

## Private Automatic Branch Exchanges

In the January issue of this journal a description was given of a private automatic branch exchange designed to conform to the requirements of the British Post Office. The equipment provided a maximum capacity of eighty extension lines and the facilities offered included fully automatic service between extensions, connection to the main exchange through a small manual switchboard, direct dialling-out to the main exchange by certain extensions, trunk offering by the P.A.B.X. operator, night service, exchange prohibition and tie line working.

From a consideration of this small exchange it will be realised that the scope of application of the principles of automatic switching to varying private branch exchange requirements is very wide. The facilities provided are, of course, not governed by the size of the P.A.B.X. Several systems, however, have been applied in the past to meet different local conditions.

The main difference between the various systems lies in the mode of operation between extensions and the main exchange via the manual switchboard. In the P.A.B.X. already referred to, incoming calls from the main exchange are answered by the operator who extends each call to the required extension by means of a standard cord circuit. Up to the present, this procedure has been adopted almost universally. At this point, however, various methods of obtaining connection with the extension may be introduced and conversely, the means provided for an extension to call the operator may vary.

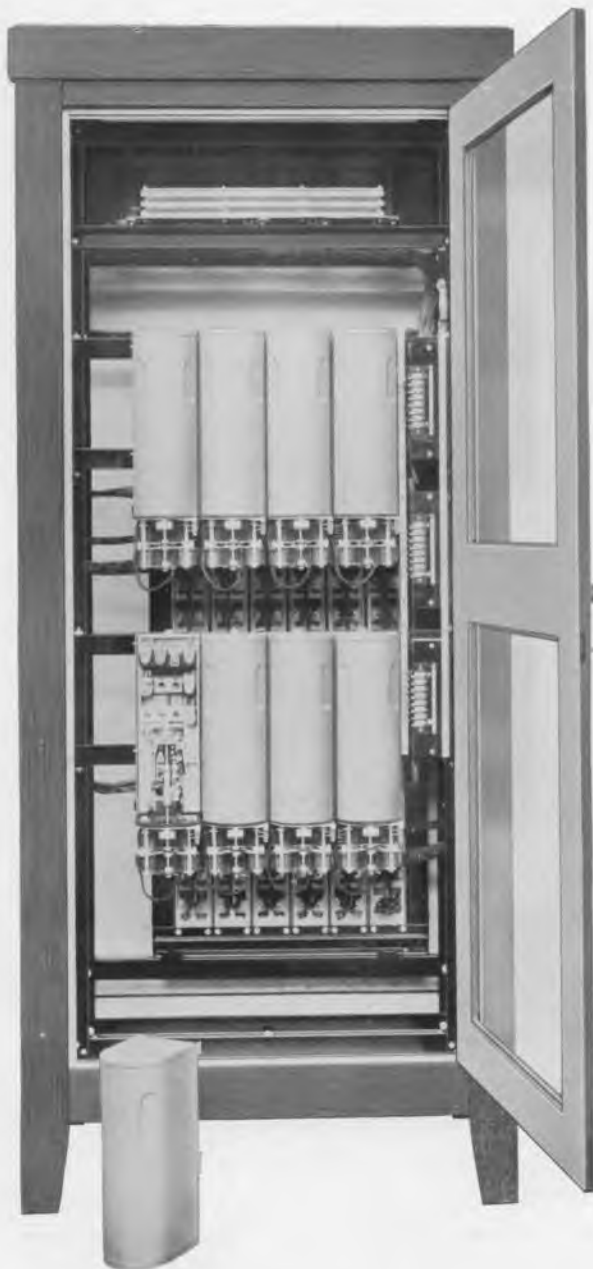


Fig. 1

The system already described employs a full extension multiple on the manual board, each line terminating in a jack and lamp. By dialling "0" an extension causes the corresponding line lamp to glow and when the operator plugs into the associated jack the automatic switches are released. To connect an incoming call to the extension, the operator uses the same jack and rings out in the usual manner

