No. 5 crossbar marker

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In the No. 5 crossbar system only two types of switching frames are employed for completing talking connections. These are the line link and trunk link frames. All connections through them are established by markers, of which there may be from three to twelve in an office depending upon the calling rate and the number of subscribers. A talking connection through these frames has three components: a line link, a junctor, and a trunk link. The line links connect the line switches to the junctor switches of the line link frame; the junctors connect the junctor switches of the line frames to those of the trunk frames; while the trunk links connect the junctor switches to the trunk switches of the trunk link frame. For any connection, there are ten line links, ten or more junctors, and ten or twenty trunk links that might be used. The marker must first determine which of the suitable components are idle, and then select one of each type to form a continuous path.

This work of the marker is required for

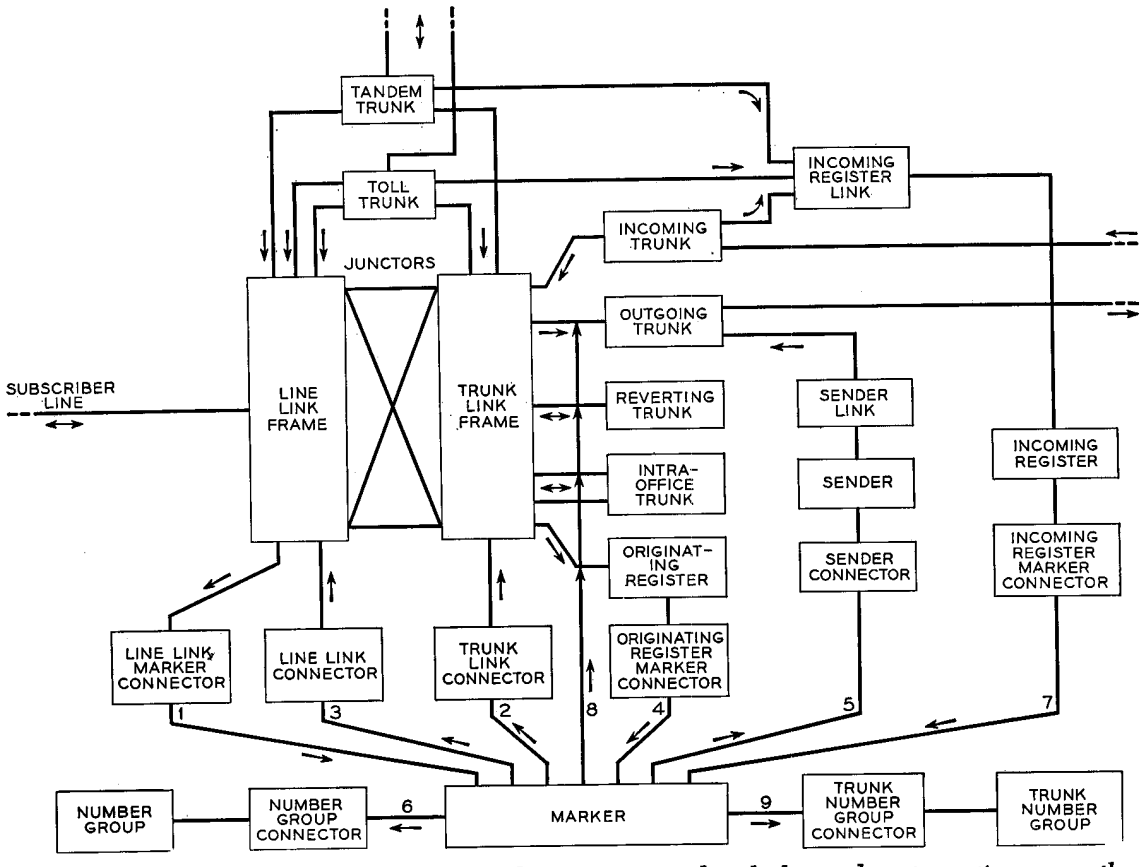

Fig. 1—Block diagram indicating the circuits that are associated with the marker at one time or another.

all types of connections, but before it can be carried out, the marker must have certain other information regarding the call, perform certain other functions, and determine the locations on the line link and trunk link frames between which a connection is to be established. Its actual procedures differ, therefore, with the kind of call, which may be any of nine types: dial tone, intra-office, reverting, outgoing, incoming, through tandem, through toll, pulse conversion, or inter-marker group.

