgroup B. Those senders in any A subgroup which are selected by OS0 relay in a marker will occupy level zero of the switches on which they appear. Similarly, senders selected by OS1 will be on level one and so on. In sender subgroup B, those senders selected by OS0 will occupy level five, those senders selected by OS1 will be on level six and so on. No matter what sender the marker chooses in either subgroup, the operating path for the select magnet for a sender is through operated contacts of a trunk link connector relay. Because our marker has already seized the trunk link frame, and has the connector relays operated, it uses this means to direct it to those switches on the outsender link frames which are associated with the trunk link frame it has selected. The operation of one SS0 to 9 select magnet operates SHK which in turn operates SHKA. When a marker operates the select magnet for a sender on a particular switch, it also operates the select magnets on corresponding levels on all other switches associated with the trunk link frame with which it is working. For example, if in a particular office each trunk link frame has three outsender link switches associated with it, and a marker has selected a sender which appears on level zero of one of these switches, it also operates the two other magnets for levels zero on the two other switches. However, only one trunk on all the sixty verticals of these three switches can have its F relay operated at one time. Therefore, the two extra select magnets which operate do no work nor cause any trouble.

6.06 Now the marker must operate the hold magnet for the particular vertical of the particular switch that has our trunk on it. The hold magnets are grounded on one side. On OS 731-1, sheet 1, each hold magnet is connected by one wire of a cross connection to a lead which carries its winding to operated contacts of an F relay in the trunk. Of all the trunks on all the outsender link switches associated with the trunk link frame used on this call, only our trunk has its F relay operated. This is naturally so because our marker has seized this trunk link frame and has selected this particular trunk. This carries the operating circuit to the trunk link connector and thence into the marker. The marker has two methods of operating the hold magnets. They are the same as the methods described for operating hold magnets on trunk link and line link frames. This operation has been described in Section 2 - Dial Tone Call. After the hold magnet on the outsender link is operated, the ON relay on OS 731-1, sheet 2 operates. Its path is through the operated crosspoints on the HM lead, through the operated F relay of the selected trunk, through the operated contacts of the select magnet associated with the sender, the operated contacts of M relay in the trunk link connector to the marker circuit and ground through winding of SLK. Now the selected outgoing sender is connected to the outgoing trunk through the operated crosspoints.

7. Transferring Information to the Outgoing Sender

7.01 When the outsender connector relays operated, they closed through leads from our marker to the sender. The marker passes information over these leads, checks that it is locked up in the sender and then releases the common channel between itself and the sender.

7.02 The marker transfers the following information to the outgoing sender:

(a) Office code and numericals of the called line.

(b) Number of digits to be outpulsed.

(c) Arbitrary digit to be prefixed in outpulsing.

(d) Speed and pulsing condition required.

(e) Type of trunk test required.

7.03 On OS 719-1, sheet 2, we see the gating relays in the marker. These relays were operated when the marker started to select an outsender. In operating, these relays allow the grounds from the contacts of the digit register relays in the originating register to operate the digit register relays in the marker. This operation is shown on sheet 1. The AC, BC and CC relays in the marker have already played a part in this call when the code point was grounded. The marker digit register relays operate, two-out-of-five for each digit to correspond to the dialed digits which are stored in the originating register. On sheet 1, we can trace a ground in the originating register from the ON1 and MST1 relays operated through the last steering relay operated to the "7" lead of the digit register which is one higher than the last digit dialed. This single "7" is carried through the circuit from originating register to marker to outsender. It is used to indicate the last digit position. Table A shows the operation of the digit register relays including the extra "7" in the last plus one digit register. If the digits dialed happen to fill up the complement of the digit registers (eleven digit toll call) then the ground comes into the marker on the M7 lead and operates the ST7 relay.

TABLE A

Number of Digits Received by Marker	2/5 Digits in Registers	Single "7"
1	A	B7
3	A-C	D7
4	A-D	E7
5	A-E	F7
7 - Intraoffice (AMA Call) and Outgoing Call	A-G	H7
8 - Outgoing Call to Manual Office (With Party Letter)	A-H	J7
10 - Subscriber Dialed Toll Call	A-K	L7
11 - Subscriber Dialed Toll Call and Party Letter	A-L	ST7

7.04 When the digits are received by the marker and passed on to the outsender, the marker makes a check of the information. On FS 76 of SD-26002 (the completing marker) it operates two relays in series. The ORK1 and ORK2 (originating register check) operate through contact chains of the A to L relays. The contacts of the A to L relays, shown on this FS, belong to the A to L digit register relays in the marker shown on OS 719-1, sheet 1. There is one path for getting through the A relays, it is when two out of five of them are operated. There are two paths for getting through the B relays. When two of them are operated or when only B7 is operated, we can go through. There are three paths for getting through all the others: (1) when two out of five are operated (2) where none are operated (3) when a single seven is operated. By using Table A, the student can trace the paths for various numbers of digits stored in these relays. We will see what purpose the ORK1 and ORK2 perform after we see how the other information is passed to the sender.

7.05 The marker has to tell the outsender how many digits to outpulse. If our subscriber dials a telephone in a nearby central office, he will dial seven digits. The sender does not have to outpulse the office code if we have direct trunks. On OS 716-1, sheet 1 which is the block diagram of our central office area, we can see that for a call to Baring 2 central office we have direct trunks. The marker would tell the sender to delete three digits. That is, outpulse the D, E, F and G digits. However, if our call was to Murdock 7, we would have to send five digits. There is a common group of trunks serving both of these offices, therefore we would have to send the "six" or "seven" of MU 6 or MU 7 to direct the call to the proper central office. In this example, the marker would tell the sender to delete two digits. That is, outpulse the C, D, E, F and G digits. For a third problem consider a call to Fairview 3 central office. We can see on the block diagram how this call is reached through the tandem switching center. We would have to send the entire office code out so that the tandem office could translate it for connecting to Fairview 3. In this case our marker would tell the sender to delete no digits. That is, outpulse all of them A to G.

7.06 The delete information comes from a DL- punching of the route relay. Each route relay has one and it has the same number as the route relay. There are fifteen punchings in the marker which represent various delete conditions. They are numbered DLOS to DL6S, DLOP to DL6P and NDI. The DL- punching of a route relay is cross-connected to one of these punchings according to the marker cross connections for the office. The meanings of these punchings are explained in the D section of SD-26002-01 (completing marker). So that the student can understand this process, we will discuss the three examples in paragraph 7.05.