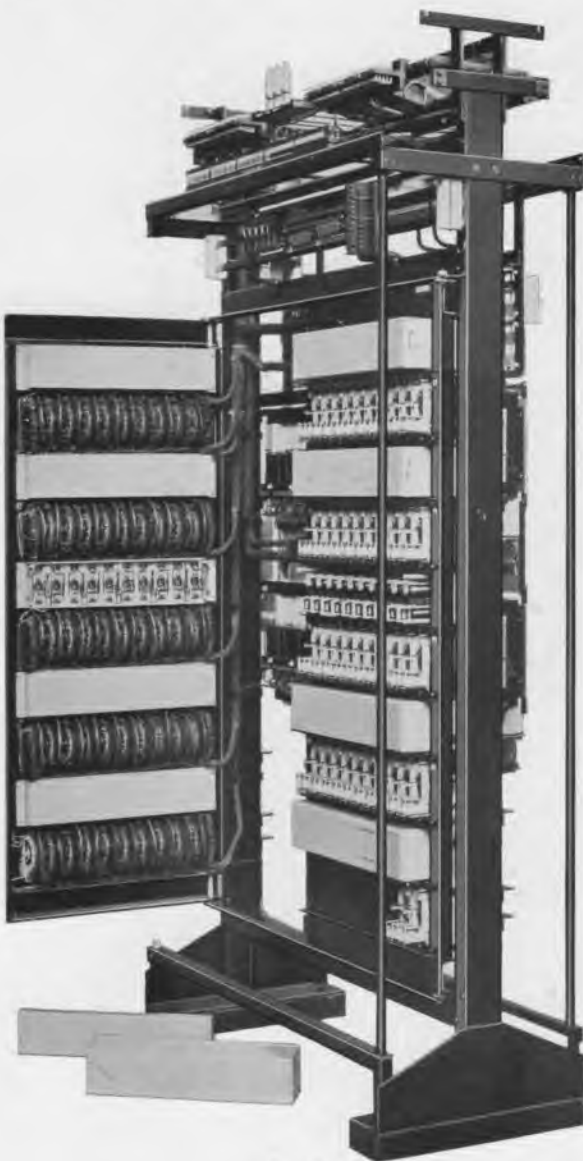


Fig. 2

An alternative system is one in which the automatic switches are in use for the duration of each call from extension to operator. This is particularly suited to conditions where direct out-service is provided for all extensions, in which case there are comparatively few calls to the operator. A number of special line circuits are fitted on the manual board, each circuit being equipped with a jack and calling lamp. When an extension dials "0," the selector which has been taken into use operates vertically to the "0" level and then searches automatically for one of the lines to the manual board. The associated lamp glows and the operator answers after plugging into the corresponding jack.

One of the chief advantages of this system is that a very simple extension line circuit can be employed as no extension answering jack equipment is required on the manual board. A jack of simple type is fitted for each extension line to enable the operator to extend incoming calls.

A further P.A.B.X. system differs considerably from those already reviewed. In this, the extension line circuits have no appearance on the manual board and to extend a call to any required extension, the operator dials into the automatic plant, utilising the usual train of switches. Calls from extensions to operator are completed over special line circuits to the manual board, which are accessible from level "0" on the selector bank multiple. Although the simplicity and economy of the scheme is evident, it will be appreciated that this system does not possess great speed of operation as it is necessary for the operator to dial each time when calling the extensions.