The various circuits with which the marker is associated at one time or another in handling the various types of calls are shown in Figure 1. Since the marker performs its functions in a very short period of time—usually only a fraction of a second—there are only a few markers in any one office, and connections between a marker and the other circuits are established through connectors*. Some of these establish connections when another circuit seizes a marker, and others establish the connections when the marker seizes another circuit. Arrows on the connecting lines of the block diagram, Figure 1, indicate the direction of seizure in all cases.

Since the originating registers and the various types of trunks are all connected to the trunk link bay, the marker gains access to them through the trunk link connector and the trunk link frame. The various paths to and from the marker have been assigned arbitrary numbers in Figure 1, and these numbers will be referred to in discussing the work of the marker in handling the various types of calls.

When a subscriber lifts his handset to place a call, the operation of his line relay causes the marker to be seized over path No. 1. Such a seizure tells the marker that an originating register must be connected to the calling line so that the number about to be dialed may be recorded. Since dial tone will be returned to the subscriber by the register as soon as it is connected to the calling line, these connections of originating registers to calling lines are referred to as dial tone connections. For such a connection, the circuits employed are indicated in Figure 2.

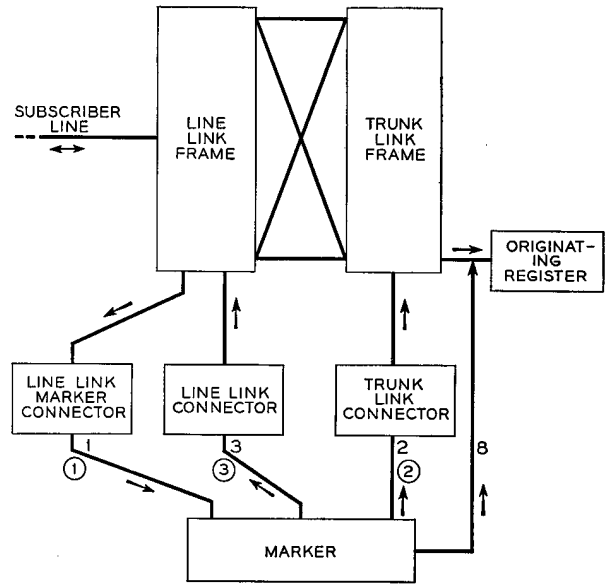

Fig. 2—Circuits associated with the marker for a dial-tone connection.

As soon as the line link frame has seized a marker over path 1, it immediately identifies itself to the marker by its frame number. Over testing path 8, the marker at once proceeds to find a trunk link frame not in use by another marker and having an idle originating register connected to it. Its method of doing this will be later described.* Having found such a combination, it at once seizes the trunk link frame through a trunk link connector, path 2, and selects one of the idle registers. During this time it has also started to find the location of the calling line on the line link frame over paths 1 and 3.

Subscriber lines are connected to the verticals of the crossbar line switches on the line link frame, and are identified by a particular vertical group, a horizontal group and a vertical file. The vertical group includes the fifty lines on the corresponding five adjacent verticals of the ten crossbar switches mounted one above the other on a line link bay. There may be from six to twelve vertical groups depending on the number of bays in the line link frame. The horizontal group includes all the lines on one horizontal row of crossbar switches, and there are 29 to 59 lines in each horizontal

* See page 58.

* See page 45.

