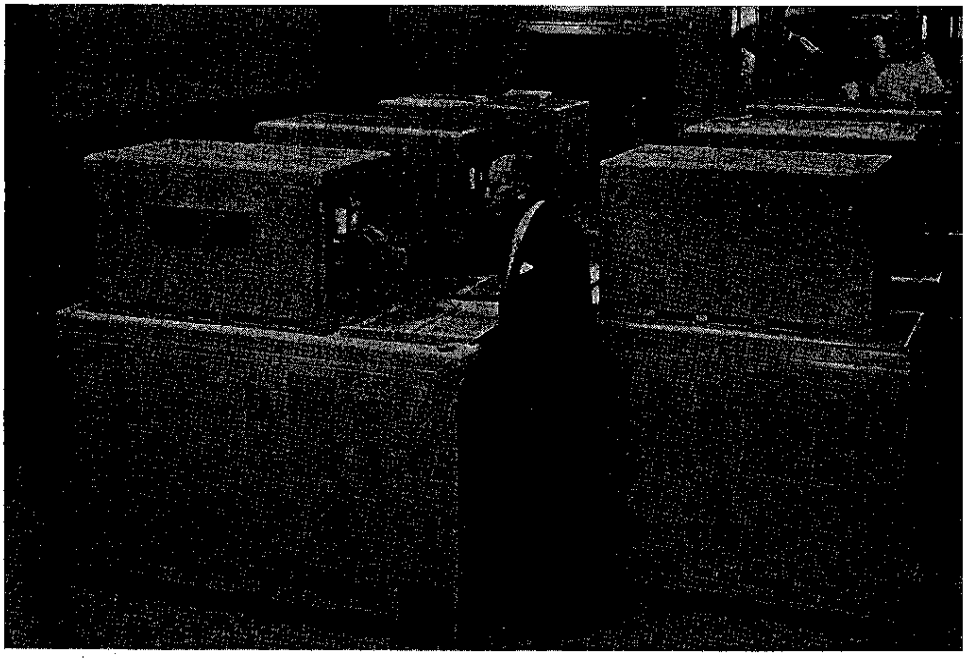

O. Myers of the Laboratories inspects a card translator at the Newark, N. J., 4A installation.

Common-Control Features In Nationwide Dialing

J. B. Newsom
Switching Systems Development II

For nationwide toll dialing, there will be about seventy strategically located automatic switching offices, known as control switching points (CSP's). The switching system for these CSP's requires features such as automatic alternate routing, six-digit translation, code conversion, and the storing and sending forward of variable numbers of digits. These features are made possible by the common-control equipment used in the 4A system, each piece of equipment contributing its particular share as determined by nationwide dialing requirements. This article gives a general description of the various items of common-control equipment and the integration of this equipment into a fast, comprehensive switching system capable of handling both operator and customer nationwide dialing.

To provide those features essential at key offices — control switching points (CSP's) — in the nationwide dialing plan, the 4A toll crossbar system has been developed. Nationwide dialing is based on each customer's telephone number, consisting of the local office code and the individual line number, and these are preceded where necessary by three additional code digits representing the area in which his local office is located. This nationwide dialing numbering plan, together with the CSP offices, provides the basic toll switching facilities for direct dialing by operators, and eventually by cus-

tomers, of toll calls to the entire country and Canada.

For these CSP offices to meet nationwide dialing requirements, the common-control circuits of the 4A system, such as senders, decoders, translators, and markers, incorporate many new features and circuit arrangements. Among these features are six-digit translation, extensive automatic alternate routing, control of the number of digits to be pulsed forward, code conversion, improved trouble-recording arrangements and additional testing and maintenance facilities. The block diagram, Figure 1, shows, the basic interconnecting arrangement of the common-control circuits in the 4A system.

One of the new features of the 4A system is known as "variable spill," and this feature is incorporated in the senders. The number of digits to be "spilled forward" to the next office may vary from call to call, and the senders are arranged to spill forward from one to eleven digits as the call requires, by information from the card translator. This results in the sender spilling forward all digits as received, or in omitting, substituting, or prefixing digits as necessary. The earlier No. 4 toll system used three types of incoming senders and two types of outgoing senders to receive and trans-