Before passing to the latest P.A.B.X. system, it will be of interest to note some of

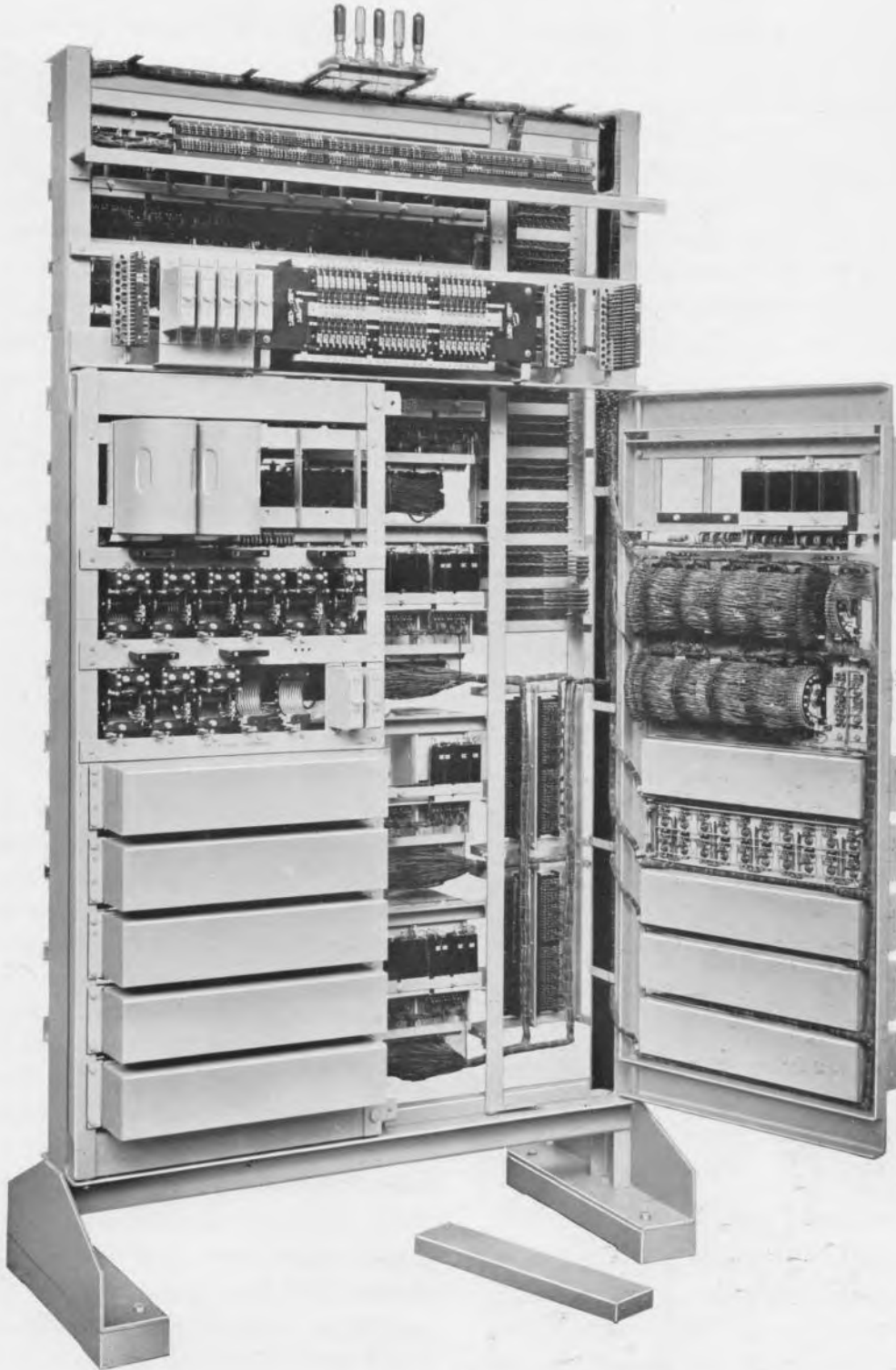


Fig. 3

the plans adopted in regard to the lay-out of the automatic equipment. Dust-proof cabinets are often employed and Fig. 1 illustrates a typical unit of this type in which is mounted line circuit and final selector equipment for fifty extension lines. When required, additional units are placed side by side, thus ensuring a neat and compact lay-out of the exchange. The group selectors are fitted in similar cabinets.