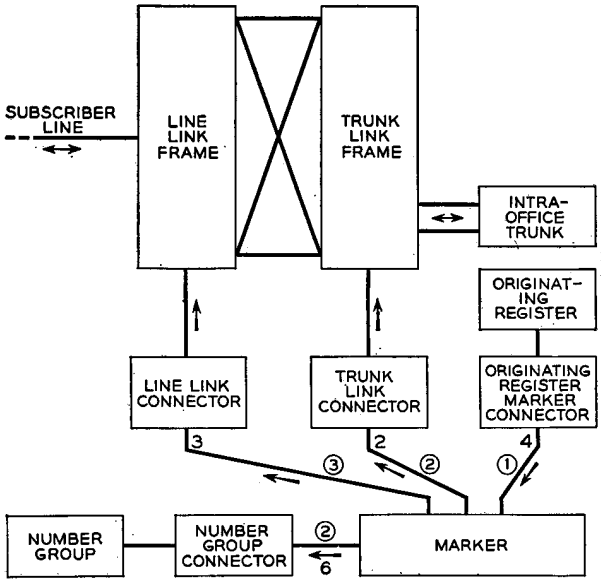

Fig. 3—Circuits associated with marker in completing a call to another subscriber in the same office.

group. A vertical file consists of the ten lines vertically above one another on a line link bay. The vertical and horizontal group identifications indicate the line as one of five on a particular crossbar switch, and the vertical file identification specifies the particular one of the five lines that are involved.

Over leads through the line link marker connector, the marker identifies a preferred vertical group and horizontal group having lines awaiting service. It also connects to the line link frame via a line link connector, path 3, and tests the five lines that are common to the particular horizontal and vertical groups it has already determined, and if more than one is calling selects only one in a prescribed order of preference.

It now has the location of a calling line on the line link frame and that of an idle originating register on a trunk link frame, and thus proceeds to find and close an idle set of links and junctors between them. Once this has been done, and the calling line location stored in the register, the marker releases, and the register sends dial tone to this subscriber.

The number the subscriber dials into the register so connected may be for a subscriber in another office, and thus require a connection to a sender and an outgoing trunk for its completion, or it may be for another subscriber in the same office or even for another subscriber on the same calling line. The latter two types of call are known as intraoffice and reverting calls, respectively, and neither requires a sender.

Whatever the type of call, the register will

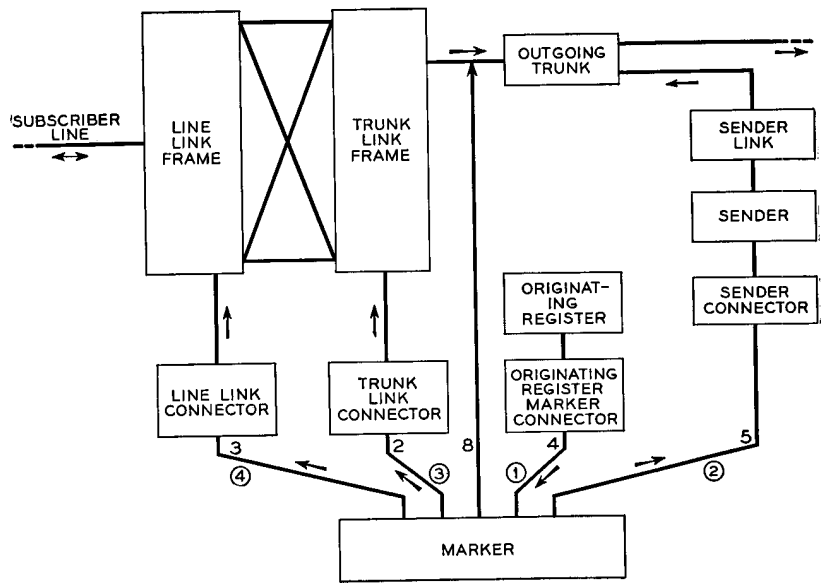

Fig. 4—Circuits associated with marker in completing a call to a subscriber in another office.

