

# The Ericsson Bulletin

No. 11

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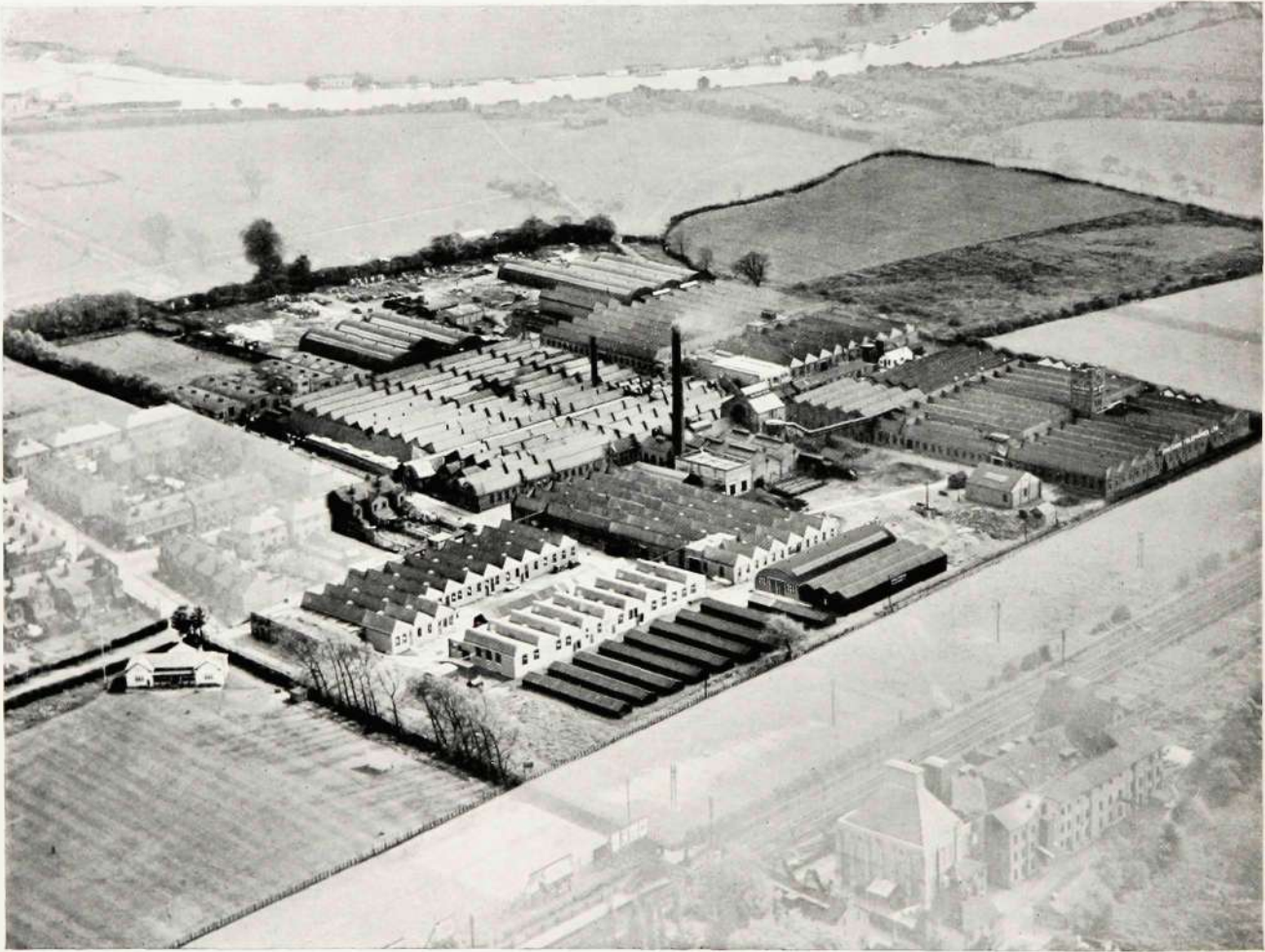


TELEPHONE WORKS,  
BEESTON, NOTTINGHAM

*Telephones : Beeston 54225 (3 Lines)*

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

*Telephones : Holborn 3271 (3 Lines)*



Aerial View of the Works, Beeston, Nottingham

## The Latest Post-Office Type Auto-C.B. Table Telephones

**S**INCE the article entitled "New Bakelite Telephones" appeared in Bulletin No. 8 of January 1936, the Ericsson Company in collaboration with the engineers of the British Post Office, have developed an improved type of table telephone with an

pleasing proportions, together with the choice of colour, will ensure æsthetic satisfaction in any surroundings.

The body is made in highly polished moulded material and the external metal fittings are finished bright chromium plate,



Fig. 1—Telephone for Auto-Systems

outer appearance very similar to the table telephones described in the article referred to above. When the new telephone is used on automatic common battery systems it is equipped with a finger dial impulse switch and appears as shown in figure 1, while figure 2 shows the telephone as used on manual common battery systems.

The telephone is available in four standard colours, namely, black, chinese red, ivory and jade green. The simple lines and



Fig. 2—Telephone for C.B. Systems  
with Tray pulled out

so providing hard wearing properties and easy cleaning facilities when in service.

A further advantage from the user's point of view is the sliding instruction tray incorporated in the metal base plate,



Fig. 3—Instruction Card and Directory Open

illustrated in figures 1, 2, 3 and 4. This metal tray with moulded knob and front strip, is provided with a pair of hinged flaps as shown in figure 4. The upper flap is made from sheet metal and forms a shield for the transparent flap beneath. For the British Post Office the metal flap is marked with the "publicity badge" on its outer surface only, the inner surface is left unmarked. If desired the flap can be chemically engraved on one or both surfaces to display any permanent markings and instructions. The lower flap is made from

transparent sheet material doubled on itself to form a holder for a printed instruction card, which is approximately  $3\frac{7}{8}$ " square and can be printed with information of a variable nature, such as, exchange codes used in multi-office exchange areas, see illustration figure 3. Since the transparent flap allows both sides of the card to be seen, advantage can be taken of this facility to display instructions printed on both sides of the card when necessary. The two flaps are attached to a spring-controlled double hinge which forms a clip for an alphabetically indexed writing pad, to be seen in figures 3 and 4. The writing pad should prove a great boon to the telephone user, as it can be made into a private directory of the more frequently called subscribers, and is thus always to hand when required. Renewal of the pad is a matter of a few seconds only, as it is a simple matter to insert a new one between the hinged flaps and the sliding tray.