In cases where a room is definitely set aside to accommodate the automatic plant or where an abnormal amount of dust is not present, open type racks may be used. This procedure is generally adopted for exchanges of several hundred lines and is of course, more economical in such cases than the provision of cabinets. Fig. 2 shows a P.A.B.X. line unit of practically standard main exchange design on which is mounted the preselector and final selector equipment. The preselectors and line and cut-off relays are fitted on two hinged gates, each of which may be equipped with fifty circuits, the whole unit thus having capacity for 100 extension lines. Separate units of a standard type accommodate the group selectors.

Fig. 3 illustrates a 100-line unit of similar design but so arranged that it may be used primarily for a two-digit system and later for a three-digit system, provision being made in the latter case to mount the group selectors on the line unit, thus dispensing with group selector racks.

### **The Auto-Cord P.A.B.X. System.**

As a result of investigations into the problems associated with the operating requirements of private automatic branch exchanges The General Electric Co. Ltd. has evolved the "Auto-Cord" P.A.B.X. system. This makes use of operating features which

are new to P.A.B.X. design, and which result in a system providing a grade of service of a standard not hitherto reached. It is claimed that it incorporates the advantages of all existing systems and successfully overcomes the limitations that have, up till now, been present in the mode of operating private automatic branch exchanges.

It is in the method of providing external connections that the special features of the Auto-Cord system are principally concerned.

Fig. 4 illustrates, in abbreviated form, the trunking diagram of an Auto-Cord P.A.B.X. and it will be noted that where this differs from standard systems is in that portion of the diagram which is termed the "Auto-Cord Circuit," the automatic switching plant being of standard type.

The usual type of cord circuit having two plugs and cords is replaced by the Auto-Cord circuit, comprising one plug and cord and two rotary type switches. Each Auto-Cord circuit also includes a transmission bridge combined with an impulse repeating element and associated with each circuit are some of the keys which are usually employed in the operation of a fully manual cord circuit. Every connection established between P.A.B.X. extensions and the main exchange, either in an outgoing or incoming direction, is completed through an Auto-Cord circuit. From this summary of its principal features an understanding of the operation of the system may now be obtained by reference to Fig. 4.

An extension requiring connection to the main exchange removes his receiver and dials "0." The selector which has been taken into use operates to the "0" level. An idle Auto-Cord circuit is now caused to be seized with the result that one of the rotary type switches associated with it—the extension



