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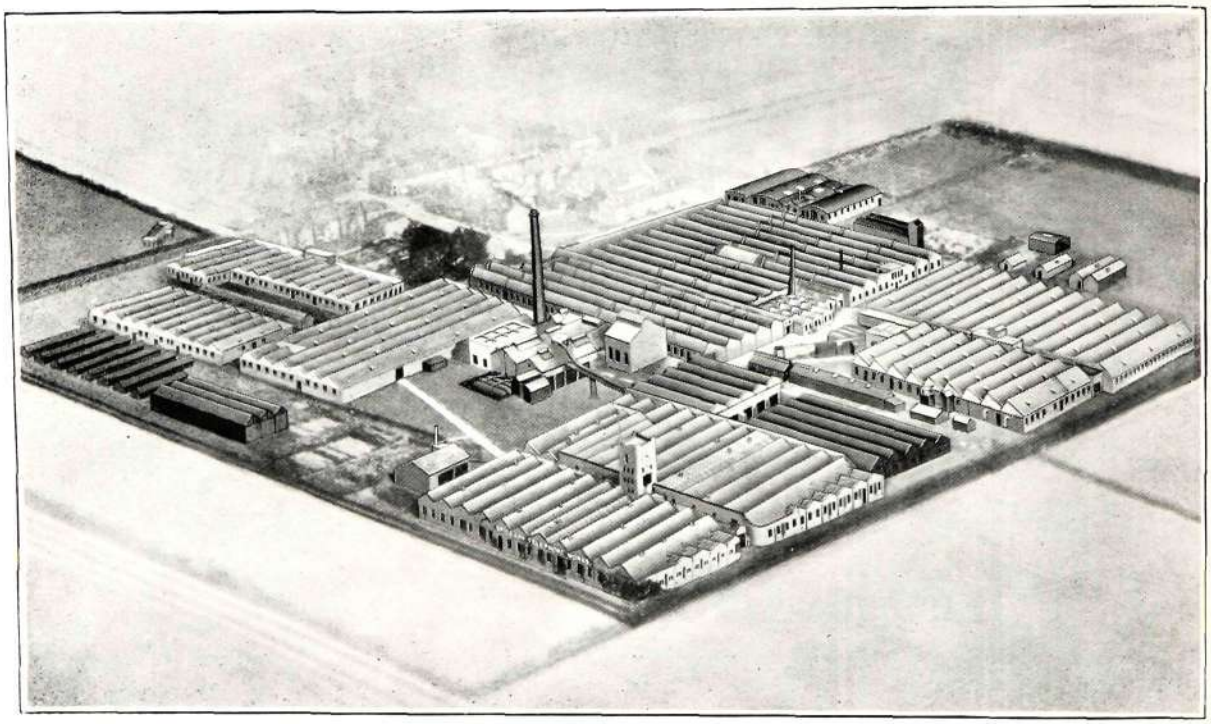


Aerial View of the Works, Beeston, Nottingham

Standard Private Manual Exchange Switchboards

IN spite of the increasing application of automatic telephony, a considerable demand still exists for small manually operated switchboards. In many establishments it is preferred to retain the services of an operator, who is able to maintain that " personal touch " which is sometimes so valuable, and is unattainable with an automatic system. Where calls are infrequent, and the operator is not fully occupied, she may probably utilize her time with some simple routine work. Many cases thus arise where the manual switchboard has distinct advantages over the automatic type.

With this in view, it has been the policy of the Company for many years to hold a certain number of standardized CB and magneto switchboards in stock to supply the demand for urgent deliveries. There is reason to believe that this policy has been amply justified, for on various occasions we have been able, in cases of emergency, to despatch switchboards at a few hours notice.

With the object of supplying a greater number of customers from stock, standard switchboards have been developed which are of more adaptable designs than hitherto, and can therefore be equipped at short notice to fulfil varying requirements.

The new range of standard floor pattern switchboards which has been introduced incorporates modern circuits and apparatus, with accommodation for junction lines to a main exchange if required. The circuits used being of a simple and straightforward character, installation, operation and maintenance should produce no difficulties whatever.

CB. Floor Pattern Switchboards.

The 24 volt CB boards are stocked in two sizes of frameworks with capacities, equipments and codes as indicated below :—

N.304. 50 line framework.

	Capacity.	*Equipment.*
Extension lines	50	50
Cord circuits ..	10	10

N.305.

Extension lines	50	30
Cord circuits ..	10	6

N.310. 100 line framework.

	Capacity.	*Equipment.*
Extension lines	100	100
Cord circuits ..	12	12

N.311.

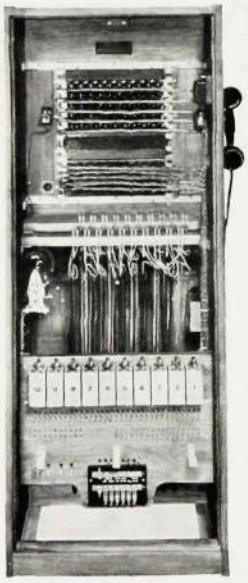
Extension lines	100	70
Cord circuits ..	12	10

Wiring is provided for the full capacity of circuits in each size of switchboard.

Construction Details.

The cabinets are constructed of selected teak, substantially dimensioned to withstand strains imposed during shipment. A matt wax polish is used for the exterior, as this is found more durable than a bright finish. The profile of the cabinet follows the modern trend for simplicity of design, with sides finished flush to allow two or more switchboards to be bolted together to form a suite of sections.

Access to the interior of the board is by means of a rear door, which when removed, exposes the apparatus and wiring. A similar lift out panel is also fitted in the front below the keyboard to allow for removal of cords and cord weights. The keyboards are hinged, and when opened, wiring to keys and supervisory indicators may easily be examined.



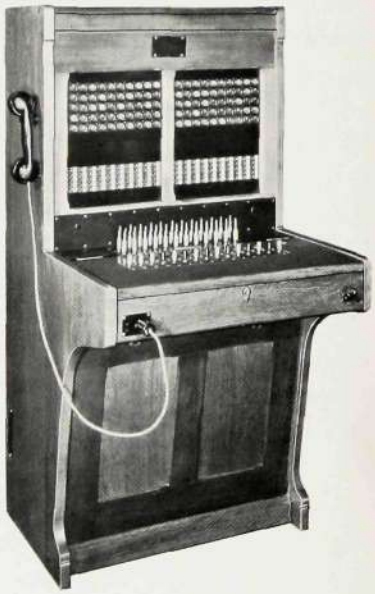
Front **Rear**
50-Line C.B. Switchboard N.304

All apparatus is mounted on a rigid metal framework, which also assists to strengthen the cabinet. Terminals and fuse panel for the different circuits are mounted on a connection rack at the rear, with suitable designations to facilitate installation and testing.