The base plate with sliding tray illustrated in figure 4, is readily detached from the telephone after unscrewing the four corner screws of the captive variety. Removal of the base gives immediate access to the ringer and its gongs, and to the

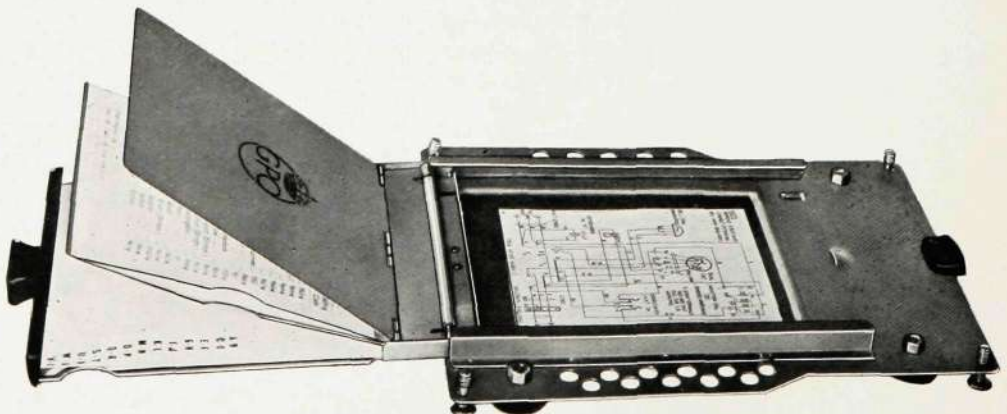


Fig. 4—The Tray Assembly Detached from the Telephone

condensers, induction coil and cord connection block, as seen in figure 5. Incidentally, when the base is removed, it is possible to adjust the ringer and gongs, or replace the cords without removing the chassis from the moulded body.

The chassis, figures 5 and 6, is made from sheet metal and carries all the electrical components with the exception of the finger dial impulse switch. The components are all standard British Post Office types, and furthermore the gongs, ringer, induction coil, cradle-switch, springset and micro-telephone are all interchangeable with those used on B.P.O. telephone No. 162 and bell set No. 25.

On the underside of the chassis as seen in figure 5, are the cord connection block, anti-side-tone induction coil, dual condenser, ringer and two gongs. The upper side as seen in figure 6 is occupied by the cradle-switch lever, cradle springset, the connection block for the dial connecting cord, and a suppression unit the purpose of which is described hereafter.

The two connection blocks are moulded in black bakelite. The terminals are retained in the blocks by a half twist on the soldering tag portion, and they are provided with 4BA connection screws and cupped washers.

The two gongs are fixed to short pillars on the chassis by means of 2BA screws. Between each gong and the pillar is a

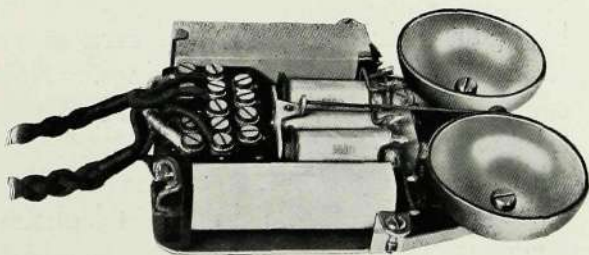


Fig. 5—The Underside of the Chassis

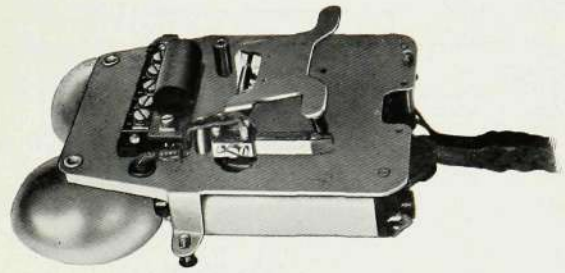
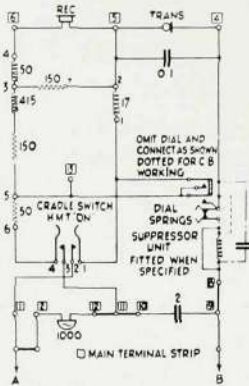
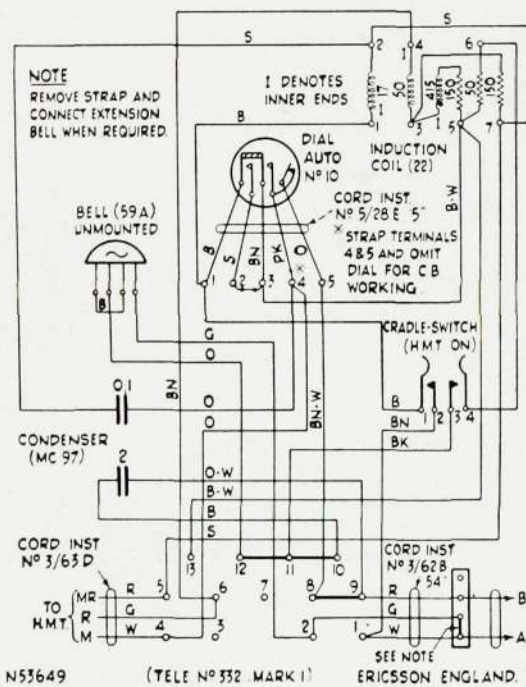


Fig. 6—The Upperside of the Chassis

spring steel locking washer which effectively prevents the gong becoming loose under working conditions. The two gongs are made from different thicknesses of material, giving to each a different tone. The tones have been specially chosen to provide a more distinctive and pleasing signal than is the case when gongs of the same tone are employed. Adjustment is provided by having the fixing hole eccentric with the outer rim of the gong.

The ringer is of very simple construction and is easy to adjust. The polarizing magnet is of cobalt steel rod, having the armature pivoted at one end, whilst the other end fits into the iron yoke, which is slotted in such a manner that it forms an effective clamp for the magnet. When adjustment is necessary the clamp is slackened off by loosening one screw only, the magnet is then free to move into or out of the yoke. The two coils are wound to 500 ohms each and have the windings terminated on metal tags fixed in one of the end cheeks. Since these tags are also used for connecting the telephone wiring, it is an easy matter to connect the coils either in series or in parallel. In the instruments here described the coils are connected in series, thus giving a total resistance of 1000 ohms.

The cradle switch mechanism shown in figure 6, consists of a pivoted spring-controlled lever carrying an insulated



**Fig. 7—The Circuit of the C.B. Sets (above) explanatory (left) a facsimile of the circuit as supplied with each instrument**

provide means for altering the circuit conditions. The terminals numbered 4, 5 and 6 are normally used for the micro-telephone connections. One end of the desk cord is connected to this block, the other end being terminated on a 4-way moulded terminal block. The standard length of the desk cord is 4 feet 6 inches. A 3-way desk cord is used and by removing a strap on the 4-way terminal block, an extension bell can be connected in circuit.

plunger for opening the contact springs. The contact springs are fitted with twin contacts of pure silver. The lever is normally actuated by two metal plungers, which project through the cradle portion of the telephone body. These metal plungers are depressed by the micro-telephone when at rest in the cradle, and they slide freely in metal bushes attached to the telephone body only, thus facilitating the removal and replacement of the chassis. Incidentally the chassis is retained in position by means of three captive screws similar to those on the base plate. The switch mechanism is so designed that any adjustment of the contact springs can be made with the chassis removed from the telephone body, with the sure knowledge that correct operation of the contact springs will take place when the chassis is screwed into place.