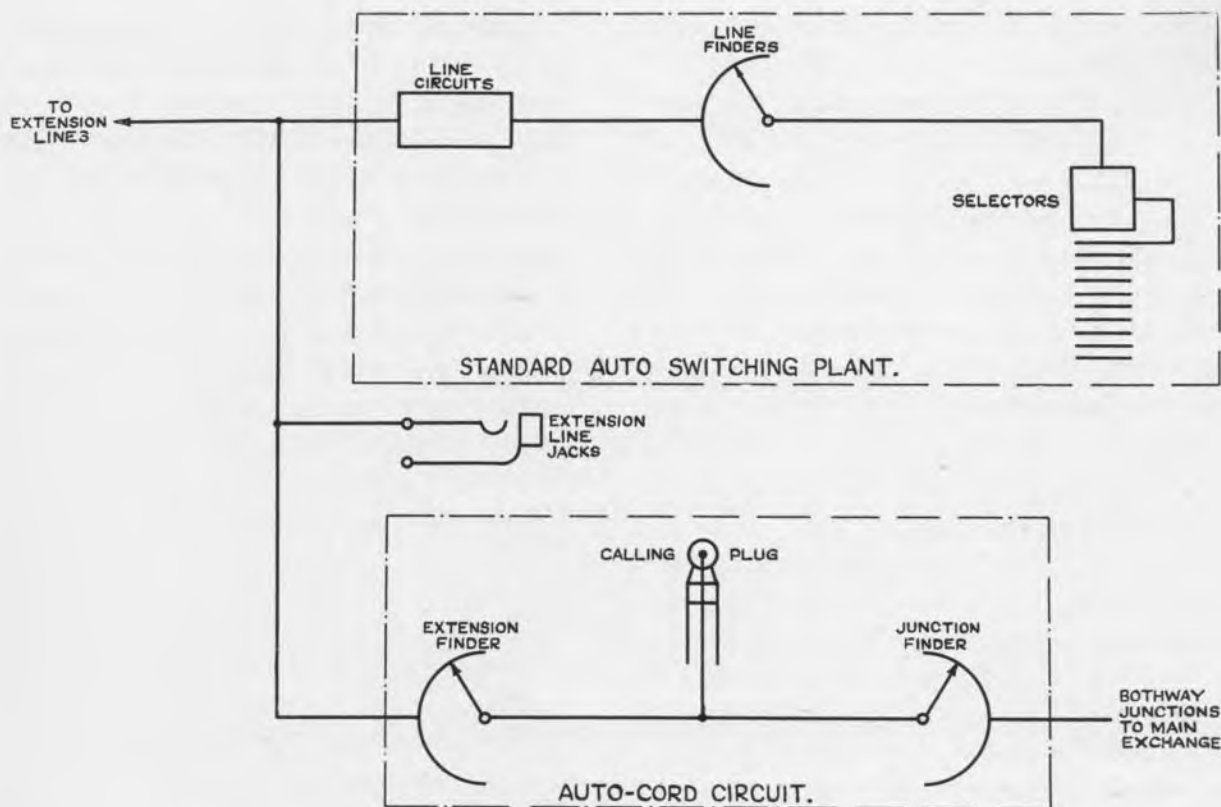


FIG. 4  
TRUNKING SCHEME OF AUTO-CORD P.A.B.X. SYSTEM

finder switch—hunts for the calling line and makes connection with it. The automatic selector and line-finder circuits are then restored to normal and the calling extension is directly connected to the Auto-Cord circuit. A calling lamp fitted on the key shelf of the manual board and associated with the particular cord circuit in use now glows to attract the attention of the operator.

The operator responds to the call by throwing a speaking key associated with the particular Auto-Cord circuit and speaks to the calling extension. On being informed that connection is required to the main exchange the operator throws a junction connecting key. This action causes the second rotary type switch associated with the Auto-Cord circuit

—the junction finder switch—to hunt for an idle junction to the main exchange. If the main exchange is automatic, dial tone will be heard when a selector at the main has been seized and the operator will then restore the junction connecting key.

If the calling extension is aware of the number of the wanted main exchange subscriber he now dials the requisite trains of impulses and the operator restores the speaking key. The impulses are received in the Auto-Cord circuit where they are repeated over the junction to the main exchange.

At the termination of conversation the calling extension replaces his receiver. This action releases the switches in the main exchange and also restores the Auto-Cord

circuit to normal when it will be taken into use on ensuing calls.

On the class of connection which has been described it will be noted that the work on the part of the operator consists simply of throwing and restoring two keys in order to set up the connection, no action being necessary at the termination of the call. The operator has, however, full control over the initial connecting of the caller to the main exchange and may use discretion as to whether the call is one that should be extended.

In the event of an extension requiring connection to the main exchange and not wishing to dial through or not knowing the number of the wanted subscriber, the operator dials the necessary digits. This is carried out while the speaking key is thrown and no other action by the operator is necessary. At the completion of dialling the operator restores the speaking key and leaves the connection under the control of the calling extension.

An incoming call from the main exchange makes connection with an idle Auto-Cord circuit in the same manner as an outgoing call from a P.A.B.X. extension. In this case the associated junction finder switch is employed to make the necessary connection between the exchange line and the Auto-Cord circuit. A junction calling lamp glows on the manual board to indicate the class of caller and the operator answers after throwing the speaking key connected with the particular Auto-Cord circuit.

