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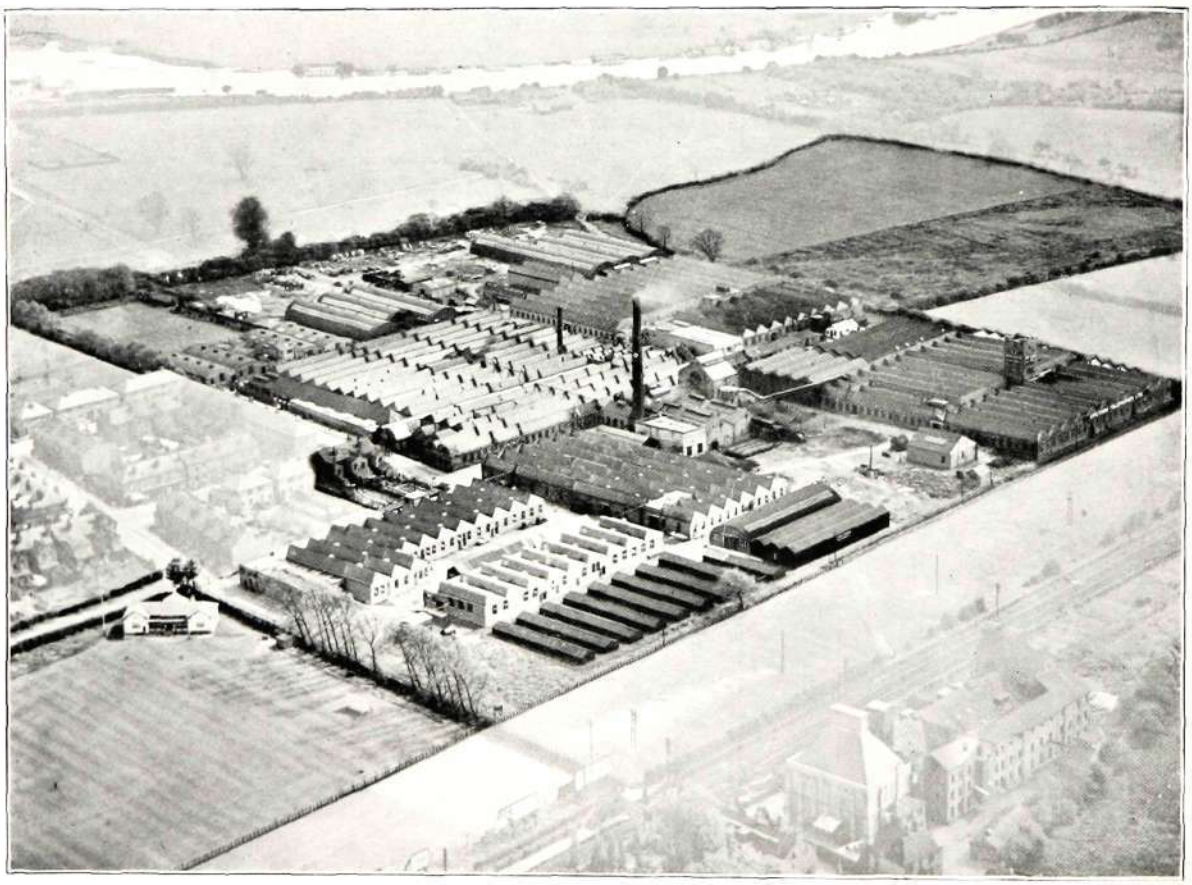


Aerial View of The Ericsson Works, Beeston, Nottingham

Auto-CB and LB Table Telephones for "Plan Number" Working

THE new Post Office table telephones described in Bulletin No. 11 of July 1937 have been further developed to cover a variety of methods for working extensions, known as "plan number" working.

In this article therefore, the modified instruments, the apparatus required and a few plan number schemes are illustrated and described.

Complete Instruments.

A telephone fitted with the maximum of three push buttons is shown in figure 1. The buttons are situated between the cradle wings immediately in front of the micro-telephone. They are made of metal with a bright chromium finish, and are free to move up and down in counterbored holes drilled in the body, in which they are retained by a washer and screw on the inner end of each button.

A metal designation label is fitted below the buttons to indicate their functions, that shown being for three extensions. The label is of the chemically engraved type with bright chromium characters and black background, and is fixed by means of two screws which engage with metal bushes inserted in the telephone body. When less than three buttons are required the vacant holes are fitted with bright chromium finished metal dummies. Bodies drilled for one and three buttons are standardized. This type of telephone (figure 1) is a standard auto-CB as described in the previous article but fitted with a key unit, described hereafter, and has a magneto bell.

For some of the plan number workings the extensions are fitted with a D.C. trembler bell, and a view of the underside of this type of chassis is shown in figure 2. The bell movement is insulated from the chassis frame, and four terminals for connecting the bell in series or parallel are

Fig. 1—A Typical "Plan Number" Telephone

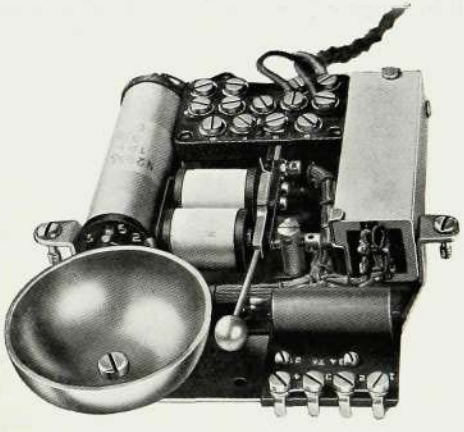


Fig. 2—The Chassis of a Telephone with Battery Bell

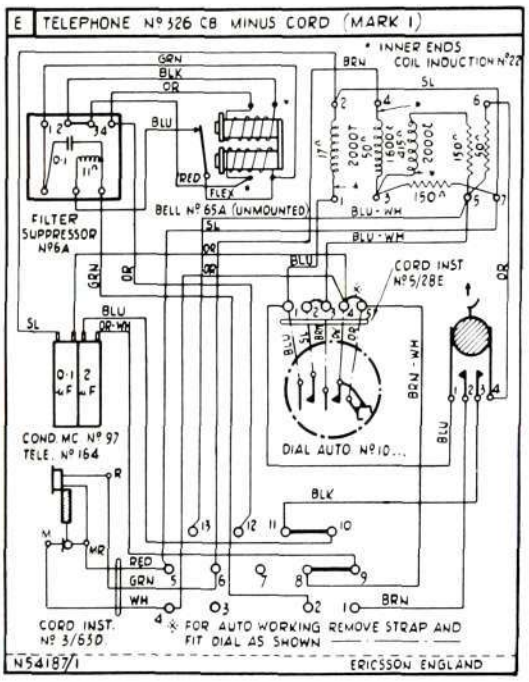


Fig. 3—Circuit of the Telephone with Battery Bell

mounted on the base of a suppressor unit which is fitted for the purpose of reducing to a minimum, interference with radio. The circuit of this type of instrument is seen in figure 3.

Key Units.

All key units have spring sets of the make-before-break change over type, known as " K " combination.

A key unit with one set of K springs is illustrated in figure 4 where is it seen fitted in place on a chassis, the operating push button occupying the central position on the telephone.

Telephones so equipped are primarily for use in connection with a private branch exchange (P.B.X.), so that, when a call is extended to a subscriber on the public exchange, the P.B.X. operator's attention may, if required, be attracted by momentarily pressing the button on the telephone, thus flashing the supervisory signal on the P.B.X. switchboard. The operator then breaks-in and ascertains the requirements of the extension. A diagram of the instrument for this purpose is shown in figure 5. This instrument can also be arranged as a main station with a single extension on the lines of plan No. 1 figure 11.

For other extension schemes the telephones are fitted with key units having a number of K spring sets, the standards at present being 4 and 9 sets.

A key unit with 4 K spring sets is illustrated in figures 6 and 7, and is arranged so that the push button on the telephone operates respectively (left to right) 2K-1K-1K spring sets. Each of the 12 contact springs is connected, consecutively from left to right figure 6, to the terminal block where the four sets of terminals are numbered 1 to 12 downwards.

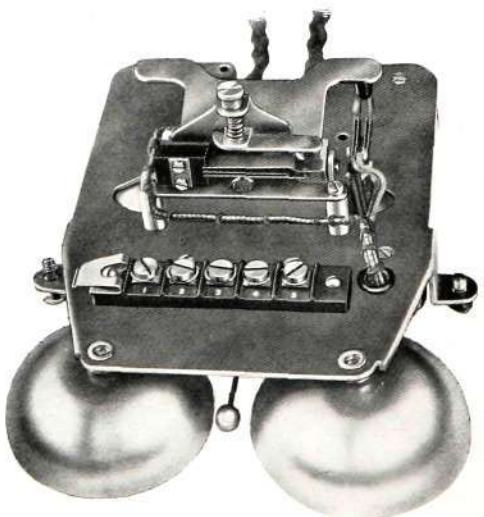


Fig. 4—A Chassis with a Single-set Spring Unit in position

The plungers for operating the spring sets are restored by means of a phosphor bronze leaf spring, bearing on the bottom of each plunger which also has a projection that engages with a pivoted latch bracket for locking the plunger in the operated position, figure 7, right front.

The latch bracket is cut away opposite the centre plunger so that this key is always non-locking. On the inside of the bracket there is a differential plate which can be fixed, by means of two screws, in any one of eight positions as shown dotted in the diagrams figure 8 where A, B and C represent the three plungers.