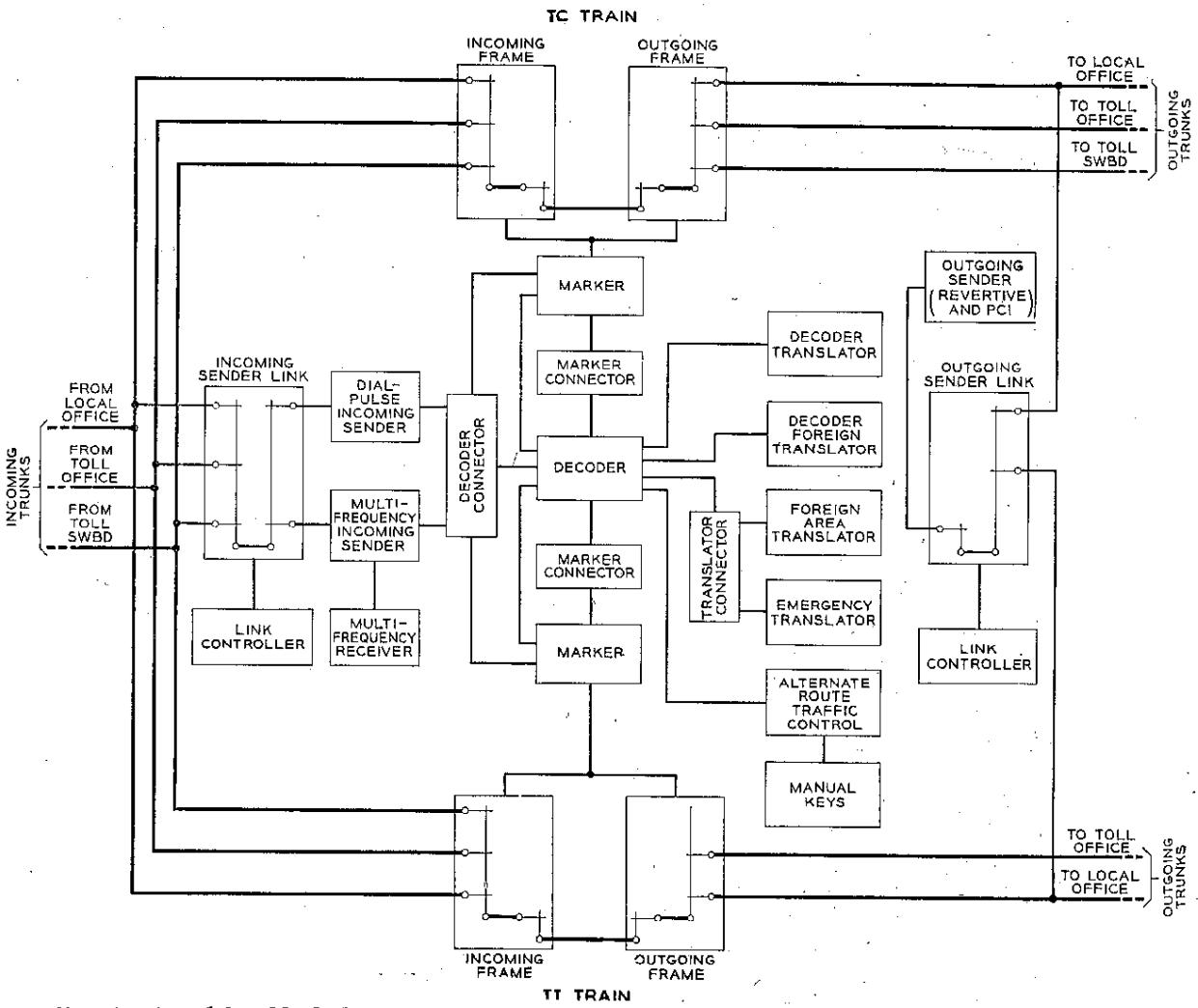

Fig. 1 — Simplified block diagram of a 4A system. The trouble recorder, not shown, connects to all items and will drop a punched trouble record card whenever trouble occurs.

mit all the necessary signals. In the 4A system, these same functions have been integrated into only two incoming and one outgoing sender.

Another important factor in nationwide dialing influenced decoder-marker arrangements. On some types of calls, the first three digits are sufficient to provide for the selection of an outgoing trunk. On other calls, however, more than three digits are needed. Because of the diversity of the codes used, it was not economical for the sender to predetermine whether to present three digits for translation or to wait for more than this number. The senders therefore always make a request for translation after the first three digits are received.

On those calls where more than three digits are needed, decoding and translation facilities are used only to signal the sender to release the decoder and wait for the rest of the code digits. On such calls the marker is not needed until the proper number of code digits is presented. Also, the marker is not needed on any call until the decoding and translating functions are complete. The number of markers necessary, therefore, could be reduced if the markers were separated from the decoding and translating facilities, and brought into service only when and if needed. In the 4A system the decoding, translating, and marker functions have been separated so that a decoder selects a translator and a marker as may be needed by a particular call. This separation also permits early release of the decoder and translator, while the marker is still engaged in setting up a connection between the incoming and outgoing trunks. The number of each of these important common-control circuits required in a 4A office is thus reduced to a minimum.

