

PRIVATE AUTOMATIC BRANCH EXCHANGES

New Standard Units

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A private automatic branch exchange (P.A.B.X.) provides automatic intercommunication between telephones on business or private premises, together with external communication to public exchanges or other telephone installations. Internal communication is obtained by dialling the required extension number, and the connexion is made automatically. Outgoing calls are made either automatically by dialling a selected number, which produces direct switching to the public exchange, or by dialling another selected number to obtain the P.A.B.X. operator or attendant, who then controls the connexion and extends the call to the public exchange.

For incoming calls, there is no technical difficulty in dispensing with the operator and arranging for the calls to be handled automatically. A practical objection, however, is that extension numbers would have to be known to public-exchange subscribers, who would also need to know exactly which extension they wanted in a given instance. Thus at the point at which an incoming call arrives at the P.A.B.X., there should be some member of the staff who can guide the call to the appropriate extension.

The General Electric Company has developed two new standard P.A.B.X. units, one with a capacity for two exchange lines and 23 extensions, and the other for ten exchange lines and 49 extensions.

With the smaller unit one or more of any five selected extensions performs the duty of an operator for incoming calls.

With the larger unit, there is an attendant's cabinet at which incoming calls can be extended to the required extension by the depression of keys. The operation is such that it can easily be performed by a member of the staff of the establishment in addition to other duties.

2 + 23—Line P.A.B.X.

This exchange has a capacity of 23 extensions and two public-exchange lines. The exchange lines can be connected to automatic or C.B. manual systems. Incoming calls from the public exchange are answered at one of the five selected extensions and may be transferred from there to any other extension as required.



Fig. 1.—2+23-line P.A.B.X. with doors removed.

The automatic unit (Fig. 1), which contains all the exchange equipment, is constructed with air-spaced, double sheet-metal walls. The lift-out doors are similarly constructed and when in position make the unit dust-proof. The overall dimensions of the unit are 6' 3" (191cms) high, 2' 0" (61cms) wide, and 1' 2" (35.5cms) deep.

Dial, busy and *ringing* tones are derived from vibrators.

The following circuits are incorporated:—

- 5 Extension line circuits with exchange-answering facility, (numbers 20—24)
- 18 Extension line circuits without exchange-answering facility, (numbers 25—39 and 41—43)
- 4 Local connecting links.
- 2 Exchange line circuits, (with transfer facility).
- 1 Allotter circuit
- 1 Ring, tone and common alarm circuit.
- 2 Mains failure circuits.

The trunking of the circuits is shown in Fig. 2.

Any extension user can make or receive local calls, and any extension may have an executive right-of-way facility to enable him to break in on an existing call. This facility can be established for an extension by the simple strapping of terminals in the unit. Any extension user may make calls to the public exchange, or may be barred from making such calls by the strapping of two terminals.

Calls incoming from the public exchange ring alarm bells and can be answered at any of five selected extensions. If required, the bells can be arranged to ring in two groups, the second group being rung with the first after a delay period. The second group of exchange-answering extension users will then need only to answer incoming calls if the first-called extension users are away from their telephones.

Press-buttons for the transfer of exchange calls are fitted to all telephones on exchange-answering extensions and other extensions when required.

In the event of a mains failure, two exchange-answering extensions are automatically connected directly to the public-exchange lines to maintain the service. During maintenance of an exchange line circuit in the P.A.B.X., a key can be thrown to bypass the circuit and connect the exchange line directly to one of the exchange-answering extensions.

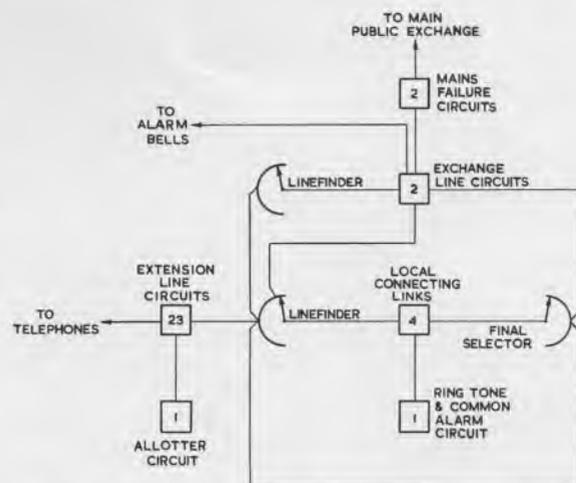


Fig. 2.—Trunking diagram—2+23-line P.A.B.X.

