

The G.E.C. Auto-Cordless P.A.B.X.

A Simple and Economical System for Small Installations.

ALTHOUGH the same principles and basic design have been widely employed in private automatic branch exchange equipment for both large and small installations, it cannot be said that this practice results in the requirements of small installations being met in the most economical manner.

If a system of small capacity is contemplated the capital and operating costs of an automatic equipment and the associated manual switchboard of the usual floor pattern type may well prove prohibitive. An appreciation of this fact showed the necessity for a close study of the conditions to be met before any equipment could be claimed as the ideal for small installations and as a result the G.E.C. Auto-cordless system was evolved. This employs a small cordless switchboard for public service connections. The prime objects of the design are economy and simplicity and both are secured largely as a result of the adoption of this cordless pattern manual board, which offers also the further advantages of its type, namely, compactness and freedom from troubles which arise from defective cords.

The automatic equipment is very similar to the G.E.C. rotary type P.A.X., employing rotary switches as line finders and final selectors and operating in accordance with normal P.A.B.X. practice. It is in regard to the setting-up of external connections, how-

ever, that the auto-cordless P.A.B.X. may claim particular merit. Automatic switching is incorporated in the cordless circuit, resulting in the operating procedure being reduced to an absolute minimum whilst extending to the setting up of external connections the same speed and accuracy which characterise the internal service. The exact manner in which this is effected will be clear from the description given later. Briefly, to establish connection for either an incoming or outgoing call the operator depresses two keys associated respectively with the extension and the junction and then, on momentarily depressing a third key, the required connection is completed automatically. Supervision of the board thus makes so little demand upon the operator that it may be included with other duties.

The system is capable of economic application to installations of up to fifty lines capacity, the particular equipment to be described serving twenty-five extension lines and four junctions. The following outline of the features will show that economy in initial and operating cost has been achieved without any restriction of the facilities.

Local Connections.

These are completed automatically upon the calling extension dialling the required number.

Connection to the P.A.B.X. Operator

Access to the operator is obtained upon the calling extension dialling "0". If a call to the main exchange is required, the operator may extend the connection and, if the main exchange is automatic, the required number may be dialled by the operator or by the extension. On completion of the connection the circuit arrangements provide for the operator to have no further interest in the call but, however, a key is provided to enable her, at her discretion, to retain supervision.

Direct Out Service.

Extensions, by dialling "9", may obtain direct connection to the exchange without the intervention of the operator. A junction is automatically taken into use and a "junction engaged" lamp on the switchboard provides an engaged signal to prevent the operator from endeavouring to set up a second connection on that exchange line.

Release.

On local calls, the connection is released when either party replaces his receiver

Forced Release.

If, at the end of conversation on a direct out connection, the extension fails to replace his receiver, the prolonged glowing of the junction engaged lamp causes the operator to challenge. On failing to receive a reply the "extension release" key is thrown and the junction is then free for further use.

Trunk Offering.

Individual indication of busy extensions is not given on the manual board since such

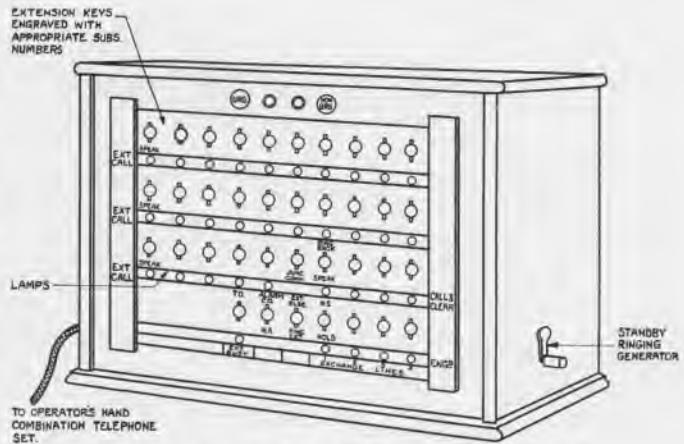


Fig. 1.—Auto-cordless Switchboard for 25 Extensions and 4 Exchange Lines.

indication would involve a considerable current consumption. On an "extension" key being thrown, however, a common "extension busy" lamp glows if the wanted line is engaged, and denotes to the operator that to speak to the extension the trunk offering key must be thrown.

Ring Back.

On a call via the P.A.B.X. switchboard, an extension may be recalled on giving the clear signal by means of a "ring back" key, one of which is provided for each exchange line connecting circuit.

Night Switching.