7.07 Our first call was to Baring 2. The route relay assigned to Baring 2 is R32. We want the sender to outpulse only the D-G digits, which is to say - delete three digits. On sheet D8 of SD-26002-01, cross connection table Part 6, we can see that the DL3S punching represents the deletion of the A, B and C digits with no 11 prefix. This is what we want. So DL32 is cross-connected to DL3S. On FS64 of SD-26002-01 this allows our route relay R32 (Baring 2) to operate the DL3 and DLS relays.

7.08 Our second example was a call to Murdock 7; delete the A and B digits. The route relay assigned is R33. In the same cross connection table, we can see that DL2S stands for deletion of A and B digits with no 11 prefix. And so we cross-connect DL33 to DL2S. This would cause the route relay to operate DL2 and DLS relays.

7.09 The last example was a call to Fairview 3. The route relay is R25. It is reached through a tandem center and so we pulse all seven digits. This means we delete no digits. In the cross connection table we find that punching DLOS represents this condition. Cross-connect DL25 to DLOS. This causes DLO and DLS relays in the marker to operate on this call.

7.10 There is one example which differs in principle from these. On intraoffice calls for message rate subscribers where AMA trunks are used, the marker attaches a sender. This is so because the sender acts as the liaison between the crossbar and automatic message accounting equipment. The marker must use a sender on intraoffice AMA calls. The sender doesn't pulse. We use the NDI punching (no digits - intraoffice) for this. For our central office which we have followed on the operational sketches, DL21 (the DL punching of route relay 21 - the IAO AMA route relay) is cross-connected to NDI. This sends an indication to the outsender that tells it not to pulse digits.

7.11 The marker also transmits class control information to the outsender. This part comes off of the CL- punching of the route relay. There is a CL- punching for each route relay and it is numbered the same as its route relay. There are twelve class punchings in the marker numbered CL0S to CL5S and CL0P to CL5P. Each route requiring a sender has its route relay CL-punching cross-connected to one of the twelve class punchings. These class control relays cause the marker to transmit various kinds of information. The particular kind of class control needed depends on the kind of pulsing, kinds of trunks, etc. Part 7 on sheet D9 of the marker drawing - SD-26002-01 - describes the several features of class control. Whatever kind of class information is used on a call is checked by the marker to see that it is locked up in the sender. The class check operation is discussed in a later paragraph.

7.12 If one arbitrary digit is to precede the numericals of a called number, the CR cross connection in the marker is used on the route. The marker grounds the CR- leads through the outgoing sender-connector to operate relays CR $\frac{2}{5}$ (code route) in the outgoing sender. The CR $\frac{2}{5}$ relays are used to record the arbitrary digit preceding the numericals of the called number. Arbitrary digits are used to give a physical, theoretical, or extheo code indication. They are also used to give an office A or an office B indication to the terminating office, or as directing digits for step-by-step tandem. If these relays are not operated, the sender DCR (delete code route) relay operates to bypass the arbitrary digit relays.

7.13 In dial pulsing senders, it is possible to affix one, two or three arbitrary digits. If two or three arbitrary digits are to be prefixed to the outpulsed number, the ARN, BRN, and CRN cross connections in the marker are used on the route, as required. The marker grounds the AR-, BR-, and CR- leads through the outgoing sender-connector to operate relays AR $\frac{2}{5}$, BR $\frac{2}{5}$, and one CR $\frac{2}{5}$ (arbitrary digit) in the outgoing sender. When a converted code consists of two arbitrary digits, the tens digit is determined by relays BR $\frac{2}{5}$ and the units digits by relays CR $\frac{2}{5}$. When a converted code consists of three arbitrary digits, the hundreds digit is determined by relays AR $\frac{2}{5}$, the tens digit by relays BR $\frac{2}{5}$, and the units digit by relays CR $\frac{2}{5}$.

8. Check of the Information in the Sender -- Non-AMA Call

8.01 The marker has passed the necessary information to the outsender for a non-AMA call. It gives the sender time to lock up the information and then cuts off the grounds which operated the marker and sender relays. If the sender has successfully locked in all the information, it returns a ground on each of the several leads used. This ground holds up the particular relay in the marker that is connected to the lead. The marker then checks to see if all the relays remain operated. In Paragraph 7.04 of this section, we checked for two out of five of the dialed digits by operating the ORK1 and ORK2 relays in series. The marker will cut off the operating grounds that operated these relays and then check if the ORK1 and ORK2 remain operated. It performs a check similar to this for the class, delete and arbitrary digit information.

8.02 On FS64 of SD-26002-01 (completing marker), we examined the class and delete relay operation. For our particular call we have one of the CLO to 5 and either CLP or CLS and one of the DLO to 6 and either DLP or DLS relays operated. To get down to particular cases let's assume we have an individual flat rate customer in Podunk 5 calling a subscriber in Mission 3. This is a free call; no AMA features are involved. If we assume that Mission 3 is also a No. 5 crossbar office, then we can assert that multifrequency pulsing would be used. A look at the cross connection table, Part 7 on sheet D9 of SD-26002-01, tells us we should cross-connect CL31 (CL punching of Mission 3 route relay) to CL2S. This operates CL2 and CLS relays on FS64. This particular class doesn't send a signal to the sender. However, we must operate class relays in the marker in order to provide a checking path.

8.03 The delete information was discussed in detail in previous paragraphs. Let us simplify; say for this call that we want to outpulse the four digits of the telephone number and delete the A, B and C digits. Looking at Part 6 of the cross connection table on sheet D8, SD-26002-01, we see that we must cross-connect our route relay punching DL31 to DL3S. This operates the DL3 and DLS relays in the marker. The DL3 relay grounds the DL3 lead to the sender, operates the DL3 relay in the sender which locks and returns ground back on the lead to hold the marker DL3 relay operated. See FS69 on SD-26002-01. The ground for operating the DL3 relay in the sender comes through operated TGS1 contacts (transmit ground supply relay). This relay was operated when the marker started to seize an outsender connector. The TGS1 relay supplies grounds for any delete, class, code route (compensating resistance) leads that must be grounded by the marker for outsender information.