Local Call (Dial 20-39 and 41-43).

The extension user lifts his handset, thereby operating the line relay associated with his line. This relay in turn actuates the allotter circuit, which directs the start signal from the line circuit to an idle connecting link. The linefinder of this link steps and continues to do so until its wipers stand on the contacts associated with the calling line circuit. *Dial* tone is extended to the caller, who proceeds to dial the required number.

The final selector of the link responds to the dial impulses and, after the second digit, reaches the outlet of the required extension.

If the required extension is free, the bell is rung intermittently and *ringing* tone is heard by the caller. When the required extension user lifts his handset, ringing current and *ringing* tone are stopped. The call is automatically disconnected when either the calling or called extension user replaces his handset.

If the required extension is engaged, *busy* tone will be received by the caller, who should either replace his handset or make use of the executive right-of-way facility (if he is provided with it), by dialling 1, when he will be connected to the required extension. A warning note is given to the established connexion when the third party breaks in. Both parties of the established connexion are requested to replace their handsets, the bell of the required extension is then automatically rung and the call proceeds in the normal way.

Call to the Public Exchange (Dial 9)

The calling extension user lifts his handset, whereupon an idle link is engaged, upon receipt of *dial* tone the caller dials 9. The final selector is directed to the first of the two exchange-line outlets, if this is busy, the call passes to the outlet for the second exchange-line, if this one is also busy, *busy* tone is returned to the caller.

Executive right-of-way is inoperative on public-exchange calls.

When the final selector stands on a free outlet,

it engages the exchange line relay-set associated with that outlet and causes the associated linefinder to hunt until the wipers are standing on the contacts of the calling extension. The calling extension is thus connected directly to the exchange line, and the link circuit is released for other calls. The call can be transferred by the caller to any other extension if his instrument is fitted with a push-button.

Incoming Call from the Public Exchange

An incoming call is signalled on alarm bells installed in positions where they can be heard by extension users with the exchange-answering facility. The sequence of operation is :—

(a) The exchange bells are rung, and when any one of the exchange-answering extension users lifts his handset, the linefinder of the engaged exchange line steps until its wipers reach the contacts of the answering extension. This extension is thus connected to the incoming call. Should more than one extension user lift their handsets, the linefinder stops at the first extension it finds, the other answering parties hear *dial* tone.

(b) Having ascertained the name or number required, the extension user depresses the button on the instrument. The exchange line is held and the extension is connected to a local link.

(c) The wanted number is dialled and one of the following operations performed.

(i) *The call is accepted* by the wanted extension. The exchange-answering extension user replaces his handset, the linefinder again steps until the contacts of the wanted extension are found, and the exchange line is then switched to the required extension. The exchange-answering extension is left free to make or receive other calls.

(ii) *The call is not accepted.* The exchange-answering extension user again depresses the *transfer* button, which releases him from the local link and reconnects him to the public-exchange line.



Fig. 3.—10 + 49-line P.A.B.X.—the attendant's cabinet.

(iii) *Required extension user engaged.* The exchange-answering extension user makes use of the executive right-of-way facility. By dialling 1, he offers the call to the required extension, if it is accepted, the required extension user replaces his handset, and is automatically re-rung. The exchange-answering extension user hears *ringing tone*, when this ceases, (indicating that the called extension has replied), he replaces his handset and the public-exchange line is connected to the required extension, as in (i). If the call is refused, the procedure is as in (ii).

(iv) *No reply from required extension.* The procedure is as in (ii).

10 + 49—Line P.A.B.X.

This larger exchange incorporates all the facilities of the 2 + 23—line P.A.B.X., together with many others which are made possible by the fitting of an attendant's cabinet. The equipment has a capacity of 49 extension users, and ten exchange lines which can readily be connected to most types of public exchange system.

Incoming calls from the public exchange are received at the attendant's cabinet, from which they are extended to the required extension by means of key-calling equipment instead of the usual dial. This equipment provides a much simpler and quicker method of operation whereby the extension is obtained by depressing keys numbered 1—0 in the same sequence as dialling

(i.e. tens then units). Supervision by the attendant is not necessary, but the attendant may be recalled by the called extension, who may also transfer the call to another extension without recalling the attendant.