To complete the connection the operator plugs into the jack connected to the wanted extension line with the plug associated with the Auto-Cord circuit and rings out in the usual manner. A supervisory lamp is associated with each Auto-Cord circuit and this lamp glows to give the clearing signal when

the called extension eventually replaces the receiver at the termination of conversation. The action of the operator in withdrawing the plug in response to this signal clears the Auto-Cord circuit and renders it free to be used by other callers.

One of the principal advantages claimed for the system is that although the operator is given control over the initial setting-up of each outgoing call to the main exchange, time is not taken in dialling for every caller. In addition as the releasing of these calls is performed automatically, the time given by the operator to each call is reduced to an absolute minimum.

It may be said that the Auto-Cord system combines the advantage of a direct dialling-out system with that of a P.A.B.X. in which all outgoing calls are set up by the operator. The chief advantage of the former system is its speed of operation but it has also a feature which is adverse to the efficient operation of the public exchange, because the main exchange operator may often be troubled with enquiry calls which could be dealt with by the P.A.B.X. operator. This does not arise when all outgoing calls are controlled by the P.A.B.X. operator but hitherto on such systems, the local operator has had to effect all the necessary dialling and pay attention to the supervision of the call in order to release the connection at the termination of conversation. On this class of P.A.B.X., therefore, the percentage of operators to extension lines is naturally higher than that on the direct dialling-out system.

The Auto-Cord system overcomes the limitations discussed above, for although all outgoing calls are controlled by the local operator, this control is only exercised when it is actually necessary, that is, at the origination of the call. Once the extension is con-

nected to an exchange line the operator is relieved of any further interest in the call.

A further advantage is claimed for the Auto-Cord system from the fact that exchange calls are released with a minimum loss of time and consequently an Auto-Cord circuit is capable of carrying more traffic than a cord circuit of the fully manual type. Having less work to perform on each call the operator also can deal with a heavier traffic and therefore it is apparent that a considerable economy in operators and cord circuits is obtained. In addition the traffic carrying capacity of the lines to the main exchange is also increased, for they are always released promptly and the junctions are never held in use unnecessarily. Hence the Auto-Cord system effectively increases the working efficiency of operators, cord circuits and junction lines.

It will be clear that the manual board equipment, particularly such as jacks and lamps, is reduced to a minimum. Each extension line is provided with a jack, this being the total equipment necessary on the vertical portion of the manual board. As the exchange lines make connection to the cord circuits automatically, exchange line jacks, lamps and dialling keys are no longer required. For each Auto-Cord circuit one plug and cord only is necessary. The saving in manual equipment that is a feature of this system permits the use of a considerably smaller and simpler manual switchboard; in fact, a small board of the wall pattern will prove to be sufficient for the control of an exchange of quite appreciable size.

Referring to the automatic switching plant required in association with the Auto-Cord

system, this may be of the very simplest type as it carries internal traffic only. In addition, the fact that exchange connections are not established through the medium of the automatic switches considerably reduces the number of switches required for an exchange of given size.

It has been explained that the function of the extension finder switches, associated with the Auto-Cord circuits, is to hunt for calling extension lines. This feature may lead one to assume that it involves complication to each extension line circuit. Actually, however, these line circuits are not affected to any degree and may be of the simplest type. As line circuits in an exchange are an important consideration, for their number is naturally greater than that of any other circuit, this point is one of importance when the question of cost is introduced.

The principal features of the Auto-Cord system may be summarized as follows —

- (a) Provides extensions with dialling-out and clearing facilities and yet gives the operator control over the initial setting-up of outgoing calls.
- (b) Simplification and reduction of work for the operator
- (c) Increase in traffic carrying capacity of cord circuits and junction lines.
- (d) Reduction in size of manual board.
- (e) Reduction and simplification of automatic switching plant.

It is claimed, therefore, for the Auto-Cord system that, while meeting every requirement that can be demanded of a P.A.B.X. system, it provides a high grade of service with a plant which is low in cost.