8.04 A sender can be made to send out one, two or three digits before pulsing the regular complement of digits. Such digits as these are called arbitrary digits. They are controlled by the connection on the CR- punching of the route relay. These digits are used in complex numbering areas where certain central offices have the same digits. In this situation, one of the conflicting codes is given an arbitrary assignment to replace its central office code. The subscriber isn't aware of this, however. He dials the regular office code. The route relay for this route has its CR- punching connected to one of the CRO to 4P or CRO to 5S punchings shown on FS62. This connection is used where one arbitrary digit is assigned to a route. For two or three arbitrary digits the code conversion relays CV- are used. FS62 shows this feature. If any arbitrary digits are required, the marker passes them to the sender and checks that they are locked up in a way similar to the delete and class information. However, for the particular call we set up in Paragraph 8.02, no arbitrary digits are required. In cases like this, the CR- punching of the route relay is connected to the CR5S terminal. So for our route, we cross-connect CR31 to CR5S on FS62.

This operates the CR5 and CRS relays in the sender. On FS66 we see how the different CR- relays that are operated causes either the CRK1 or CRK2 relays to operate and how they also send a ground to operate a relay in the outsender. The contacts of CR5 do not appear in this circuit. Because we don't want to set up any kind of arbitrary digit information in the sender, we used this relay for our call. However, some one of the CR- relays must be operated so as to provide a checking circuit path for the marker.

8.05 On FS77, when the outsender connector relays operated to let all this information pass to the sender, the marker operated its OST1 relay (outsender timing). The OST1 then operates the timed-operate OST relay. The OST operates OST2 and then OST2 starts the action to cut off all the grounds which operated the marker and sender relays. It first releases the KG relay on OS 719-1, sheet 2. This in turn releases the gating relays which cut off the ground supplies from the originating register that operated the various digit register relays in the marker and outsender. If the sender has all the digits locked up, it will return grounds back on these leads to the marker which hold up its own relays as well as the markers. If this is successful, the ORK1 and ORK2 relays in the marker remain operated.

8.06 The OST2 relay also opens the path of the TGS1 releasing it. The TGS1 then removes the ground supplies for operating the CLK-, DLK- and CRK- relays which were operated on FS66, FS67 and FS69. On our call, we decided that DL3 lead would be grounded. This operated DLK1 relay on FS69. The released TGS1 removes the operating ground but the sender returns its locking ground on the lead to keep DLK1 operated. We also decided, on this call, that no class leads to the sender would be operated. Yet in the marker, the CL2 and CLS relays are still held operated by the route relay.

8.07 When the OST2 relay operated, it released the OST1 on FS77. The OST1 in releasing releases the OST timed release relay. Now we can operate the RSC (registration sender check) relay. This is the relay which is going to check that all the relays operated in the marker are still being held by the sender. Because the path of the RSC relay is intricate, we will examine it here. It operates through the normal XT5, AMA5, ND1, NDK, through either CVS normal or H wiring, CR5 operated for our call, CL2 and CLS operated for our call, DLK2 and DLK1 operated, normal AMA3, operated ORK1, ORK2 and OST2, normal OST, OST1, OSE1 and operated OST2.

8.08 When the originating register connected to the marker, it grounded a lead to the marker which operated the OR relay. This identified the call as coming from an originating register. On FS77, we can see that the OR operated the GTL and GTL2 relays. On an outgoing call such as we are following, which is not an AMA charge call, the GTL and GTL2 relays remain operated until the marker disconnects. On FS1, the operated GTL2 relay allowed the calling line location to be passed into the marker where it was stored in a relay circuit. On FS2, we see how the contacts of these relays provide a checking path for the RK1 and RK2 relays. The marker functions for transferring the calling line location from this relay to the relay which controls line link frame seizure, is the same in an outgoing call as it is in the call-back stage of the intraoffice call. This process can be reviewed in Section 5 - Intraoffice Call.

8.09 When the marker has operated RSC, it has an indication that all the required information has been successfully transmitted to the sender, is locked in and that the sender has returned a ground to the marker on each lead used. Now the marker can release the common channel in the outsender connector.

On OS 729-1, we see how the operated RSC releases the OSC. The OSC in turn releases the MP- and multicontact relays that provided the common channel between the senders and our marker. However, the marker still keeps a few leads in the individual channel. These will be used to control the sender functions later on in the marker's SOG job. On OS 730-1 we can see that the S- relay which has been operated, will continue to be locked up until the marker disconnects. This S- relay is associated with the sender we are using and with our marker. In other words, in an outsender connector there is an S- relay for each sender, for each marker.

9. Check of the Information in the Sender -- AMA Call

9.01 When an AMA charge is involved in a subscriber outgoing call, more information must be considered by the marker and passed to the sender. This information is the calling subscriber's line location, the central office code structure, the structure of the called telephone number, whether the calling subscriber is a tip or ring party and message billing index.

9.02 On OS 716-1, sheet 3 suppose a 2-party message rate subscriber in Podunk 6 is calling a subscriber in Baring 2. If we trace the route relay path through R32 to SC14 and through operated screening relay S38 (this is his assigned S- relay - see OS 715-1, sheet 3) we see that the route series relay is MBS1. One of the MBS1 to 9 relays operate when an AMA charge is involved.

9.03 On FS42 of SD-26002-01, we see that the MBS1 relay operates AMA relay. The path is through FN normal, MBS1 operated, normal FN, OPR, BL, VP and CAA relays to ground. On FS78, the AMA operates AMA3, 4 and 5. On FS60, the AMA3 allows the MC and SC multicontact relays to operate in the outsender connector. These relays pass to the sender the additional information mentioned in Paragraph 9.01.

9.04 On FS64 we see a punching CP- associated with a route relay. Each route relay has a CP terminal numbered the same as its route relay. For our call to Baring 2 the punching is CP32. It should be connected to one of the CP0 to 9S or CP0 to 9P terminals according to Part 5 of the cross connection table on sheet D8 of SD-26002-01. On our call there are three digits in the called office code. We have three choices for our cross connection. They are CP3P, CP3S, CP8P and CP8S. However, each of these four terminals represents a different number structure of the called telephone number. The terminals are explained in Table B. They are used for four different kinds of telephone numbers.