In addition to a direct-out facility (dial 9), extensions can call the attendant by dialling 0 for calls to the public exchange or for enquiries.

A facility is also provided whereby up to four manual extension users call the attendant simply by lifting their handsets. After setting up a call from one of these extensions, there is no need for supervision by the attendant as the call is controlled by the extension user himself.

The attendant's cabinet (Fig. 3) is constructed of well-seasoned hardwood and has overall dimensions of 1' 2 $\frac{1}{4}$ " (36cms) long, 10" (25.5cms) deep, and 9 $\frac{1}{2}$ " (24cms) high. The keyboard and backboard are hinged to give full accessibility to the wiring. The cable from the automatic unit is terminated on connectors which are mounted on a false bottom of the cabinet. Plug connexions to the cabinet permit the top section to be removed without the disconnexion of any wires, (Fig. 4).



Fig. 4.—10 + 49-line P.A.B.X.—attendant's cabinet with keyboard and backboard open and base removed.

The automatic unit (Figs. 5 and 6) is constructed of single sheet metal, having hinged and lift-off doors front and rear with car-type door handles, one handle on each door being of the locking type to prevent interference by unauthorised persons. In the base of the unit is fitted a small compartment with locked doors where the engineer's tools and other equipment may be safely stored. The overall dimensions of the unit are 7' 0" (213.5cms) high, 3' 6" (106.75cms) wide and 1' 10" (56cms) deep.

Dial, *busy* and *ringing* tones are provided by vibrators.

The following circuits are incorporated in the exchange equipment :—

- 49 Auto extension line circuits.
- 4 Manual extension auxiliary line circuits.
- 10 Exchange line circuits.
- 7 Local connecting links.
- 2 " 0 " level circuits.
- 1 Call back and transfer circuit.
- 1 Attendant's (marker and position) circuit.
- 1 Night service extension circuit.
- 1 Alternative night service circuit.

The general trunking of these circuits is shown in Fig. 7

Provision has been made to enable any facility to be provided for any extension in most instances by simple inter-terminal connexions. These facilities are :—

- Direct outgoing public-exchange calls. (Extensions not given this facility can still make public-exchange calls via the attendant.)
- Transfer facility, provided by fitting a press-button to any instrument.
- Manual extension service to any four extensions, (these are included in the maximum of 49 lines, since each uses an automatic line circuit).
- Night service to enable any incoming call from the main exchange, during the period of night service, to ring a particular extension bell.

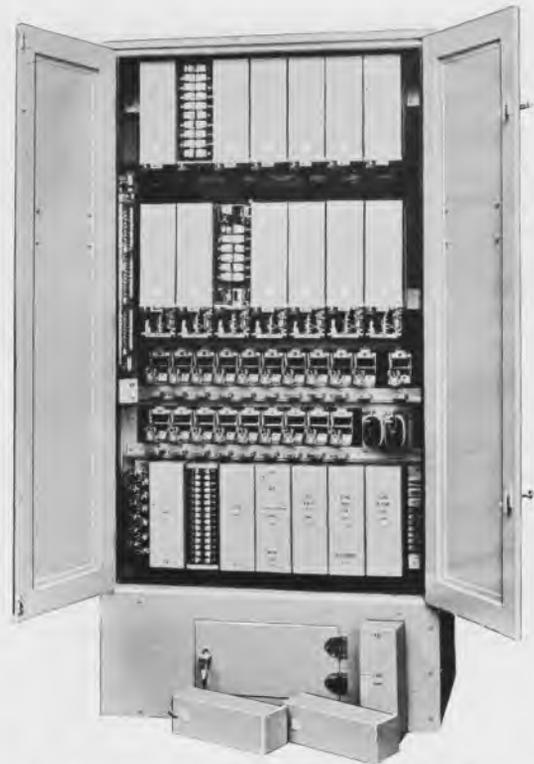


Fig. 5.—10+49-line P.A.B.X.—automatic unit with doors open.

Direct executive right-of-way is not provided but the attendant can be requested to trunk offer to the required extension and request the user to replace his handset.

Local Call (Dial 21 to 69)

The extension user lifts his handset, whereupon an associated line relay operates and passes a signal to the start circuit.

