



101-Type Key Equipments

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Systems Development

I. EQUIPMENT FEATURES

THE extension telephone and the PBX both provide increased communication facilities for the subscriber, but there are many situations where the simple extension is not adequate and where the PBX is either too elaborate or unsuited to the particular requirements. To meet these intermediate demands, there has grown up in recent years a wide assortment of subscriber facilities known as "wiring plans." Their increasing diversity has lately led to a coördination of their design, and since most of them require keys to perform certain operations, the name "key equipments" is applied to the latest types.

Although, in general, the key equipments are designed for serving smaller numbers of lines and trunks than the PBX, this is not always the case, since the larger key equipments frequently accommodate more trunks than the smaller PBX's. The distinction is chiefly one of function, and it is quite common to find one or more of the key equipments used on PBX extensions. The fundamental purposes of the PBX are: first, to economize on trunks by giving a large number of extensions access, through the PBX board, to a comparatively small number of trunks; and second, to allow intercommunication between all the local extensions. With the key equipments, intercommunication, although

sometimes provided, is generally more incidental, and the ratio of central office trunks to local extensions is ordinarily higher. The primary purpose of the key equipments is usually to allow any of a number of stations to answer or originate calls on any of a number of trunks, but the more specific uses will appear from the following description of a number of the leading equipments.

In the 15A and 23A key equipments, the keys are usually in the form of push buttons in the base of the telephone handset. These two systems are alike except that the 15A provides for only one central office trunk, and the 23A, for two. They have already been described in some detail in the RECORD.* Talking and signalling between local stations are carried on over a single intercommunicating channel, and a call may be held at one station while the telephone instrument is used for communicating with another station over this intercom-

*RECORD, April, 1933, p. 244.



Fig. 2—The keys and lamps are arranged in ten-line units, and each unit has a common holding key

municating line. All or only part of the local stations may be given access to the outside lines. These two systems are employed chiefly by large estates, where the local extensions may be installed in the various living rooms, the butler's quarters, the garage, or in any of a number of places that local conditions dictate. With either the 15A or 23A, as many as eleven extensions may be employed.

The 107 and 108 key equipments are essentially the same as the 15A and 23A except that they provide for only five extensions and one central office trunk. The distinction between the 107 and 108 is that the latter permits intercommunication, while the former does not. The keys for these two equipments, instead of being in the

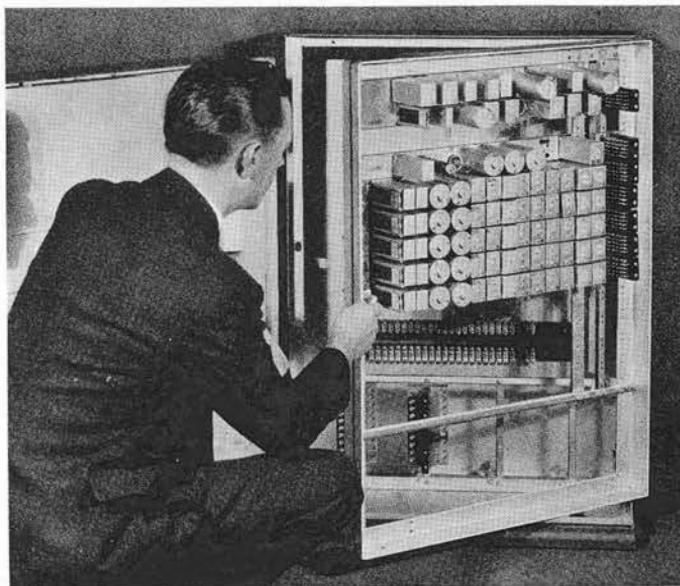


Fig. 1—Relay cabinet used with the 101-type key equipments
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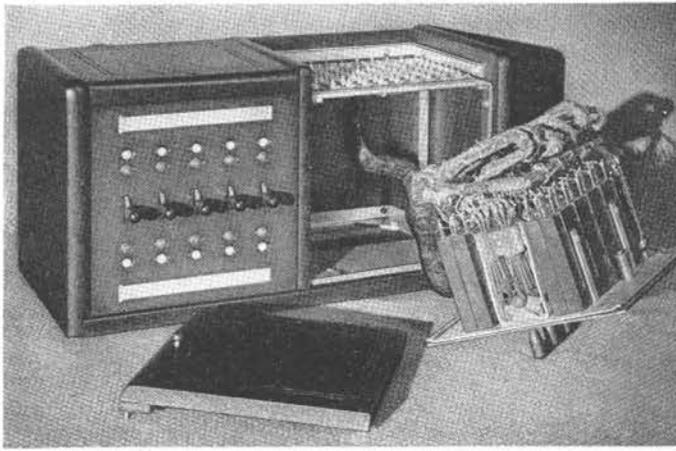


Fig. 3—The key and lamp equipment is all mounted on a metal face plate, which may be mounted in a wood box or set flush in the top of a desk or table

base of the handset as with the 15A and 23A, are assembled in a small metal box that can be mounted on the side of a desk or in any other convenient place, and standard telephone sets are used with them.