TABLE B

	Central Office Type	Number Central Office Code Digits	Typical Tel. No.	Cross-Connect Route Relay CP- Terminal To	Number Structure
1.	Dial - Less than	0	1234	CP0P	4DG
	10,000 Lines	1	A1234	CP1P	"
		2	AB1234	CP2P	"
		3	ABC1234	CP3P	"
2.	Dial - With Numbers	0	1034 or 10345	CP0S	5DG
	Over 10,000	1	A1034 or 10345	CP1S	"
		2	AB1034 or 10345	CP2S	"
		3	ABC1034 or 10345	CP3S	"
3.	Manual With Individual	0	1034, 1034J or 10345	CP5P	L5D
	Lines, Party Lines and	1	A1034, 1034J or 10345	CP6P	"
	Individual Lines Higher	2	AB1034, 1034J or 10345	CP7P	"
	Than 9999	3	ABC1034, 1034J or 10345	CP8P	"
4.	Manual With Individual	0	1234 or 1234J	CP5S	L5T
	and Party Lines - No	1	A1234 or 1234J	CP6S	"
	Numbers Over 9999	2	AB1234 or 1234J	CP7S	"
		3	ABC1234 or 1234J	CP8S	"

9.05 The CP32 punching of the Baring 2 central office route relay is cross-connected to one of the punchings according to which one of the four general categories it comes under. If Baring 2 is a crossbar office then we connect CP32 to CP3P. This connection would allow the Baring 2 route relay to operate CP3 and CPP relays on FS64. On FS70, we can see that the CP3 relay grounds the CP1 and CP2 leads to the sender when the TGS2 operates. The CPK1, 2 relays also operate and will perform the check of these leads for the marker.

9.06 The CP3 and CPP relays also ground 4DG lead on this page. The operated TGS2 supplies the ground and operates NSK1 relay (number series check). NSK1 will perform the check of these leads similarly to the other lead-checking relays.

9.07 The MBS1 relay which we operated in series with R32, the Baring 2 route relay, sends message billing information to the sender. On FS68, the MBK (message billing check) relay operates if one MBS- is operated. The operated MBS1 and MBK ground MB0 and MB1 leads to the sender, operating the MB0 and MB1 relays there and also operating MBK1 and MBK2 in the marker. The operated TGS2 supplies the ground.

9.08 On FS65, the SCC operates from the operated OGC. The SCC relay (service call) (operates on all customer calls; the TVA (transverter test) operates on AMA test calls. Either NOB or OBS operates from a ground in the originating register depending on whether or not our call is observed. On FS69 these relays send signals to the sender so as to operate appropriate relays and also operate check relays - MBK1, 2, 3 - in the marker.

9.09 On FS1 we see how the calling line location passes from the register to the marker through contacts of the GTL2 relay, and then on to the sender through operated MC and SC in the outsender connector. Part of the information needed to complete a successful check of the calling subscriber's line location is the number of the line link used on the dialing connection. On FS46 we see how this information passes from the originating register to the marker and is stored on two out of five of the LL- relays. On FS2, the RK1 and RK2 (registration check) relays operate in series through a checking path of the calling line location relays and the line link relays. RK1 and RK2 operate RK3.

9.10 On FS42 we can operate the CLG (class control ground relay) through operated AMA4, RK3 and ON FS77, operated TGS2, AMA3, TGS1, ORK1 to 2, KK and through the operated outsender connector multicontact relays to ground. CLG operates OST1 on this sheet. The OST relay is timed operated to give the sender a chance to lock up the information and return grounds on the leads, to the marker. The OST operates OST2 which opens the paths of the gating control relay KG on this sheet. The gating relays cut off the operating grounds of the A-L digit register relays from the originating register. The operated OST2 releases the GTL, GTL2, TGS1 and TGS2 relays. These four relays remove the ground supplies that operated the various information relays in the marker and outsender. However, the marker and sender relays will remain operated to the locking grounds supplied from the sender.

9.11 There is one more piece of information to consider on this call; it is the tip or ring party indication of the calling subscriber. On FS10, we see how the normal TP1 and TP2 relays in the originating register operate the RP and RPA relays in the marker. The TP1 and TP2 relays operate when the calling customer is the tip party of a 2-party line. This gives the marker a TP (tip party) indication. On all other calls, the RP (ring party) relay operates. On FS43 we see how the operated RP and CLG operate the RPK in the marker and RP in the sender. The sender returns a locking ground to hold operated its RP and the markers RPK after the CLG is released. If the call were from a tip party then the TP in the sender would operate from the TP in the marker.

9.12 Now the marker is ready to make a check of the successful transfer of the information. When the ground supply relays KK, TGS-, GTL and GTL2 on FS77 release, OST1 releases. OST1 times down the OST relay. If our transfer is successful we can reoperate GTL and GTL2 in parallel. The path is through operated RK2, RK1, AMA3, normal ND1, NDK, CVS, operated CR5, CL2, CLS, DLK2, DLK1, CPK1, CPK2, NSK1, MBK1 to 4, ORK1, 2, OST2, normal OST, OST1, OSE1 and operated OST2.

9.13 When the TGS2 relay released it opened the path of the CLG relay. On FS42, we can operate the CLK relay. Its path is through the operated AMA4, normal CLG and NS1, operated SON and RP, normal TP (number one contact), normal TP again (number two contact), normal TPK, operated RPK, RP, AMA and AMA4. Of course for a tip party call, the TP and TPK relays would be operated and the RP and RPK would be normal. Now we can operate the RSC on FS77. Its path is through normal XT5, operated OGC, CLK, GTL, normal OST1, operated AMA3, OST2 and OGC. The RSC starts the release of the outsender connector circuit.

9.14 When a call involves an AMA charge, the marker determines the AMA recorder assignment of the selected trunk and passes it on to the sender. It checks this information similarly to the other information passed to the sender. Actually this process takes place before the marker releases the outsender connector. On FS79 we see the trunk class relays ONN to 9NP. Trunks associated with AMA equipment have a cross connection from their associated KT or RN- punching to one of the ten ONN to 9NP punchings in the trunk link frame. There is a KT or RN punching for each trunk link frame appearance. The A appearances are designated RN--, and the B appearances KT--. They are numbered according to the switch and level appearance of the trunk. The ten punchings ONN to 9NP represent the ten maximum AMA recorder numbers to which a trunk can be assigned. For example, if our outgoing trunk is on an A appearance, switch 5, level 2 and is assigned to AMA recorder 1, we should cross-connect RN52 to 1SE.

