The Ericsson Bulletin

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Contents

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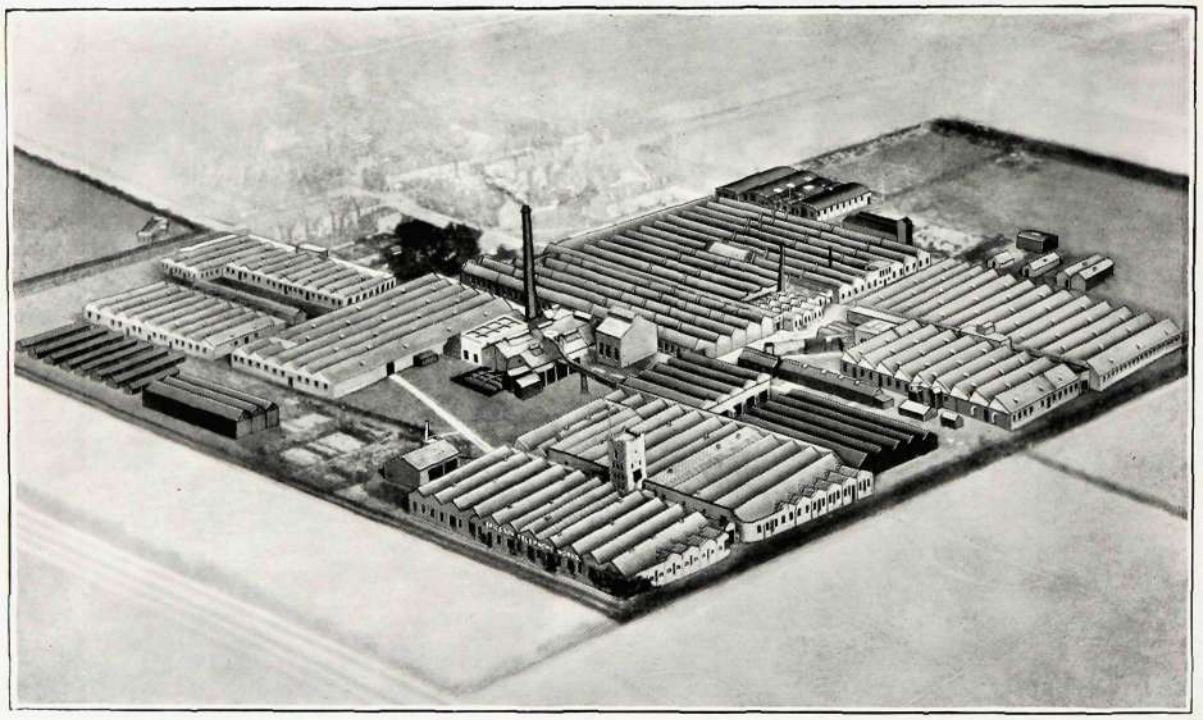
TELEPHONES Ericsson LIMITED

TELEPHONE WORKS,
BEESTON, NOTTINGHAM

Telephones : Beeston 54225 (3 *Lines*)

Head Office : 67/73, KINGSWAY, LONDON, W.C. 2

Telephones : Holborn 3271 (3 *Lines*)



Aerial View of the Works, Beeston, Nottingham

The 22 Line P.A.X.

IN a previous issue of " The Ericsson Bulletin " a description was given of register controlled P. A. X's, covering boards having capacities of 35 to 400 lines. Where the number of lines required is less than 20 it is found more economical to depart from the register control principle and for this reason the Ericsson Company have developed a board, which is particularly suitable for small installations, and is operated on straight-forward linefinder-connector principles.

The board provides for a maximum of 22 lines with three connecting relay sets, and employs 3,000 type relays and single motion switches (uniselectors) of approved British Post Office design. Ringing and tones are generated by a special relay group which is started and stopped automatically as required and is particularly economical in current consumption.

A 24 volt supply is required for operating the board and this may be derived from primary or secondary cells, or when an A.C. supply is available it may be operated from an eliminator. Wide voltage limits are possible and satisfactory operation is guaranteed between 20 and 30 volts.

Telephones of any pattern using B.P.O. standard dials giving 10 I.P.S. may be used and lines varying between 0-1000Ω loop resistance can be accommodated. When desired, long line equipment can be provided, so that lines having a greater resistance than 1000Ω may be connected. The minimum permissible wire to wire insulation for an extension line is 50,000Ω.

EQUIPMENT AND LAYOUT OF BOARD.

Fig. 1 shews a view of a P.A.X. with covers in position, while Fig. 2 shews the same P.A.X. with covers removed. The board illustrated is equipped for 15 lines and two connecting circuits. It should be noted that wiring is always provided for the full capacity to enable additional equipment to be added with a minimum of trouble.

Located at the top left hand corner is the fuse panel carrying the necessary fuses for feeding the various circuits on the switch-board; to the right of this, connection strips are fitted for terminating the lines. Immediately below the fuse panel and connection strips a uniselector shelf is fitted for accommodating the connector and line finder switches ; two connectors are shewn to the left with a spare bank position for the third, whilst the two switches on the right are the line finders, the spare bank on the right being the position allocated for the third line finder when fitted. At the extreme right-hand end of this shelf is fitted a link strip provided for the purpose of busying the links when it is desired to carry out routine tests, etc.

Below the uniselector shelf are fitted three mounting plates carrying the line equipment and allotter relays. It will be noted that the line relays are fitted under individual covers ; this is to avoid cross-talk, since these relays are utilized for feeding current to the transmitters as well as fulfilling the usual function of providing a calling signal. The bottom shelf accommodates the connecting relay sets and, on the right, the ringing and tone relay set all of which are mounted as jacked-in units. As will be seen, ample space is available below these relay sets to accommodate additional equip-ment for any special services that may be required, and in certain instances it is found

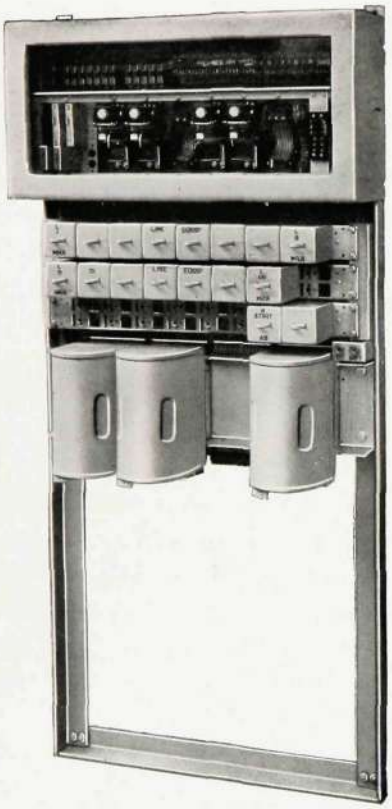


Fig. 1—The 22-line P.A.X. with covers on

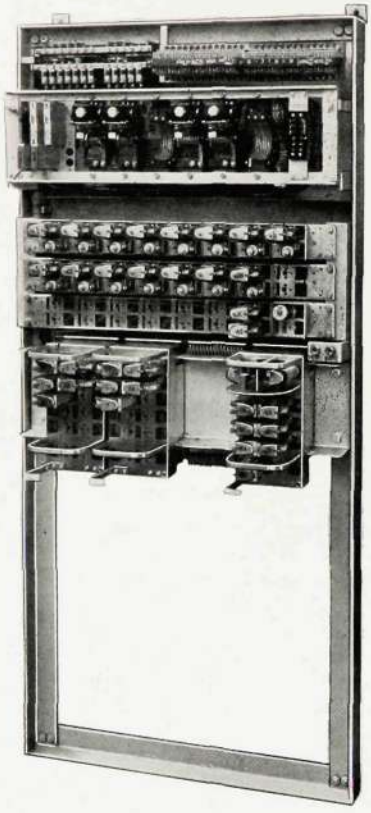


Fig. 2—The 22-line P.A.X. with covers removed

convenient to mount the power equipment here.

