Station Keys for Telephones

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Switching Apparatus Development

A BROAD variety of wiring plans and key sets have been available for a number of years to enable telephone subscribers to connect to any of several lines, to transfer calls, signal extensions, or perform any of a number of switching operations that would make their telephone service more useful. With the advent of the combined telephone set, which includes the ringer and other equipment in the base of the telephone, the 1A key telephone system* was developed to provide a large number of switching arrangements, all controlled by keys mounted in the telephone base. Such an arrangement greatly improves the appearance of the station equipment by avoiding separately mounted keys and ringers, and is more convenient to use because of the close association of the keys with the telephone itself. Ordinary telephone keys, however, are far too large to use in the restricted space of a handset base. It was necessary, therefore, to develop keys that would fit in the shallow clearance of the base.

To reduce the vertical space required by the keys, the contact springs were made L-shape, the contact ends extending horizontally and the terminal ends extending vertically upward with small soldering lugs projecting horizontally backward. A further reduction in the vertical space required was obtained by using a conical spring in place of the usual cylindrical restoring spring. With a cylindrical spring, the minimum height is the number of turns times the diameter of the wire, while with a conical spring the turns lie within one another so that the minimum height becomes the diameter of the wire alone. In this way the depth required is less than half that needed for the usual

*RECORD, *June*, 1940, *p.* 315.

type of key. A maximum of nine contact springs may be assembled in each unit, and such an assembly is shown in Figure 1. The contact springs are operated by a plunger with a hard-rubber tip that is pushed down between the two lipped springs.

It was desired to mount as many as six of these assemblies in the base of a telephone set, and thus horizontal as well as vertical space was at a premium. The springs themselves were therefore made of lighter material than that used for ordinary keys, and the amount of travel between operated and unoperated positions was reduced. To insure adequate contact pressure and sequence under these conditions, a strip of insulating material is included in the spring pile-up to pre-position the springs. This strip, evident near the front ends of the springs in Figure 1, is slotted to receive projections from the springs. It permits each stationary spring to be given an initial tension so that only a slight displacement of the moving spring is needed to build up adequate contact pressure. The slots also fix the unoperated positions of the stationary springs so that the desired operational sequence may be more readily obtained. Spacing strips of this type are commonly used with relays, where the amount of motion is also strictly limited, but they are not ordinarily used with keys.

One of the complete keys is shown in Figure 2. The spring assemblies are fastened to a brass mounting plate, and two steel brackets are used to attach to the base of the handset both the mounting plate and an insulating plate that serves as a terminal block for both the keys and the handset. The front edge of the brass plate is drilled for the plungers that operate the keys, and a narrower brass strip is held beneath the mounting plate and drilled for the hard-rubber tip of the plungers. A metal washer is fastened to the plunger just above the hard-rubber tip, and between this washer and the lower brass strip is the conical restoring spring that holds the plunger in its normal or "up" position. A third strip, called a slide plate, is mounted so as to be

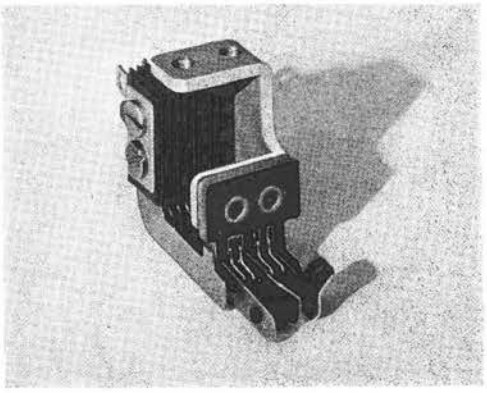

Fig. 1—Spring assembly of keys used for 1A *key system*

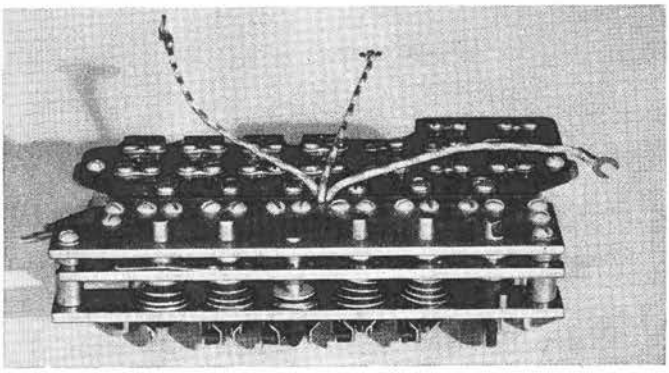

Fig. 2—One arrangement of the six-button key used with the 1A *system*

just above the washers when the plungers are in the normal "up" position. This plate is drilled for the plungers with an oversize hole, and is free to move horizontally in the direction of its length. It provides the locking and releasing feature commonly used with mechanically locking keys. Most of the spring assemblies are used to associate the handset with