9.15 On FS78, we see the operating path of the RN relay. Where RN operates, it allows the 1SE relay, which is operated on our call, to operate RNO and RN1. This circuit transfers the AMA recorder number from a one-out-of-ten indication on the ONN to 9NP relays to a two-out-of-five indication on the RN relays. When RNO and RN1 operate, RNT1 operates. The path is through either NOB or OBS operated (observed or nonobserved), normal RNT2, RNT, operated RN 2/5 (RNO and RN1 on this call) operated MBK5, AMA5, normal RNT2, to ground through the outsender connect relays. RNT1 times operated the RNT (recorder number timer). RNT operates RNT2 through the same path which operated RNT1. The RNT2 opens the grounds which operated the RN 2/5 relays in the marker and sender and also RNT2 releases the RN relay. The marker and sender RN 2/5 relays remain operated to the locking ground supplied by the sender. RN also releases RNT1 and this times down the RNT. When RNT releases, RNK1 and RNK2 operate in series if the transfer of recorder number to the sender has been successful.

10. Building the Channel

10.01 The information necessary to select the line link frame is transferred from the originating register and stored in the marker. This information is used to identify the line link frame on which the calling line is located. The operations for selecting the line link frame are described in Section 5 - Intraoffice Call.

10.02 The marker proceeds to seize the line link frame after it has seized the trunk link frame. The operation of relay TFK2 (trunk frame check) completes the operating path for relay MP- in the line link frame (OS 703-1). The operation of relay LFK (line frame check) indicates the seizure of the line link frame.

10.03 Junctor control is similar in operation to that described in Section 5 - Intraoffice Call.

10.04 Channel test and selection are similar in operation to that described in Section 5 - Intraoffice Call.

10.05 The operation for releasing the channel used in establishing the dialing connection is similar to that described in Section 5 - Intraoffice Call.

10.06 The operation of the select and hold magnets is similar to that described in Section 5 - Intraoffice Call.

10.07 The false cross, continuity, and double-connection tests are similar in operation to that described in Section 5 - Intraoffice Call. However, relay DCT1 (double-connection test) is not operated until the advance indication is sent to the outgoing sender and the relay AVK1 (advance check) is operated.

11. Advance Signal and Linkage Check

11.01 When the connection between the outgoing trunk and the calling line is completed, the marker operates the sender AV (advance) on relay FS49, SD-26002-01. When AV in the sender operates, it operates AVK (advance check) relay in the marker. The operated AV relay in the sender allows it to go on with its trunk test then outpulse the digits.

11.02 Before releasing, the marker checks the channel linkage between the calling line and the outgoing trunks. If this channel is correctly set up and tested, relay LK1 (linkage check) operates to indicate that the channel is ready for service. Under heavy traffic conditions, the operation of relay LK1 operates the DIS1 and DIS2 (disconnect) relays. The marker now starts to release. The release of the marker is similar in operation to that described in Section 5 - Intraoffice Call.

11.03 The advance and linkage check relay paths are spelled out below. A bar under relay means it is normal.

AV relay (non-AMA call) FS49

S(OSC) RSC $\underline{\text{AMA5}}$ $\underline{\text{PCL2}}$ SLK2 SOG1 $\underline{\text{SP}}$ $\underline{\text{MT17}}$ DCT CKG4 GT1 $\underline{\text{FLG}}$ $\underline{\text{GT5}}$ $\underline{\text{PU}}$.

AV relay (AMA call) FS49

S(OSC) RSC RNK1 RNK2 AMA5 $\underline{\text{PCL2}}$ SLK2 SOG1 $\underline{\text{SP}}$ $\underline{\text{MT17}}$ DCT CKG4 GT1 $\underline{\text{FLG}}$ $\underline{\text{GT5}}$ $\underline{\text{PU}}$.

AVK1 relay FS61

OSK4, ~~FKA,~~ AVK, OSC-, OSE, SON.

DCT1 relay FS49 - noncharge call

$\underline{\text{LK1}}$, $\underline{\text{RV3}}$, SOG1, $\underline{\text{TTK}}$, $\underline{\text{OTT}}$, $\underline{\text{CLK}}$, NOC, OGC, AVK1, SOG1, $\underline{\text{SP}}$, $\underline{\text{MT17}}$, DCT, CKG4, GT1, $\underline{\text{FLG}}$, $\underline{\text{GT5}}$, $\underline{\text{PU}}$.

DCT1 relay - charge call

Path is same as for non-AMA call, except CLK is operated, NOC normal.

The CLK relay is operated on AMA calls (intraoffice and outgoing) to check the transfer of the ring or tip party signal to the sender. On non-AMA calls when the trunk must receive a class signal from the marker, the class check (CLK) relay is operated. On non-AMA calls, when the route relay is either NCCN, TCCN or TCNC, the marker must send class signals to the trunk and go through the class check process. Reference sheet RM 702-1 lists various trunks, class signals and relays operated in the marker and trunks.

LK1 relay -

TOG2, DCT1, DCT2, DCT, CKG4, GT1, FLG, GT5, PU.

12. Marker Disconnect and Trunk Test

12.01 If the marker happens to be in heavy traffic while performing an SOG job with a sender, it disconnects in the usual manner. If the marker should be in light traffic, the disconnect operation is held up until the sender sends a successful trunk test signal to the marker. This signal indicates that the sender has made a successful continuity test on the conductors of the trunk from the sender through the outsender link, outgoing trunk, trunk conductors and circuit of the incoming trunk in the distant office.

12.02 If the marker is in heavy traffic, its HTR relay is operated during the SOG job. On FS50 of SD-26002-01, the DIS1 and DIS2 relays operate in parallel.

DIS1 and DIS2 - Heavy Traffic

MT1, MON1, TRL1, TRR, TR1, HTR, RRK, RRC, PSR, TRS, SOG1, RK3, FMK, FML, MT17, ITR2, LK1.