On referring to these diagrams it will readily be seen that the lock and non-lock of plungers A and C and the trip and non-trip by plunger B are controlled by the

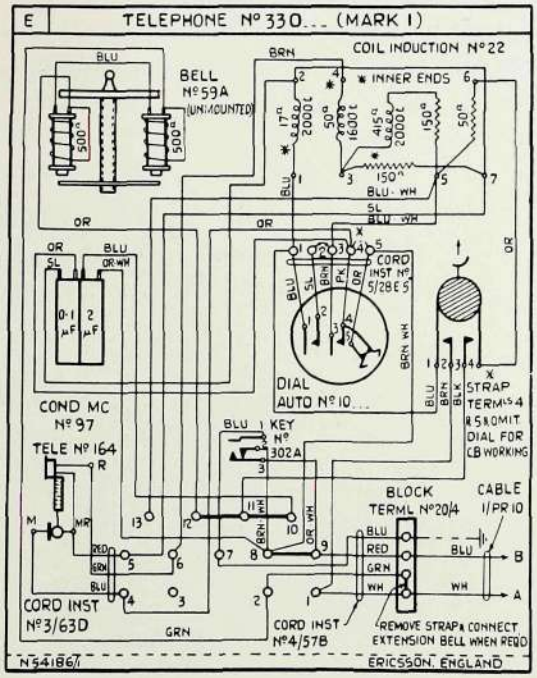


Fig. 5—Circuit of a P.B.X. "Recall" Telephone

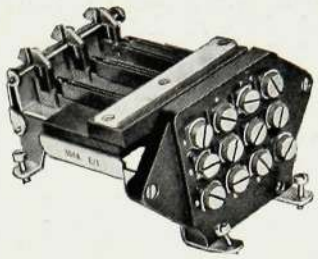


Fig. 6—A 4K Spring-set Key Unit

position of the differential plate and therefore with the standardized multiple spring-set key units a variety of extension schemes may be set up as required. Furthermore, for some extension schemes it is necessary to release locked plungers by the replacement of the micro-telephone on the cradle. For this purpose there is supplied with each key unit a T shaped plate which, for convenience is normally attached to the side of the key unit as seen in figure 7 on the left hand side. When the extension scheme necessitates micro-telephone release, as stated above, the T plate is removed from the key unit and fixed to the cradle lever as shown on a standard auto-C B chassis figure 9, so that by engaging with a projecting limb, "X" in figure 8, on the latch bracket, the plungers are released.

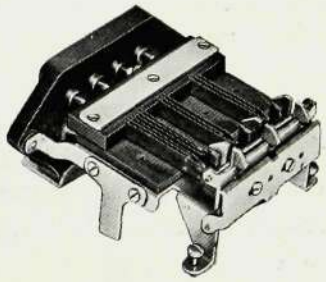


Fig. 7—Another view of Fig. 6

Figure 10 illustrates the 9 K spring set key unit mounted on a chassis. The contact

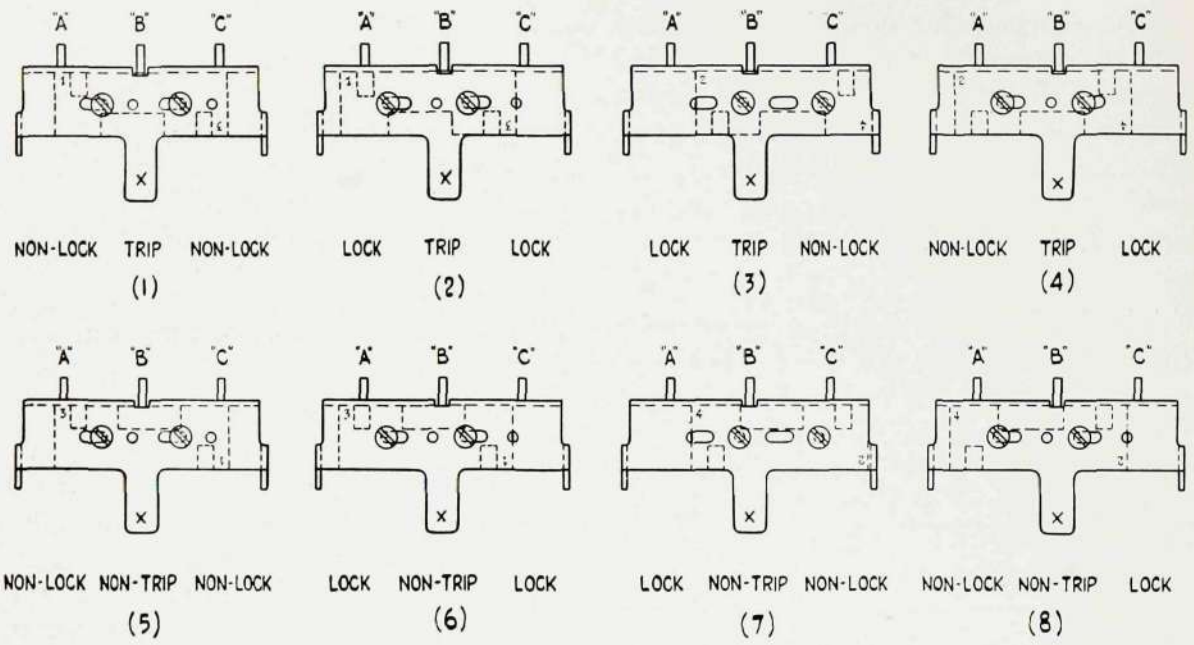


Fig. 8—Drawings of the various positions of the Differential Plate which is shown dotted

springs are connected to the terminals in the same way as for the 4 K unit, the end terminal numbered 28 being spare. The spring sets are arranged so that the three plungers operate 4K-1K-4K sets respectively. This key unit is designed to allow for the more elaborate plan number schemes which may arise from time to time.

All contact springs on the key units are made of phosphor bronze and twin contacts are fitted. The spring sets can be correctly and accurately adjusted and tensioned before the unit is mounted on the chassis. Finally to make these key units as complete as possible, they are provided with captive type fixing screws.

It should also be noted that the chassis of the standard auto, CB and LB instruments are arranged for the key units

Fig. 9—A Chassis with the T plate fixed for Micro-Telephone release of key plungers

Fig. 10—A Chassis with a 9K Spring-set Key Unit

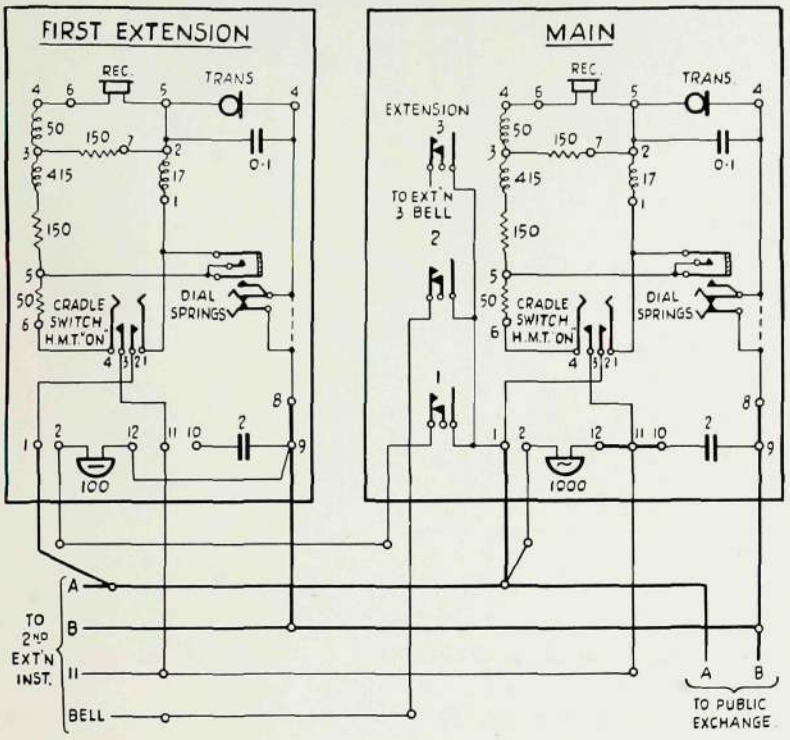


Fig. 11—Diagram of Plan No. 1 C.B.

and T plate described above to be screwed in position, so that, by having the body drilled for the push buttons, the standard instruments can be adapted for plan number working if required.

A few extension schemes are described below.

PLAN NO. 1.