The relay equipment for all four of these smaller systems is mounted and wired as complete units on nineteen-inch plates which, in turn, are assembled on a hinged gate inside a metal cabinet. The cover of the cabinet may be readily removed and the gate opened to give access to the wiring. Suitable mounting arrangements permit the cabinet to be fastened on the wall or to the floor as may be most convenient. Battery for operating the relays and signalling current for the lamps are usually obtained over cable pairs from a nearby central office. When larger amounts of current are needed, or when the distance to the central office is greater, a local storage battery may be used, which may be charged either by a local rectifier or over cable pairs from generating equipment located in the central office.

The 100 key equipment, which has

also been described in the RECORD*, permits several central office, PBX, or private telephone lines to be made available to a telephone user with but one telephone set. These same telephone lines can also be made available to as many as eleven other telephone sets on the same premises by the use of multiple key boxes. Any person before whom the lines appear may either originate or answer calls. The 100

key equipments are generally used in such places as brokers' offices, small taxicab headquarters, or telegraph offices. They may also be employed as small order-receiving turrets.

New key equipment, similar to the 100 type but of considerably greater capacity, has recently been developed and called the 101A and 101B. With these new equipments as many as forty lines can be made to appear before one attendant, and the lines may be multiplied to as many as twelve attendants. As with the other systems, the equipment includes a key box and a relay cabinet. The latter is similar to those used with the other systems, but because of the larger number of lines that may be used is provided in three sizes—the largest of which is shown in Figure 1. All of the cabinets have a hinged gate on which $1\frac{3}{4}$ -inch mounting plates are fastened; the smallest size accommodates up to four plates, the medium size up to eleven plates, and the largest size up to eighteen plates. The smaller cabinet is designed for wall or floor mounting, and

*RECORD, July, 1930, p. 527.

the two larger ones, although they may be mounted on a wall, will usually be located on the floor.

The key equipment is provided in ten-line units as shown in Figure 2. There is one holding key per unit and five line keys, each of the latter controlling the connection to two lines depending on whether it is moved up or down. Line lamps are mounted immediately above and below the keys. All this apparatus is mounted on a metal face plate and wired to a terminal panel with a flexible cable as a complete unit. This construction makes it simple to set the face plate flush with the top of a desk or table when desirable, and in this form the system is known as the 101B key equipment, the 101A designation being reserved when the box-mounted key units are employed. An "old brass" finished moulding, which matches the face plate, is used to frame it in its flush mounting.

Depending on the conditions of use, there may be from one to four of these key units used at any one position, and to provide greater compactness when several are to be used together,

combination mountings have been provided. In one, two ten-line units are mounted in a cabinet back to back so that they will be accessible to two people sitting on opposite sides of a table. Another arrangement is two units side-by-side as shown in Figure 3, where one of the units has been removed to show the construction. This double unit is just like two single ones except that the two end panels are replaced by a separator through which the two cabinets are bolted together to give the appearance of a continuous cabinet. When mounted flush in the top of a desk two frameworks are available, one for two key units and the other for four. When not fully equipped, blank face plates the size of the key units are used to fill up the remainder of the cut-out. A metal cover is fastened to the underside of the framework under the desk to protect the units against dust and mechanical injury.

Among other uses the 101-type key equipment lends itself well to providing secretarial service, where a girl in an outer office may answer any of several lines. An installation of this