12.03 If the marker happens to be in light traffic during an SOG job using a sender, the disconnect operation is held up until the sender makes trunk test. To discuss this point, we must go back to the seizure of the sender by the marker. On FS50, the TG (trunk guard) relay in the marker operated when the ON in the sender operated. This relay remains operated while the marker completes the outgoing job. When the marker finally operates the AV relay in the sender, this is a signal for the sender to start its trunk test functions. The sender places a test relay in series with the trunk conductors. Meanwhile the marker has progressed to the point where it operates the DIS1 and DIS2 relays. The path for operating these relays is opened by the operated HTR relay. The marker TGT (trunk guard test) relay operates to the ground instead. On FS50 the path of the TGT is:

TG, HTR, RRK, RRC, PSR, TSR, SOG1, RK3, FMK, FML, MT17, ITR2, LK1.

The TGT operates and locks through operated TG and its own contacts to ground. When TGT operates, it provides an operating path for the DIS1 and DIS2. When the sender completes trunk test, it opens the TG lead to the marker through its operated TG1 relay, releasing the marker TG relay. TG releases TGT and marker disconnect is accomplished.

12.04 If, for some reason, the trunk is not a continuous circuit, the sender will not operate its trunk guard relay. The TG relay in the marker will remain operated holding up the TGT. The TGT will keep operated the DIS1 and DIS2. When the TGT relay first operated, it started a timer in the marker. On FS110, we see how TGT operates the SFT (seize frame timer) relay. The SFT relay starts the SDT timing circuit. The marker allows the sender the operating time of this SDT timer to complete trunk test. If it doesn't get an OK test signal from the sender in time, then the SDT timer operates. This causes the marker to print a trouble record.

12.05 The operated TGT relay locks up those relays in the marker which pertain to trunk and sender selection so that the indications of their selection will appear on the trouble card. On OS 729-1 we see that the operated OSG- relay locks to the TGT. This allows the sender group to appear on the card. The OSG- holds up the SON. On OS 730-1, the SON locks up the selected OS-. This gives us the sender OS- punch on the card. The OSE locks to the SON and the OSK locks up to the OSE on this sheet. On OS 731-1 the SSA or SSB is held up to the OSK. Now we have the sender group, subgroup and sender selections on the trouble record. On OS 702-2, sheet 1, we can see how the operated TGT locks up the operated FS- relay on this call. This gives us the trunk link frame number of the outgoing trunk. On FS25 of SD-26002-01 we see how the TGT relay locks up the operated TB- relay on this call. This gives us the level of our trunk on the trunk switch. On FS29, the operated TS- relay locked up to the TGT. This gives us the trunk switch of our selected trunk. All this information appears on the trouble card. These trouble cards have an identifying punch - TGT.

13. Outpulsing the Digits

13.01 Each of the different senders operates and performs various tests and functions differently than the others. We will not go into a detailed discussion here. We have examined the subscriber outgoing job and have dwelled on those points and operations which are different, involved or complex. The remainder of the call - the sender outpulsing - can best be followed in the circuit descriptions. The dial pulse sender is CD-26050-01, the multifrequency sender is CD-26051-01, the revertive pulse sender is CD-26052-01 and the panel call indicator sender is CD-26053-01.