This is a scheme which provides for one main telephone and several extensions. Figure 11 is a diagram of the connections for Auto and C.B., and figure 12 a similar case but for magneto systems. The main instruments are fitted with from one to three push buttons and the differential plates on the key units are fixed in the position shown in drawing 1 or 5 figure 8. When more than three extensions are required an additional key unit and push buttons external to the telephones may be used. The main sets have a magneto bell whereas the extensions are provided with a battery type trembler bell. The exchange line is connected to all instruments and outgoing calls can be made from any. Incoming calls operate the ringer in the telephone at the main station where the callers requirements are ascertained. If the call is for one of the extensions, the appropriate button on the main instrument is depressed, thus applying battery from the

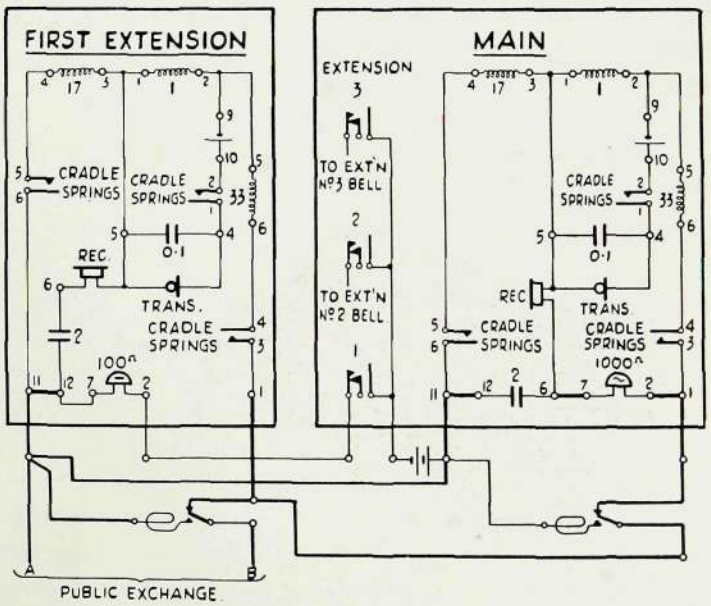


Fig. 12—Diagram of Plan No. 1 Magneto

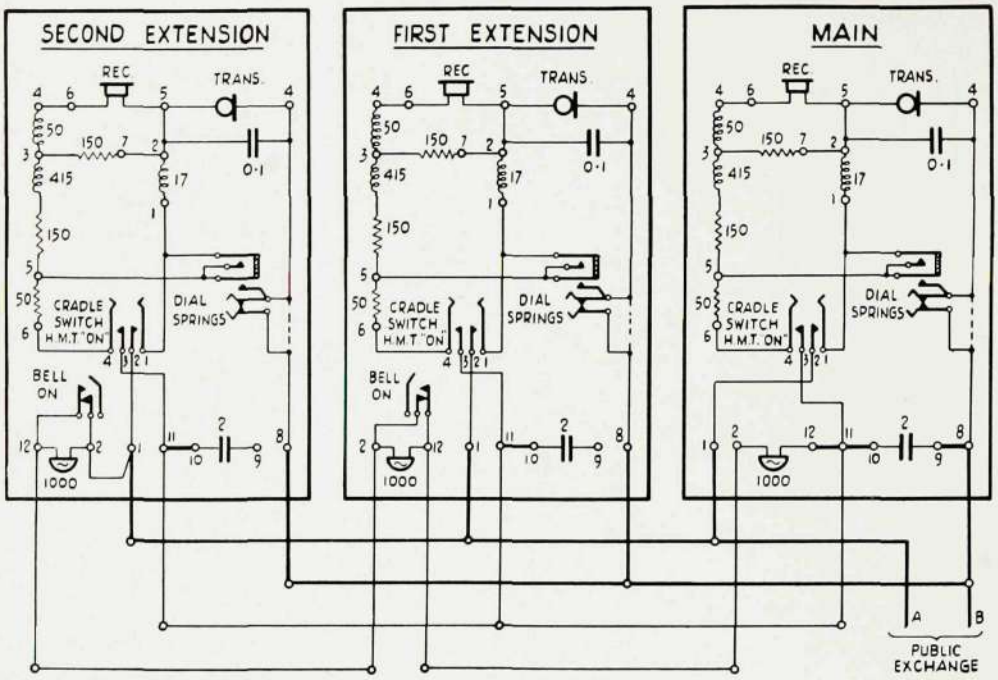


Fig. 13—Diagram of Plan No. 1A

exchange line to operate the trembler bell in the extension telephone where the call is then answered in the normal manner.

PLAN NO. 1A.

In this case, figure 13, there is one main and one or two extensions. All instruments have magneto type bells which are connected up in series. The extension instruments, only, are each fitted with two buttons one of which merely releases the other when required, and is not shown in the diagram. The differential plate on the key units is fixed in the position shown in drawing 3 or 7, figure 8, and a label marked " bell on ", " bell off " is fixed in front of the buttons. The exchange line is connected to all instruments and outgoing calls can be made from any of the three telephones, but incoming calls normally ring the main telephone bell and can only be signalled at the extensions by depressing the " bell on " buttons, which remove a short circuit from the extension bells, and remain locked until released by the " bell off " button. It will thus be seen that incoming calls can be signalled at one, two, or all three stations as required.

PLAN NO. 3.

For one main and one extension telephone with secrecy at the extension when required. This arrangement is shown in figure 14. The main telephone is fitted with one push button in the centre position and the P.B.X. type of key unit as seen in figure 4.

The extension has two buttons one labelled " secret " and the other " normal ", the latter being for releasing the former and is not shown in the diagram. The differential plate in this case is fixed as drawing

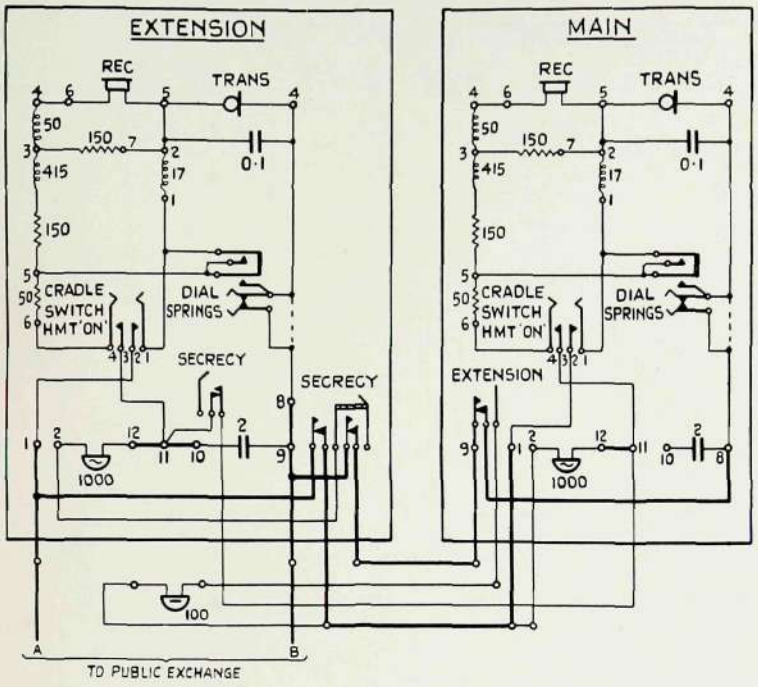


Fig. 14—Diagram of Plan No. 3

" normal " button is depressed.

It will be appreciated that should the extension require automatic release of the secret key after each secrecy call, so that the main shall answer all incoming calls this is done by fixing the T plate, mentioned above, to the cradle lever, in which case the " normal " button is not required.

PLAN No. 8.

Two exchange lines terminate separately on two main telephones and are

3 or 7, figure 8. The exchange line is connected to the main via the extension's key unit, so that normally incoming calls are signalled at and answered by the main. When a call requires the attention of the extension the push button at the main is depressed thereby ringing a battery bell fitted in any convenient position at the extension station. In replying the extension, if desired, can disconnect the main from the exchange line by depressing the " secret " button thereby connecting the extension instrument only to the exchange line, and while so connected incoming calls are signalled there on the instrument bell. When the extension again desires the main to answer incoming calls the