The total overall dimensions of the board are 4'-6" high by 2'-1" wide by 10" deep, and when desired it can be mounted close against the wall to save floor space, arrangements having been incorporated so that access to the wiring is possible from the front. This has been accomplished by arranging the equipment on hinged shelves which swing open for inspection purposes.

POWER PLANT.

(1) *Using Primary Cells.*

This arrangement is recommended only in cases where no electric supply is available. Twenty-three primary batteries are required having a capacity of 500 ampere hours.

(2) *Using Secondary Cells.*

This scheme is suitable where there is a D.C. supply. Two batteries of secondary cells each having a capacity of 20 ampere hours are required, either being suitable for operating the equipment for 2-3 days. The charging current is provided by inserting suitable voltage dropping resistances in the mains leads.

(3) *Operating direct from A.C. Mains.*

This is the most satisfactory method and has many advantages, some of which are as follows :—

(a) No charging plant is required.

(b) No batteries are required.

(c) The initial cost is lower.

(d) The maintenance costs are reduced since the system is fully automatic and does not require any attention.

(e) Considerably less space is required.

The equipment required for this method of operation is a battery eliminator which consists essentially of a transformer, a Westinghouse metal rectifier and " smoothing " equipment consisting of condensers and choke coils, etc. The transformer primary is tapped and can be used on supply voltages varying from 100-250 volts. Full details of these and other eliminators are given elsewhere in this issue of the Bulletin.

FEATURES ON STANDARD BOARD.

(1) Automatic intercommunication between any two parties on the system.

(2) A low pitched continuous tone termed " dialling tone " to indicate that dialling may commence.

(3) A low pitched interrupted tone termed " ringing tone " to indicate that the called party's bell is being rung.

(4) A high pitched continuous tone to indicate that the called party is engaged.

(5) Release of the connection is dependent upon the calling party.

(6) Preference facility.

(7) Battery testing is employed throughout so that the blowing of a fuse automatically renders busy the circuit or circuits served by the blown fuse.

Switching Operations during the Progress of a Call.

The removal of the receiver operates the line relay which marks the calling line selectable in the banks of the line finder, and at the same time causes the allotter to allocate a free connecting relay set. The line finder switch associated with the allotted connecting relay set now hunts for the calling line, and when this is found dial tone is transmitted to the calling party to indicate that dialling may commence. Unlike the usual systems of this type, the line relay remains connected to the calling party and is used for impulsing and transmission purposes. When the dial is operated the line relay responds and steps the connector switch, associated with the connecting relay set in use, to the desired line. If the called party is free, ringing is connected and ringing tone is transmitted to the calling party. When the called party answers the ringing is cut-off and the two parties can converse. If the called party is engaged, busy tone is transmitted to the calling party who should then replace the receiver and call later. Provision is made so that selected parties can gain access to engaged lines. This facility can be readily incorporated by a simple strapping on the line connection strip.

The trunking arrangements are shewn in diagrammatic form in fig. 3.

Special Facilities

The 22-line board has been so designed that the initial cost is at a minimum, but nevertheless the equipment details and circuit arrangements are such that all the additional facilities enjoyed by users of the larger P.A.X's can be readily added without alteration to the standard board. The special services now available are as follows :—

Round Call or Person Finder Facilities

Provision can be made for a round call to be given for any one of 10 selected parties. Lines requiring this service are given special numbers apart from their normal directory numbers. The digit 7 is usually allocated for round-call working and the dialling of this digit connects the calling party with the round-call equipment, at the same time releasing the regular connecting relay set and leaving this free for use on other calls. The special number allocated to the wanted party must now be dialled into the round-call equipment and this causes a number of bells or buzzers to sound a code signal round the offices or factory. The wanted party can answer the call by removing the receiver from any instrument and dialling '8'. This action automatically places the wanted party in communication with the caller and stops the code signals. The replacement of the receiver by the calling party releases the connection.

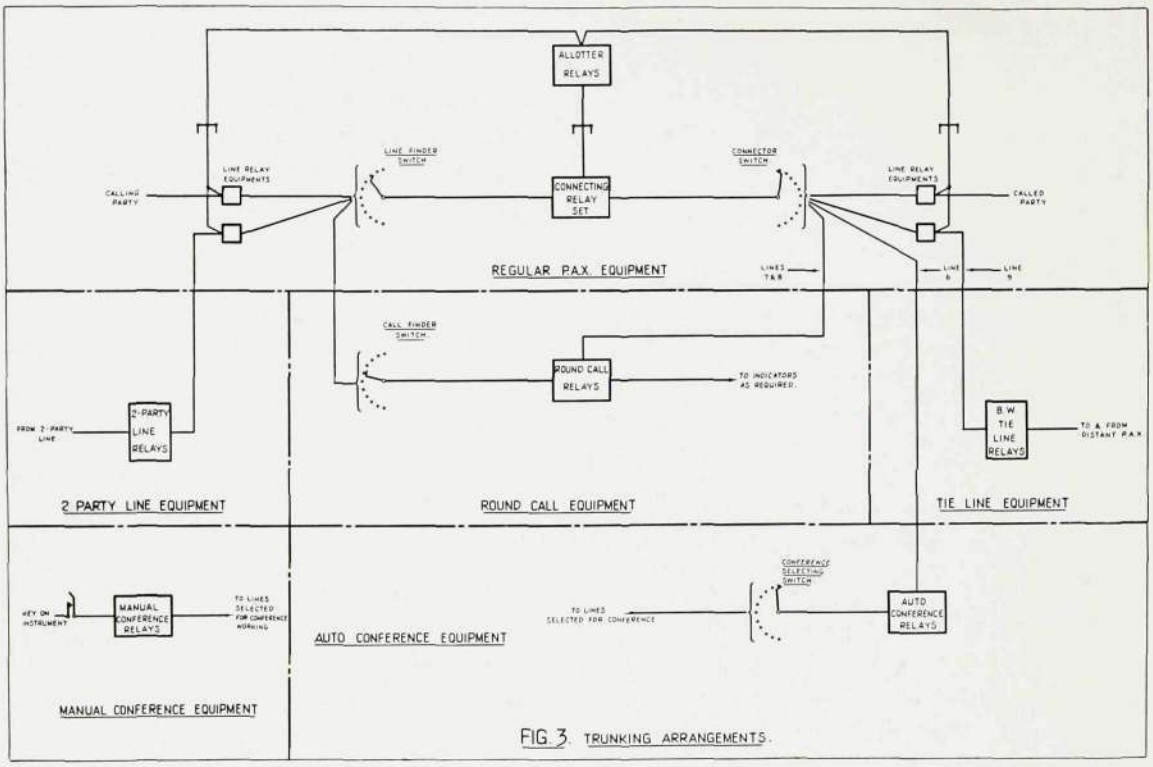


FIG. 3. TRUNKING ARRANGEMENTS.

Tie Line Working

The digit "9" is usually allocated for this service, and when dialled, access is obtained to the tie line relay equipment, and the line to the distant P.A.X. is seized. Further impulsing by the calling party is then repeated to the distant P.A.X. to select the required number on that P.A.X. Particular care has been taken in the design of these tie line circuits so that it is possible not only for two 22-line P.A.X's to be coupled together via tie lines, but also a 22 line board may be coupled to a register controlled P.A.X. without any modifications being necessary. Other tie lines can be provided to suit special cases when desired. A calling party with preference facilities can gain access to the tie line while it is engaged. A warning tone can be introduced to indicate to the parties already engaging the tie line that intrusion has taken place.

Automatic Conference Facilities

This enables conference facilities to be provided for any 9 selected parties. Such lines are given single digit conference numbers apart from their normal directory numbers.

The conference circuit occupies one position on the connector multiple and access is gained by dialling 6.

Any non-conference line can be appointed to set up a conference connection.

The initiating party can call all the required lines consecutively without disconnecting between calls.

When a conference call is in progress any party can release from the conference by momentarily replacing his handset.

Any conference party can join a conference connection by dialling the number of the conference unit followed by digit "0" and his own conference number.

A connecting circuit is taken into service only whilst a conference call is being set up.

Non-conference lines can also be asked to join a conference connection temporarily for consulting purposes.