The cord connection block is equipped with 13 terminals, some of which are connected together with metal straps to

When the telephone is required on a manually operated common battery system, a dummy, as shown in figure 2, is fitted in the dial aperture. When working to an automatic system the dummy is replaced by the appropriate finger dial impulse switch as shown in figure 1. The switch is connected in circuit by means of a 5-way flexible cord attached to the 5-way connection block on the upper side of the chassis. A metal strap is fitted across terminals 4 and 5 on the 5-way connection block, when the telephone is used for manual working. This strap is removed when the impulse switch is connected for automatic working. A spring clip is provided at one end of the 5-way terminal block for holding the flexible cord away from the impulse switch springs. This ensures the chassis being returned to the telephone body without the cord interfering with the free movement of the impulse switch. The aperture in the telephone body is formed to take the standard B.P.O. dial impulse switch.

The usual circuit diagram is pasted inside the base plate in the recess beneath the sliding tray, as seen in figure 4. A reproduction of this diagram for the Auto-C.B. telephone is shown in figure 7. It will be seen that several new features are provided in this circuit. The anti-side-tone induction coil is provided with six windings, and its introduction is noteworthy for the fact that the transmission efficiency is somewhat better than the standard fixed by the British Post Office for telephone No. 162 and bell set No. 25. The average efficiency of transmission is approximately 1 db. better than the standard, and reception is equal. The side-tone reduction is greatest on the longer subscribers loops, this giving two advantages; firstly, as the side-tone is correspondingly reduced the user tends to speak louder, thus making it better for the more distant user; secondly, the absence of side-tone makes it much easier to receive the distant user's conversation.

There is a further point to be noted, namely, the 50-ohm non-inductive winding on the induction coil, which in conjunction with the 2 micro-farad condenser forms an effective absorption combination across the impulse contacts of the finger dial switch during impulsing.

There is also a 0.5 micro-farad condenser connected across the transmitter for the primary purpose of reducing radio interference to a minimum.

The two condensers (2 micro-farads and 0.5 micro-farad) are accommodated in one metal case, the outer dimensions of which are 1 inch by 1 inch by  $3\frac{3}{16}$  inches. Although the bulk is so much smaller than previous types, the normal electrical properties have been maintained. The reduction in size has helped considerably towards the com-

compact arrangement of the components on the chassis.

Provision is also made for fitting a radio interference suppression unit across the finger dial impulse contacts. A view of this auxiliary component is shown in figure 8. It is also to be seen attached to the terminal strip in figure 6. This component consists of a small compact form of capacity inductance and resistance, mounted on a

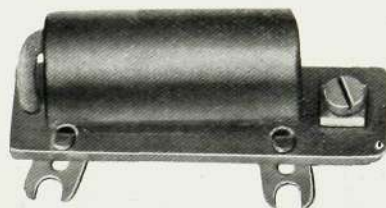


Fig. 8—Interference Suppression Unit

bakelite base carrying terminals which allow the unit to be inserted in the circuit without disturbing the permanent wiring. When this suppression unit is connected in circuit it absorbs the high frequency component of the dialling impulses, so reducing interference from this source to an absolute minimum. The unit is not a permanent feature and is only intended for use when interference is troublesome, normally it is not required.

The micro-telephone shown sectioned in figure 9 is the modern moulded type, fitted with a 3-way cord of normal length 3 feet 6 inches. The connections from the receiver to the transmitter chamber are of heavy gauge insulated copper wire soldered to screwed brass terminal inserts and are embedded in the moulded handle. The receiver is of the inset type, the fixing screws also serving as electrical connections. The polarizing magnet is of the cobalt chrome steel type, so reducing the weight



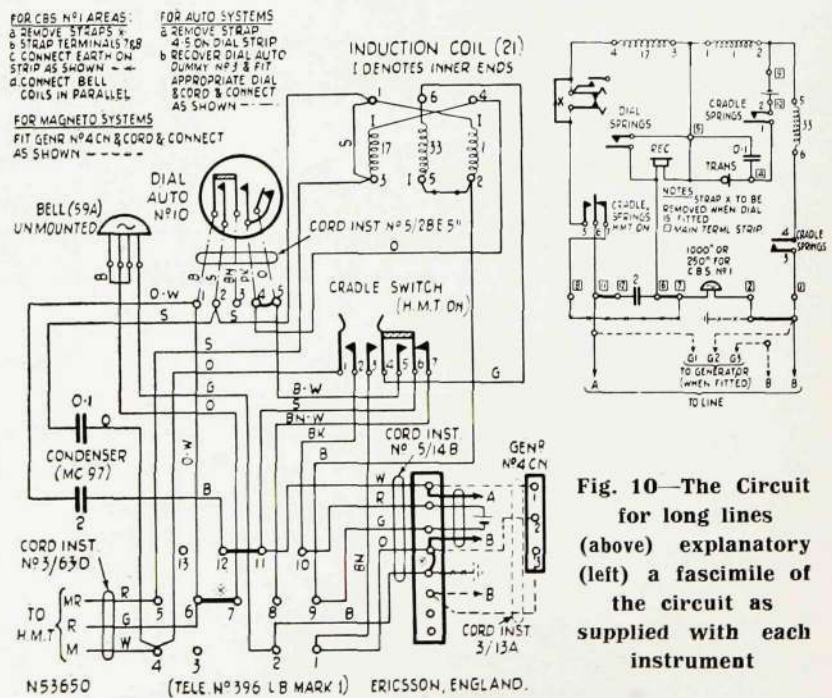
**Fig. 9—A Cross-Section of the Bakelite Micro-Telephone**

to a minimum. The inset transmitter is the highly efficient type previously described in the Ericsson Bulletin No. 9 dated July 1936. The transmitter connections consist of a springy centre pin and a double contact flat spring, which automatically complete the circuit when the inset is placed in position. The moulded earpiece screws on to the receiver inset case and clamps the diaphragm. The mouthpiece is fixed by means of a "secret" bayonet clip arrangement, and a special key is provided for unlocking. This device provides an effective means of preventing unauthorised interference.