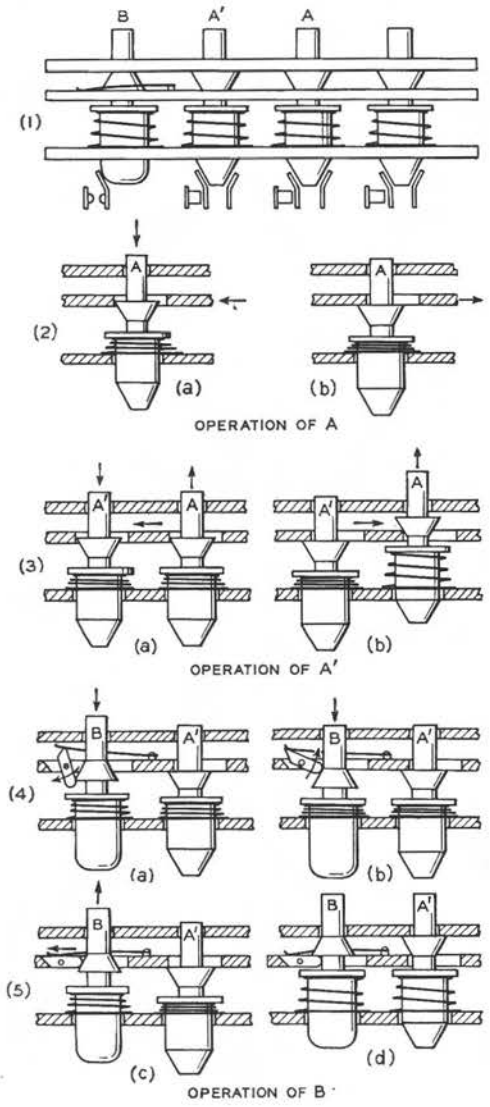

Fig. 3—Diagrammatic representation of the locking bar and the pawl mechanism for the hold button

one or another of a group of lines, and by the use of the slide plate, the depression of any one of the "line" keys will release any other, and will lock itself in.

This slide plate is slotted at each end for the two end posts holding the plates in place, and is held in one extreme position by a coiled spring fastened to the top plate. Each plunger has a flat-topped cone-shaped section just above the hole, and as the plunger is depressed, the cone forces the slide plate to one side until the top of the cone is below the slide plate, which then snaps back above the shoulder of the cone and holds the plunger depressed. When another plunger is operated, its cone will push the slide plate to one side, and the key already operated will release just before the newly operated key is locked. These actions are shown in lines 2 and 3 of Figure 3.

With the 1A key system it was desired to provide a common holding key so that a call on any line could be held, and the handset disconnected from that line and connected to another. This requires that there be an appreciable interval between the closing of the contacts of the "hold" button and the releasing of the line button operated. With this slide plate construction, however, it is evident that the releasing of the line would follow almost immediately the closing of the holding contact. To secure the time interval desired, the cone on the "hold" plunger is inverted so that its flat shoulder faces down, and in the slide plate the edge of the hole that normally rests against the plunger is cut out and fitted with a pawl. This is tipped down by the shoulder of the cone when the plunger is depressed, and then is snapped back by a flat spring as the shoulder passes beneath

it. The arrangement is shown in lines 4 and 5 of Figure 3. When the "hold" button is depressed, the slide plate is not moved because of the deflection of the pawl. When the button is released, however, the slide plate is deflected by the upward motion of the cone, and the operated "line" button is released. In this way the "line" button is not released until an appreciable interval after the "hold" contact has been made.

The key plungers shown in Figure 2 are operated by insulating buttons that project through the handset base. If these buttons were rigidly attached to the plungers, either the manufacturing tolerances would have to be very small, or the holes in the base would have to be considerably larger than the plungers to allow for manufacturing variations. This is avoided by mounting hard-rubber buttons loosely in the base of the handset, and giving them a flanged base that is somewhat larger than the tops of the plungers. The arrangement is shown in Figure 4. With such a design, accurate alignment of plunger and button is not necessary.