When a conference call is made to an engaged line, the caller is advised by tone that this particular line is engaged, and a short tone is also induced on the engaged circuit to indicate that one of them is wanted on the conference circuit.

An engaged conference party can be recalled.

A conference party who is engaged on another call can be transferred to the conference connection.

Manual Conference Facilities

Two schemes are available :—

(a) All parties requiring conference facilities are provided with a key, the operation of which switches their line on to a common speaking circuit. Each line is operated independently.

(b) Certain master stations are provided with a set of keys associated with the parties with whom it is desired to hold conference. The operation of a key causes ringing to be connected to the line associated with it. The operation of a number of these keys causes each line to be rung, and when the various parties answer they are connected to a common speaking circuit and the conference can proceed.

Loud Speaker Facilities

Any line can be fitted with a loud-speaker and an additional facility is usually provided in the connecting relay set to transmit busy tone when the distant party clears. This warns the party at the loudspeaker instrument to restore the amplifier key.

Discriminating Ringing Equipment

When desired, provision can be made so that selected parties when making calls will give a distinctive ring to the wanted party. This feature is useful for the managers or other important personages and ensures a quick response to their calls.

2-Party Line

In certain instances it may be desirable to provide two telephones on one pair of wires. These telephones can have full automatic facilities by fitting a relay switching group. Either of the parties can call the other by dialling a special digit, allocated for revertive service, which releases the connecting circuit and rings the wanted party. When the latter replies, speech can take place between the two parties.

Every effort has been made to incorporate all the features known to be in popular demand. Other facilities can however be incorporated when required.

It should perhaps be pointed out that, owing to the simplicity and reliability of these boards, they can readily be adapted for use as public exchanges in small rural areas since the current consumption is particularly low and a minimum of attention is required.

Intermediate and Extension Telephones

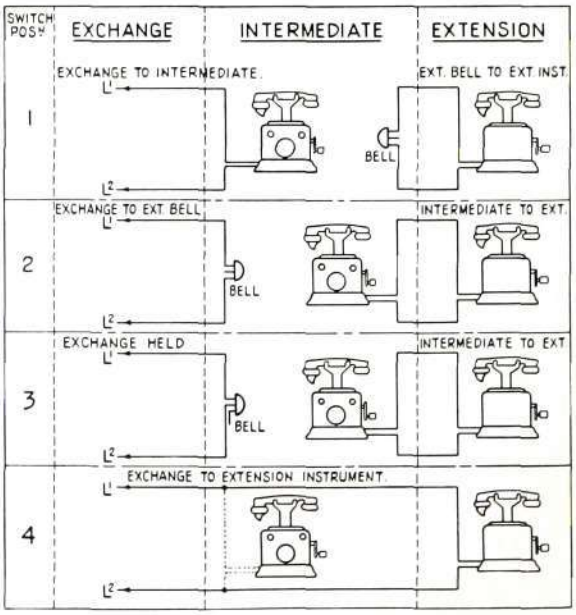
THERE are very many instances, especially among small businesses and large private houses, where the facility of communication with the public exchange is desired from two points, but which does not warrant the renting of two exchange lines. To meet such cases the Ericsson Company has, for a number of years, supplied instruments of various designs some of which included a separate switching set.

The Auto Intermediate Instrument

For whatever purpose, the table type of telephone is undoubtedly the more popular, and it was realized that such an instrument incorporating all the necessary apparatus for giving the facilities which enable communication on an exchange line from two different stations, with intercommunication also between the stations, would be extremely popular. The Ericsson intermediate table telephones for this purpose have therefore been vastly improved during recent years and, as may be seen from the illustrations, incorporate the switch, indicator, and generator, with a bell in the terminal block or wall case, and a bakelite micro-telephone of high transmission and reception efficiency. This one-piece instrument is much more convenient to use than the separate telephone and bell set with switch, and therefore it is rapidly being standardized by the majority of large telephone administrations throughout the world. Four instruments are manufactured, the auto intermediate and the auto extension, and their C.B. counterparts.

In describing the facilities, reference will be made to the case of the exchange line of a busy executive whose private secretary or deputy answers all enquiries, and only passes forward to the executive calls definitely requiring his attention.

The intermediate instrument is for the secretary's use, and the extension instrument for the executive. All the switching is done by the secretary at the intermediate



Schematic of Connections for each position of the Switch

instrument and the various facilities controlled by the rotary four position switch on this instrument are as follows :—

Switch Position No. 1.

Exchange to Intermediate. This is the normal position of the switch, calls from the exchange ring the bell in the intermediate instrument and those from the extension the bell in the wall case. A differently toned bell is provided in the wall case to differentiate between a call from the extension and one from the exchange.

Switch Position No. 2.

Intermediate to extension. This allows intercommunication between executive and secretary. The signalling either way is by means of magneto generator, and speaking current is supplied by two or more local cells dependent upon the line resistance. Calls from the exchange, it will be noted, will now ring the bell in the wall case.

Switch Position No. 3.

Intermediate to extension, exchange held. This position holds the exchange line whilst speaking to the extension. The necessity for this condition often arises when the secretary receives an enquiry which necessitates consultation with the executive before replying.

Switch Position No. 4.

Exchange to extension. This puts the executive through to the exchange. To prevent interruption of the call by the secretary a star type indicator on the intermediate instrument is operated during the time the line is engaged. In this position of the switch it is sometimes required that the intermediate instrument is in parallel with the extension. This is accomplished on the terminal block by means of two straps which when removed gives secrecy of conversation between the extension and exchange.

The Auto Extension Instrument

Both intermediate and extension instruments have the same constructional details, i.e. steel casework with moulded bakelite cradle stand and reinforced cradle, and being of robust design are capable of withstanding rough usage with the minimum amount of attention.

Removal of the single-hole-fixing plate gives access to the bell, terminal block, dial

Interior of the Intermediate Instrument

and desk cord connections, also the two screws fixing the main body cover, the latter may then be drawn upwards on the four corner pillars revealing the other components of the instrument.

Mounted as a unit, the generator, star indicator, rotary switch and induction coil are positioned for maximum accessibility, and the cable form is designed to allow easy withdrawal of any piece of apparatus for inspection or adjustment.

The dial is fitted with a moulded bakelite cover effectually protecting the mechanism from dust and to a certain extent mechanical injury, the complete assembly may be removed from the dial mounting without disturbing any other piece of apparatus.

The cradle switch is fitted to the metal top by the nut clamping the bakelite cradle stand, and the actual contact springs are mounted on a U shaped bracket giving a wide range of movement to allow easy adjustment. Movement of the bakelite cradle stand is prevented by two pressed indentations in the top engaging with suitable recesses moulded in the base of the stand.

Terminals are provided on the bell set or wall case of the intermediate instrument, and on the terminal block of the extension instrument, for the connection of an extension bell when required.

A diagram showing all connections and colours of cable-form wires is securely affixed to the metal base of each instrument.