There is also available a local battery type of telephone. The circuit for this is reproduced in figure 10. This telephone differs from its common battery counterpart as follows: the anti-side-tone induction coil has only three windings instead of the six required in the normal C.B. telephone; the cradle switch springset is provided with 3 additional contact springs; a 5-way desk cord is fitted, terminating on an 8-way moulded terminal block. All the components

are interchangeable with those used on the C.B. telephone. The instrument is intended for use on extra long C.B. and auto direct exchange lines, and for C.B.S. and magneto systems. A local battery for providing transmitter current is needed with each telephone; in addition, a separate hand generator is required on magneto systems for providing signalling current.

From the foregoing description it will be appreciated that everything possible has been done to make this instrument thoroughly up-to-date and attractive to the user. Also that particular attention has been given to the main essentials, namely, improved speech transmission and reception, accessibility of components, robust construction, easy maintenance, pleasing appearance and lastly, the convenience of the user.



**Fig. 10—The Circuit for long lines (above) explanatory (left) a fascimile of the circuit as supplied with each instrument**

## Electrolux Limited Telephone and Staff Locator Equipment

**I**N the last few years Ericsson Telephones Limited have become increasingly active in the development and installation of Private Automatic Telephone Exchanges (P.A.X.s.) and many special facilities and auxiliary services have been designed as a result of studying customers' particular requirements. It is the purpose of this article to describe a typical installation, that of Messrs. Electrolux Ltd., the well known vacuum cleaner and refrigerator manufacturers.

The installation consists of a P.A.X. and a "staff locator" or "round call" system.

### THE TELEPHONE EQUIPMENT.

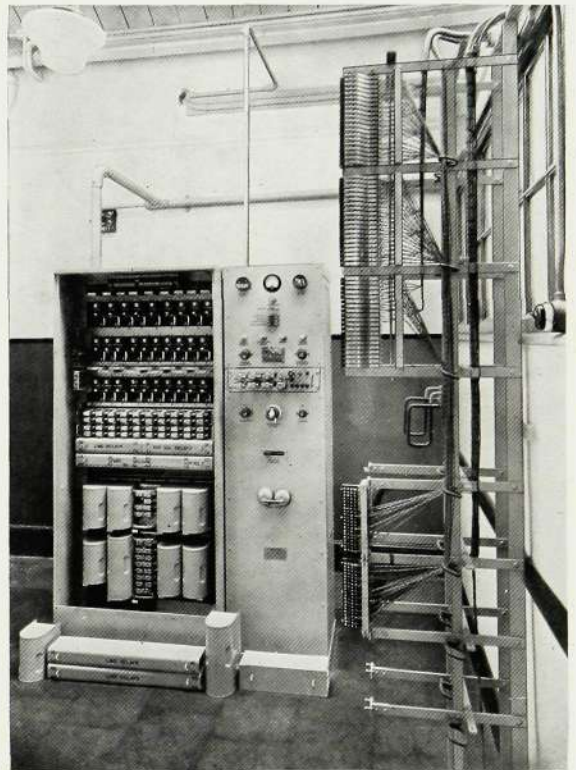
The P.A.X. equipment, as shown in the illustrations, consists of a 50-line unit, an automatic charging panel, a main frame and a battery. Facilities are incorporated for extending to a maximum of 400 lines by the addition of further 50-line units.

A previous issue of "The Ericsson Bulletin" has described in detail the register controlled P.A.X. units similar to that installed at this exchange. It will therefore be sufficient to mention here the main features.

The equipment consists of 50 line relays, 7 line finders and group selectors, 6 connectors, 2 registers, a pole changer and tone set. The line finders and group selectors, connectors and registers comprise uniselectors and relay groups.

Fuse panels, equipped with fuses of the alarm type, are fitted at the top of the unit for protection of the various circuits. At

the left hand side of the unit, adjacent to the two lower shelves of uniselectors, can be seen battery and test jacks, register busy keys and connector links, all of which are utilized for routine testing purposes.



**The 50-line Auto. Switchboard, Charging Panel and Main Frame**

All apparatus conforms to the latest Post Office practice and the relays are the P.O. 3000 type incorporating twin contacts. Relay groups are protected by individual dust covers.

The unit is completely enclosed by a sheet steel cabinet with removable doors at front and rear.



**The Battery Room**

The power plant comprises a single battery of 24 secondary cells in sealed-in type glass boxes of 50 ampere-hour capacity, floated by an automatic charging unit. The function of the latter is to keep the battery in a sufficiently charged condition and at the same time prevent the voltage from exceeding the operation limits of the telephone apparatus.

The charging panel is a self-contained unit comprising mains transformer, metal rectifier, smoothing equipment and all control apparatus, and is mounted adjacent to the P.A.X. cabinet, as shown in the photograph.

The control meter, which is a miniature contact voltmeter, is mounted at the top left hand corner of the panel and operates when the voltage of the battery reaches the predetermined low or high limit. The charging rectifier is then switched in or

out of circuit as the case may require. Should the control meter fail to function and the battery continue to discharge or overcharge, the alarm meter which is on the opposite side of the panel, and is also a contact voltmeter set to operate at slightly higher and lower limits, then comes into operation and lights the appropriate alarm lamp.

The ammeter in the top centre of the panel registers the current taken from the rectifier during charge. The top panel also mounts the keys for manual operation and routine test, supervisory lamps and battery fuses.

Immediately beneath the top panel are mounted the various relays for controlling the circuit; these are protected by a common cover. The adjustment of the charging current is carried out by means of the regulating switch and sliding resistance mounted on the bottom panel of the unit.

The chief feature of the power plant is, of course, that it operates entirely automatically, requiring no skilled supervision and no maintenance apart from periodical attention to the battery as regards electrolyte.

The scheme can be applied for either direct or alternating current supplies. Where the supply is D.C. a small motor-generator set with automatic motor starter is installed in place of the transformer and rectifier.

#### THE STAFF LOCATOR EQUIPMENT.

The staff locator or round call system is controlled by an attendant and has no connection with the P.A.X. except that it is served by the same battery. The equipment consists of the control board and the signals, the latter being mostly of the audible type.

The control board consists of two items, viz. the operating panel and the control unit. The operating panel is attached to

the front of the manual board used for routing public exchange calls. It is equipped with a dial, dial key and two lamps. By operating the dial key and then dialling two digits the operator can set up any one of 50 different codes, the signals being situated in the various departments of the works. One of the lamps, coloured green, responds to the impulses actuating the signals, thus providing the operator with a visual check as to whether the correct code has been dialled. The other lamp, coloured red, is a pilot lamp and indicates to the operator that the dial key is operated and the equipment either ready to receive a call or that a call is being transmitted.