CIRCUITS.

Each equipped line circuit includes a 500Ω disc type calling indicator and line jack. Indicators and jacks are mounted ten per strip, and numbered with the circuit designation to which they belong. On an incoming call the indicator operates, but is restored to normal and disconnected from the line when the cord circuit plug is inserted into the line jack. The indicator has an operating figure of ten milliamperes.

Exchange line circuits when equipped, are terminated on break jacks, the inner springs of which are connected to 1000Ω hand-restored drop indicators. A 1 μF condenser is included in the circuit of each indicator to prevent operation by battery current from the main exchange. The sleeves of the exchange line jacks are connected to earth through contacts of a night extension key.

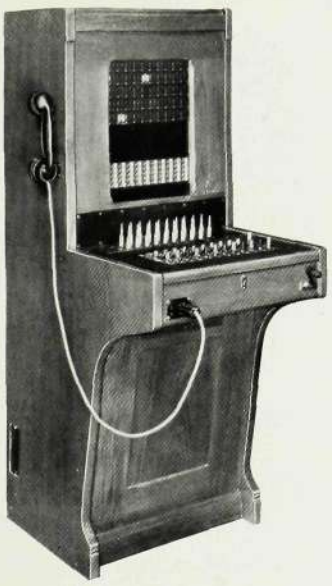


100-Line C.B. Switchboard N.310

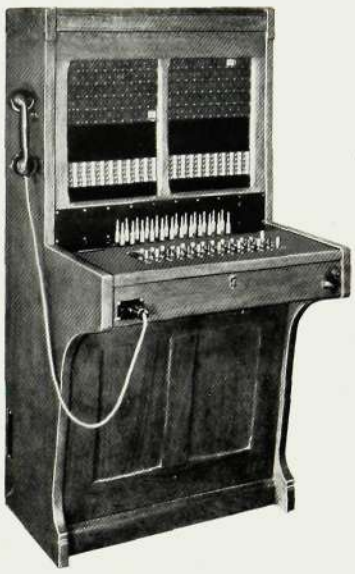
Connecting cord circuits are equipped with supervisory indicators giving double negative supervision, i.e. the flags or shutters of the indicators are displayed during the period of conversation. Battery for the cord circuits is fed through balanced high-impedence retardation coils, which regulate the current for speaking and signalling purposes, and also furnish impedence to prevent cross talk or other inductive interference due to a number of simultaneous connections to the common battery.

By means of a special circuit arrangement a single ring back key serves all cord circuits.

Switchboards with exchange line facilities are equipped with triple conductor cords and a 1000-ohm sleeve relay per cord circuit. This relay operates when a plug is inserted into an exchange line jack, disconnecting the P.B.X. battery, to allow current for transmission to be drawn direct from the main exchange. Simultaneous clearing is given to the P.B.X. operator and main exchange upon completion of an exchange to extension call.



N.704



N.710

50 and 100-Line Magneto Switchboards

A moulded bakelite hand micro-telephone, used in conjunction with an " anti-side-tone " induction coil for the operators telephone circuit, gives a high quality of speech transmission and reception. The current for the operation of this circuit is received through the cord circuit 80Ω + 80Ω retard coils.

Suitable power for the operation of the switchboard may be obtained from A.C. mains through a rectifier, in which case no batteries are required. Where the supply is D.C., two sets of cells and a charging board with a suitable rheostat are necessary.

In the case of switchboards connected to a public exchange, current may be fed from the exchange battery over special conductors in the underground cables, thus eliminating the need for any rectifiers or batteries, etc., at the switchboard.

MAGNETO FLOOR PATTERN SWITCHBOARDS.

A corresponding range of magneto floor pattern switchboards, of a design and appearance almost identical with the CB boards described above, is also available.

The magneto system, of course, shows to greatest advantage on long lines, or where high line resistance and possibly low insulation make the use of the central battery system impracticable.

The codes of this series are as follows :—

N.704. 50 line framework.

	Capacity.	*Equipment.*
Extension lines	50	50
Cord circuits ..	10	10

N.705.

Extension lines	50	30
Cord circuits ..	10	6

N.710. 100 line framework.

	Capacity.	*Equipment.*
Extension lines	100	100
Cord circuits ..	12	12

N.711.

	Capacity.	*Equipment.*
Extension lines	100	70
Cord circuits ..	12	10

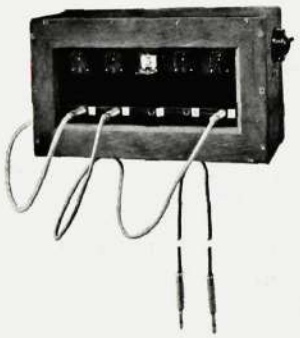
Wiring is provided for the full capacity of circuits in each case.

CONSTRUCTION.

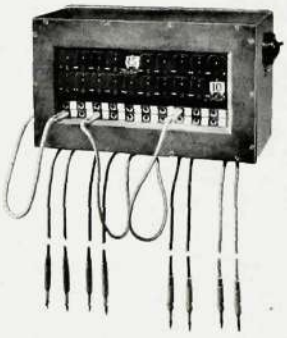
As regards the construction details, the description already given for the C.B. switchboards applies equally well to the magneto boards.

CIRCUITS.

Magneto circuits have been of stabilized design for many years and few remarks are therefore necessary, but a summary of the chief features may be of interest.



N.613



N.610

5 and 20-Line Magneto Wall Boards

The 1000Ω drop indicators employed in the line circuits are disconnected during speech.

The cord circuit clearing indicators are of the press-button-restored type and are mounted on the keyboard.

The operator's telephone circuit includes an "anti-side-tone" induction coil and moulded bakelite hand micro telephone.

Emergency hand generator, and night alarm circuits are provided.

MAGNETO WALL PATTERN SWITCHBOARDS.

A standard range of magneto wall pattern switchboards is also stocked, and an addition to these, the N.610 type, has recently been developed. This board is suitable for small installations up to a maximum of 20 lines, providing a simple and reliable system in cases where the number of calls is not excessive.

The following sizes are available :

Code.	*Equipment.*
N.610.	20 lines and 5 through cords.
N.611.	15 ,, 4 ,, ,,
N.612.	10 ,, 3 ,, ,,
N.613.	5 ,, 2 ,, ,,

All the above equipments are accommodated in a standard size teak case of modern design.

CIRCUITS.