All the apparatus used in the construction of the instruments is of well proved design, and where possible for reasons of standardization and service, is

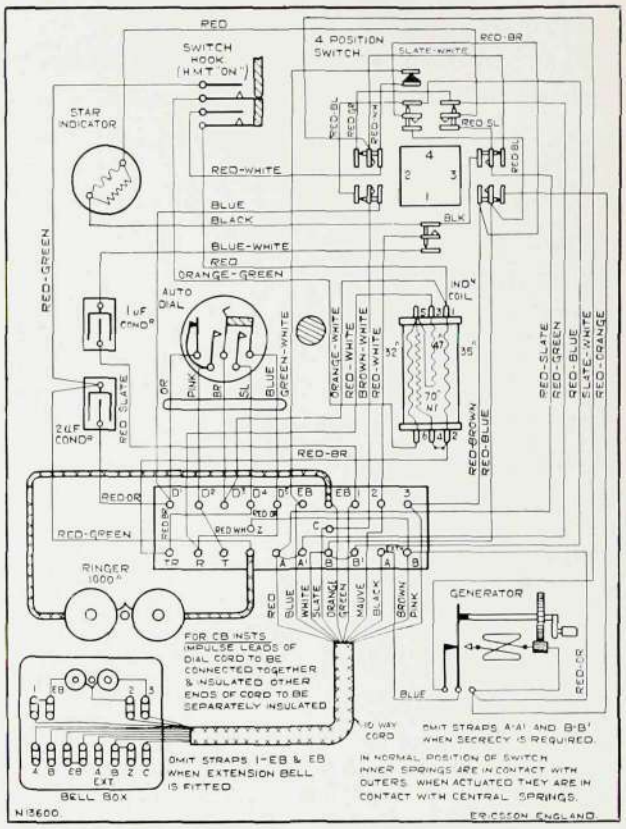
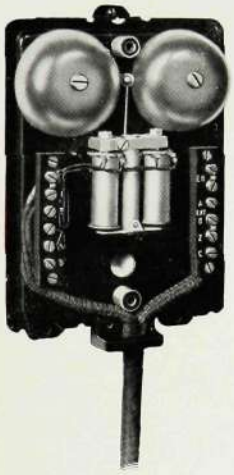


Diagram of Connections

of British Post Office type. The following components are fitted :—

Generator, 3 magnet, resistance 400Ω	P.O. No. 4C
Condenser, 2 μF.	P.O. No. 102
Condenser, 1 μF.	
Induction coil, resistance 35Ω + 47Ω + 70Ω N.I.	
Bell (in instruments) resistance 1000Ω	
Bell (in wall case) resistance 1000Ω	P.O. No. 59A
Star indicator, resistance 75Ω + 150Ω N.I.	
Switch, 4 position	P.O. No. 248
Hand-microtelephone	P.O. No. 164
Dial	P.O. 10FA.
Terminal block	P.O. Strip, 4 terminal.

Most of the above components are too well known to warrant detailed descriptions ; therefore, for the purpose of this article only the less familiar apparatus will be mentioned.



The Bell-Set

The bakelite cased bell set associated with the intermediate instrument is an adaption of B.P.O. Bell Set No. 25 with the induction coil and condenser omitted and terminal blocks arranged to accommodate the 10 way cord.

The base plate is a brass pressing mounting the bell movement, gongs, and the moulded bakelite cord guide. The polished moulded bakelite cover of modern design harmonises well with the black casework of the table set.

The four position rotary switch of the intermediate instrument is of particularly robust design and operates the various spring combinations through the medium of hardened stainless steel balls, providing in practice a very positive action. All the spring banks have a make before break action of the contacts to prevent interruptions on the exchange line when switching from one position to another.

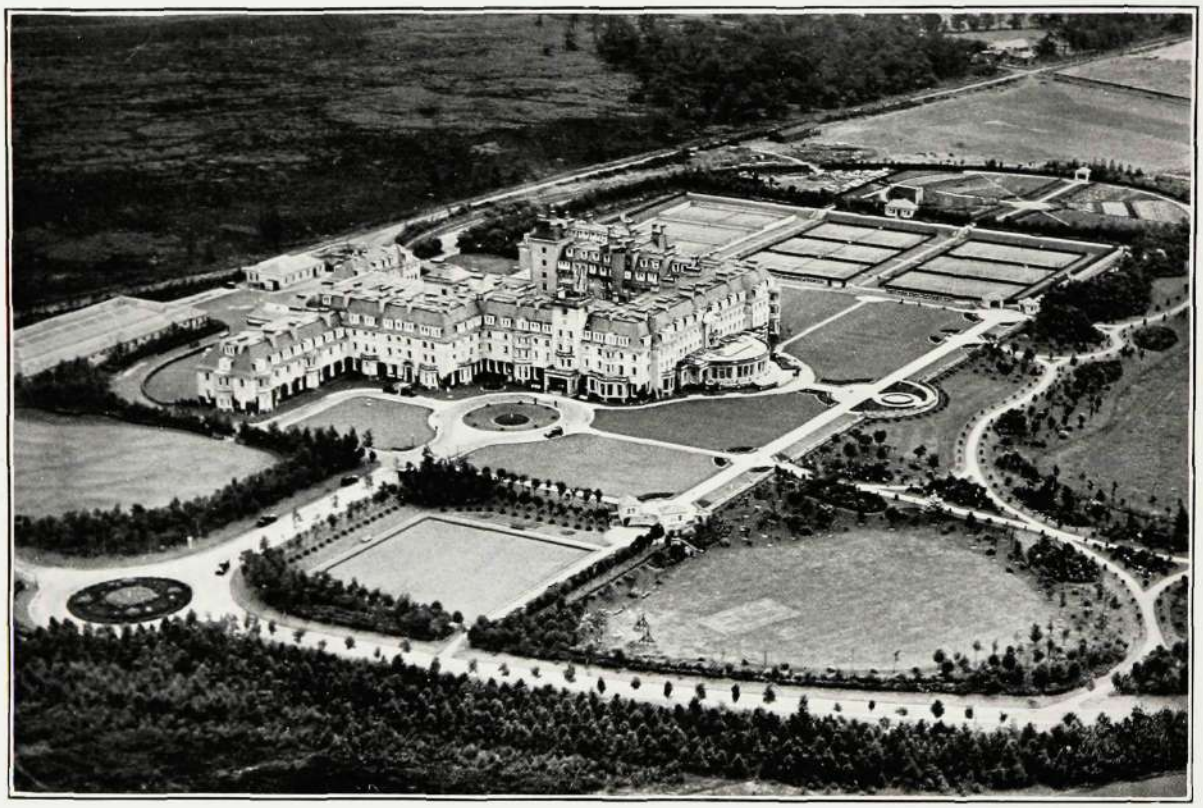
The Star Indicator

The star indicator has been specially designed to resist the detrimental effects of high temperature and excessive humidity. Except of course for the magnetic iron cores, armature, and rustless steel spindle, all the component parts are made from brass in contrast to the normal practice of employing zinc-base or similar alloys which are subject to rapid disintegration under severe tropical conditions.

The speaking circuit is the well known 4-winding induction coil circuit, used as standard on C.B. systems, and which when tested on the standard transmission circuit as specified by the British Post Office, i.e. toroidal repeater exchange system, 22 volt battery, and 300 ohms subscribers line, the efficiency as regards volume, intelligibility, articulation and side tone, is at least equal to that specified by the P.O. for telephone No. 162.

Gleneagles

C.B. Manual Switchboard for The London Midland & Scottish Railway Company, Ltd.



Courtesy of the L.M. & S. Hotel Controller.

An Aerial View of the Gleneagles Hotel and Surroundings

THE problem of providing an efficient telephone service, giving, from a visitor's point of view, the minimum of inconvenience when placing a call, was solved by The London, Midland and Scottish Railway Company when the decision was made to install an Ericsson common battery manual switchboard in the well-known Gleneagles Hotel, Scotland.

The switchboard consists of two No. 10 type one-position frameworks with matt polished mahogany facings. A cable turning section is also fitted, and provision made to add a further switchboard section when occasion demands.

The initial switchboard equipment includes the following :—

Extension Line Circuits (multipled) ..	370
Service Lines	40
Post Office Junction Lines ..	10
Connecting Cord Circuits	30

Also the usual operator's telephone, cord test, ringing alarm, coupling, effective and ineffective meter circuits.

Extension line circuits are fitted with line relays each of 300 ohms resistance. A series multiple with five point break jacks is employed, thus obviating the necessity for cut-off relays. The sleeve of each multiple and answering jack is connected via

resistances of 30 ohms to earth for engaged test purposes.

Designation strips are fitted above each answering jack, with engraved labels of different colours denoting the group numbers. Labels for extension lines 0–99 are coloured pastel blue, 100 to 199 yellow, 200 to 299 turquoise, 300 to 399 green, and 400 to 499 pink.

Service line circuits for staff purposes are connected to jacks and calling lamps on the first operator's position, with ancillary jacks on the next position. Visual engaged signals are equipped for these lines above the respective designation strips.

Post Office junction lines are designed for working to an automatic exchange, with through clearing and operator re-call facilities. The circuits are arranged to allow for conversion to common battery or common battery signalling as and when required.