Depending on the position of a time switch in the common circuit, the start signal is passed to a link. If the link on which the time switch is standing is engaged, the start signal is passed to the next link via a chain circuit until a free link is found. Time switch selection has been provided in addition to the chain circuit to give a more even distribution of calls to all links and to allow calls to proceed in the event of a faulty link.

The operation of the A relay in the link taken into use engages the link and returns *dial* tone to the caller, who then dials the required number. The first digit causes the final selector to step vertically, and the second digit causes rotary stepping. The wipers of the final selector then rest on the contacts of the required extension. If the required extension is free, the bell is rung intermittently and *ringing* tone is received at the calling extension. When the required extension handset is lifted, ringing current and *ringing* tone are automatically stopped. The call is disconnected when either extension user replaces his handset. If the required extension is engaged, *busy* tone is returned to the calling extension user who should then replace his handset.

If an unallotted outlet or a non-working level is dialled in error, *busy* tone is returned to the calling extension.

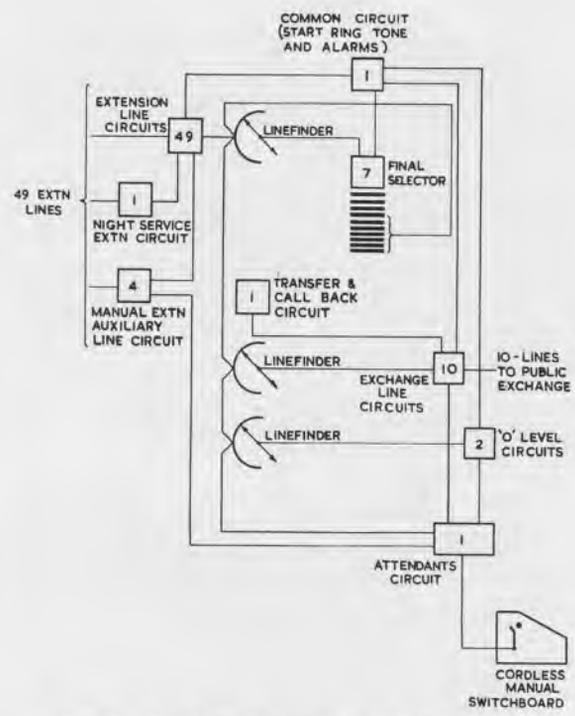


Fig. 7.—Trunking diagram 10+49-line P.A.B.X.

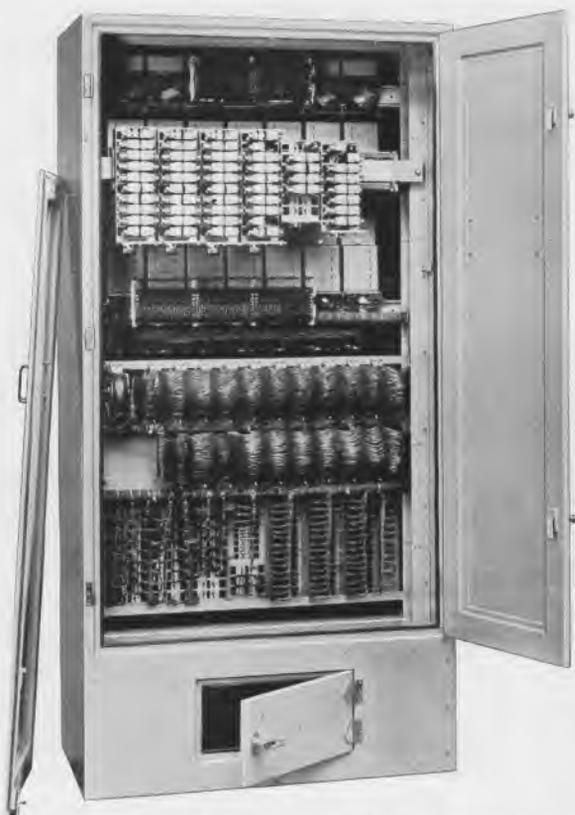


Fig. 6.—Rear of 10+49-line P.A.B.X. with one door opened and the other removed.