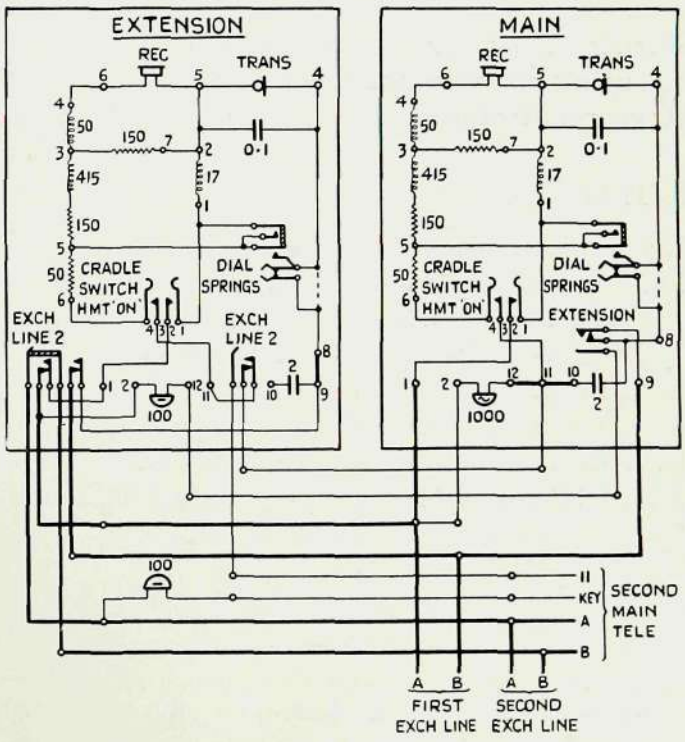


Fig. 15—Diagram of Plan No. 8

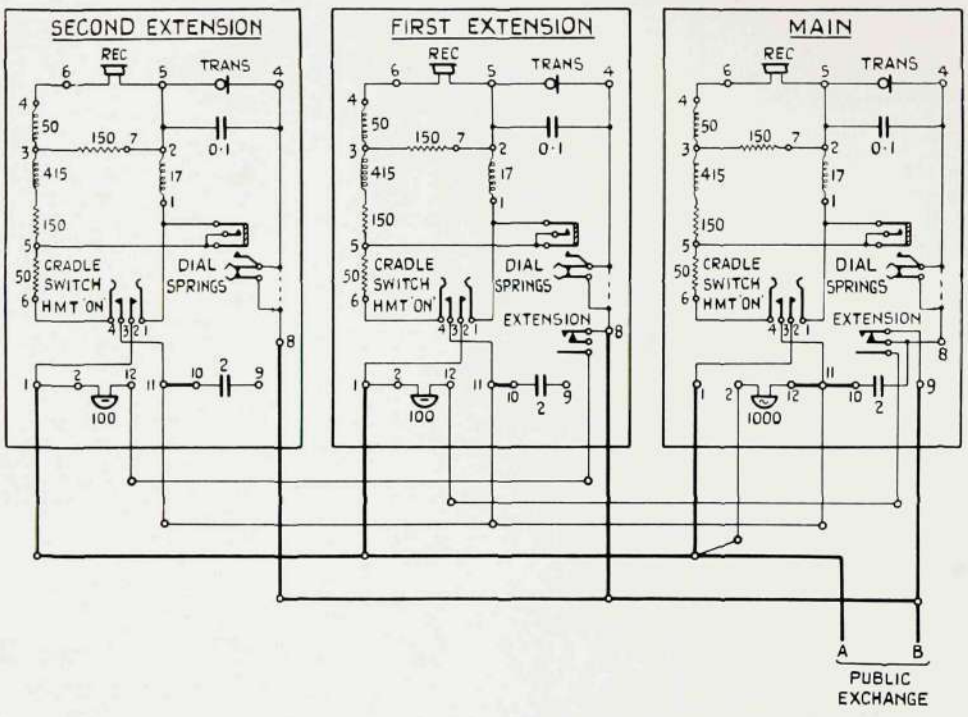


Fig. 16—Diagram of Plan No. 11

extended to an extension which has access to both lines in accordance with the diagram in figure 15.

The main telephone chassis are equipped as shown in figure 4, while the extension chassis has a battery bell as in figure 2, and is fitted with one of the multi-spring key units, having the differential plate fixed as at 4 or 8 figure 8 and the T plate mounted on the cradle lever. There are two press buttons on the extension telephone and a label marked " line 1 ", " line 2 ". The bell in this instrument is connected to line 1 and its main telephone, and another different toned bell is fitted near by for line 2 and its instrument.

When making outgoing calls it is necessary to listen to ascertain if the exchange line is already engaged or not. Incoming calls are answered at the main telephones and any for the extension are signalled thereto by pressing the button on the main instrument.

Normally the extension is connected to line 1 but is transferred to line 2 by pressing the button so marked.

The line 2 button when depressed remains locked until released by line 1 button, which is non-locking, or by replacing the micro-telephone.

Plan No. 11.

This plan figure 16 has the exchange line connected to three instruments, a main and two extensions, so that out-going calls can be made from any of the instruments. Incoming calls are answered at the main

and can only reach extension 2 after extension 1 has ascertained the nature of the call. In this way extension 2 is guarded against being troubled with calls except where absolutely essential.

The main telephone is fitted with a P.B.X. type of key for calling extension 1; extension 1 has a key unit, with the differential plate fixed in any position 5 to 8 figure 8, for calling extension 2; and extension 2 has no key. The bell at the main is the magneto type while each of the extensions has a battery type.

From the foregoing and also the previous article, it will readily be seen that this new design of telephone can be universally used, and also adapted for numerous schemes of extension working.

Part of one of the Telephone Assembling Shops

B.P.O. Unit Auto Exchange (U.A.X.) No. 12 Type

PRIOR to 1929 small automatic exchanges for country areas were in the experimental stage and therefore no standard equipments were available. The necessity for standardized units to meet the rapidly increasing demand for automatic service in these areas was apparent, and in the early part of 1929 the British Post Office (B.P.O.) installed the first standard type exchange known as "unit auto" No. 5. This had capacity for 100 lines and was connected by junction lines to a nearby exchange, the latter being known as the "parent" exchange.

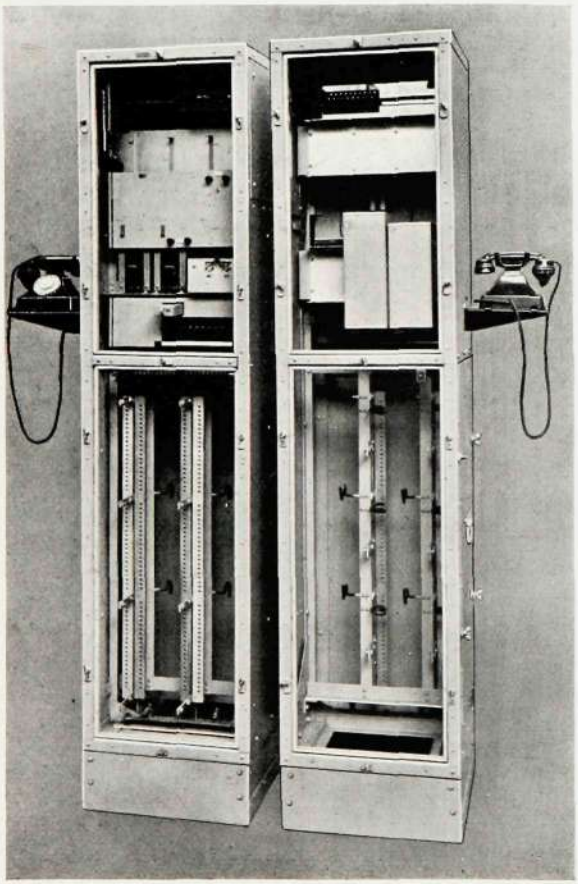


Fig. 1—Front and Rear View of an Auxiliary Unit

All local calls on unit auto No. 5 could be completed automatically, but calls to and from other exchanges were routed via the manual board in the parent exchange.

The success of this type of unit was rapid and by the end of 1930 over 300 exchanges were installed.

In order to cater for a larger number of subscribers, unit auto No. 6 was introduced ; this provided similar facilities to No. 5 but had capacity for 200 lines. At a later stage it was found necessary to provide an even larger type equipment known as unit auto No. 7 with capacity up to 800 lines.

As already stated above, subscribers on unit auto Nos. 5 and 6 can only dial to subscribers on the same exchange, subscribers on other exchanges being obtained by the caller dialling 01 and obtaining the services of an operator in the parent exchange. When the B.P.O. decided on a programme of general automatization, it became desirable that subscribers should be able to dial calls to other exchanges, and consequently it was necessary to provide a unit auto exchange that had facilities which would enable the subscribers to dial subscribers on other exchanges in the area. To cover this demand unit auto No. 12 was developed, and replaces No. 5.

CONSTRUCTION AND EQUIPMENT DETAILS.

Unit Auto No. 12 has capacity for 100 lines inclusive of subscribers and junctions and, as the title implies, is built up in unit form. In order to provide for various equipments three different units are manufactured, namely: auxiliary, 12A and 12B.

Auxiliary Unit. Figure 1 shows the front and rear view of the auxiliary unit which accommodates the main distribution frame, (shown in the lower portion with heat coil and fuse mountings removed) the testing equipment, and relay sets containing the common equipment, such as, ringing, tones, time pulse and multi-metering equipment. The ringing and tones are generated by vibrating relays and the time and meter pulses are obtained by means of interacting relays and uniselectors. The telephone shown at the side of the unit is used as a service instrument or for testing lines, as required.

12A Unit. On the left of figure 2 is shown the front view of a 12A unit. Three relay mountings accommodating a total of 25 line relay equipments together with the allotter and routine test relays are fitted on the bottom shelf. Immediately above are fitted the line finders and the allotter switch. Above these switches are the subscribers and traffic meters while the next shelf accommodates the selectors. Capacity for 4 line finders and selectors and one allotter is available.

At the top of the unit are the terminal strips for intercabling and cross connection purposes. Removable panels are arranged on both sides of the top compartment to provide a clear enclosed run for intercabling between the units when lined-up.

On the right of figure 2 is shown a rear view of the 12A unit. The top channel-type shelf accommodates the junction relay sets for parent or other exchanges and the lower shelf is for the associated multi-metering relay sets. Capacity is provided for 4 relay sets per shelf.

On the left of figure 3 the unit is shown with the gate, on which the line relays and line finders are mounted, opened out thus giving easy access to the wiring for maintenance purposes, etc. The right hand view shows the unit totally enclosed with all covers in position.