On a system of this size and type there may be numerous occasions on which the switchboard is of necessity unattended, and too frequently in normal P.A.B.X. operation such a circumstance results in delay in answering incoming calls. To guard against this, if the attendant leaves the board at any time, the night switching keys on the auto-cordless switchboard may be thrown to connect the exchange lines to predetermined extensions who will then receive incoming calls direct. This arrangement in no way

interferes with the ability of such an extension to make and receive local calls and if such a call is in progress when an incoming call is received at the manual board, ringing tone is fed to the extension to denote that an exchange call is awaiting attention. On receipt of this tone the extension replaces his receiver to release the local connection whereupon his bell is rung and he accepts the incoming call.

Tones.

The following tones are employed to indicate to a calling subscriber the various conditions obtaining. Ringing tone, an interrupted low frequency tone to indicate that the bell of the called line is ringing, Busy tone, an interrupted high pitched tone indicating that (a) the called extension is engaged, (b) all local links are engaged, (c) all exchange lines are engaged, Dead Number tone, high pitched and continuous, indicating that a dead or unallotted number has been dialled.

Executive's Right of Way.

An executive's telephone set may be fitted with a press-button, operation of which enables the executive to interrupt a call in progress if he wishes to speak to one or other of the two extensions conversing.

Main Exchange Prohibition.

If it is desired that the direct-out facility should be withheld from certain extension lines, circuit arrangements are made so that if such an extension dials the digit "9", the normal procedure for a direct-out call, connection is not established and dead number tone is applied to the calling line.



Fig. 2.—Typical Automatic Apparatus Cabinet for 25 Lines.

Restricted Direct-Out Service.

Although all extensions may be permitted to dial out directly it may be desired to restrict direct-out calls to the single-fee area, trunk calls being obtained only through the P.A.B.X. operator. Arrangements may be made in the P.A.B.X. equipment to effect this restriction provided that such restriction is a regular feature of the service in the area and the necessary discriminating equipment is fitted at the main exchange.

Alarm.

Lamps are provided on the manual board, designated "urgent" and "non-urgent" and the appropriate lamp glows to indicate a fault condition. If a subscriber lifts his receiver and, after a period varying from $2\frac{1}{2}$ to 5

minutes, fails to dial a number, the "non-urgent" alarm lamp glows. A blown fuse causes the "urgent" lamp to glow immediately.

Voltage and Dialling Range.

The apparatus is designed to operate on a current supply of 26 volts with limits of 24 and 28 volts. Between these limits an extension line loop resistance of up to 250 ohms and a leak of 20,000 ohms are permissible. Steps are taken to minimise current consumption and if it be assumed that the number of local calls of average duration of 90 seconds is 168 per day with exchange line calls of half this number and of 180 seconds holding time, then a 25 ampere-hour battery will supply the necessary operating current for seven days.

Equipment.

A steel rack accommodates all the automatic apparatus and is housed in a hardwood cabinet having a glass-panelled door at the front and a lift out panel at the rear, affording ready access to the apparatus and wiring. The manual board is constructed of the best seasoned hardwood, the front panel, carrying the keys and lamps, being hinged, whilst a removable panel at the rear gives access to the terminal strips for connection of the incoming cables. All the apparatus is of standard construction, the relays being fitted with twin contacts of silver except in heavy duty circuits, when platinum is employed. Materials and finishes suitable for meeting

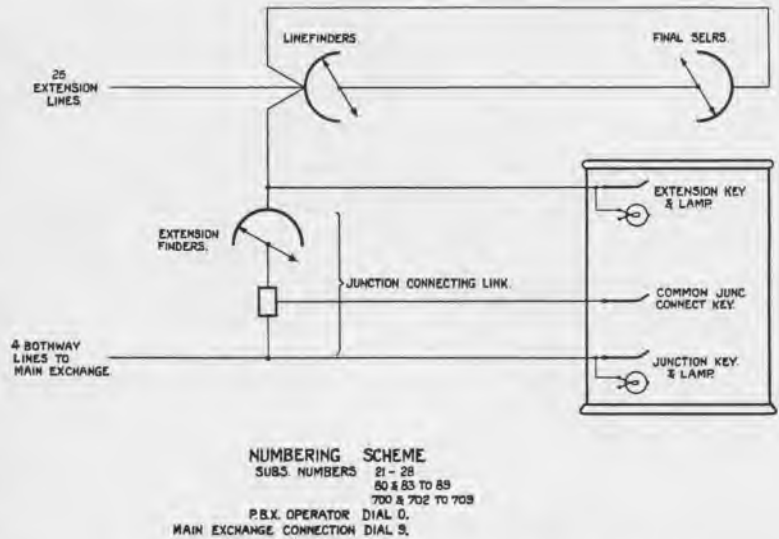


Fig. 3.—Trunking Diagram, Auto-cordless P.A.B.X. System.

adverse climatic conditions are incorporated if the equipment is required for tropical service.