The line circuits are each equipped with a line jack and a 1000Ω drop indicator which is permanently bridged across the line but is of sufficiently high impedance to prevent any appreciable loss of speech currents.

Connections between lines are made with "straight through" cords, the clearing signal being given on the line indicators. Supervision is effected by means of an operator's plug and cord which connects to a standard magneto telephone mounted adjacent to the switchboard. An alarm buzzer fitted inside the switchboard may be thrown into circuit whilst the operator is temporarily off duty.

A distinct advantage of this type of switchboard is that whilst two parties are connected together it is impossible for the operator, either accidentally or intentionally, to overhear a conversation between them.

Only the most recent additions to the range of standard switchboards available from stock are included above. It is anticipated, however, that the more "flexible" designs described will have a larger sphere of utility than the earlier types.

The Ericsson Telephone Coupling Unit

THE problem of how to connect certified types of mining telephones and switchboards to uncertified telephones, so as to retain unimpaired the safety of the underground system, has been before the Mines Department and telephone manufacturers for a number of years. The connection of any telephone of uncertified type to a safe system naturally rendered the certification valueless by introducing the element of risk, and special telephones were developed for surface use in offices etc. Nevertheless, there have undoubtedly been cases, particularly in regard to connections via switchboards, where such unsafe connections have occurred.

The ideal device would naturally be one which while allowing ringing and speech unimpaired both ways between " certified " and " unsafe " circuits, would yet absorb or by-pass any surplus energy from the latter so that the energy injected into the certified system was insufficient to cause ignition. Research was considerably hampered when projected methods reached the stage of practical development, because of the very real difficulty of determining the most dangerous conditions to be met. A coupling unit which might be safe against a very high voltage (over 350 V. was found to exist in practice) of limited energy, might prove inadequate to cope with a greater energy at much less voltage, so that while practical methods had been developed, the Mines Department were unable to certify any for use.

The use of a simple series condenser in each line was mooted and at first was considered as a solution, until the evidence collected by the Mines Department showed that for safety the capacity would have to be reduced to such an extent as to introduce a transmission loss of approximately 12 decibels and severely attenuate if not prohibit ringing. Finally the Mines Department made an exhaustive survey of the various systems and sources of energy and were able to undertake tests for certification.

The need for a coupling unit was early apparent to Ericsson Telephones Ltd., and after consideration of possibilities, the laboratories commenced investigations. A coupling unit which would pass speech only was considered, for use at switchboards or other attended points, but the necessity for " night extensions " during periods where there was no normal attendance made this undesirable, and in addition it would have rendered normal operation much more cumbersome.

An effective coupling unit must not only protect against the injection of dangerous energy, but it must not itself jeopardize the safe working of a certified system under any possible condition. Of the propositions under review which met this requirement one appeared particularly suitable for development, being basically simple, permanent and sufficiently flexible to permit proportioning to any electrical conditions likely to be found suitable as the result of the survey of service conditions.

Dry rectifiers, such as the copper oxide type for instance, in addition to their rectifying properties, have a curved current/voltage characteristic, and the resistance in the " forward " direction is much higher for small than for large values of the impressed voltage, thus two series of rectifier units of suitable characteristics can be assembled

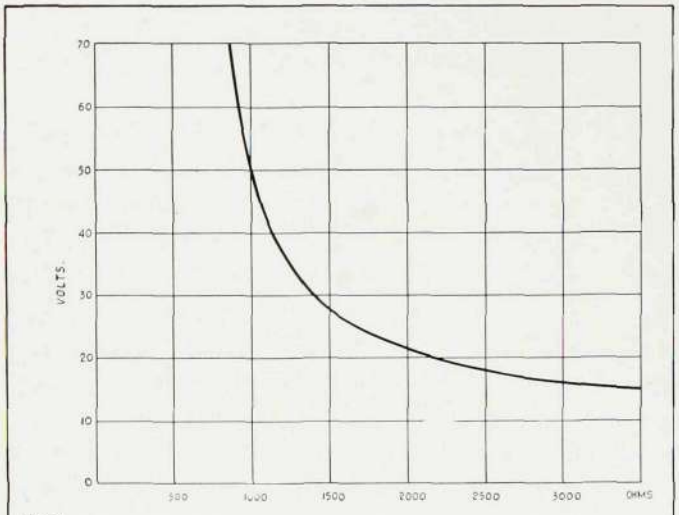


FIG.1. TYPICAL VOLTAGE RESISTANCE CURVE OF SELECTED 'BACK TO BACK' ELEMENTS ASSEMBLY.

" back-to-back " to give a shunt which has a negligible effect on speech currents, causes but a small loss where the impressed voltages are of the same order as those of a certified system yet provides a rapidly increasing shunt where the voltages rise beyond this. The effect is illustrated in Fig. 1. By the insertion of impedance on the " surface " or " unsafe " side of this shunt, the arrangement becomes to a large extent self-regulating in its behaviour under

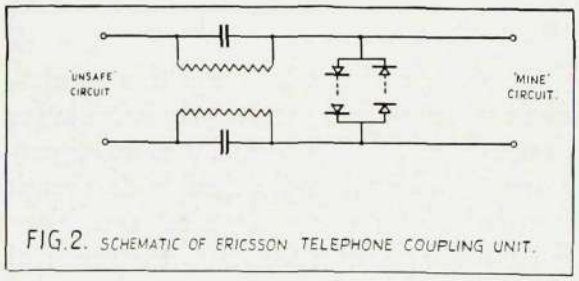


FIG.2. SCHEMATIC OF ERICSSON TELEPHONE COUPLING UNIT.

conditions in the dangerous range. This impedance consists of a condenser and a non-reactive resistance in parallel. The arrangement is shown in Fig. 2.

The Ericsson " Telephone Coupling Unit " (Mines Dept. Certificate T/Tel 41. 28th July, 1936 and British Patent No. 433,381), is the practical expression of this development. The components are very generously proportioned for the service conditions they have to meet, and provide a high factor of safety. The Westinghouse metal rectifier units incorporated are individually tested and matched to provide the closest possible approach to uniformity. A stout iron case, rust-proofed and heavily enamelled, houses the coupling unit. Fig. 3 shows the unit in case with the cover off.

One unit per unsafe telephone line connected to a certified telephone or switchboard, and one unit per junction line between an uncertified surface switchboard and a certified switchboard, should be fitted. The coupling unit should of course be situated outside the " danger zone " so as to provide full protection for the whole of the connected system.