12B Unit. Figure 4 shows (left) the front view and (right) the rear view of a

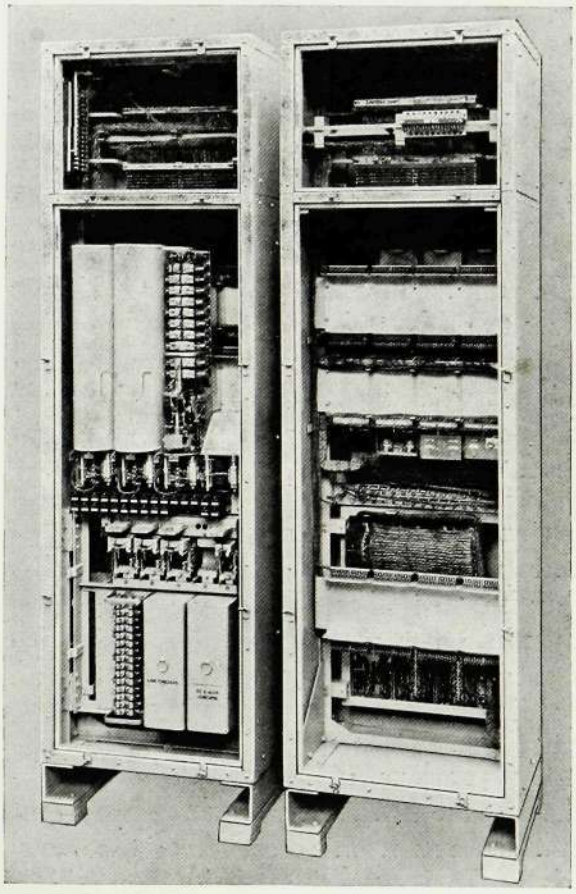


Fig. 2—Front and Rear View of a 12A Unit

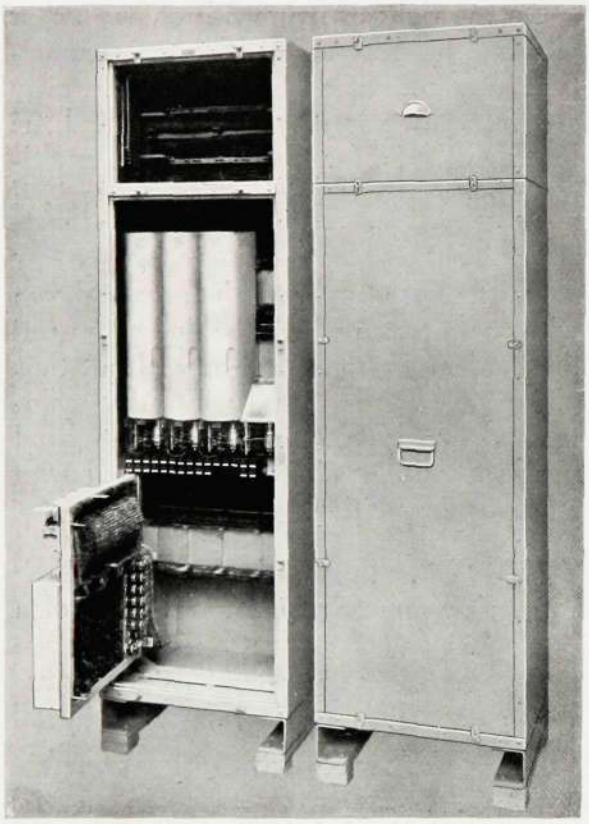


Fig. 3—Front View of a 12A Unit with gate open, and a View of the Unit totally enclosed

12B unit. This is arranged on similar lines to a 12A unit except that it is smaller in size and accommodates only 20 line circuits while its width will allow for only 3 selectors and relay sets being accommodated on the shelves.

General. It will be appreciated that as these units are installed in unheated buildings it is necessary to take every precaution to ensure that, as far as possible, the equipment is protected from varying atmospheric conditions.

On previous unit type exchanges the main frame (M.D.F.) was of the open type and suffered from corrosion of the metal parts. By incorporating it in the auxiliary unit with the other apparatus mentioned above, this trouble will be very considerably minimized or even eliminated altogether.

Incoming cables enter the auxiliary unit through holes cut in the removable wooden false-floor which is then sealed with a special compound.

Between the units, when lined-up, a wooden gasket is fitted to make the joint airtight and provide a through cabling space in the top compartment.

The cabinets are constructed of angle iron, sheet iron and wood on the cavity-wall principle.

The recesses for the doors are fitted with a pliable circular rubber insertion, against which the doors are clamped by means of metal plates and thumb screws.

The overall dimension of the cabinets are :—

Auxiliary and 12B units 6′ 10¼″ high x 1′ 7½″ wide x 1′ 9″ deep.

12A units 6′ 10¼″ high x 2′ 0″ wide x 1′ 9″ deep.

Composition of Complete Unit Auto No. 12 Exchange.

A complete 100 line exchange consists of one auxiliary unit, two 12A units and two 12B units lined up from left to right (front) in the following order :—AUX ; 12A ; 12B ; 12A ; and 12B.

If 50 lines are required the two right hand units are omitted while if only 25 lines are wanted the last three units are omitted leaving an auxiliary unit and one 12A unit.

Apparatus and Finish. The line circuits employ 600 type relays ; all other relays are of the 3000 type. The meters are the 100 type, and the group and final selectors are the Strowger type.

Standard finish is provided for the various pieces of apparatus, but enamelled wire is used for all conductors in cable forms and jumpers.

POWER PLANT.

Where an A.C. supply is available a single battery is provided with automatic charge and discharge arrangements.

If the supply is DC a double battery scheme is installed with a dynamotor for charging. In cases where no public supply is available a similar arrangement is provided except that the dynamotor is replaced by a petrol engine set.

ACCOMMODATION.

A standard type building with internal measurements of 14′ 0″ x 7′ 7″ and a clear height of 8′ 9″ is used to accommodate all equipment. This is similar in size to that provided for unit auto No. 5, so that if it becomes necessary to replace a No. 5 unit by a No. 12 unit, the same building can be used without difficulty.

TRUNKING ARRANGEMENTS, NUMBERING SCHEME, AND OPERATION.

Figure 5 shows typical trunking arrangements. The subscribers line circuits terminate on the banks of 50-point line finders which are connected to selectors of the 2-motion Strowger type. The lines are divided into two separate 50-line groups each group having an allotter which, on the origination of a call selects a free line finder and causes it to search for the calling line.

The incoming side of the relay sets also terminates on the line finder banks and incoming calls via these relay sets are handled by the auto equipment in a similar manner to a subscribers call.

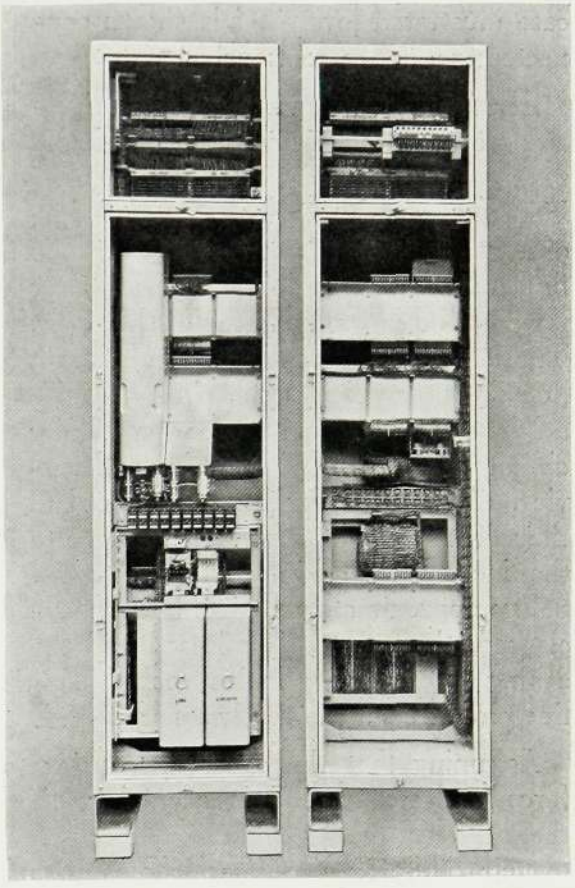


Fig. 4—Front and Rear View of a 12B Unit

The first digit dialled is used for discriminating between local and junction calls. The digit '2' is prefixed to each subscribers number and a multiple range of 200-299 is available.

The digit '9' is used to gain access to the equipment at an automatic parent exchange. Dialling 'O' routes the call via the group of junctions connected to level '9' but a discriminating signal which results in the parent operator being signalled is passed over the junction. By routing level '9' and level '0' traffic via the same relay sets an economy in junctions is effected.

Levels 3, 4, 5, 6, 7 and 8 can be used for junctions to other exchanges. In the

case illustrated level '8' is shown connected to a non-parent exchange.

Local Call. When a subscriber originates a call the allotter causes a line finder to search for the calling line. The allotter is in use only during the searching time of a line-finder and immediately the line finder seizes the calling line the allotter releases and is available for further calls. The allotter is arranged so that a different line finder is seized each time a call is originated, this feature preventing a faulty circuit from seriously interfering with service. The linefinder extends the call to the selector, which transmits dial tone to the line. If the calling party fails to dial before approximately 1 to 5 minutes have elapsed, the selector is released and the calling subscriber remains locked to his line circuit until the receiver is replaced.

Assuming that the caller dials prior to forced release conditions occurring, then the initial digit "2" causes the selector to step to level 2 and release. The 2nd and 3rd digits step the selector in a vertical and rotary direction respectively and tests the called party's line. If the line is engaged the caller will receive busy tone. When the called line is in a P.B.X. group the selector will search for a free line in the group and return busy tone to the caller only if all lines in the group are engaged. If the called line is free, ringing is connected and ringing tone transmitted to the caller in the usual manner.

When the called party answers the calling party's meter is operated and conversation can proceed.

Call to Parent Exchange (Manual Board). The caller is connected to a selector as described above and dials 'O'. This causes the selector to step to level '9', seize a free junction to the parent exchange,

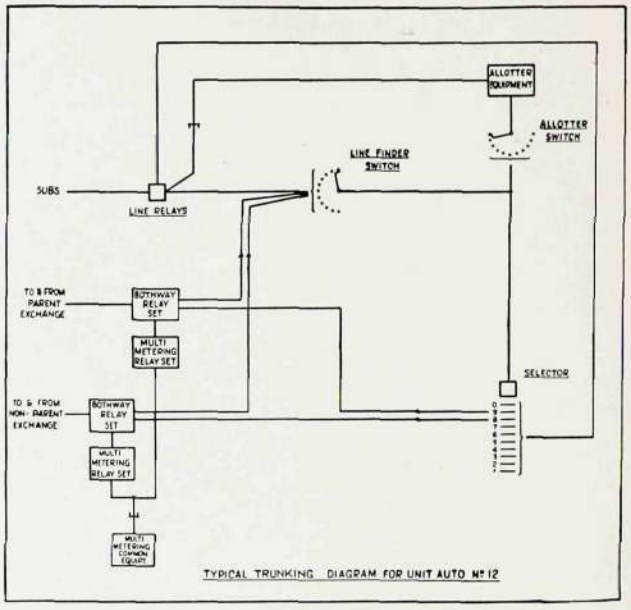


Fig. 5—Trunking Diagram

and signal a manual operator at that exchange. In the event of the caller being barred trunk calls (e.g. coin box lines) the operator receives a visual indication which informs her that she must collect the necessary fee. The bank wiring on level '9' is 'slipped' so that on repeat calls a different junction is seized and consequently faulty circuits will not prevent access to a junction which is in working order.