seize a marker over path 4 and request that a connection be set up. If the call is for another subscriber in the same office, the work of the marker will be as indicated in the block diagram of Figure 3, where, as in the other diagrams, the order in which the various paths are used is indicated by the numbers in circles. As soon as the marker has been seized, the register transmits to it the number dialed by the subscriber and the location of the calling subscriber's line. The marker, recognizing the office code as requiring an intraoffice trunk, at once proceeds to find and seize a trunk link frame not in use by another marker and having an idle intraoffice trunk. At the same time it seizes the number group frame over path 6 to determine the location of the called line on a line link frame. It secures this information as described later,* and then seizes the indicated line link frame, and tests to see if the line is idle over path 3. If it finds the line idle, the marker tests for idle links and junctors and connects the line to the intraoffice trunk. It then seizes the line link frame of the calling line, again, tests for idle links and junctors, and connects the line to the other end of the intraoffice trunk. Having passed ringing information to the trunk, over path 2, the marker releases.

For a reverting call, the marker proceeds as for an intraoffice call, but after finding from the number group that the called line location is the same as the calling line, it releases the intraoffice trunk it had seized, seizes a reverting trunk, and connects the line to it. After giving the trunk the ringing information it obtained from the number group, the marker releases.

Had the marker, on decoding the office digits transmitted to it from the originating register, found that the call was for a subscriber in another office, the work of the marker would be as indicated in the block diagram of Figure 4. As soon as the marker has been seized, the register transmits to it the number dialed by the subscriber. The marker, recognizing the office code as requiring an outgoing trunk, at once proceeds to find an idle sender of the proper type and a trunk link frame not in use by a marker and having an idle trunk to the desired

* See page 79.

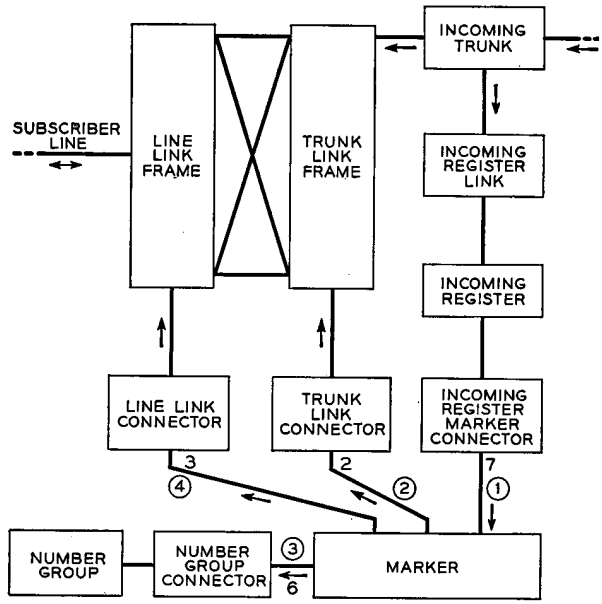

Fig. 5—Circuits associated with the marker in completing an incoming call.

office. It first seizes this sender over path 5. Then, while transmitting to it the number wanted in the distant office, the marker seizes the trunk link frame over path 2 and connects the sender to the trunk. It then seizes the line link frame of the calling line over path 3, the number of the frame and the location of the line on the frame having been given to it by the originating register. It now finds and connects an idle path through the line link and trunk link frames, tells the sender to proceed, and then releases.

All incoming calls, whether on an interoffice, a tandem, or a toll trunk, and whether for termination in the office or for extension through it, seize an incoming register on arriving. The register records the digits pulsed into the office, and then seizes a marker over path 7 and transmits the digits to it. If the call is to terminate in the office, the circuits involved are as indicated in Figure 5. As soon as a marker is seized and has decoded the office digits, it at once seizes the trunk link frame to which the calling trunk is connected. It has already received the frame number over path 7. The marker then goes to the number group to

determine the location of the line being called. With this latter information, it seizes the line link frame indicated, and completes the connection through the frames as before.