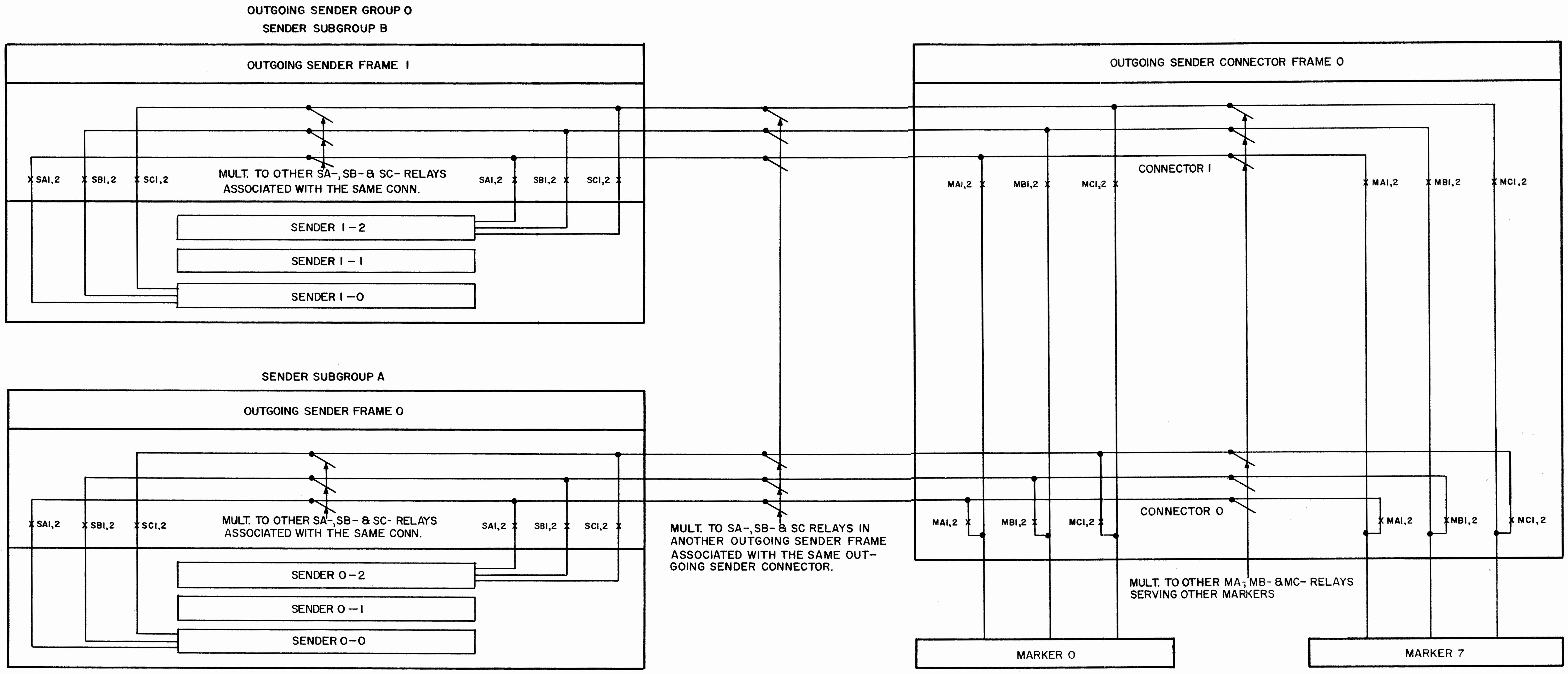


FIG. 2—THE COMMON CHANNELS BETWEEN MARKERS AND SENDER SUBGROUPS

FIG. 2

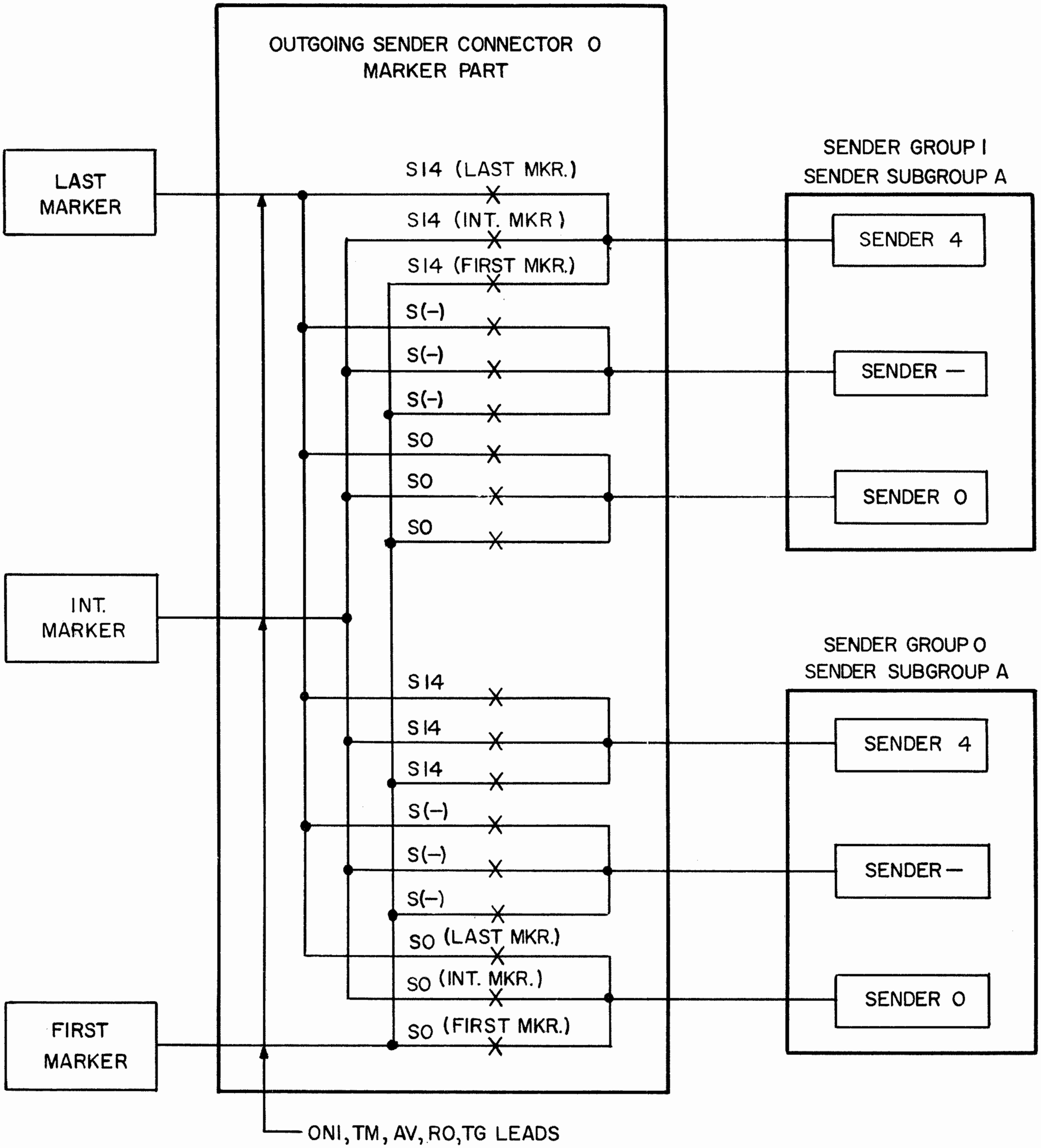
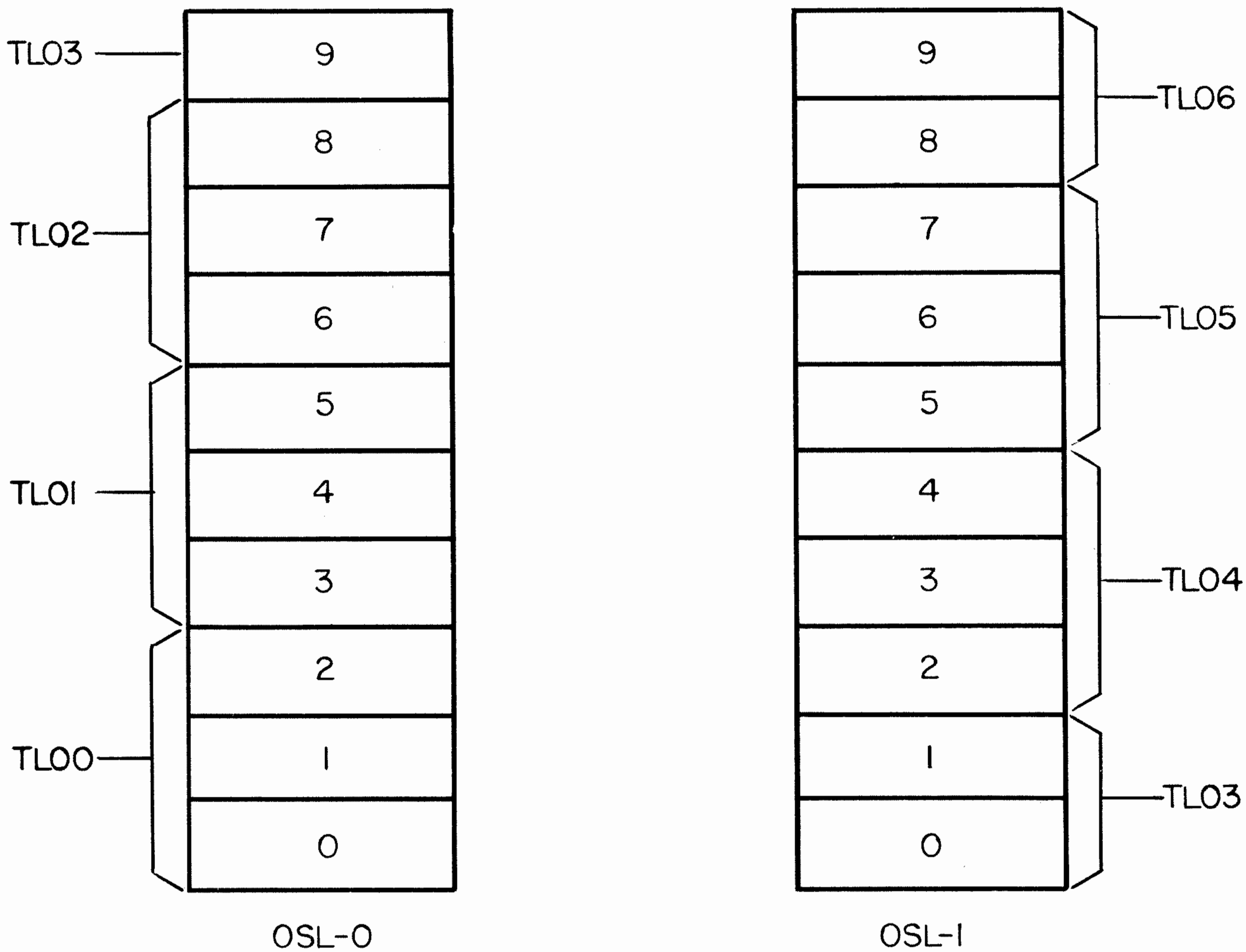