The connecting cord circuits are of the condenser divided type, with balanced double-wound relays for battery feeding. Separate positive clear supervisory signals are provided for called and calling extensions. Extra contacts are equipped on all operator's ringing keys to complete the motor start circuit for machine ringing. Each position is equipped with a switching key for hand generator connection, also a coupling key to join the operator's telephone circuits, thus enabling one attendant to control the switchboard. Meters fitted at the rear of each position and controlled by keys on the keyboard allow the operator to register all effective and ineffective calls.

Fuse panels, equipped with fuses of the alarm type are fitted in each section above the cord circuit relays. The disruption of a fuse is notified to the operator by a visual or audible signal.

To assist the cabling scheme the intermediate distributing frame is erected in a recessed portion of the switchroom, with all terminal blocks, local and multiple, fitted on the front of the vertical uprights.

In the apparatus room are situated the main distribution frame, relay racks, power switchboard, ringing machines and rectifiers.

The main distribution frame which consists of six verticals, is equipped on the line side with fuse mountings; on the exchange side cables from the switchboard are connected to terminal strips, and the Post Office junctions are connected via fuse mountings and protectors.

A relay rack, consisting of two bays, is erected at right angles to the main frame. One bay is equipped with line relays and their respective alarm fuse panels, the other with relays, connection strips and alarm fuse panel for P.O. junction lines. Motor start relays, with associated spark quench apparatus are fitted on the line relay bay.

Two sets of 24 volt secondary cells, each with a capacity of 180 ampere-hours are accommodated in a separate compartment adjoining the apparatus room. Battery charging is from the main 250 volt single phase 50 cycle hotel supply via 12-ampere metal-rectifiers. Overload circuit breaker, charge and discharge switches, battery fuses, voltmeter and ammeter are fitted on the power switchboard.

Ringing supply of 75 volts 24 cycles is provided by two 5 watt ringing dynamotors operating from the 24 volt battery through suitably designed choke coils.

The order was placed about 12 weeks before the opening of the spring season, so that very special efforts, both on the part of the Company and the Railway Company, were successfully made to provide the visitors with an efficient telephone service within so short a time.

The Elimination of Batteries in Small Automatic Telephone Exchange Operation

SINCE the inception of automatic telephone exchange switching, it has been one of the ideals of the telephone engineer to produce a complete equipment which could really be called automatic, in so far that, provided no apparatus fault occurs, it would give good service over an extended period, without receiving any manual attention whatsoever.

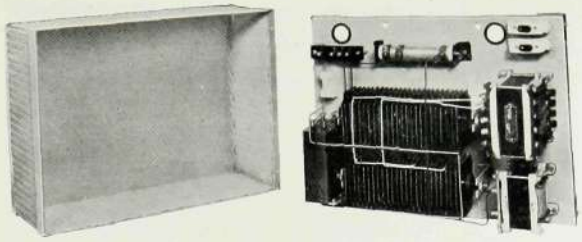
Up to a short time ago, this ideal, while possible technically, could not be realized fully in practice owing to the exacting demands on the power supply of automatic systems; the chief difficulty being to provide a maintenance free power source whose voltage would remain within the necessary close limits during heavy usage of the exchange.

In the past, the almost universal method of dealing with the problem under all conditions has been to provide accumulator batteries, which are charged from an external power supply—the regularity of charge and general battery condition being supervised by an attendant, or maintenance officer. This arrangement is perfectly satisfactory in the case of large exchanges, where a trained maintenance staff is always in attendance, and where a large reservoir of energy is required to maintain public service over a breakdown period of the charging power source, but in the case of the small private exchange, even when the battery is charged automatically, the lack of the necessary attention to maintain important conditions such as the acid level, etc. is a great drawback, and the need of an alternative scheme, in which all manual attention to any part of the exchange equipment can be dispensed with entirely, has long been felt.

Recent years have seen, *inter alia*, the development of three very important factors which have at last enabled the telephone engineer to produce a power unit requiring even less maintenance than his own switching equipment. These factors are (a) the increase in the generation and distribution of alternating electric power, (b) the development of the maintenance-free metal-rectifier, and (c) the production on a commercial scale of reliable high-capacity electrolytic condensers.

It is approximately 3 years ago that the Ericsson Company produced their first automatic exchange for working directly on the power mains without the aid of batteries or rotating machinery, and judging by the great demand for this type of board, a very real contribution has been made to the already long list of merits of the small automatic exchange. The power units used with this equipment are referred to as battery eliminators, and incorporate Westinghouse metal rectifiers. In view of their extending use, no doubt a few comments on the salient features of our standardized equipment will be of value to all who are interested in this aspect of exchange power supply.

It has been found from experience that the greatest appeal of battery eliminators occurs in the case of small automatic exchanges of anything up to 50 lines capacity, accordingly we cater primarily for this equipment range.



Battery Eliminator for 22-line Exchanges

This popularity in the smaller sizes is due to the fact that exchanges served by eliminators rely solely on the main power supply for their immediate source of energy, and any discontinuity in this supply will interrupt the telephone service, therefore, in the case of larger and more important equipments, a power supply incorporating a reserve of power, e.g. an accumulator battery, is usually preferred. In some cases, however, the enthusiasm for a battery free exchange up to 100 lines capacity has been so great that an eliminator for this purpose, on 50 volt exchange equipments can also be supplied, see illustration. A complete list of our eliminator equipment is given below :—

Battery Eliminator for 100-line Exchanges

Code.	*Application.*	*Output.*	*Dimensions.*
N.20447	Small direct switching exchanges up to 22 lines.	24 v—3.0 amp.	1′ 7″ x 1′ 2″ x 8″
N.20384A	Register exchanges up to 35 lines.	24 v—4.25 amp.	1′ 6″ x 1′ 6″ x 1′ 0″
N.20385A	Register exchanges up to 50 lines.	24 v—5.5 amp.	1′ 6″ x 1′ 6″ x 1′ 0″
N.20444	Register exchanges up to 100 lines.	50 v—7.5 amp.	1′ 3″ x 1′ 0″ x 5′ 9″

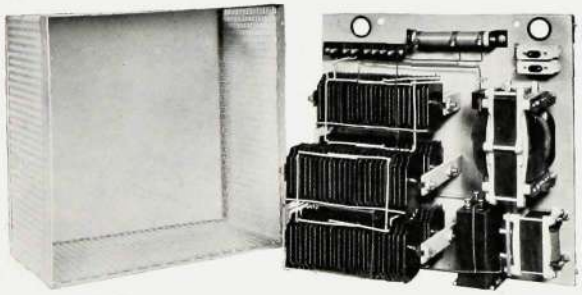
All the above-mentioned eliminators are capable of operating on the following mains voltages, at frequencies of from 40-100 cycles per second :—100, 110, 120, 200, 210, 220, 230, 240 and 250. Other frequencies can be dealt with but require special treatment resulting in a slight increase in cost. The output values quoted take into account a mains voltage variation of ± 6%.

As previously indicated, the rectifying operation is performed by dry plate metal rectifiers which require no maintenance attention whatsoever, further, due both to the stability of this type of rectifier and to the light electrical loading our design imposes, an almost inexhaustible life is anticipated. Smoothing is effected by a low-pass filter of generous proportions, and accounts for the unusually silent background experienced during the conversation period. In order to make the best use of this filter equipment the output of the rectifier is divided into two parts, one of which is highly smoothed and feeds the speech circuits and any other delicate apparatus such as tone relays, the other is considerably less smoothed and is used in all cases where a high degree of smoothing would be of little or no value.

An output voltage control is incorporated on all recent designs, and ensures an almost constant voltage across the exchange bus bars, even when operating under heavily flunctuating load conditions. This results in both the transmission and signalling tone levels remaining substantially constant also, a feature which is of particular value on busy exchanges.

