No. 5 Crossbar

INTRODUCTION*

A little over ten years ago, the first crossbar central office was cut into service by the Bell System. Known as the No. 1 crossbar system, it was designed for large cities where the panel system had been used for almost twenty years. Since then approximately 350 crossbar dial offices of this type, serving nearly 5,500,000 subscriber stations, have been installed in the larger cities throughout the United States. During these years improvements have been made in the No. 1 crossbar system to make it more serviceable to the telephone user and to meet the new problems which have arisen.

Bell Telephone Laboratories' engineers have continued their searches for new and better telephone switching systems. One such search was for a dial system that would better meet the telephone switching requirements for areas on the outskirts of metropolitan cities and at the same time care for medium- to large-sized offices in other areas. Work on this problem culminated in the development of the new No. 5 crossbar system, and on July 11, 1948, the first office of this type was placed in service at Media, Pa., a suburb of Philadelphia.

The field of application of this new switching system is more extensive than that of any previously developed. The No. 5 system is capable of operating with all present local, tandem, and toll switching systems of the Bell System and of the independent companies which connect with it. In addition, it can serve as a tandem or toll-center switching office where this is advantageous. It can be readily equipped with features for operation as required at toll centers for nation-wide operator toll dialing and also for automatic message accounting, which permits subscriber dialing to be extended to considerable distances. No. 5 crossbar is designed for operation with as few as four digits in a subscriber number, or it can complete calls which require as many as 11 digits, (dialed by operators) three for the national area code, three for the office code, four for the numericals, and the last for the station letter of the called number on certain types of party-line service. The No. 5 crossbar system is like the No. 1 System in employing relays and crossbar switches for all switching operations; in using primary-secondary arrangements of crossbar switches to funnel the traffic from lines to trunks and from trunks to lines; in having the utmost freedom of action in routing each call; in employing registers, senders, and translator elements for only a short time on each connection; in delegating control of practically all switching and pulsing operations to the markers; and in including automatic alternate routing, second trial, and automatic trouble detection features.

It differs from the No. 1 system: in its switching plan; in its trunking arrangements; in its utilization of new apparatus; in its equipment design; in its circuit operation; and in its maintenance processes. This combination of innovations gives No. 5 unusual versatility with standardization while the extended use of the common con-

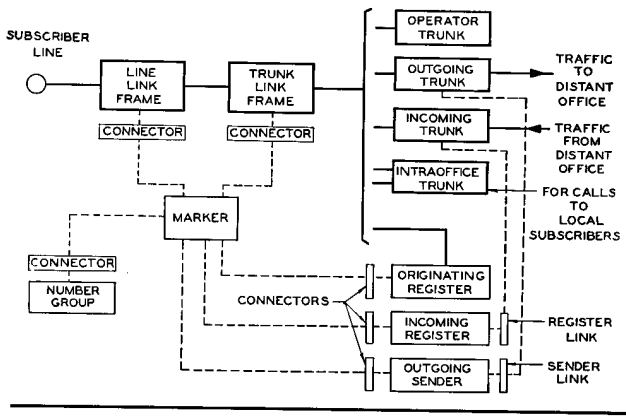

Fig. 1—Basic arrangement of the switching plan of the No. 5 crossbar system. Every subscriber line appears on one of the line-link frames, and all trunk and originating register circuits appear on the trunk-link frames.

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trol principle and the introduction of new maintenance concepts endow the new system with other important features, a few of which are discussed here.

The No. 5 crossbar system is different from No. 1 primarily in its switching plan, a simple block diagram of which is shown in Figure 1. Each subscriber line appears on one of the line-link frames and all trunk and originating register circuits on trunk-link frames. As in the case of No. 1, the line has but a single appearance on the line-link frame, and this serves for both originating and terminating calls. Every connection is set up from a trunk or a register to a calling or a called line through crossbar switches on trunk-link and on line-link frames. The common control equipment which is used to set up the various connections includes the markers, the connectors, the number groups, the senders and registers, and the sender and register links. Once a talking path is established, all control elements are released and only the line-link, trunk-link, and trunk circuit elements remain in the connection.

Before any talking path is set up, all needed information on calling and called parties is registered in a way which enables a marker in a uniform and flexible manner to call into the connection only those switching, signaling, transmission, and supervisory features required for the particular call. On every subscriber call, the calling line, through a connector, engages a marker to connect the calling line temporarily to an originating register through crossbar switches of the line-link and trunk-link frames after which the connector and marker are released. When all of the needed information on calling and called parties is stored in the originating register, a marker is again engaged for a fraction of a second to establish the talking connection. Knowing both ends of the connection required and with no switching equipment committed, the marker is free to set up any kind of a call with the best combination of elements.

If the call is to another subscriber in the same office, the marker connects an idle intraoffice trunk circuit to the calling and called lines.

If the call is to a destination outside the office, the marker recognizes this from the information dialed and proceeds to connect the calling line to a trunk circuit in the proper group. If a sender is needed, the marker connects one of the appropriate type to the trunk circuit through a sender link. Senders receive information from the marker and transmit it in the form of pulses to registers, other senders, or directly to switches as required in the systems of the connecting offices. This information includes the subscriber's numerical digits and may include office code digits as well. Since senders must be capable of operating with the standard kinds of signaling, four types are available for dial-pulse, revertive-pulse, multifrequency-pulse, and panel call-indicator operation. Multifrequency pulsing is generally used for signaling between No. 5 offices, to and from No. 4 toll crossbar offices, to No. 1 crossbar, and to crossbar tandem offices.

If the call is incoming from another office, the incoming trunk circuit associates itself with an incoming register through an incoming register link. The incoming registers receive information from senders, dials, or key sets in the distant offices and pass this information to the markers for establishing the switching connection either to a called subscriber line in the same office, or to a distant office when through switching of toll or tandem traffic is involved. Incoming registers, like senders, must be capable of operating with the standard kinds of signaling; hence there are dial-pulse, revertive-pulse, multifrequency-pulse, and B-switchboard registers.