Six-digit translation was needed for economical use of toll lines or trunks because in many instances there are two or more routes or trunk groups from a particular CSP office into other numbering areas. For calls to such areas, both the area code and office code are used to determine the route. The need for six-digit translation means that there are a great many more codes to be translated than previously, and this required considerable extension and revision of translating facilities in the 4A system. Another important translating feature needed was a flexible and rapid means of changing and adding to the translating routing information. This was needed for adjusting the translating and trunking arrangements to meet the frequent changes in toll and local plants.

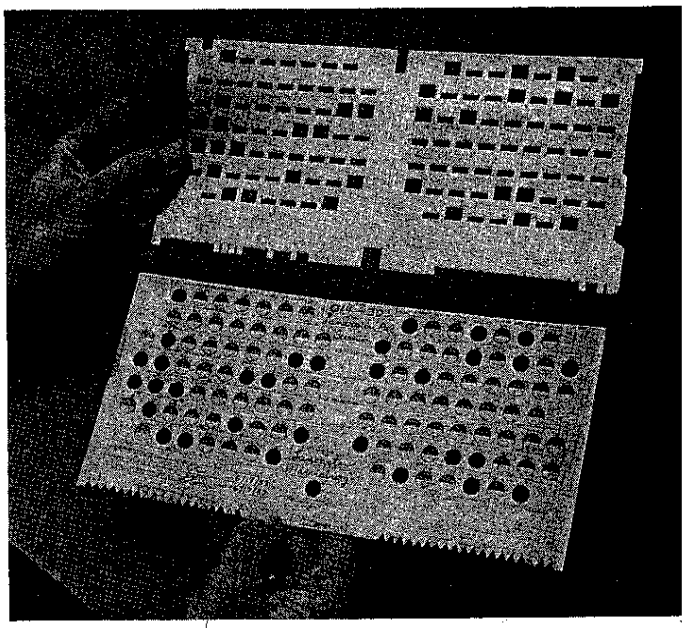

Fig. 2 — A punched metal code card, top, and the template used as a punching guide. The cardboard template is punched as desired and inserted into a card-punching machine. This machine then enlarges the holes in the metal card to agree with the template.

These translation problems encountered in nationwide dialing were solved by the development of the card translator.* In designing the translator, it was not feasible to design a single machine capable of accommodating the many thousands of code-cards needed in nationwide dialing. In a 4A office, therefore, several translators are used, each capable of holding about 1,000 cards. The headpiece of this article shows a group of card translators. The translator cards, Figure 2, representing the codes to be translated, fall into four general groups or classes. These are: (1) three-digit code cards for local offices within the home numbering area, (2) three-digit area code cards,

* A more complete description of the card translator will be given in a forthcoming issue of the RECORD.

(3) six-digit foreign-area code cards, and (4) alternate-route cards.

Because some of these cards are used more than others, they are placed in groups in particular translators. Those translators that contain low-usage card groups can be used in common, with only one or two translators per office for each 1,000 such cards. The translators are grouped, therefore, according to the cards they contain, as follows:

Decoder translators contain cards for local three-digit office codes, three-digit area codes, alternate-route codes and, where space permits, some high-usage six-digit foreign-area codes. One of these translators is provided per decoder and connection to it is made by connector relays in the decoder.

In foreign-area translators are placed most of the six-digit foreign area code cards. One of these translators is provided per office for each 1,000 cards. They are in a common pool and are selected by a single-ended translator-connector circuit. Arrangements are such that a maximum of nineteen of these translators may be used.

In some CSP's there may be enough high-usage six-digit cards to warrant providing each decoder with an individual foreign-area translator.

The emergency translator is for emergency use. It can be used as a substitute for any other translator, by transferring the cards.

In nationwide dialing, the diversity of routings requires the use of several different types of outpulsing. Also, the number of digits to be sent ahead is often either more or less than the number of digits received. Moreover, the received digits themselves must sometimes be changed to other digits in order to reach the called destination. In addition to this, even on a single call these items of information change as shifts are made among the various alternate routes possible. These and many other similar conditions require a flexible and diverse translator output to meet the needs for automatic alternate routing, code deletion, code conversion, code substitution and the various types of outpulsing to be used. This rather complex but interesting problem will be discussed in detail in future articles.