The subject of isolation of the low tension circuits from the mains voltages is obviously

of particular importance on telephone equipments, and has therefore received very careful attention on these power units. The insulation of the step down transformer is maintained at an exceptionally high figure by insulating materials of great durability, and as a final precaution an earthed metallic screen is built into the transformer between the primary and secondary windings ; this screen causes the main fuse to blow if the unearthed (and therefore dangerous) pole of the mains attempts to flash over to the



Battery Eliminator for 35-line Exchanges (i.e. with 3 units)
Battery Eliminator for 50-line Exchanges (i.e. with 5 units)

secondary circuit. Insulation tests are carried out at a voltage of 2000 r.m.s. which is approximately 10 times the value of the maximum applied voltage occurring in practice. All high-tension terminals are bakelite covered to preclude the possibility of stray wire, etc. causing dangerous interconnections.

When eliminator equipment is required for tropical use, or in locations where the ambient air temperature is likely to exceed 100°F, the electrical loading of the rectifiers is reduced appreciably, also special finishes are provided throughout. It is important, therefore, when specifying for non-standard conditions of use, to ensure that the correct choice of equipment is made, and where any doubt is felt it is strongly advised that the assistance of our technical department should be obtained on the matter.

When installing eliminator equipment the following points should be given attention :—

(a) Correct mounting position chosen in relation to the rectifiers and electrolytic condensers.

(b) Location to be as dust free as possible, also fumes liable to cause corrosion must be avoided.

(c) A ground clearance of at least 12" should always be provided.

(d) The eliminator should be as near to the exchange as possible.

The correct mounting position occurs when the rectifiers are horizontal, and the electrolytic condensers are in a vertical position with the terminals at the top. This arrangement ensures the necessary circulation of cooling air to the rectifiers and must therefore be obtained always.

Air circulation is further promoted by the perforations in the all metal cover and by adequate ground clearance. Dust ingress due to these perforations is of no consequence other than to cause unsightliness.

All eliminators are externally finished in grey and chromium plate.

Power Distribution in Automatic Exchanges

IN designing a system of Power Distribution over equipment racks in automatic telephone exchanges, it is desirable that the scheme should be:—

(*a*) of compact design,
(*b*) easy to install,
(*c*) flexible, i.e. easy to extend,
(*d*) efficient.

To meet the above requirements, Ericsson Telephones Limited evolved a method which uses a combination of bus bars and cables.

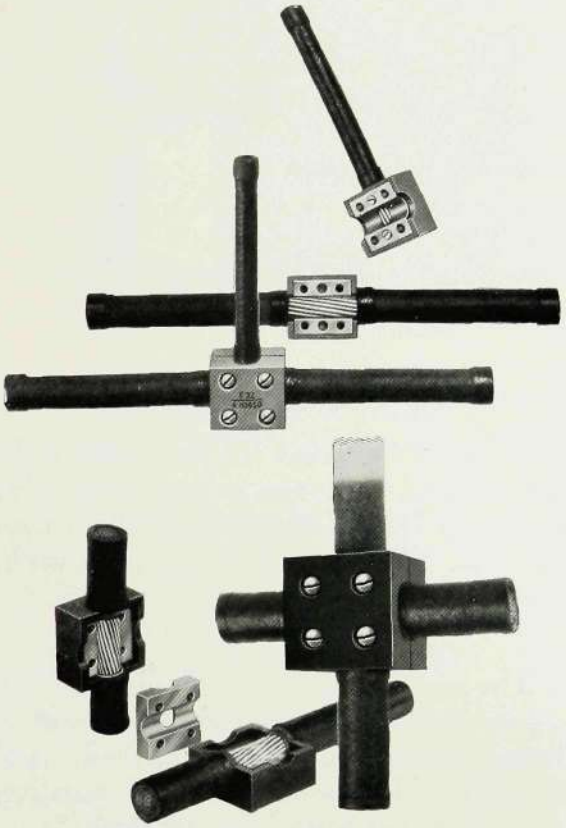


Fig. 1—Joints before and after Assembly

When cables are used for distributing power, it is necessary to provide runways to support the cable. Also, where bus bars are used, supports must be provided for the bars, the positive bar being bolted direct to the supports, while the negative bar is insulated.

The Ericsson system uses bus bar run on the flat for the positive feed and V.I.R. cable for the negative. As the positive bus bar is at earth potential it can be bolted direct to the rack frameworks, no special insulated bracket or support being required ; the negative cable is run on the bus bar which acts as a support for the cable. Joints and branch feeds from the bus bars are made by means of bolted or clamped lap-joints, and branch feeds from the V.I.R. cable are made by means of a specially designed cable clamp ; this arrangement takes up a minimum of space.

The cable clamp consists of two metal inserts designed to hold at right angles the two cables it is required to join. The inserts bring the strands of wire of the cables into direct contact with each other, and are clamped together by screws. They have moulded on them a covering of high insulating property making the assembled clamp a fully insulated joint. (see Fig. 1).

By clamping and/or bolting all joints on the positive bus bars and using the insulated clamp joints on the negative cables, all soldering, with its attendant faulty joint troubles is eliminated, together with the potential danger of spilt solder falling into the automatic equipment ; the installation of the power distribution feeds thus resolves itself into a simple assembly.

When an extension is required it is only necessary to bolt a positive bus bar to an

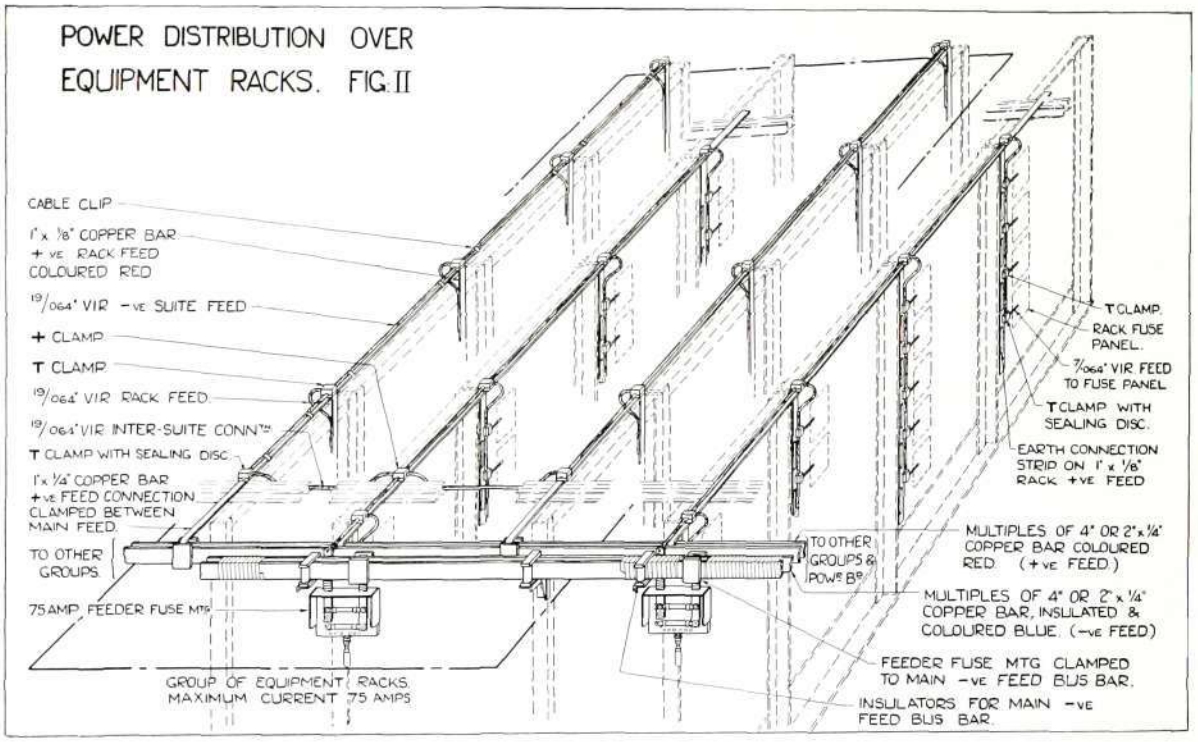


Fig. 2—Arrangement of Power Distribution over Racks

existing bar, strip the V.I.R. covering off the negative cable and assemble the insulated clamp joint with the extension cable. The extension can be carried out without interruption of the power service ; also the danger of short circuits due to working on the system when alive is obviated, owing to the completely insulated negative arrangement.