Fig. 3—Coupling Unit in Case

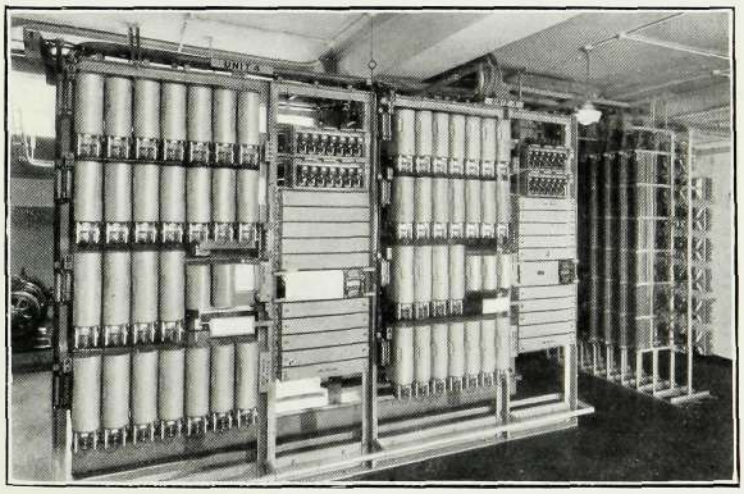
As an indication of the telephonic efficiency of the coupling unit, it may be stated that the transmission loss involved does not exceed 1 db., while the ringing loss is the lowest consonant with effective protection, and owing to the properties of the device the absorption of ringing energy becomes progressively less with falling energy output.

P.A.X. Equipments at Broadcasting House

A P.A.X. installation at Broadcasting House has already been described in Bulletin No. 3. The ultimate capacity of the system originally installed was 400 lines. However, after the exchange had been in commission for about three years the B.B.C. had so extended their premises and personnel that this ultimate was considered quite inadequate; furthermore, the room housing the P.A.X. equipment would only accommodate an equipment for 400 lines. In view of these facts, it was decided to replace the existing installation by one giving an ultimate capacity of 1,000, and to utilize the power equipment and, as far as possible, the jacked-in equipment on the new installation; the whole of this equipment to be removed from the seventh floor to the lower ground floor.

Since the new exchange was cut into service, various extensions have been made and at the present time the exchange is serving 600 lines, plus tie lines.

One illustration shows a front view of two units and a partial view of the combined main and intermediate distribution frame; the other illustration shows the wiring side of the units, with the combined main and intermediate distribution frame in the background. A unit comprises all the necessary equipment, with associated alarms, for serving 100 lines. It consists of two panels, the right-hand one containing the line relays and line finders, and the left-hand one the "jacked-in" equipment comprising group selectors, final selectors, assigner relay sets and main alarm relay set. The line finders are 50-outlet uniselectors, so that it is necessary to have two groups each consisting of seven finders, to serve the 100 lines. Group selectors of the two-motion, 100-outlet type, are directly connected to the line finders. They are seen in position on the upper two shelves of the left-hand panel of the unit. The group selector banks are fully wired to connection strips at the rear of the shelves and from there cabled to the intermediate distribution frame for grading and cross-connecting to final selectors. A group of eleven final selectors, also of the two-motion, 100-outlet type, serves the particular hundred lines associated with the unit. The banks are wired to connection strips at the rear of the shelves and from there cabled to the intermediate distribution frame. It is interesting to note here that the eleven final selectors with access to the hundred subscribers on the unit, will carry, without undue loss, all the traffic originated



Front View of Two Units with the Distributing Frame on extreme right

by fourteen finders and group selectors, split into two groups, each with access to fifty subscribers. From the standard traffic curves, with a grade of service of one lost

View between the Units with the Combined M.D.F. and I.D.F. in the background

call in two hundred, a group of seven finder switches will carry 2.2 traffic units, whilst a group of eleven selector switches will carry 4.6 traffic units. Thus the total traffic originated by two groups of seven finders is 4.4 traffic units and is handled satisfactorily by a group of eleven final selectors.

It will be noted from the illustrations that the jacked-in equipment is accommodated on channel type shelves, and that alarm fuse panels are fitted at the ends of the shelves to protect the equipment and to guard against fire risks.

Twin contacts are fitted on all relays to minimize trouble that may be caused by dust. A grading chart is fitted on each unit showing the grading and cross-connecting between the group selector level, associated with the particular unit, and its final selectors. It will be realized that there are only ten outlets on each group selector level, and that it is necessary to extend the group selector multiples from the various racks to the intermediate distribution frame, to provide a centralized field for grading and cross-connecting to the eleven final selectors associated with each level.

A small portable tester allows a quick routine of all the switching and line equipment to be made.

The following special operating features are incorporated on this installation :—

(*a*) Either party releases after a period of 30 seconds.

(*b*) Automatic release of the connection if a subscriber seizes a switch but does not dial after a period of between 30-60 seconds.

(*c*) Automatic release of the connection if the subscriber takes more than 30-60 seconds between the digit impulse trains.

THE CHANGE OVER.

Owing to the restricted space of the cable runways, it was necessary to utilize five cables to bring down the line connections to the new main frame where they were terminated and temporarily isolated by wood pegs until the actual cut-over. Parts of the original equipment such as batteries, power board, charging machines etc. had to be transferred below for service again, so that it was impracticable to maintain an unbroken service. The change-over therefore was carried out during a week-end, and commencing on a Friday night the new equipment was ready for service on the Monday morning, and proved satisfactory in every way.

The Installation of Automatic Telephone Exchanges

IT will be appreciated that it is difficult to present in the space available, more than an outline of such a comprehensive subject, the amount of work involved on site depending upon the contracting company's methods. The following is therefore typical of an Ericsson installation.

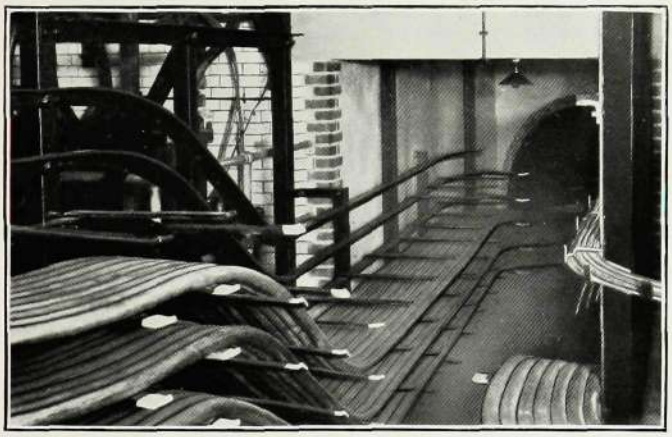


Fig. 1—Underground Cables Entering a Large Exchange

Arriving on site, the installer checks the position of the cable holes, motor generator piers, cable chases, and the main distribution frame trench etc., to the measurements shown on the relevant drawings. Floor levels are checked and any difference in level receives attention, this is usually overcome by planing the wood block surface. The marking of the floor for the position of the 6″ x 4″ floor angles, which are the bases for the various racks, now proceeds. The floor angles also act as weight distributors over the floor area. Strict attention must be given to the accuracy of the measurements, otherwise difficulty will be experienced at a later stage in the erection of cable supports and overhead ironwork generally, which are finished off at the works ready for bolting together.