Call to the Public Exchange (Dial 9)

The calling extension user lifts his handset, and after receiving *dial* tone dials the single digit 9. The final selector steps to the ninth level and to contact one. A signal is extended via the time switch to the exchange line circuit at which the time switch is standing. If the circuit is engaged, the signal is passed to the next circuit until a free circuit is found. This signal engages the exchange line relay-set, which causes the associated linefinder to operate until the wipers are standing on the contacts of the calling extension. The link circuit is released for other calls, and the caller is connected direct to the public exchange. If the public exchange is automatic, the caller dials the wanted number.

Public Exchange Call set up by Attendant

The attendant operates the EXCH. TEST key, whereupon the line lamps of all engaged exchange lines glow. The attendant thus knows which lines

are free. The *speak* key of any free line is then operated to engage the public exchange and the required call is made in the usual manner. If the call is to be extended to an extension, the attendant keys the required number on marker keys, causing the associated linefinder to hunt for the required extension. Ringing current is automatically applied and the lamp associated with the exchange line glows until the required extension user lifts his handset. The lamp is then extinguished, and the attendant restores the *speak* key, leaving the call controlled by the extension. If the required extension is engaged, the exchange line lamp flashes. The attendant then either makes use of the trunk-offer facility and breaks in on the busy extension, or allows the public-exchange subscriber to *park* on the required extension until the extension is free, when the bell will be automatically rung. The exchange-line lamp then glows steadily, being extinguished when the call is answered.

Call to the Attendant (Dial 0)

The single digit 0 is dialled to place the final selector on contact one of the 0 level. A free 0 level circuit is engaged and causes the 0 linefinder to locate the calling extension and to release the link circuit. If both 0 level circuits are engaged, the caller does not receive tone but can *park-on*, the call will then be switched to the first circuit that becomes free. The caller hears *ringing* tone and a lamp glows on the attendant's cabinet, the attendant answers by operating the associated 0 level *speak* key.

Calls incoming from the Public Exchange

An incoming call gives a flashing signal on an exchange-line lamp, the attendant answers by operating the corresponding exchange-line *speak* key. The call is extended to the required extension as described under *Public Exchange Call set up by Attendant*.

When night service is in operation, incoming calls are signalled on alarm bells situated in convenient places and/or on the bell of one selected extension. If the alarm bells are used, any extension user can answer the incoming call by dialling 8, when the linefinder of the exchange line hunts for the answering extension. If the selected-extension method is

used, the call is answered in a similar way. A warning note is given to the user if the extension is in use when an incoming exchange call is signalled.

Transfer of Exchange Calls

All exchange calls, either incoming or outgoing, can be transferred to any other extension from instruments equipped with press-buttons. The extension user depresses the button once, to hold the exchange line and to connect his extension circuit to the transfer circuit. This circuit in turn connects the extension to a link on which the required number is dialled. Upon the called party accepting the call, the originator of the transfer replaces his handset and the exchange call is connected to the required extension.

If the transfer circuit is engaged, the operation of the button causes the lamp of the extension line on the attendant's cabinet to flash, the attendant can then be requested to transfer the call.

If an extension, wishing to transfer a call, finds the wanted party engaged, he can attract the attention of the attendant by depressing the press-button three or four times, the exchange line lamp flashes, and the attendant can carry out the transfer using the trunk-offer facility if necessary.

Calls by Manual Extension

The manual extension user lifts his handset, causing the lamp associated with the extension to flash. The attendant answers by operating the MAN. EXT key.

For local calls the attendant operates the DIAL key to connect the manual extension to the associated line circuit and thence to a link circuit. The required number is dialled by the attendant. If the calling extension user has replaced his handset, the attendant can re-ring on the line. The attendant retires from the call by restoring the MAN. EXT key.

For public-exchange calls the manual extension user replaces the handset and, when the required call is set up, the exchange line is extended in the normal way by keying the number of the manual extension.

Power Supply.

Power supply for both P.A.B.X. installations can be obtained either from AC mains, by use of a smoothed rectifier unit, or from a 24-cell battery with suitable charging arrangements.

Installation.

Either of the P.A.B.X. units can be installed with the minimum of skilled labour. The work consists

of bolting the unit to the floor, erecting a wall-mounted main distribution frame, and cabling from the unit to the M.D.F. with a 25-pair cable for the 2 + 23-line unit and 49-pair and 10-pair cables for the 10 + 49-line unit.

An additional 64-wire cable runs between the automatic unit and the attendant's cabinet of the 10 + 49-line exchange. In both installations a pair of wires feeds the power to the units.