Beside the "line" and "hold" buttons already described, other types are available. Fewer than nine springs may be used, or the locking feature may be omitted to give simple "push-button" action, which is desirable for signaling purposes. Another form is

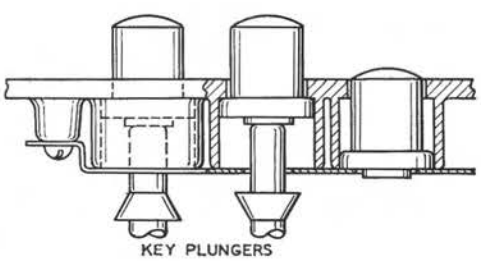

Fig. 4—Button construction in base of combined telephone set

the "turn" key, one of which is shown at the extreme right of Figure 2. A button of this type is useful for such operations as transferring a line or cutting off an extension or ringer.

Two standard multi-button keys have been provided for the 1A system: the 561 and the 562. The former has

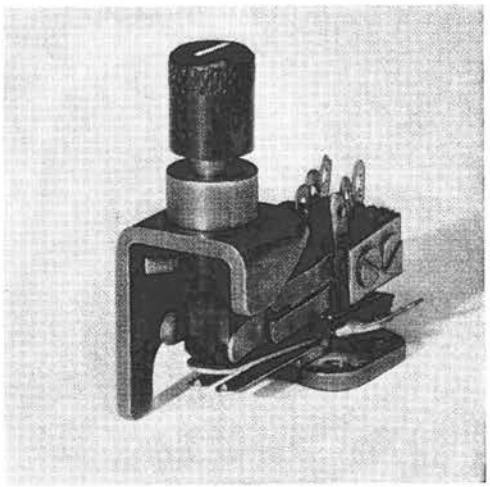

Fig. 5—Small key developed for the small combined telephone set

four spring assemblies and the latter six, but the keys of either type are available in a variety of spring combinations. Both units mount in the large telephone set used primarily for the 1A key system.

For stations of the 1A system that have access to only one or two lines, the smaller telephone set may be used. In this smaller telephone set, the only room available for a key is a restricted space between the ringer magnet and the wall of the housing. To fit in this space, the very small key shown in Figure 5 was developed. Known as the 559, it is a combination turn and push button. One set of springs is operated when the button is turned, and another set—usually employed for signaling—when the but-

ton is pressed. The "press" contact may be made with the button turned in either direction. The button of this key is fastened directly to the plunger, and alignment is provided by using slots instead of holes for the mounting screws. Shoulders on the mounting screws permit the key assembly to be firmly held while still permitting a small amount of lateral motion in any direction. This key may be used for picking up either of the lines associated with the telephone set, for transferring a call to an extension, for cutting off an extension or ringer, or for signaling.

With these three types of keys, the 1A system can provide almost any form of switching service desired. The keys are ordered to meet the operating requirements, and all the connections for the telephone set are made on the terminal block of the key when the system is installed.

Contributors to this Issue

SINCE PRIVATE BRANCH EXCHANGES and key telephone systems have been ALBERT TRADUP'S life work, he was very well prepared to undertake the coördination of development work on the telephone system for the Air Corps' Information Centers. Entering A. T. & T. in 1920, Mr. Tradup was assigned to formulating the electrical, mechanical and physical requirements for PBX switchboards. Since the consolidation of the D. and R. with the Laboratories in 1934, he has continued that work in the Systems Development Department. He was graduated by the University of South Dakota in 1915 with a B.S. degree, when he entered the Northwestern Bell.

CLINTON SHAFER, JR., joined the Laboratories in 1925, shortly after receiving an M.E. degree from Stevens Institute of Technology. He started in the Inspection Engineering Department and was transferred to the Outside Plant Development Department when it was organized in 1927. From then until 1940 he was engaged principally in development work on rubber-covered wire. Since then he has been engaged in outside plant facilities studies.

J. O. EDSON received the B.S. in E.E. degree from the University of Kansas in 1929, and at once joined the Technical Staff of the Laboratories. Here, with the Toll Circuit Development Department, he has devoted the greater part of his time to the development of carrier telephone systems—in later years chiefly the type-J and type-K systems. He has also developed a certain amount of measuring apparatus, such as the oscilloscope described in this issue.

R. E. CRANE graduated from the Harvard Engineering School in 1923 and immediately joined the Engineering Department of the Western Electric Company. He has been engaged since that time in development work on carrier telephone systems. For the last several

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