The main frame with fuse mountings is erected first, and the trench filled in with concrete and smoothed over, so that the termination of street cables, usually done by the customer, can be carried out. Fig. 1 shows an underground cable chamber at a large London exchange.

Whilst the erection of the main frame has been proceeding, the floor angles have been fixed thus enabling the various apparatus racks to be placed in position as soon as they are received. These racks are temporarily supported until the erection of the overhead ironwork reaches the point where the racks are situated. The intermediate distribution frame is erected and braced together with the overhead ironwork provided. The base angle of this frame is laid on ruberoid sheets placed on the wood block floor and

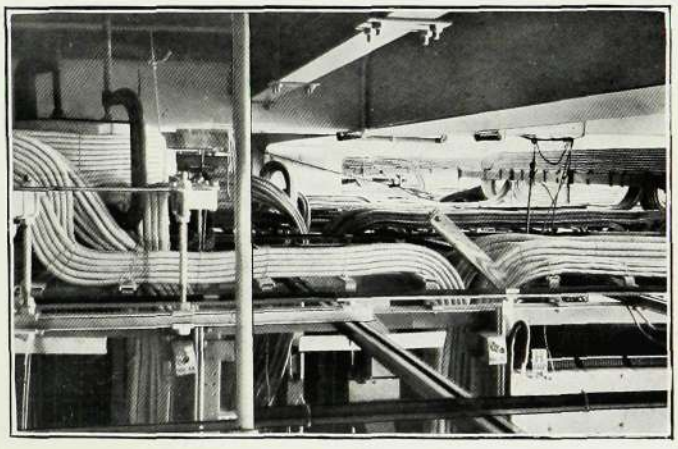


Fig. 2—View over Racks of Cabling in Progress

Fig. 3—Cabling and Wiring Multiple Side I.D.F.

surrounded by a wooden curb. The space inside this curb is filled in with cement and prevents dust from collecting between the base members.

The time has now arrived when preparation for cabling between the M.D.F. and I.D.F. is made. The cables are carried on cable supports, which are designed to follow the most convenient route to the respective racks and at the same time take into consideration the question of distribution of weight on the floors. It will be appreciated that the erection of "plan of racks ironwork", i.e., overhead supports for the racks, and cable runs, cannot be completed unless the racks are delivered in their correct sequence, dependent upon the floor-plan layout, and at the schedule time. This factor is of the utmost importance for successful installation procedure, and has a very material influence on the cost. In order to attain this feature, very close co-operation is necessary between the engineering, manufacturing, progress and installation departments.

Cabling represents a large proportion of installation work and much care and foresight are necessary by the engineering and draughting departments in planning the scheme. There are approximately 20 standard sizes of braided cable in use, and the great care and patience required in running large quantities of cables, feeding from different angles and levels, will be appreciated from the view over racks shown in Fig. 2.

The cables between the M.D.F. and I.D.F. are run and laced to the cable supports by the use of 12 strand twine impregnated with beeswax. A definite route and position is allocated on the cable support, and shown on the respective drawings. The cabling specification gives particulars of the numbers and sizes of cables required per group of circuits for the initial and ultimate equipments, also the number of wires required per circuit.

Fig. 4—Running Cables and Wiring Local Side I.D.F.

The cables are run to their allocated positions on the frames as indicated on the equipment drawing concerned; then cut to the required length, due allowance being made so that when all the cables are run in there is sufficient length to enable the individual cables being placed in correct order and position. The procedure is similar for cabling on other portions of the equipment. It is usual, however, first to complete the sections of the M.D.F. and I.D.F. which are allocated to the subscribers circuits, so as to allow forming and wiring to commence. The wireman first arranges his cables in the correct order for terminating, the cables then being stripped of the outer covering and immersed in beeswax heated to a temperature not greater than 350° F. The connection strips are fixed in the positions shown on the I.D.F. equipment drawings, and the work of lacing and fanning the wires in the cables begins. The wires which are insulated with silk and wool, or silk and cotopa, are identified by means of a standard colour scheme of which the colours blue, orange, green, brown and slate form the basis. Figures 3 and 4 give a clear view of cabling and wiring in progress at the multiple and local sides respectively of the I.D.F. at Wanstead Exchange, London.

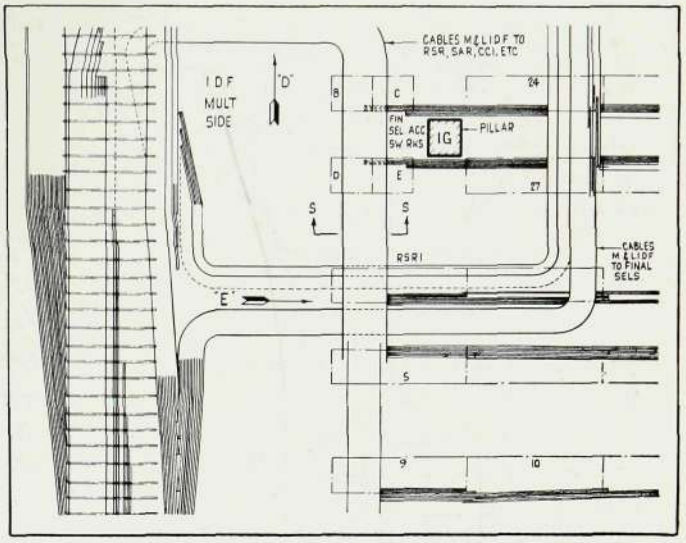


Fig. 6—Part of a Plan Drawing

Whilst the foregoing has been in progress, work is proceeding in other directions. Apparatus racks have been erected, braced and supported; further cable supports erected and cabled, cables stripped and wiring put in hand (Fig. 5). The process of cabling is simplified and directed by means of detailed drawings showing plans, elevations, and cross sectional views of the cabling scheme (Figures 6, 7 and 8 respectively). The cross sectional views are given an alphabetical index letter which is referred to on a cabling route sheet.