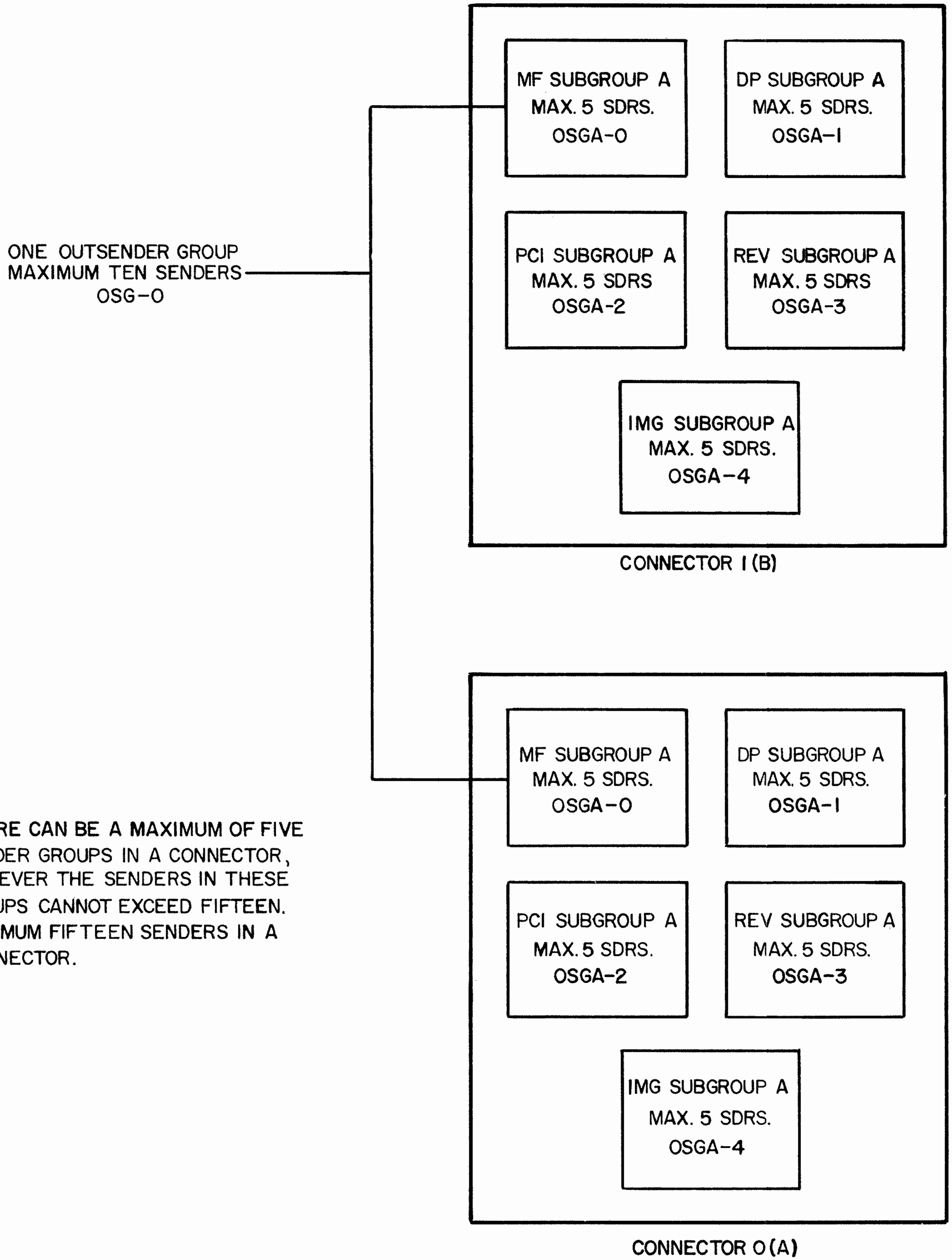
FIG. 3 — THE INDIVIDUAL CHANNELS BETWEEN MARKERS AND OUTGOING SENDERS

FIG.3



TYPICAL ARRANGEMENT OF ASSOCIATION OF OUT SENDER LINK SWITCHES WITH TRUNK LINK FRAMES.

FIG. 4



THERE CAN BE A MAXIMUM OF FIVE SENDER GROUPS IN A CONNECTOR, HOWEVER THE SENDERS IN THESE GROUPS CANNOT EXCEED FIFTEEN. MAXIMUM FIFTEEN SENDERS IN A CONNECTOR.

FIG. 5