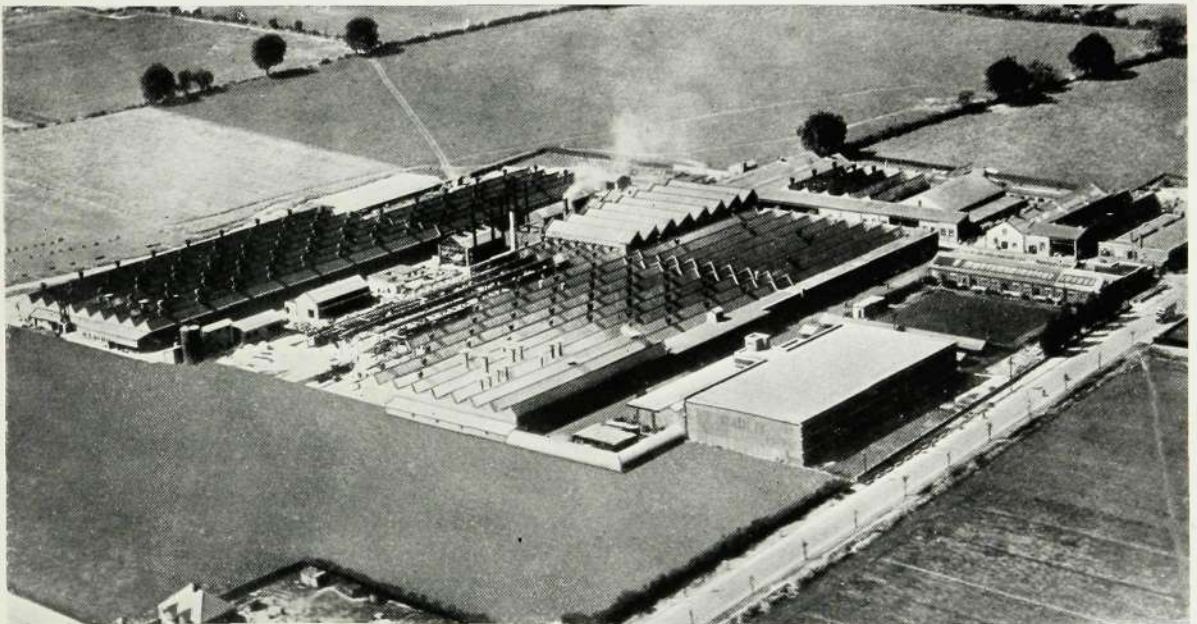
The control unit is a wall mounted hinged case fitted away from the operating panel ; it is equipped with three uniselectors and a relay group. The dialled impulses from the operating panel set the switches into any one of 50 different positions, according to the digits dialled, and the

circuit is completed for pulsing out the required code to the remotely situated signals.

The signals consist of bells, klaxons of the buzzer type, klaxons of the hooter type, and lamps, according to the location. The audible signals, consisting of the first three mentioned, are all mains operated but the lamps are illuminated directly from the battery pulses transmitted from the control unit.

In the case of the mains operated signals it is necessary to fit a special relay in the circuit. This relay responds to the code pulses and brings in the signal or signals (in parallel) via its local contacts. The case in which the relay is fitted also includes an ironclad fuse cut-out for terminating the mains feeds. The relay contacts are twin tungsten owing to the fact that they are in circuit with the mains supply.

The equipment has proved extremely useful in finding any wanted person throughout the works and is giving entire satisfaction, thus another Ericsson product is conforming to the usual high standard of the Company.



**Aerial View of the Works of Electrolux Limited, Luton, where Ericsson Communication Equipment is in use**

## Testing of Private Auto Exchanges

**D**ESCRPTIONS of various private automatic exchange installations have appeared from time to time in the "Ericsson Bulletin".

These have been mostly concerned with the site, type of exchange, description of the frames, racks, apparatus, etc., and the method of operation.

It may, therefore, be of interest to give an outline of the special precautions taken during testing at the works and after installation to ensure the very highest grade of efficiency and service. A great deal of time and thought are spent in evolving effective methods of testing and routining so that the equipment is shipped with confidence and a minimum of attention is necessary after it is brought into service.

It will, of course, be appreciated that the scope of this article does not permit a full detailed description being given of all the tests that are applied, and therefore only the general functioning has been covered.

The testing in the factory may be divided into two categories, as follows:—

- (1) Testing of rack wiring and all permanently wired apparatus.
- (2) Testing of jacked-in relay sets.

### (1) TESTING OF PERMANENTLY WIRED APPARATUS.

Early tests consist of "buzzing" to prove that the miscellaneous leads, battery jacks, routine test jacks, etc., are wired correctly, and after these preliminaries the main tests are commenced. These are carried out by means of a test box connected to the circuits under test, arrangements being made so that the test box applies, either automatically or semi-automatically,

all tests that are considered necessary to ensure the efficient operation of the board.

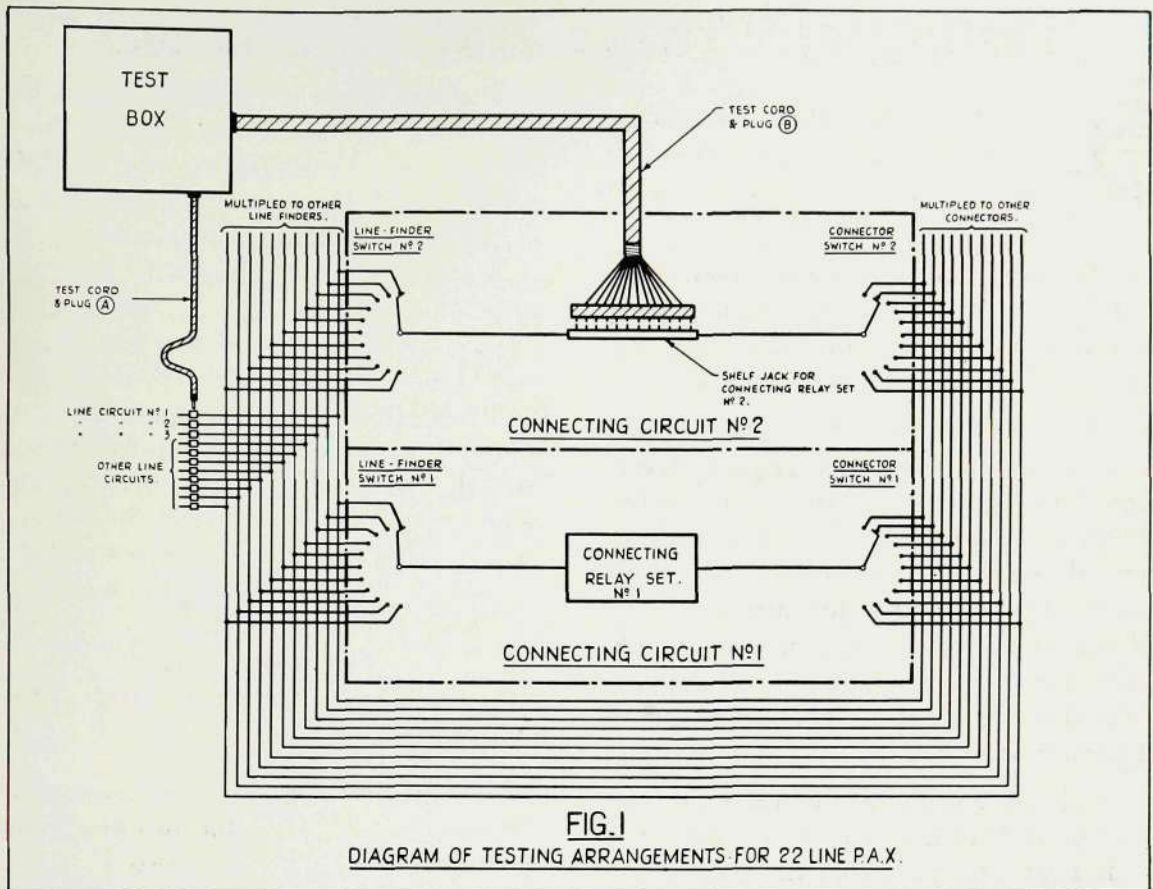
The above will be more readily understood by a brief reference to the method of testing our 22 line P.A.X. The arrangements are shewn diagrammatically in Fig. 1.