Fig. 5—Erecting Racks and Cables Run-in

As the installation proceeds the time arrives to commence work on the power equipment. The motor generator sets are placed on the piers provided for the purpose, and suitable cushions are placed under the machine bedplates to reduce any possible vibration being

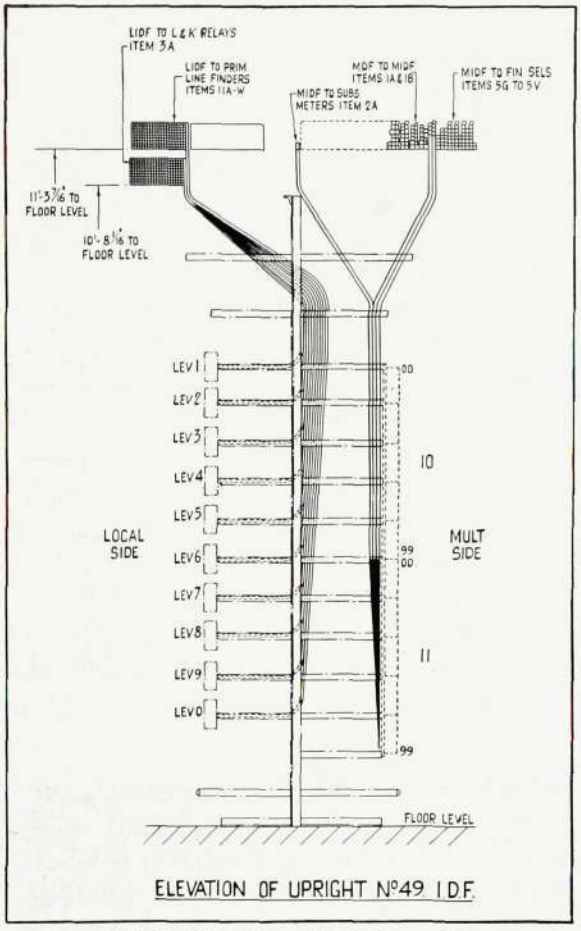


Fig. 7—Elevation of I.D.F. upright

transmitted to the building. The erection of the copper bus bars or rod from the power board to the batteries is commenced in readiness for the batteries. The power distribution scheme to the apparatus racks is also put in hand and is, generally, as described in the last issue of the Bulletin.

During the progress of the power distribution scheme the batteries are erected and the plates burnt on. It is customary to sub-let this portion of the installation to the suppliers of the battery equipment, who specialize in this class of work.

To the main battery fuse mountings, or circuit breakers the bus bars from the power board are terminated. One battery is then filled and tested for capacity, the filling and testing of the second battery is usually left until just before the exchange is opened for public service.

Meanwhile, progress has been made on other portions of the equipment. The jacked-in selectors and relay sets, which are hung on channel type shelves on the racks, are placed in position and wipers are adjusted. The racks are inspected for dry joints in soldering, loose apparatus and fixings, and general cleanliness.

The equipment is now subjected to a variety of tests ; an important one of which is the " call through test ". Broadly speaking, this test consists of a number of calls originated and passed through the exchange so that each selector, relay set or junction circuit is brought into use at least once. At the conclusion of the contractor's call through test the equipment is handed over to the customer.

Soldered Connections.

To give some idea of the work involved, in the case of a typical director type exchange, with 4,300 lines equipped, there are nearly half a million actual soldered connections on site, excluding factory soldering and the line side external terminations on the main frame, which would bring the total into the millions.

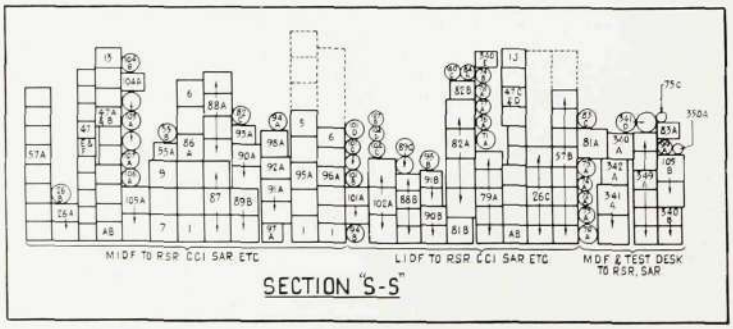


Fig. 8—Cross-section of Cable Run at "S-S" Fig. 6

The Controlled Pulse Unit

THE demand for an apparatus to give a constant length of output pulse irrespective of the length of input pulse, has led to the development by the Ericsson Company of the Controlled Pulse Unit. This apparatus has several advantages over its prototypes in the realm of mechanical delay mechanisms. The usual electro-mechanically or mechanically tripped clockwork mechanism is normally under the stress of being fully wound, and once operated it cannot be put in motion again until it has been rewound and reset. The controlled pulse unit, however, is under no continuous stress and may be used repeatedly without any attention whatsoever; furthermore, there are no parts requiring lubrication or similar maintenance.

The modern trend of accurate scientific control is rapidly superseding the " hit-and-miss " methods, so that there are many fields open for this type of apparatus, and a typical example will no doubt help to demonstrate its usefulness more clearly.

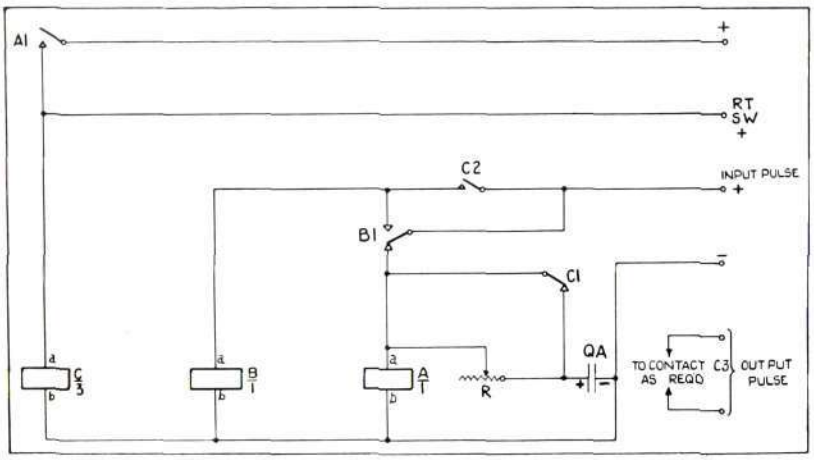
Imagine a fire station at the time of receiving a fire call. Many signals have to be immediately originated; firemen have to be called, engines started, traffic signals set to permit of an easy egress, engine shed doors opened, and many others, depending upon local conditions. The concentration of these signals to one master control is highly desirable, but consideration of the duration of individual signals will immediately reveal difficulties. A pulse of five seconds may be sufficient to start the preheated motor of a fire engine under any circumstance, but the ringing of a bell for the same time is certainly not long enough to ensure the rousing of a sleeping fireman. On the other hand, a pulse of one minute may be regarded as long enough to call the fireman, but the same pulse would probably lead to the premature failure of the starting batteries.