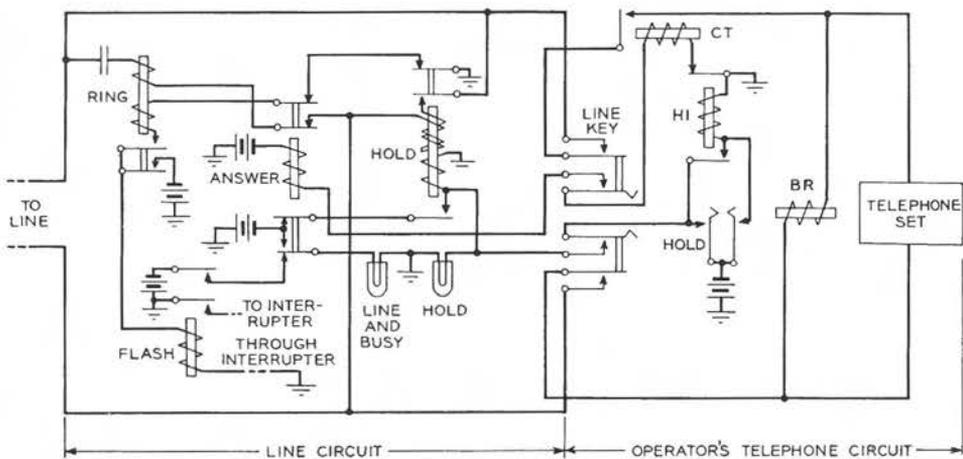


Fig. 4—Simplified schematic showing the wiring of one of the line circuits and the attendant's telephone circuit

secretarial type is suggested by the photograph at the head of this article.

II. CIRCUITS

IN developing the 101-type key equipments certain specific classes of service were particularly in mind, but the circuits were arranged to be flexible enough to meet any demand that was likely to be placed on equip-

a maximum of forty lines in units of ten each, and the lines may be multiplied to appear at as many as twelve of the key equipments. The attendant may use a hand set or an operator's head receiver and breast transmitter, and the circuits may be arranged for either manual or dial service. The lines may be regular central office lines or they may run to a PBX board or to another key equipment.

Each of the lines is provided with a line lamp and a hold lamp. On incoming calls, the line lamp flashes and when a line is busy, it lights steadily. The hold lamp lights when the attendant is holding a line while she is getting information wanted or is talking over one of the other lines. Connection between a line and the attendant's telephone set is made by a line key, each of which serves two lines—the key being thrown up for one line and down for the other. A single holding key serves for a unit of ten lines, or for several units if more than one is used at a single position. It is operated only momentarily, and afterwards the line key may be returned to the normal position so the attendant may talk over another line.

A simplified schematic showing the wiring of the attendant's circuit and of one of the line circuits is given in Figure 4. In a ten-line unit there will be ten line circuits like that at the left of the diagram but only the one

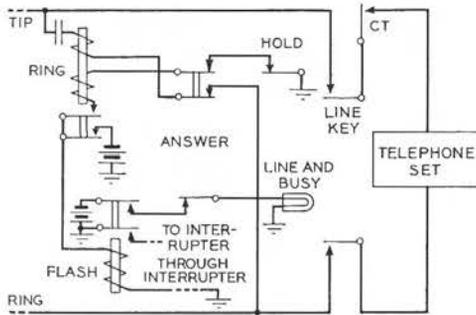


Fig. 5—Circuit connections immediately after a line has been rung

ment of this type and size. Probably the widest use for the new equipments will be for order-receiving service in smaller business houses, for information bureaus such as are used by railroads, for brokerage houses, and for steamship lines to provide for booking passages. They are also very well suited to secretarial service. With a number of doctors occupying the same suite or building, one of the new key equipments would enable a single attendant to answer any of a number of lines when the doctors were out; and when they were in, the key equipment would not interfere with their personal use of their phones. The equipment provides for

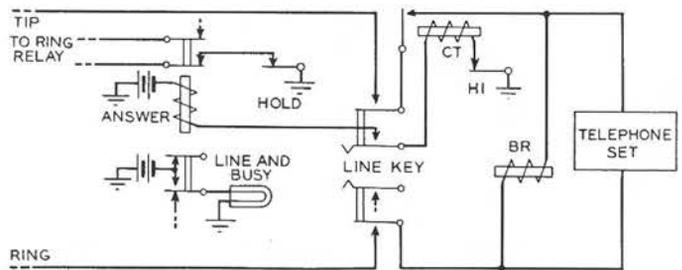


Fig. 6—Circuit connections after a line key has been operated

attendant's circuit, and if more than one of the ten-line units are used at the same location, a single attendant's circuit will serve them all. Through contacts not shown in the diagram, the attendant's circuit is wired in series through contacts on each line key that are closed when the keys are not operated. This prevents the local telephone set from being connected to more than one line at a time. When more than one key is operated, the telephone set will be connected to the line with an operated key that is nearest the right-hand side of the unit.