Call to Parent Exchange (Auto Equipt.) In this case '9' is dialled and the call is routed over the parent exchange junctions to an incoming selector at the parent exchange. The caller is now able to dial to subscribers in the parent exchange, or to exchanges connected to the parent exchange.

Call to Non-Parent Exchange. The caller dials the call digit (e.g. 8 in figure 5) and seizes a junction to the required exchange. If the exchange dialled is a manual exchange the operator is signalled and can connect the caller with the desired line.

If the exchange dialled is automatic, subsequent impulsing operates the auto equipment to select the desired number on that exchange or to route the call to another exchange.

Multi-Metering. When a caller dials a digit which results in a junction to another exchange being seized, the multi-metering and route restricting relay set associated with the junction relay set functions and performs one of the following operations :—

(1) Connects the appropriate fee lead to the meter wire. Provision is made for 1, 2, 3 or 4 unit metering.

(2) Connects N.U. tone to line if the number dialled is a spare code or is barred to the caller.

(3) Provides manual hold conditions on a call to a manual board obtained via a distant auto equipment.

If the multi-metering and route restricting relay set is unsuitable for dealing with the required number of codes, additional equipment is provided to cover a larger number of codes. This equipment is common to all multi-metering relay sets and if a call is originated to the common equipment while it is in use on another call, busy tone is returned to the caller.

Incoming Calls from Parent Exchange Manual Board. The operator plugs into a jack in the outgoing junction multiple and dials the required number. The operator does not listen for dial tone ; the linefinders are homing type switches and the incoming junctions terminate on the first choices on the line finder banks and therefore it is unlikely that dialling will commence prior to the linefinder finding the calling line. If however this does occur busy tone is transmitted to the operator at the conclusion of dialling.

If the operator dials a free line, ringing is connected in the usual manner and ringing tone is transmitted to the operator.

If the called line is engaged the operator receives busy flash and tone, but provision is made so that the parent exchange operator can gain access to the engaged line, for the purpose of offering trunk calls, etc. by the momentary operation of the ringing key. The call is offered to the engaged line and the subscriber is requested to clear the line. When the clear is received on the cord circuit supervisory lamp the ringing key is again momentarily operated to apply ringing to the wanted party's line.

Incoming Call from Parent or Non-Parent Auto Equipment. The linefinder finds the calling junction and on receipt of the dialled impulses the auto equipment functions in a manner similar to that on a local call.

Alarms and Test Number Equipment. Alarm extension arrangements are not provided on this type of board but provision is made so that an operator at the parent exchange can dial a test number and ascertain, by the tone received, the condition existing at the U.A.X.

The above description gives a general idea of the layout, facilities and operation of unit Auto No. 12 which is now in use throughout this country and is giving good service. It may be of interest also to mention that there are two similar types of equipment available viz. :—unit auto Nos. 13 and 14.

Unit auto No. 13 has capacity for 200 lines and replaces unit auto No. 6 while U.A. No. 14 will replace U.A. No. 7 and has capacity for 800 lines. Both of these exchanges are provided with the 2000 type selector. The transmission feeds are of the ballast type and balanced tones are provided.

The Ericsson "Alnico" Magnet Hand Generator

(Prov. Patent 27065/37)

THE magneto generator, hand operated, has proved itself over a considerable number of years to be one of the most reliable pieces of signalling apparatus particularly when conditions are unfavourable. In spite of the general use of C.B. and automatic systems for public exchanges and even for branch exchanges the number of hand magneto generators manufactured for the telephone industry is very considerable indeed.

Until recently progress in the design of the magneto generator has necessarily been slow, owing to the lack of development of permanent magnet materials. After the replacement of ordinary carbon steel by chromium and tungsten steels no new magnet steels appeared for many years, and magnet design became more or less stationary. The cobalt chrome steels were the first outstanding development, but owing to their high cost in the early stage, their general adoption remained uneconomical for several years, excepting for certain designs of apparatus which were particularly adaptable. During the past few years considerable attention has been paid in the Beeston Works to the development of a hand generator which would have an efficiency equal to that of existing type generators of twice its weight, or alternatively have twice the efficiency whilst retaining the same weight of machine. It was also considered advisable to design the shape of the generator to be consistent with the most modern trend of design for telephone apparatus, and from figure 1 it will be realized that this has been most successfully accomplished.

After careful consideration it was decided to proceed with the revolving armature in preference to the inductor type of machine.

In the early stages a 15% cobalt-chrome cast magnet which incorporated the necessary pole-pieces was adopted, but with the advent of the new magnetic alloy aluminium-nickel-cobalt, known in the trade as "Alnico" a new field for development was opened up and the construction of the generator was completely redesigned. The exceptional characteristics of this new alloy, which gives the maximum energy per unit volume of any permanent magnet material yet available, made it possible for magnets to be adopted for the bridge

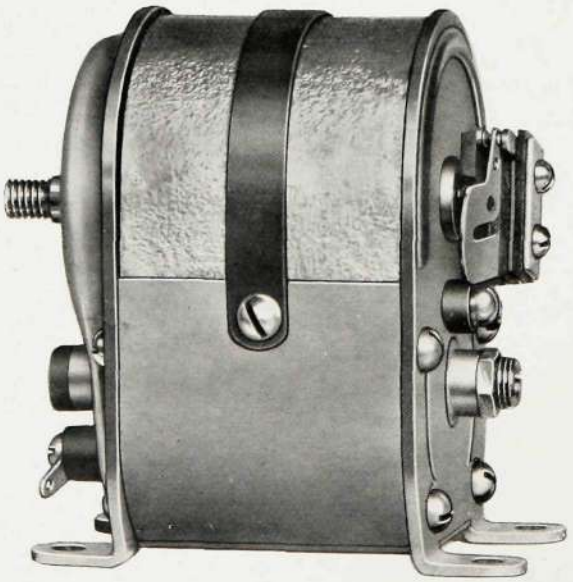


Fig. 1—The Generator without Handle, full size

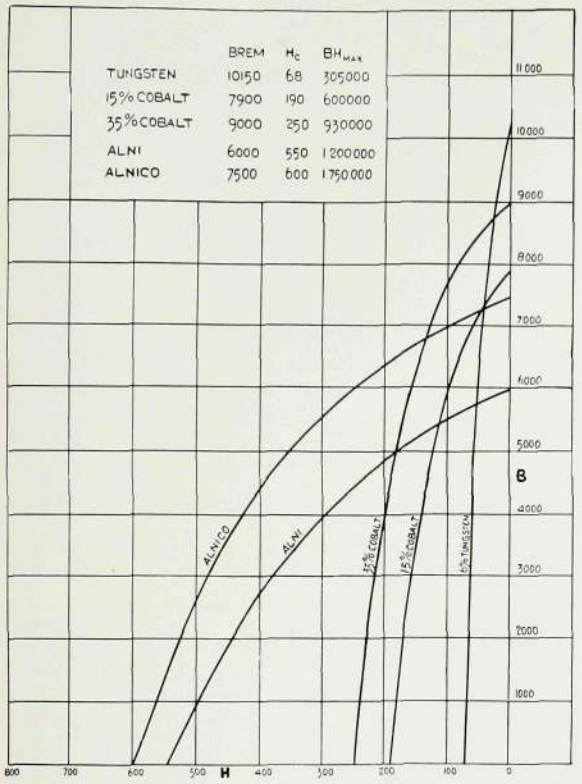


Fig. 2—Characteristics, and Demagnetization Curves of Magnet Metals

only and allow of good quality soft iron pole pieces to be used. Furthermore the specific gravity of the alloy is lower than that of the cobalt steels, thus giving some further reduction in weight.

Figure 2 shows the remarkable advantages of the new magnet material "Alnico" over the magnetic alloys hitherto available.

One serious difficulty to overcome in the design of a small hand-driven machine is the high starting torque. During normal running a heavy magnetic drag occurs twice per armature revolution when the maximum change in reluctance takes place (allowing for armature reaction). The quick snap of flux given by high magnetic fluxes and small air gaps necessitates a considerable turning torque, which may be termed the snap torque. On short lines i.e. with heavy loads this is very appreciable and in fact is sufficient in practice, particularly at the commencement of turning the handle, to tip over the telephone in which the generator is fitted unless it is firmly held down.

There are several methods which may be adopted to minimize this snap torque effect whilst retaining the high efficiency of the generator. The following are typical schemes.

i. To back off the armature for 10 to 20 mils at the trailing tip in order to reduce the flux in the air gap more gradually at the moment of snap.

ii. To skew the pole pieces on a small angle, thus minimizing the rate of flux change.

iii. To shape the poles so that magnetic saturation at the tips limits the flux.

iv. To provide a by-pass for a small proportion of the flux by means of a thin iron strip placed across the poles.