It is in the limiting of the duration of such signals that the controlled pulse units fulfil their purpose. So that, in the case above, the unit controlling the call bells would be preset to give an output pulse of one minute, whereas that associated with the engine starter circuits would be arranged to give a pulse of only five seconds. Furthermore, only these pulse periods would be given irrespective of the time that the originating signal was maintained.

The Controlled Pulse Unit with Cover Removed

The general appearance may be gathered from the accompanying illustration of a unit with its dustproof cover removed. The components may be varied to suit battery voltages in common use, and to cover output pulse ranges varying from 100 to 1000 milli-seconds up to minutes. Output pulse contacts may be provided to carry safely, currents varying from a few milliamperes to tens of amperes.

In operation, the originating signal charges an electrolytic condenser QA and operates relay A. The contacts of relay A in closing complete the operating circuit of



Circuit Diagram of the Controlled Pulse Unit

the output pulse relay C, which then operates. The contacts of relay C complete the required signalling circuit, and also a circuit for relay B via the originating pulse, as well as removing the short circuit from the variable control resistance R. When relay B operates, its make contact completes a holding circuit via the originating pulse, while the break contact removes the originating pulse from relay A and the condenser QA. Relay A is now left entirely dependent upon the energy stored in condenser QA. This energy slowly discharges through the circuit completed by the coil of relay A and the variable resistance R. The rate of energy dissipation is governed by the total resistance in this local circuit, so that, when the discharge current reaches the release current value of A, the latter will release, releasing relay C, and thereby terminating the output pulse. It will be understood that the actual pulse time is obtained by adjusting the value of the resistance R until the requisite rate of discharge is reached. In the case of an originating pulse which is longer than the required output pulse a repetition of the output pulse is prevented by relay B which remains operated until the originating pulse is disconnected.

An additional facility is given by the provision of connections enabling the output pulse relay C to be independently operated. This allows the particular function performed by each controlled pulse unit to be individually routine tested without the operation of all of the apparatus associated with the originating pulse.

Lennox Castle Mental Institution

NE of the finest and largest mental institutions in the Country has recently been completed under the control of the Glasgow Corporation Public Assistance Committee. Although the site is not more than twenty miles from this great industrial city, it is set in beautiful and peaceful surroundings. Nestling snugly on the foothills of the Campsie Fells, it is enclosed by woods and hills, and covers an area of approximately 1,350 acres. The estate takes its name from the historic family of Lennox. The present castle, which is an excellent example of the Scots Baronial type of building, was built by one of the Earls of Lennox in 1837. It has been retained and adapted for use as the nurses' home.

The project was conceived directly after the passing of the Mental Deficiency Act of 1913 but had to be suspended on account of the war. In the years following the conclusion of war the local authorities were discouraged against incurring capital expenditure, and it was not until 1925 that a real move was made. The estate of Lennox Castle was fixed upon as the site for the new mental institution in 1927 and purchased together with the castle. To inaugurate the erection of the new institution, the first sod was cut by the then Secretary of State for Scotland, the late Rt. Hon. William Adamson, on the 5th October, 1929.

The natural layout of the ground enabled the institution to be split into two parts—the male and female—with central administrative buildings. Provision is made for six hundred males and six hundred females, while the hospital section has beds for the treatment of one hundred patients. In each of the male and female sections there are ten dormitory blocks, each capable of accommodating sixty patients. In addition, each of these blocks has a day room for the accommodation of these patients. There is also a central dining hall for each section, capable of seating six hundred, and the kitchens in the same buildings are equipped to provide meals for that number.

Attached to each of the male and female sections there are workrooms and workshops for the training of patients, and in the female section there is also a laundry equipped with the latest type of machinery capable of handling the needs of the whole institution.

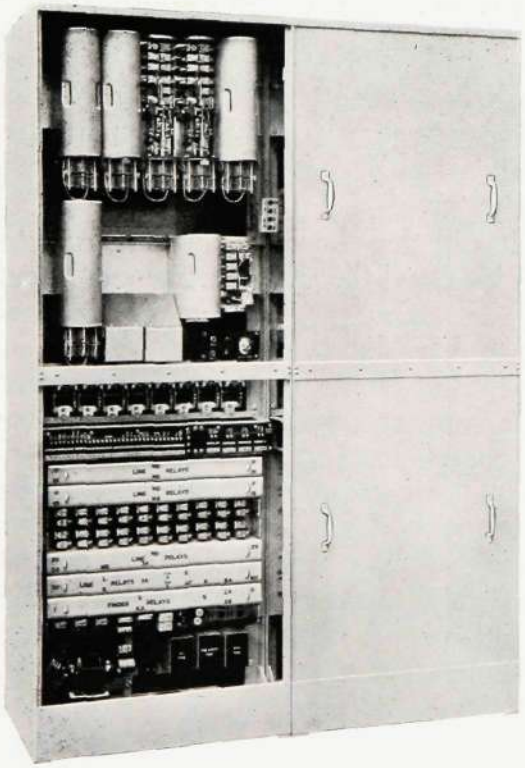
The assembly hall is the only building in the whole institution that has any pretentions to architectural treatment, the others being planned and built from a strictly utilitarian point of view. It houses the administrative offices, the telephone equipment, and wireless controls. The entertainment hall can seat thirteen hundred persons and is equipped with cinema sound apparatus.

It will thus be seen that the environs are ideal and the arrangements and layouts of the various sections are on the most up-to-date lines. The machinery and equipment for an institution of this nature are many and varied and only the best procurable has been installed. It is therefore pleasing to record that Mr. Campbell Murray, M.I.E.E., Consulting Engineer, Glasgow, who was responsible for the mechanical and electrical engineering equipment, placed the order with Ericsson Telephones Ltd., for the supply of the telephone exchange.

The private automatic branch exchange installed, commonly known as a P.A.B.X., incorporates all the latest facilities applicable

to this type of board. The equipment comprises main frame, auto unit, miscellaneous apparatus rack, ringing panel and attendant's manual board. The power equipment was supplied by the British Post-Office, as is usual on this type of contract. The exchange is initially equipped to serve 90 extension lines, and all exchange calls are routed via the attendant's board.