Connected to the test box is a cord terminated on a plug which is jacked into the position normally occupied by connecting relay set No. 2. An ordinary connecting relay set is jacked into position No. 1. The test box is now extended to the wipers of the No. 2 linefinder and connector switches via the cord and plug "B", and these switches are used to enable access to be gained to the bank multiples and line circuits.

Test cord and plug "A" are connected to line circuit No. 1 and the test box causes linefinder switch No. 2 to search for line circuit No. 1. A test uniselector (test switch) in the test box now commences to apply tests to line circuit No. 1 via the wipers of linefinder switch No. 2. It should be noted that the test switch is arranged so that the successful completion of one test gives a signal for the application of the next test, and so on. This feature is of primary importance on automatic testers and is incorporated in the design of all our testing equipment.

After certain tests have been applied to the line circuit to prove the various components, the test switch "loops" the line and thus causes linefinder switch No. 1 to function in a normal manner and seize line circuit No. 1.

Other tests are then performed automatically to prove that the various parts of



**FIG. 1**  
DIAGRAM OF TESTING ARRANGEMENTS FOR 22 LINE P.A.X.

the equipment have functioned correctly and eventually dialled impulses are applied to line circuit No. 1 which in turn operates connecting relay set No. 1. The connector switch steps to line No. 2 and connects ringing to this line circuit.

Connector switch No. 2 now moves its wipers to line circuit No. 2 and ringing, from connecting circuit No. 1, is routed via the connector bank multiple to connector switch No. 2 and thence via its bank and wipers to the shelf jack, and plug and cord "B", to the test box. Providing the tests are passed satisfactorily, the test box applies a "tripping" condition and then further tests to ensure correct polarity etc. If all is proved correct the connecting relay set is released and a lamp on the test box glows

to indicate that tests on that line are completed.

It will be observed in the foregoing that line No. 1 has been tested as a calling line and line No. 2 as a called line. When all tests have been completed satisfactorily, test plug "A" is transferred from line circuit No. 1 to line circuit No. 2 and this latter line is now tested as a calling line while line No. 3 is tested under called conditions.

Tests are continued in the above manner until all lines have been tested, after which the connecting relay set is transferred to position No. 1 and the cord and plug "B" to position No. 2.

Tests are now repeated as described above, the bank multiples thus being proved for continuity and reversal etc. The

procedure is continued until the test plug "B" has been jacked into all connecting relay set positions and tests in conjunction with a connecting relay set have been made from each position.

In order to assist the testing officer, lamps are provided to indicate the actual line circuit under test and the test being applied. Should a fault be encountered, the test switch in the test box ceases to function, and by the lamp display the testing officer is at once informed of the line being tested and the test conditions being applied, when the circuit failed.

#### (2) TESTING OF JACKED-IN RELAY SETS.

The various types of relay sets are made in large quantities, tested and stored until allocated for a particular job, and consequently it is necessary to provide means whereby these relay sets can be tested apart from the racks. A special test box is provided for each type of relay set and arranged so that it can be connected to a testing stand, on to which the relay set it is desired to test can be readily jacked-in. Fig. 2 shews a photograph of the testing

stand with relay set in position and the test box connected ready for use.

The test boxes are designed so as to be capable of simulating and applying to the relay sets in a simplified manner, conditions which are slightly more stringent than are normally encountered during service. They are arranged for automatic or semi-automatic working and in principle are similar to that described for the testing of the 22 line P.A.X. rack. Test conditions are connected via the wipers of a test switch to the relay set under test and a lamp display indicates the test being applied.

#### TESTING ON SITE.

The foregoing brief remarks will serve to indicate the general procedure for testing in the factory, and it will be appreciated that the rigid adherence to thorough testing, prior to shipment, enables tests on site to be reduced to a minimum.

The tests on site are in the nature of a final tuning, each circuit being subjected to many calls to check the correct operation and adjustment of the switches under varying line conditions. A simple test box with provision for dialling under "long line" and "leak" conditions is used for this purpose.

When all external cabling is completed and the telephone instruments have been connected, a "call through test" is made. This consists of originating and receiving calls on each instrument in the system, thus proving the cross connections and grading and checking that the directory information is correct.

The exchange is then ready to put into active service.

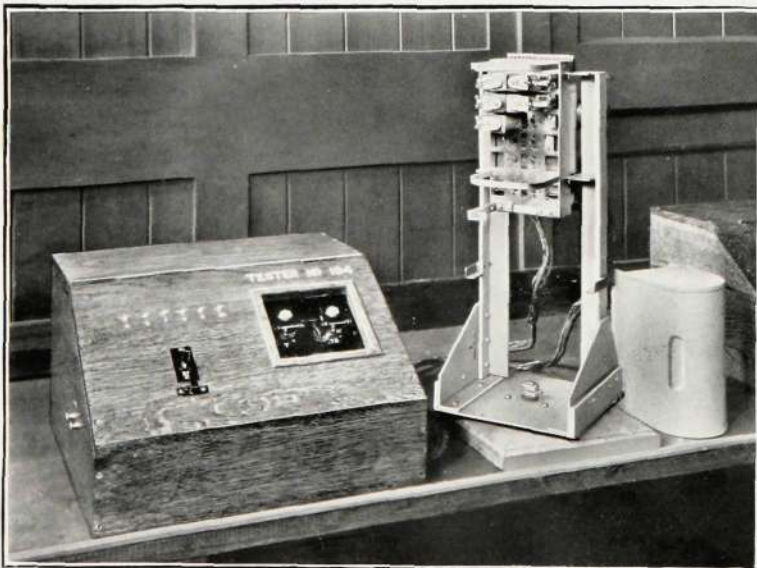


Fig. 2—Testing Jacked-in Relay Set

## Installation of the Ericsson House Exchange System



GENERAL description of the Ericsson House Telephone System with exchange facilities has already appeared in the Ericsson Bulletin No. 5 dated July 1934, but it is thought that a more comprehensive and detailed record of the advantages offered by this system, together with the methods of obtaining these facilities, would be of particular interest. To do this it is necessary to enlarge upon and even to repeat some of the original matter.