The first and the last of these methods prove the most satisfactory ways out of the

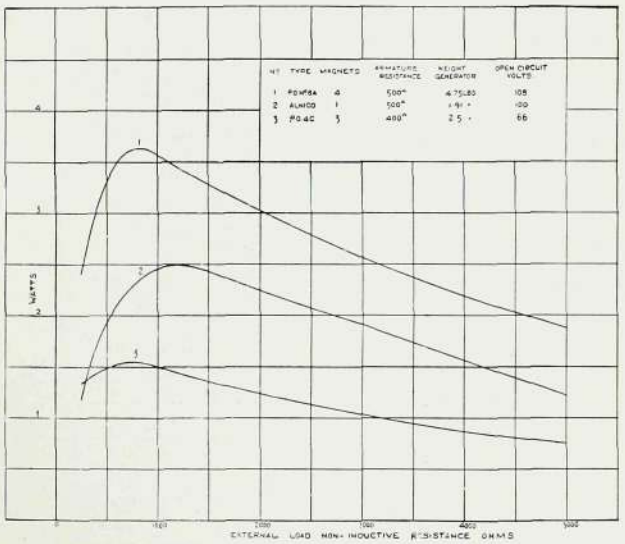
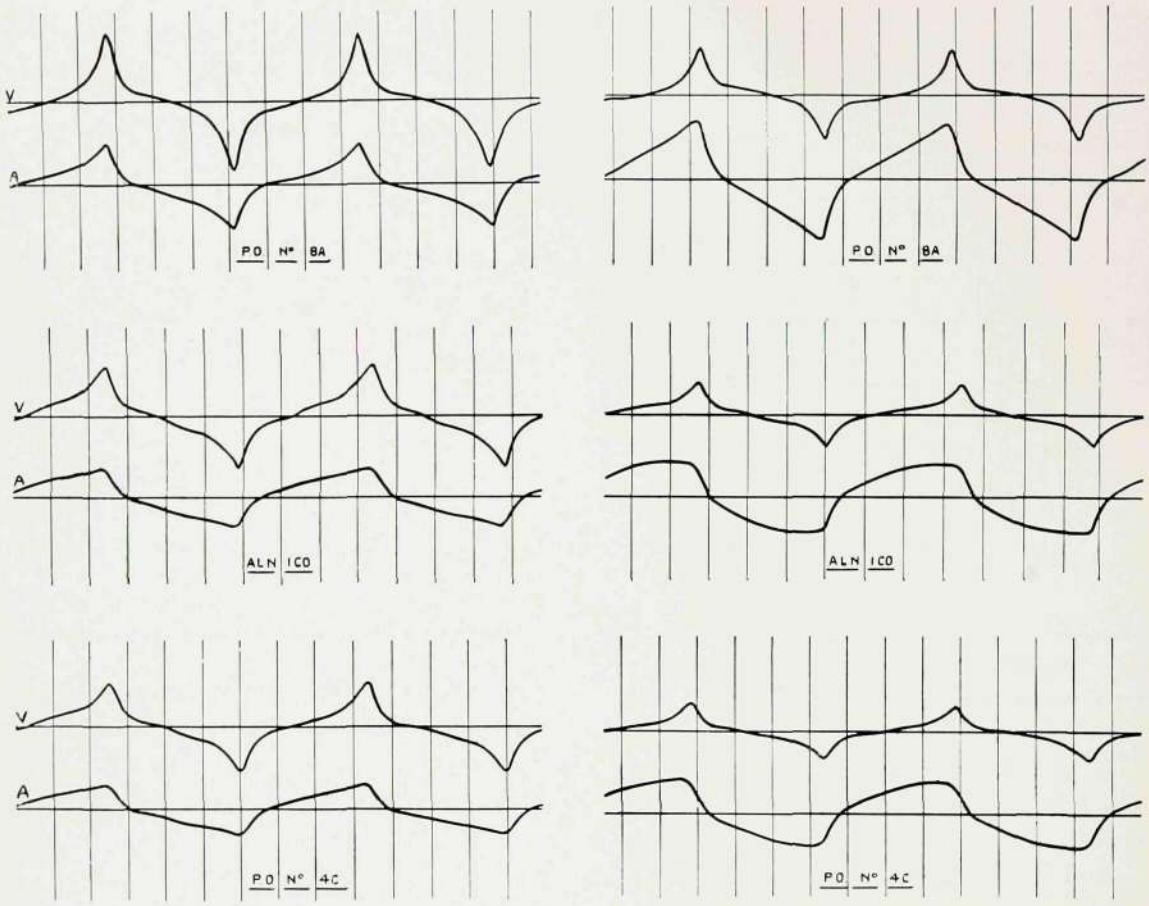


Fig. 3—Load Curve of the Generator compared with Two Others



Volt-ampere wave form with a 1000Ω ringer and 1000Ω NI resistance in series

Volt-ampere wave form with four 1000Ω ringers in parallel and 1000Ω NI resistance in series

Fig. 4—Oscillograms of Three Generators

difficulty. In addition the torque in the case of the Alnico generator has been still further reduced by supporting the armature between pivots and collecting the current by carbon brushes.

On examination of the load curves, figure 3, oscillograms, figure 4, and illustration shown in figure 5 it will readily be

Fig. 5—A Comparison in Size

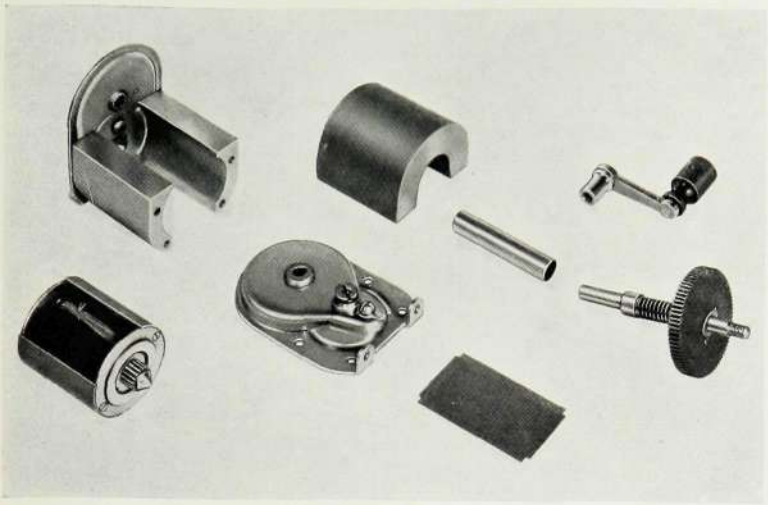


Fig. 6—"Exploded" View of the New Generator

appreciated by the comparisons that the new machine fulfils the desired requirements most successfully. The characteristic load curve, figure 3, for the new generator shows an output approximately twice that of the P.O. No. 4.C type and with this gain is associated a 25% decrease in weight and dimensions. With only a slight increase in dimensions it is possible to equal the output of the heavier type generator P.O. No. 8.A.

CONSTRUCTION DETAILS.

The special malleable cast iron armature is wound with enamelled wire to any specified resistance. The armature runs on pivot bearings which are force greased at each end by means of the cheek bearings which may be adjusted at the cut-out end of the generator. The driving gear is made of brass and has 78 teeth while the pinion is steel with 18 teeth, giving a ratio of 1 to $4\frac{1}{3}$. If necessary the pinion may be withdrawn by removing the locking nut which secures the pivot bearing. This nut is accessible by removal of the armature cheek.

It will also be noted that, apart from the handle and springset, all the working parts are totally enclosed and are therefore efficiently protected against damage due to dust or accident.

Figure 6 is an exploded view of the generator, and provides a clear illustration of the simplicity, neatness and small number of parts.

The magnet is cast and ground to dimensions where required.

The generator may be fitted in table or wall instruments or housed separately in a bakelite moulding as shown in figure 7, the overall dimensions of this being $4\frac{1}{2}$" high by $4\frac{1}{2}$" wide and 4" deep.

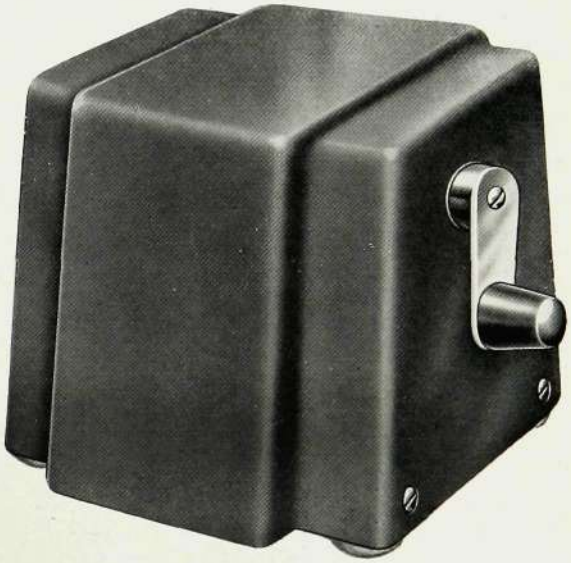


Fig. 7—The Generator in Bakelite Case

Thornton Heath Exchange London Director Area

WHEN the Postmaster General recently introduced the revised tariff for the renting of telephones and for trunk and junction calls, it was chiefly with a view to making the telephone more popular with the private subscriber, who, in this country, had been rather slow to realise the benefits gained by having an instrument in his house.

This encouragement given to householders to possess a telephone and the consequent increase in the number of subscribers, resulted in an increase in the number of telephones among the small business men and shopkeepers who formerly may have considered it uneconomical to be subscribers. The reduction in the tariff for trunk and junction calls has also benefitted large business concerns considerably, but the most important increase in the number of subscribers has been observed in the residential areas.