In each line circuit there are four major relays, one of which is common

of the attendant's telephone circuit are connected to the corresponding wires of the line circuit, and the an-

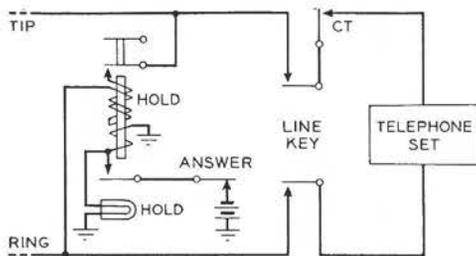


Fig. 8—Circuit connections after hold and line keys have been restored to normal

swering and CT relays are operated in series. The operation of the answering relay releases the ringing relay, and its release in turn releases the flashing relay. Battery is connected to the line lamp through a contact on the answering relay, and the lamp lights steadily to indicate that the line is busy. The operation of CT completes the connection to the attendant's telephone circuit and connects the impedance BR across the line to provide

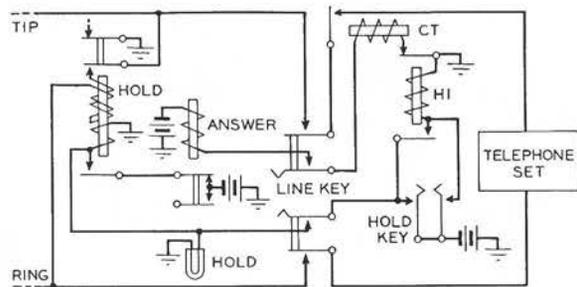


Fig. 7—Circuit connections while "hold" key is held operated

a supervisory signal at the central office showing that the call has been answered. The portion of the circuit in use at this time is shown in Figure 6. Only the flashing and ringing relays are shown, but contacts of other relays that are in the circuit are indicated.

When the attendant throws a line key to answer the call, the four wires

to four circuits. The ringing relay acts on incoming ringing current, holds itself operated through one of its contacts, and operates the common flashing relay through a relay interrupter not shown on the diagram. The operation of the flashing relay connects battery to the lamp, and the interrupter operates and releases the flashing relay about twice a second to give the flashing lamp signal that indicates an incoming call. Figure 5 shows that portion of the circuit in use at this time.

The attendant may now talk over the line, and at the completion of the call, the restoration of the line key to normal will release the answering and CT relays, and put the circuit in a condition for another call—with the operating winding of the ringing relay connected across the line through a condenser and a back contact of the answering relay. If, before terminating the call, information must be obtained by calling over another line, the attendant operates the hold key, which holds the calling line and re-

leases the telephone set for other use. The hold key is operated only momentarily, and after it is restored the line key is also restored to normal to leave the attendant's telephone set free for use on another circuit.

Holding is done by two relays and the hold key. The main holding relay is in the line circuit, but the holding key and an auxiliary holding relay are in the attendant's telephone circuit. The circuit connections during the time that the hold key is held operated is shown in Figure 7. The auxiliary holding relay, H_1 , is operated directly by the hold key, and the main holding relay, H , is operated by the hold key through a contact on the line key. The operation of H_1 releases relay CT and the answering relay, which is in series with it, and the release of the answering relay allows H to hold itself operated through one of its contacts and a back contact of the answering relay. The operation of H connects a holding resistance, wound non-inductively on its own core, across the line to hold it. The release of the answering relay extinguishes the line lamp, but the hold lamp is lighted through a contact on the H relay.

The hold key is now released, but H_1 is held operated through one of its contacts and through a contact on the line key, a contact on the H relay, and a back contact on the answering relay. It is necessary to hold H_1 operated at this point since if it were released, the CT and answering relays would be

again brought in through the line key, which is still operated. The line key, however, is now restored to normal, which releases H_1 and frees the attendant's telephone circuit for other use. The circuit will now be as shown in Figure 8; the line is held by the holding resistance, and the attendant's circuit is free.

The attendant now proceeds to call over another line or do whatever else is necessary to get the information needed. When ready to talk over the original calling line, the attendant merely operates the line key pertaining to that line. This operates the CT and answering relays, and the holding relay is released by the operation of the answering relay. The circuit is now again as shown in Figure 6, and talking proceeds. At the completion of the call, the restoration of the line key will release the CT and answering relays, and the line will be ready for another call.

When the key equipment is used for secretarial service, the bell at the subscriber's station will ring at the same time that the line lamp flashes at the key equipment. The line may be answered at either place, and the circuit, which is somewhat different from that described above, is arranged so that in either case the line lamp will change from flashing to steady, which is a signal to the attendant that the call has been answered. If desired, the circuit can be made to cut off the attendant when the main station answers.