Prior to the consideration of the system in detail, it would no doubt be of value to review the telephonic requirements which brought about its adoption. Up to the time of its introduction a subscriber had his own particular needs catered for by three alternative arrangements:—

- (1) A private intercom system, and one or more public service telephones.
- (2) A private branch exchange (P.B.X.)
- (3) A combination of a P.B.X. and a private intercom system.

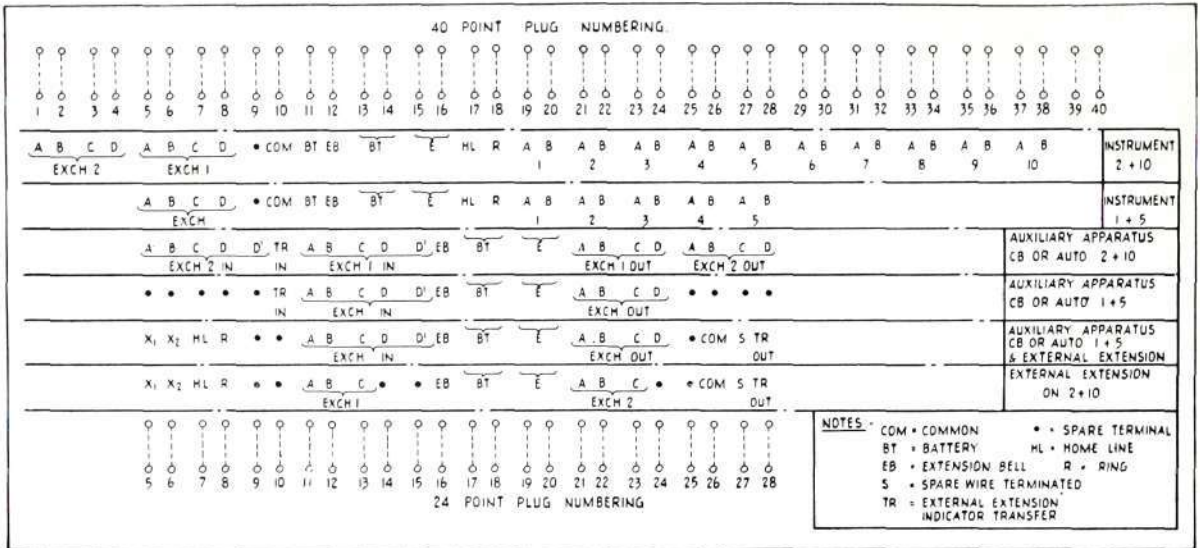
The Ericsson system caters for all such conditions, and utilizing only one instrument affords every facility offered by any previous single system or combination of systems.

As constant mention will later be made of the fundamental parts constituting the system, a general definition of such equipment is desirable.

*An Internal Extension Station* is any station served by the standard telephone instrument having the full complement of local and exchange push keys.

*A Main or Master Station* is an internal extension station specially predetermined and allocated to handle the incoming and in certain cases the outgoing exchange traffic. In normal circumstances only one such main station is desired per installation, but (as on P.B.X. working) provision is made for extending night service to other extensions by means of a second master station. It is thus possible to transfer at will the supervision and distribution of exchange calls to this "second choice main station". The main stations have in addition to the standard instrument an Auxiliary Apparatus Unit in which is housed the necessary exchange line and transfer equipment, together with an audible alarm.

*An External Extension Station* is a station equipped with a standard C.B. or auto telephone and is connected to the main cabling by means of a 2-wire cable. This station can be rung by all instruments but can only make call to internal extensions via the main station, at which special auxiliary apparatus is fitted according to the number and type of lines equipped. This facility of incorporating an external extension is of great value since it affords a means of communication to a point some distance from the main installation where the cost of installing standard multiple cable would be unduly expensive.



**Fig. 1—Connections of Plugs and Jacks of the Instruments and Auxiliary Units**

The equipment is available in two sizes for accommodating :—

(a) One exchange line and five internal or side stations (5 + 1) system.

(b) Two exchange lines and ten internal or side stations (10 + 2) system.

While these will normally cater for the usual requirements, in exceptional cases the provision of a sixth station on a five line system, or an eleventh station on a ten line system is desirable. This is accommodated by utilizing the "home" button on each instrument for calling the additional station. On either size of installation one external extension station may be fitted in lieu of an internal extension.



**Fig. 2—The 10 + 2 Instrument**

In order to facilitate initial installation and subsequent maintenance, both the instruments and units are equipped with plugs and cords, the incoming cables being terminated on jacks. The jacks are standardized

so that it is possible to plug in the smaller equipped instrument into an installation wired for a capacity of 2 exchange lines and 10 side stations. Similarly if it is desired to add an external extension at any point, the appropriate auxiliary unit may be jacked in to replace the standard exchange line auxiliary unit. This interchangeability can readily be appreciated by reference to figure 1 showing the plug point connections.

Extension bells wired from the jacks may be provided. This provision, for extending the exchange line or external extension alarm bell, enables incoming calls to be answered at other points should the main station operator be absent. On installations having two exchange lines a common alarm bell serves both exchange indicators, so that when the alarm circuit is extended it becomes necessary to test both lines at the normal internal extension. A similar test is necessary when the main station unit caters for one exchange line and one external extension.

The 10 + 2 size Instrument consists of the push-button mechanism enclosed in a moulded bakelite case as shown in figure 2, the exchange keys numbered 1 and 2 being coloured red and the local keys 1 to 10 black. The mechanical arrangement of the key movement is such that under normal circumstances the depression of any key automatically restores any previously operated local key. If an exchange key is in the operated position the depression of a second exchange or local key will partially restore the first exchange key which takes up the "hold" position

leaving a 600<sup>Ω</sup> hold coil across the exchange line. A special green conference key is included which renders the normal tripping mechanism inoperative when it is desired to set up a conference call. Two special triggers are provided above the exchange buttons on the (10 + 2) instruments in order to allow the complete release of either exchange button where "holding" both exchange lines. The necessity of such a provision becomes apparent when it is