From a particular CSP, there are many points to which calls are completed. Most of these points have alternate routes and the particular alternate-routing pattern used

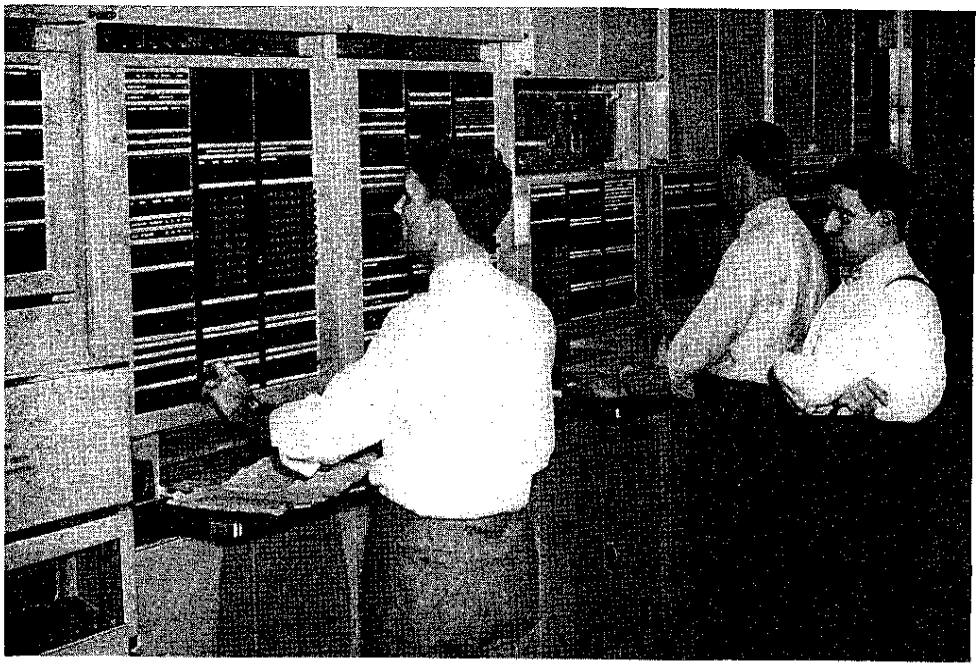

Fig. 3 — The maintenance center at Newark. Western Electric installers are testing the system prior to cutover.

to some destinations is different from those to other points or destinations. Under heavy traffic loads or cable failure conditions, it is often necessary or desirable to control the alternate-route pattern to certain destinations, and sometimes to change or cancel all of the alternate-routing patterns. The inclusion of extensive automatic alternate routing in the 4A system creates the need for some means of changing or cancelling the alternate route patterns, either individually or collectively. An alternate-route traffic control circuit is provided for this purpose. Keys give the traffic force control of the decoder circuit, causing it to cancel either part or all of its tests for alternate routes.

To facilitate the rapid detection of troubles, a card-punching type of trouble recorder is used in the 4A system. This trouble recorder, Figure 3, in the event of failure of a decoder, translator, marker, or controller, automatically punches and drops a properly designated trouble card. This materially aids in locating the cause of the failure. Necessary keys and connecting relays are also provided so that test calls can be made on decoders, translators, and marker circuits, as desired by the maintenance force. Such test calls can be made using any working code on any combination of these circuits. This is very useful in setting up and checking out new codes and routings, and also in re-establishing code and circuit combinations on which trouble records have been occurring, to isolate the cause of failure. The trouble recorder also provides key control for obtaining trouble record cards of stuck senders. For traffic study purposes, records may also be obtained of calls routed to "reorder," "delay quote," "master busy," or "no circuit." Separate automatic test circuits for senders, controllers and trunk circuits are also provided. A tea-wagon type test set is used for bench testing the selector unit of the card translator. This test set is also used for adding and removing translator cards, and for making adjustments and timing tests on the translators.

New features of the common-control circuits of the 4A system will be discussed individually in future issues of the RECORD. There will be articles on senders, decoder-connectors, decoders, translators, markers, and trouble recorder circuits. Articles will also appear on translation by means of the card translator, on code conversion, on automatic alternate routing, and on traffic usage equipment. These and other articles will aid the reader in achieving a better understanding and appreciation of the 4A toll crossbar system and many of the CSP features and requirements of nationwide dialing.

THE AUTHOR: After four years of military service in World War I, JAMES B. NEWSOM joined the Western Electric Company in 1920, directing his attention to the development of manual telephone systems and the panel telephone system. Since the incorporation of the Laboratories in 1925, he has been a member of Switching Systems Development II and has devoted time to the design of panel and crossbar systems, crossbar tandem and toll crossbar systems. During World War II he was a lieutenant commander in the U. S. Navy, assigned to the Naval Research Laboratory in Washington, D. C. Since 1946, Mr. Newsom has been in charge of a group concerned with the development of toll crossbar senders, decoders, translators and markers.