The auto unit is typically illustrated on this page. The switching equipment provides for a maximum of 12 simultaneous conversations between extensions. Calls to or from the public exchange are made without holding switching equipment. A cross-connecting field between the line relays and connector multiple is provided on the rack for traffic reasons. The unit is totally enclosed in a sheet steel cabinet with removable doors at front and rear; the whole being finished in a light grey enamel to give a pleasing appearance. The miscellaneous rack is also totally enclosed and accommodates the cord circuit and exchange line apparatus.



The Type of Auto Unit Serving the Institution

The manual board is of the floor pattern type with a capacity for 150 extension lines, 10 exchange lines and 12 cord circuits, the initial equipment being 90, 4 and 9 of these circuits respectively. Provision for night switching has been made on all exchange lines.

The line finders used are 50-outlet uniselectors and the connectors are two-motion switches of the 200-outlet type. All relays are the British Post Office (B.P.O.) " 3000 " type, incorporating twin contracts.

Alarm signals are provided to indicate :—

(*a*) When a connector is taken into service and held for an excessive period before the call is proceeded with (permanent loops etc.), the circuit conditions are such that the switching equipment is released after a period of 30-60 seconds and the calling signal on the manual board associated with the extension glows. The extension lamp provides the alarm signal in this case.

(*b*) Blown fuses.

(*c*) Whenever a fault occurs which results in the permanent energisation of a release magnet. This alarm is retarded for a period no longer than 18 seconds.

(*d*) Ringing current failure, indicating a fault on the ringing dynamotor.

All the above alarms are extended to the attendant's manual board.

Ericsson Automatic Mining Telephone

THE development of the N1087 type flameproof telephone had its inception in the desire of a large firm of chemical manufacturers to have a safe telephone service in all departments where a possible risk of inflammable vapours existed, yet for this service to be given via their central automatic exchange. When the first stages of experiment were commenced, a call for automatic instruments for the petroleum refining industry was received and this was shortly supplemented by the necessity of providing like communication in coal mines.

Intrinsically safe service, with the energy so limited as to be incapable of igniting the most inflammable mixture even under short circuit or bare wire conditions, is very difficult to provide from a standard automatic system, indeed it is very doubtful whether any commercial solution of the problem exists, so that a flameproof instrument has to be used, and armoured cable or sealed screwed conduit must be provided throughout the "danger zone".

With the door closed, the instrument has the same general appearance as the already well known Ericsson flameproof magneto telephones. Opening the outer door discloses (Fig. 1) a hand microtelephone and a dial finger plate of conventional design. The instrument shewn has the terminal chamber arranged for armoured cable, but provision for screwed conduit can be provided as an alternative.

As will be seen from Fig. 2, the principle of placing each contact or switch point in its own flameproof enclosure has been followed. By this means the effects of ignition can be made very small, as the volume of gas involved is so low.

This point may be made clear by brief reference to the principle involved in the design of flameproof equipment. When apparatus is surrounded by an atmosphere of explosive gas for any length of time, the air in the internal spaces is gradually replaced by this. Slow gas diffusion and movement due to temperature changes are the two means by which the dangerous gas enters the apparatus. Also when gas is present it would enter if the cover were removed for inspection. Should a spark

Fig. 1—Auto Mining Telephone with door open

occur within the apparatus to ignite the explosive mixture, the pressure produced is released by the passage of the burning gases through the cooling flanges. These are designed so that the heat is absorbed before the outer atmosphere is reached, so that there is no possibility of the ignition being communicated.

The efficiency of the system obviously depends to a great extent on the ratio of

cooling surface to total heat generated by the explosion. The small volumes of space obtained by the individual enclosures of the Ericsson N1087 type instrument result in correspondingly low heat generation and explosive pressure. In addition, the total mass of cooling metal is proportionately high in relation to the volume of possible explosive mixture.

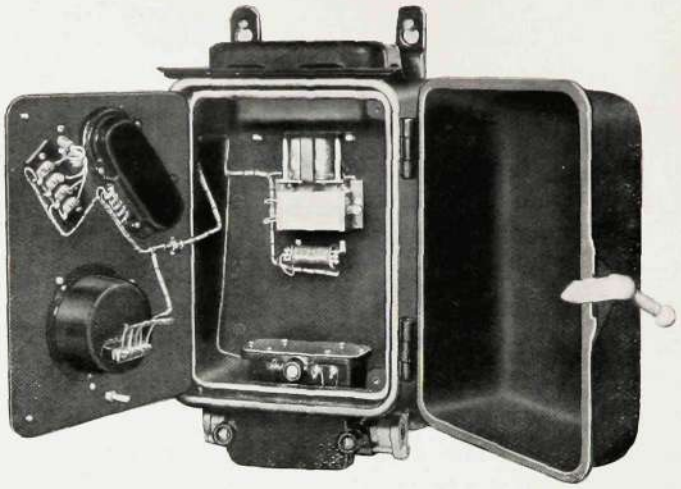


Fig. 2—Auto Mining Telephone Interior

The dial assembly is interesting in that the finger plate is independent of the dialling mechanism. Thus the safety of the enclosure does not depend on the light bearing shaft but the movement is transmitted from finger plate to mechanism by a clutch-shaft of generous proportions, coupled with a locking device which prevents damage to the dial mechanism by over-rapid dialling. Between the mechanism and the front casting carrying the flame-proof bearing a gauze is inserted as a diffuser to prevent a cone of pressure being exerted upon the bearing in the event of ignition. While this is a refinement and not an essential, it provides an additional factor of safety of particular value where hydrogen mixtures and chloroform, ether or kindred vapours are encountered. The back cover is of massive proportions and forms a spigot joint on the front housing.

The receiver switch enclosure and the terminal chamber follow the proved design of the Ericsson flameproof magneto telephones.

The isolating switch is connected directly to the lines incoming at the terminal chamber and is operated by the inner door. Opening the inner door $\frac{1}{8}$" cuts off all connection between the lines and the internal wiring, thus any necessary examination can be conducted with safety. The switch is housed in a substantial flameproof enclosure and the contact springs and their tensioning are so arranged that in the unlikely event of any mechanical breakage the instrument is automatically disconnected. Further to protect the switch an overdrive is provided to take up any surplus movement after fitting.

The instrument has been tested for flameproofness by the Mines Department and is certified for both Group I—Firedamp (methane) and Group II, Petroleum & Acetone Vapours, by Certificate No. FLP. 853 of 21st October 1936.

It will naturally be appreciated that a similar instrument can be provided for working to a C.B. System.