The scheme has been designed to cover the requirements of all types of telephone exchanges from the largest to the smallest, and also to permit the use of standardized components to as great an extent as possible. Complete standardization cannot be achieved owing to the variations of layout and current drain in the different exchanges.

The efficiency of the scheme has been proved by exhaustive tests on the negative clamp joints, made by the research station of the British Post Office.

Arrangement of Distribution.

For large exchanges the equipment racks are arranged in groups, in such a way that no group has a larger current drain than 75 amps. The general scheme is shown in Fig. 2.

The power feeds for each individual rack consist of 1" x $\frac{1}{8}$" copper bar for the positive, bolted direct to the framework, and 19/.064" V.I.R. cable for the negative, fastened to the positive bar by clips.

Earth feeds to each shelf of equipment are taken direct to the positive bar. The negative feed to each shelf fuse panel is by

means of a short 7/.064" V.I.R. link, clamped to the 19/.064" V.I.R. feed. (See Fig. 3).

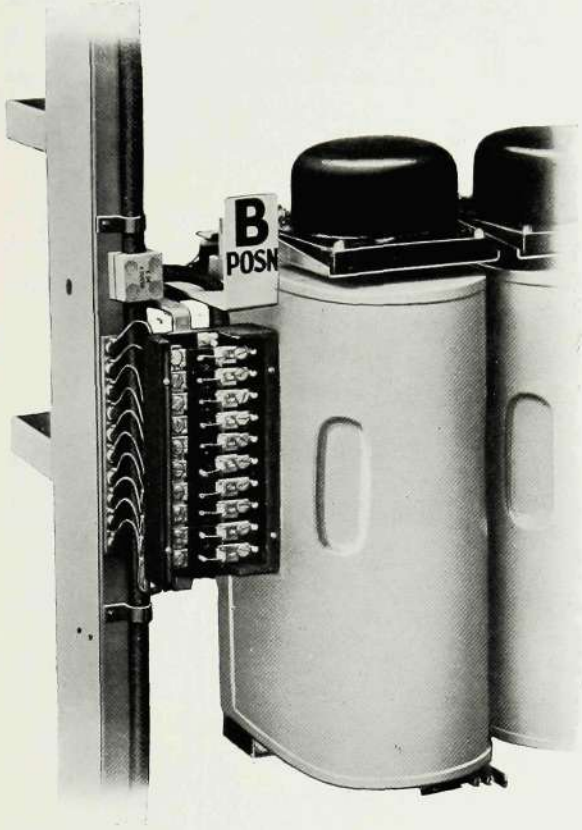


Fig. 3—View of Positive and Negative Feeds on Rack, also Shelf Fuse Panel

The power feeds for a suite of racks consists of 1" x $\frac{1}{4}$" copper bar for the positive, bolted to the rack supporting ironwork, and 19/.064" V.I.R. cable clipped to and supported by the positive bar.

The rack feeds are connected to the suite feeds by the positive bars being bolted together, and the negative cables clamped by means of clamp joints.

The main feeds, run along one end of the suites, consist of bus bars for both the positive and the negative, the negative lead being insulated throughout its whole length. They are made up of multiples of 2" x $\frac{1}{4}$" copper bar, and for the larger exchanges with heavy current drains, multiples of 4" x $\frac{1}{4}$" copper are used.

They are supported by brackets bolted to the outside angle iron upright of each end rack. The positive bar is supported direct on the bracket, and the negative by insulators attached to the bracket.

The positive connection is made to each suite by clamping the 1" x $\frac{1}{4}$" suite positive bar to the main positive bar. The negative connection to each group of suites is made via the group fuse, which consists of a simple fuse mounting accommodating the service fuse and a spare fuse. The spare fuse is so arranged that in the event of the service fuse blowing it can by a simple movement be inserted in the main circuit. The fuse mounting blocks are extended so that the incoming side is clamped direct to the main negative bus bar; the outgoing fuse block is extended to the height of the rack where connection is made to the V.I.R. suite cable.

For small exchanges, the arrangement is similar to that described above except that group fuses are omitted, the main battery fuse serving the whole of the power distribution, the sizes of cables for the negative feeds being selected so that they are protected by the main fuse.

Unattended P.A.B.X's. for 50 Extensions

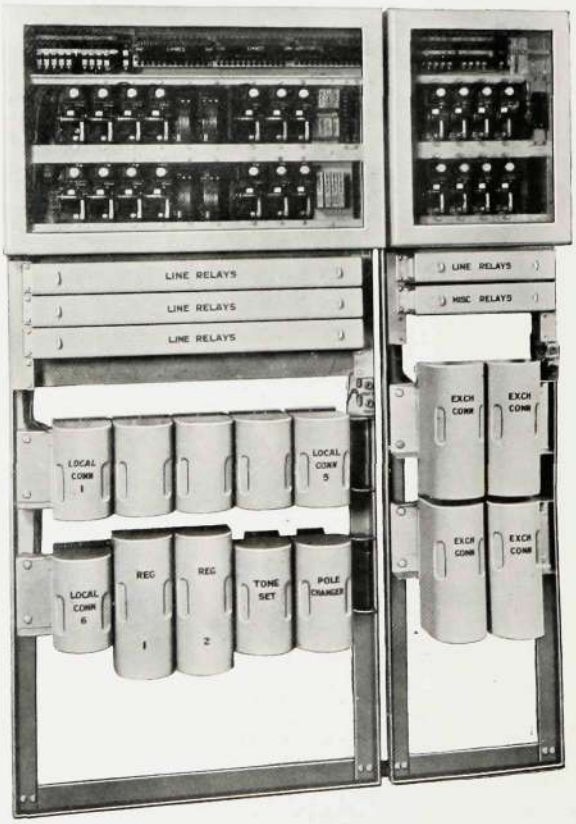
THE term Private Branch Exchange or P.B.X. is applied to a telephone switchboard situated at a subscriber's premises to fulfil the dual purpose of supplying public exchange service to a number of extensions over one or more exchange lines, and of giving a means of internal communication between these extensions. The widespread use of automatic telephony both for the public service and for private exchanges has its equivalent for this type of board also, and is called the P.A.B.X.

A well-known type of P.A.B.X. is that in which internal and outgoing exchange calls are completed automatically from the caller's dial, while incoming exchange calls are dealt with by a manual operator or attendant. As outgoing exchange calls are usually charged for individually it is generally inadvisable to allow all extensions to have direct public exchange access for fear of misuse, and it is therefore the usual practice to confine this facility to certain privileged lines, all other outgoing calls being controlled by a P.A.B.X. attendant.

For incoming exchange calls it is always necessary to complete a call through the medium of an attendant at the P.A.B.X., not because there is any technical difficulty in avoiding such service, but because the telephone number supplied from the public directory is only able to direct a call to the P.B.X. establishment, whereafter the local knowledge of an attendant is required to complete it to any desired individual or department.

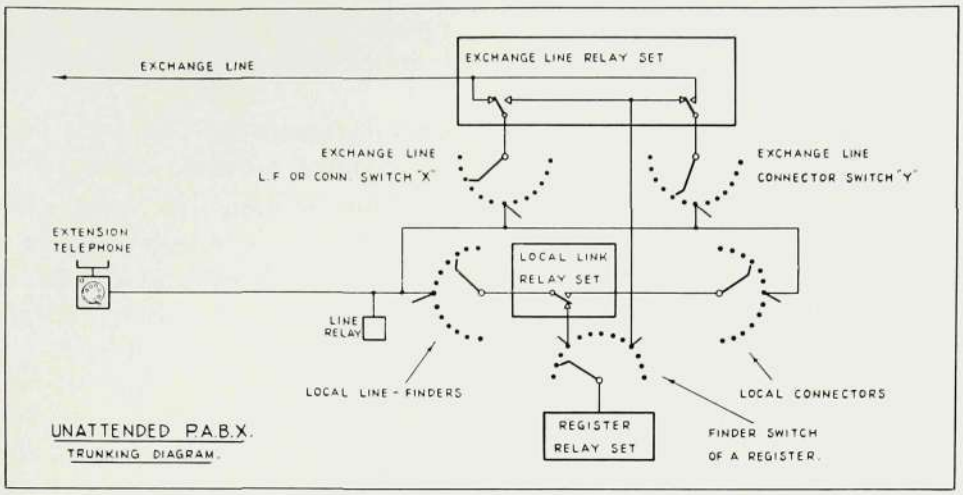
The object of an unattended P.A.B.X. is not therefore to dispense with manual aid, but to accomplish as many functions as possible by automatic means, thereby eliminating the manual switchboard and reducing supervision to such an extent that it becomes the minor duty of one or more persons occupied with other employment.