Operation.

Local Call.

In the automatic equipment four connecting links are provided each comprising a line finder and a final selector, a relay chain assigning the finders in turn to equalise the traffic carried by the links. In response to the loop condition occurring when a subscriber lifts his receiver, the associated line circuit (single relay) functions and the line finder assigned hunts for the calling line, extending it to a final selector. Dialed impulses cause the selector to step to the contact of the wanted line, at which stage, if the line is free, ringing current is applied and ringing tone fed to the calling line, whilst busy tone is heard if the line is engaged. Release of the connection follows upon the replacement of either receiver

Outgoing Call via P.A.B.X. Operator

Reference to the trunking diagram (Fig. 3) will show that the junctions are terminated, via relay groups, on the wipers of uniselectors known as extension finders. The internal lines are multipled over the bank contacts.

An extension requiring connection to the main exchange by the P.A.B.X. operator removes his receiver and dials "0". A final selector is taken into use and steps to the "0" contact causing the appropriate "extension call" lamp to glow on the switchboard. In response, the operator throws the associated "extension" key which connects her telephone to the line, releases the linefinder and final selector and extinguishes the calling lamp. Upon being informed that connection is required to the main exchange, the operator throws a "junction" key and is connected directly to the exchange. The required number is then dialled by the operator, or, if the main exchange is manual, it is given verbally. To connect the extension to the exchange line the operator then depresses a common "junction connect" key which causes the extension finder in the junction connecting link circuit to hunt for the line circuit the "extension" key of which is operated. When the line is found the calling extension is connected directly to the main exchange and the appropriate "junction engaged" lamp glows indicating to the operator that the "junction connect", "junction" and "extension" keys may be restored. When the extension replaces his receiver at the end of conversation the connection is completely released both at the main exchange and the P.A.B.X. Thus the action of the operator consists simply of throwing three keys and dialling the required number.

This may further be simplified since the calling party may himself dial the number after the operation of the "junction connect" key has caused the extension finder to connect his line to the junction.

On a normal call, as has been explained, through clearing is effected, but if the operator wishes to maintain control, she throws the "hold" key associated with the junction in use before restoring the "junction" key and subsequently obtains a clear signal from the "call and clear" lamp when the extension replaces his receiver. Under this condition the extension may "flash" the operator and have the call transferred to any other extension.

Outgoing Call Dialled Direct.

An extension requiring connection to the main exchange without the intervention of the P.A.B.X. operator removes his receiver and dials "9". The final selector taken into use responds and causes the extension finder associated with an idle junction automatically to find the calling line. The extension is thus connected to the main exchange and the linefinder and final selector are then released. Release of the connection is effected when the extension replaces his receiver.

Incoming Call.

A call incoming to the P.A.B.X. lights the calling lamp appropriate to the junction taken into use and the operator throws the corresponding "junction" key. As a result the lamp is extinguished and the operator's telephone is connected to the junction. On connection to a particular extension being requested the operator throws the "hold" key and restores the "junction" key, trans-

ferring her telephone from the exchange line to the extension keys. If she finds that the called party is free she again operates the junction key momentarily and depresses the "junction connect" key whereupon the extension finder of the connecting link in use hunts for the line marked by the operation of the "extension" key. The "junction engaged" and "junction clear" lamps glow and the extension is called by depression of the "ring back" key. On reply the "junction clear" lamp is extinguished leaving the "engaged" lamp glowing and the operator restores her keys unless she wishes to retain supervision by means of the "hold" key. If the "hold" key is restored, through clearing is effected when the extension replaces his receiver.

In the event of the called party being engaged on a local call, the common "extension busy" lamp glows when the particular "extension" key is thrown and the operator then throws the "trunk offering" key, enabling her to enquire if the local call is to be interrupted. If the called party wishes to

accept the incoming call, both extensions are requested to replace their receivers and the operator then proceeds to complete the connection.

Night Switching.

The particular extensions to which the exchange lines are to be connected are predetermined and circuit arrangements are made accordingly. The operation of the night switching keys associates the junctions with the selected extensions but does not complete the actual connections. Direct-out calls may thus be made over the exchange lines and these selected extensions are not prevented from making and receiving local calls. When an incoming call takes a junction into use the associated extension finder automatically hunts for the extension allotted to that junction. If the extension line is free ringing current is fed from the P.A.B.X. source. As has been explained, if the line is busy, ringing tone is applied to indicate to the extension that an incoming call is awaiting attention.