In the great new residential areas around outer London, where large tracks of land which were, a few years ago, open country and are now housing estates, the householder finds the telephone almost indispensable for keeping in touch with relatives, friends, and for shopping purposes.

Thornton Heath, recently installed in the London Director Area by Ericsson Telephones Ltd., is an example of an exchange which has been designed to serve the requirements of a residential district. The busy hour traffic in an exchange of this kind does not reach the high peak of a city exchange, and the subscribers' lines are therefore not required to carry such heavy traffic, so that the grouping of switches can be arranged on more economical lines.

The exchange was originally equipped for 2,600 lines but was designed to cater for an ultimate capacity of 7,300 lines ; a number which will no doubt soon be approached if the present rate of increase in the number of subscribers in the district continues.

The large number of exchanges concentrated in the London director area has necessitated the development of a complex system of junctions linking up the various exchanges. The importance of providing an exchange with a large number of junctions is rather forcibly shown by the fact that only about 20 per cent. of the total number of calls originating in an exchange such as Thornton Heath are destined for the subscribers connected to that exchange. Of the remaining 80 per cent. of the calls, the majority will be completed in the neighbouring exchanges. For this reason a number of direct junctions for automatic working have been provided to Croydon, (the shopping centre for the district) Pollards, Uplands, Addiscombe and a few other local exchanges in the area. To the majority of the exchanges in London, access is automatically obtained over junctions via the Holborn and Reliance tandem exchanges where 2nd and 3rd fee multimetering facilities are provided for exchanges outside the single fee area.

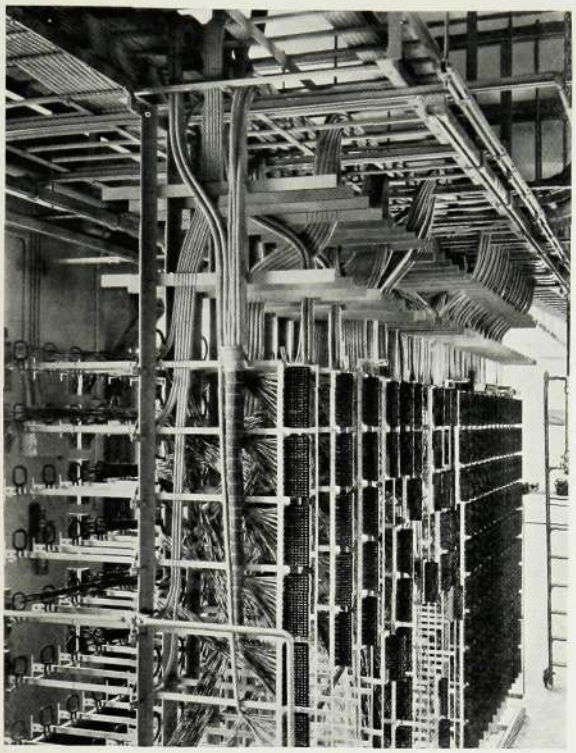


Fig. 1—View of the I.D.F. showing cabling

The floor plan layout of Thornton Heath is characterized by a design which has resulted in a remarkably straightforward and efficient method of cabling between the racks. An illustration, figure 1, gives some idea of the framework necessary to deal with the amount of cabling incoming to the I.D.F. The connection strips on the verticals shown nearest the camera cater for the cables carrying the circuits directly connected to the main frame, such as the incoming and outgoing junctions and also the miscellaneous circuits connected to the R.S.R. and S.A.R. The regular rows of connection strips at the other end of the frame are for the subscribers' lines. The method of jumpering from the blocks on this, the multiple side of the frame to the local side is clearly shown. The overhead cabling is also interesting as it clearly shows the neat way each cable drops vertically into position on the I.D.F. and reaches its particular strip without crossing.

The exchange occupies two floors in the building. On the ground floor, figure 2, are the main frame, numerical and final, selectors, test desk and the subs. meter racks. On the first floor, figure 3, are the I.D.F., the primary finder, code selector and director racks and some miscellaneous racks together with the power equipment. The batteries are also on the first floor but are partitioned off from the rest of the equipment.

The initial capacity of each battery is 900 ampere-hours with an ultimate of 2100 ampere-hours. Figure 4 shows the power board and the duplicate generating sets together with their associated motor-starters. The generating sets each consist of an induction motor flexibly coupled to an open

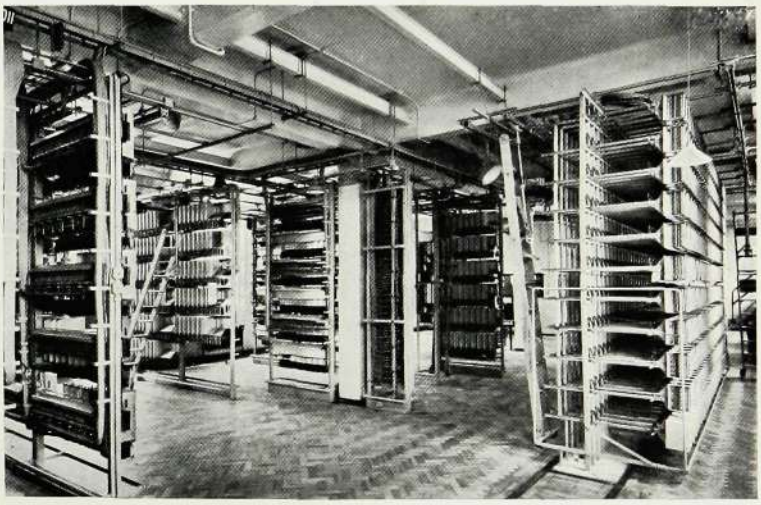


Fig. 2—General View of the Equipment on the Ground Floor

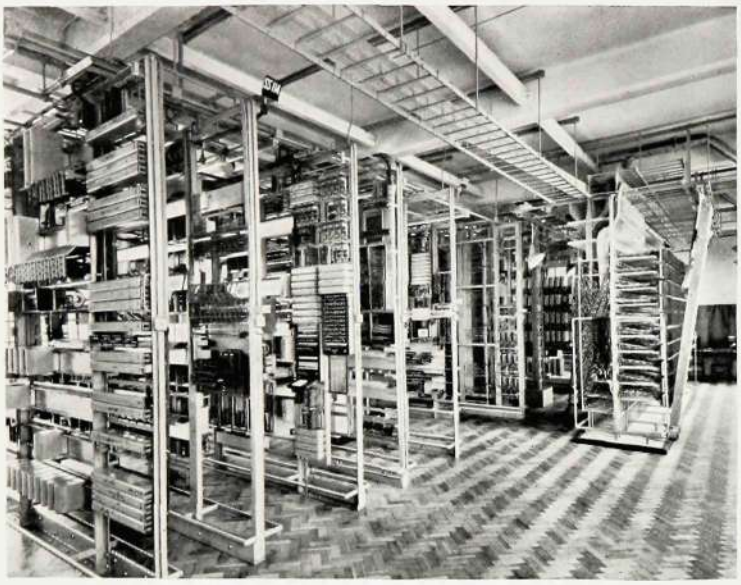


Fig. 3—General View of the Equipment on the First Floor

protected type D.C. generator developing 330 amperes at 57 volts with a regulation from 50 to 68 volts.

Routiner racks have been provided for the 1st code selectors, directors and for the outgoing junctions, while all the normal testing facilities have been provided on the test desk.

Thornton Heath is one of the first exchanges to be equipped with the automatic traffic recorder. This apparatus dispenses with the old analysis meters and frames which were used for measuring the traffic carried by the graded selector outlets, and replaces the manual switch counting method of estimating the traffic carried by a set of switches on a rack.

In an automatic exchange it is still necessary to gain access to an operator at a manual board for the connection of toll and trunk calls and for service enquiries. These facilities are not always provided at the local exchange in the London director area but the manual board service for several exchanges may be carried out over junctions to a central exchange where a manual board has been installed. In the case of Thornton Heath junctions have been provided to connect outlets from the selector banks to the manual board at Pollards exchange. Among the services provided there, is the new emergency service by which, if a subscriber urgently requires the police, fire-brigade or an ambulance, 999 is dialled. This connects him directly to a position on the manual board with special facilities for dealing with such calls. It is the intention of the Post Office ultimately to extend this service throughout the country.

The transfer of the subscribers from the old manual system to the automatic was completed on 26th May 1937 when Thornton Heath was successfully cut into service.

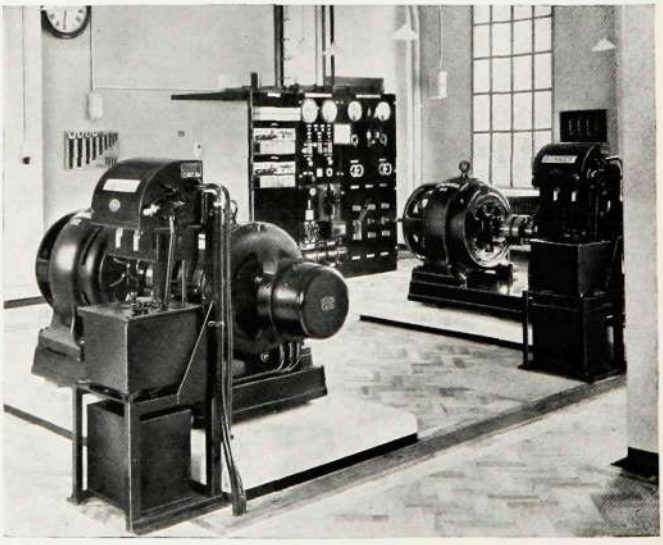


Fig. 4—The Power Board and Generating Sets