The unattended P.A.B.X. described herein operates from a 24-volt source and has a maximum capacity of 50 extensions and any desired number of exchange lines.



An Unattended P.A.B.X. for 50 Extensions with Four Exchange Lines.

The equipment consists of uniselector switches of the Ericsson heavy-duty pattern and Post Office 3000 type relays.



The Trunking Diagram

Apart from the switches and line relays, all equipment is mounted on jack-in units, each local link and exchange equipment being provided with a separate mounting.

The ringing and tone units consist of relays and a pole-changer mounted on two jack-in units provided with covers to conform to the general design of the board.

All equipment is mounted on substantial frames and efficiently shielded against dust.

The exchange operates on the register principle, where all calls are set up from register units.

The equipments for local calls and exchange calls are self-contained and function independently, except for the momentary use of a local linefinder to promote an outgoing call to the public exchange, the additional equipment necessary to combine the two services being confined to the registers.

An attendant's board for dealing with incoming exchange calls can usually be dispensed with but in cases where it is necessary such a board will be of a very simple nature.

The automatic switchboard is divided into a unit for internal calling equipment, including the registers, and a unit for exchange line equipments. It is therefore, economically possible to provide a purely internal service by using one unit, and to add the exchange line unit if and when required, the extra equipment provided in the registers for both services being relatively inexpensive.

Local calls are made over link circuits designed for the introduction of many desirable facilities, circuits being available for preference extensions, loud speaker extensions, 2-party lines, internal P.B.X. groups, round call, conference, and tie lines to similar exchanges etc. Distinctive tones are provided for dial, busy and ringing; faulty lines are deflected from the registers, and both calling and called extensions are given immediate release from a connection.

Each extension line will consist of a pair of wires, the necessary functions being provided without the use of an earth

One of the Relay Sets

connection. Extension instruments are of standard pattern, the dial being used for making enquiry calls, transfer calls and also exchange calls where permitted.

An exchange line equipment consists of two 50-point switches and a jack-in relay unit. This equipment serves calls in both directions and is designed for working with an automatic or a C.B. public exchange. An equipment required to operate to a magneto exchange would have another form, as ring-off signals are required.

A short description of the operations will best explain the facilities provided.

Outgoing exchange call from an extension with exchange access.

When the handset of the telephone is lifted, the caller is extended to an idle register over any available local linefinder and dial tone is heard. To make an exchange call the subscriber dials a special digit. This will cause an available exchange line to be selected by the register and then one of the switches on the exchange unit will function as a linefinder to find the calling line, thereafter releasing both the local linefinder and the register. The caller is then extended to the public exchange, from which dial tone will be heard and the call can be completed by dialling the directory number of the required line.

Outgoing exchange call from an extension without exchange access.

This extension will make a local call to the attendant's telephone, i.e. a normal extension with exchange access, and after supplying the necessary information will hang-up and await a call back. The attendant may then complete the call in the manner described above and after a reply has been received he can hold the line and make a local connection to the originating caller. The attendant can then speak to the extension and transfer the exchange call to the original caller.

It is also possible for the attendant to extend the connection to the public exchange and then let the caller complete his connection.

Incoming exchange calls in the daytime.

When the P.A.B.X. is called from the public exchange, an idle exchange line of the group will be automatically selected and ringing will be sent out. This ringing will energize a relay at the P.A.B.X., causing the exchange line to be extended to a register which will automatically connect the call to any one of a group of normal extensions selected to operate as attendant's lines, the the register then being released. The selected extension is automatically rung with a special period of ringing to indicate that it is an exchange call. When the call is answered, the ringing is tripped both at the P.A.B.X. and the public exchange and the caller is through to the attendant. On the caller's requirements being stated, the attendant will hold the exchange call and the attendant's line will be deflected to a register. When the required extension has been dialled and the call has been answered,

the two can speak together without overhearing to the exchange line. If the called extension is not the most suitable for dealing with the caller, the attendant can revert back to the exchange line and then make a further local call. After the attendant has received an answer from the wanted extension, he will transfer the exchange line to the extension and release his own line. As such calls are equally as urgent as the original exchange call, a special ringing period is sent out. If the wanted extension is engaged, a tone is introduced on the line to advise the extension that an exchange call is waiting. When the wanted extension replaces the receiver the bell is rung from the attendant's connection as soon as the previous call is released, and when the ring is answered the extension is connected with the attendant.

A Typical Extension Instrument

Enquiry and transfer calls.

When an extension is connected to an exchange line, whether in an incoming or an outgoing direction the latter can be held while a local call is made, and the exchange call can also be transferred to another extension and re-transferred from there to any other extension an indefinite number of times.

Night Connections.

At night time the exchange line group may be segregated into individual lines at the public exchange so that a caller can be connected through to a particular extension by dialling a night connection number specified in the telephone directory.

When a key is thrown at the P.A.B.X., the registers will cause each individual exchange line to extend incoming calls to its specified extension, this extension being decided by the cross connection of a single wire.

If such a call meets an engaged extension, the P.A.B.X. subscriber will be warned by a tone and by replacing the handset will be released from the previous call and then rung from the exchange call.

An Improved Microphone Inset

CONTINUED effort directed towards the improvement of the microphone embodied in the bakelite handmicrotelephone, results in minor changes which are embodied after lengthy tests have been carried out to prove their utility and constancy. These slight changes are usually made without necessitating any alteration to the code of the inset, occasionally, however, a modification takes place which is of a major character and as a result a new code must be allotted.

Fig. 1—Transmitter N7750

The N7750 transmitter (Fig. 1) is an instance of such a change although its contour is exactly the same as the older type N7745 with which it is fully interchangeable. The assembly of the electrodes and the type of electrode has been modified (Fig. 2) and this together with improvements in the production of the carbon granules has effected an important change of characteristics.

Fig. 2—A Full-Size Section

One consideration leading to the design of this new inset was the desirability of having a microphone that would give satisfactory efficiency and service on both C.B. and L.B. magneto instruments, so that in the case of the convertible instrument, for instance, the change to the different conditions of working could be effected without the necessity of changing the microphone.

The characteristic resistance of the N7745 inset was approximately 75 ohms. This was satisfactory for C.B. working but too high to give the necessary volume efficiency with the local battery instrument. The new N7750 inset, however, has a characteristic resistance of approximately 50 ohms, which has been obtained without detracting in any way from the high efficiency of the old N7745 when used for C.B. working, and furthermore, full efficiency with local battery working has been secured.

The low characteristic resistance of the improved inset will also result in better service under those difficult tropical conditions where an increase in the characteristic resistance occurs for reasons not yet properly appreciated. The new inset will give longer life under these conditions with greater freedom from "frying" and background noise than has yet been obtained.

It retains all the special features of the N7745, that is, the completely closed granule chamber to prevent the ingress of moisture, the special lacquer used to coat the diaphragm to effectually minimize corrosion, the complete absence of varnished silk or linen which rapidly deteriorates under tropical conditions or where conditions are moist and humid, and, as in the case of the N7745, the N7750 inset is repairable and can be taken down and reconditioned, using a few simple tools.

Regarding actual efficiency, the transmission reference equivalent is on the average 8 *db* worse than the C.C.I. datum under conditions of test defined in the C.C.I. year book 1931 pp. 53 to 61, this briefly may be said to be at least equal in efficiency to the Post Office standard telephone No. 162.