Through calls, either tandem or toll, are handled as indicated in Figure 6. Tandem and toll trunks have appearances on both trunk link and line link frames; tandem trunks have one line link and one trunk link appearance, while toll trunks have two line link and one trunk link appearance. The trunk link appearance is used for calls terminating in the office, while the line link appearance is used for calls passing through the office. The added line link appearance of the toll trunks is provided to give double assurance of finding an idle path through the office for through toll calls.

For both types of through calls, an incoming register is at once seized to record the digits pulsed in. The register then seizes a marker and transmits the digits to it. Thus far the call has proceeded as described for terminating calls. On decoding the office digits, however, the marker finds the call must pass to another office, and it therefore selects a suitable sender and seizes a trunk link frame and trunk as it did in handling an outgoing call. To determine the line link location of the calling trunk, it then seizes a trunk number group frame. Having this information, it proceeds to find an idle path between this line link location of the calling trunk and the outgoing trunk already selected. It then establishes the connection, and releases.

The major difference in the method of handling a through toll call is that there are two line link frame locations. If the marker is unable to find a path to the outgoing trunk from the location it seizes first, it will return to the other trunk number group, find the second line link frame location of the trunk, and attempt to complete from that point. Provision is also made to handle a small number of tandem or toll trunks in the regular number groups at the sacrifice of line numbers.

Besides these more usual types of calls that the marker must handle, there are also intermarker group and pulse conversion

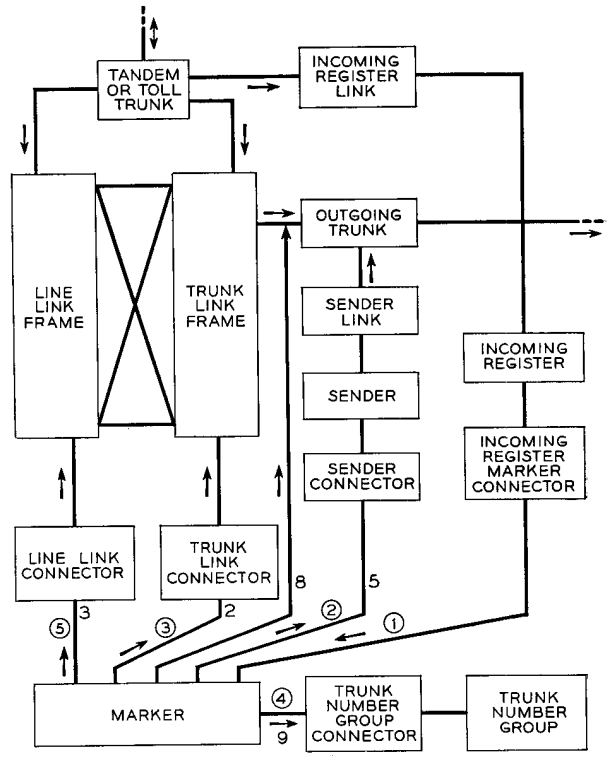

Fig. 6—Circuits associated with marker in handling tandem and toll calls.

calls. The former is a call between two No. 5 offices associated with different marker groups in the same building. For such a call the conventional outgoing trunk and sender are not used. Instead a combined outgoing-incoming trunk is used, and an intermarker-group sender performs the functions of both outgoing sender and incoming register, this being done without the usual pulsing.

Pulse conversion, which is described in detail on page 123, permits an operator at a DSA board equipped with a multifrequency keyset to complete calls over trunks direct to an office requiring revertive or dial pulses. For such a call the No. 5 office connects the pulse conversion trunk to an incoming MF register which in turn passes the number through the marker to an outgoing sender associated with the same trunk. This sender provides the proper pulses to the office selected by the DSA position.