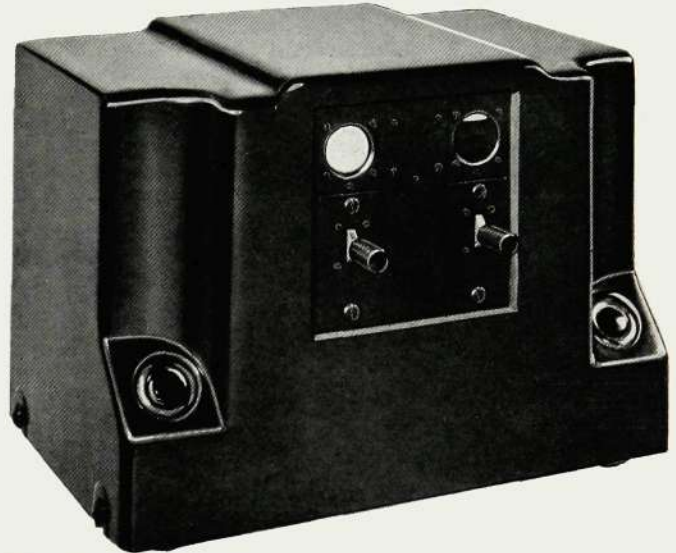


Fig. 3—A Typical Auxiliary Unit

realised that the whole of the exchange key spring-set can otherwise only be restored to normal by replacing the hand-microphone. Should both exchange lines be in use the result of replacing the handset would be to clear both exchange lines, hence the provision of individual releasing triggers. Slip-in paper labels are provided at the side of the keys for designation purposes. A diversion from the standard practice has been made in mounting the buzzer externally on the instrument plug. This allows any adjustments to be carried out without interfering with the casework of the

instrument. A standard size of case is used for both the 5 and 10 line instruments.

The special auxiliary or transfer units are also housed in a standard bakelite case as in figure 3, the equipment varying according to the particular use of the unit (see table on page 28).

*Transfer Units N.9000 (P.O. No. 1) and N.9002* are suitable for C.B. and L.B. working respectively and may be used on 1st and 2nd choice main stations on systems having one exchange line and up to 10 side stations but not an external extension station. They may however be used on 2nd choice master stations, on an installation which includes one external extension, by the addition of an indicator N.4798.A (P.O. No. 400K) in place of the dummy normally fitted.

*Transfer Units N.9005 (C.B.) (P.O. No. 1.A) and N.9006 (L.B.)* cater for the first choice main stations on installations having one exchange line, one external extension and up to 4 internal extensions.

*Transfer Units N.9001 (C.B.) (P.O. No. 2) and N.9003 (L.B.)* are suitable for use as first or second choice units on installations having 2 exchange lines and 10 internal extensions. They may also be modified by the addition of the indicator N.4798.A for use as second choice master stations when an external extension is incorporated in the system. In this case an additional unit N.9004 is fitted at the first choice main station.

*Transfer Unit N.9004 (P.O. No. 3)* is purely an external extension unit for use in conjunction with units N.9001 and N.9003 for 1st choice main station working on

systems having 2 exchange lines, 1 external extension and 9 internal extensions; or in conjunction with units N.9000 and N.9002 when more than 5 internal extensions are required on a system including one exchange line and one external extension.

Owing to the comparatively small number of standardized units, minor modifications become necessary when certain of the special facilities are desired at any particular station. This has been catered for in so simplified a form that modifications can readily be carried out on site to suit any particular requirement.

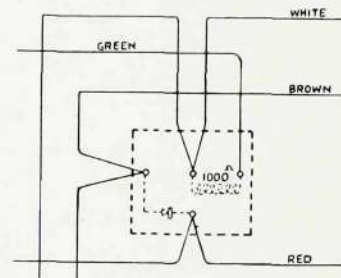


Fig. 4—Wiring for External Extension Indicator

Units N.9000, N.9001, N.9002, and N.9003 are fitted with a "dummy indicator" which is replaced by indicator N.4798.A. when required for external extensions. Provision has been made in the local cable form for this additional indicator which should be wired as shown in figure 4.

When a second choice main station is fitted, the exchange lines and the external extension indicator circuit can be transferred to this station, by throwing the appropriate keys of the first choice main station auxiliary unit or units. To provide for this facility it is necessary to remove the strap

connections on the first choice units, as detailed in the following table :—

UNIT.	STRAPS TO BE REMOVED.				
Transfer Units N9000 & N9002	T <sub>1</sub> T <sub>2</sub> T <sub>3</sub> T <sub>4</sub>				
„ „ N9005 & N9006	T <sub>1</sub> T <sub>2</sub> T <sub>3</sub> T <sub>4</sub> T <sub>5</sub>				
„ „ N9001 & N9003	<table style="display: inline-table; border: none; vertical-align: middle;"> <tr> <td style="text-align: center;">Exch. 1.</td> <td style="text-align: center;">Exch. 2.</td> </tr> <tr> <td style="text-align: center;">{ T<sub>1</sub> T<sub>2</sub> T<sub>3</sub> T<sub>4</sub> }</td> <td style="text-align: center;">{ T<sub>1</sub> T<sub>2</sub> T<sub>3</sub> T<sub>4</sub> }</td> </tr> </table>	Exch. 1.	Exch. 2.	{ T <sub>1</sub> T <sub>2</sub> T <sub>3</sub> T <sub>4</sub> }	{ T <sub>1</sub> T <sub>2</sub> T <sub>3</sub> T <sub>4</sub> }
Exch. 1.	Exch. 2.				
{ T <sub>1</sub> T <sub>2</sub> T <sub>3</sub> T <sub>4</sub> }	{ T <sub>1</sub> T <sub>2</sub> T <sub>3</sub> T <sub>4</sub> }				
„ „ N9004	T <sub>1</sub>				

These straps are clearly shown in figure 5, which illustrates the terminal block of a transfer unit with 2 exchange lines. Certain of the transfer unit key labels which are engraved both sides should also be reversed to indicate the transfer position.

While one of the main features of the system is that all exchange calls are normally secret, it may be desirable and advantageous for one or more instruments to have monitory or supervisory facilities : e.g., for trunk offering purposes. Straps are provided on the terminal block of each instrument as shown in figure 6. When supervision facilities are required strap 1-2 is removed and strap 2-3 substituted. This permits the operation of the exchange line instrument relay over a local circuit irrespective of the condition of the exchange line. Normally this relay can only operate and access be obtained to an exchange line, when the exchange line is disengaged.

An automatic dial would normally be supplied with each instrument for automatic working, but should automatic facilities not be required at the outset, the dial can

be omitted and supplied as and when required. The dial can be connected on site by means of a flexible cord as shown in figure 7.

The transfer units as standardized by the British Post Office work on the common battery (C.B.) system, and where these are connected to public exchanges utilizing local battery (L.B.) working, special auxiliary units are fitted in the lines at the exchange. It is realised however that such modifications are not always possible, especially in countries abroad, so that suitable units have been specially designed for working direct to local battery exchanges.

The main condition governing the necessity of L.B. units is the question of

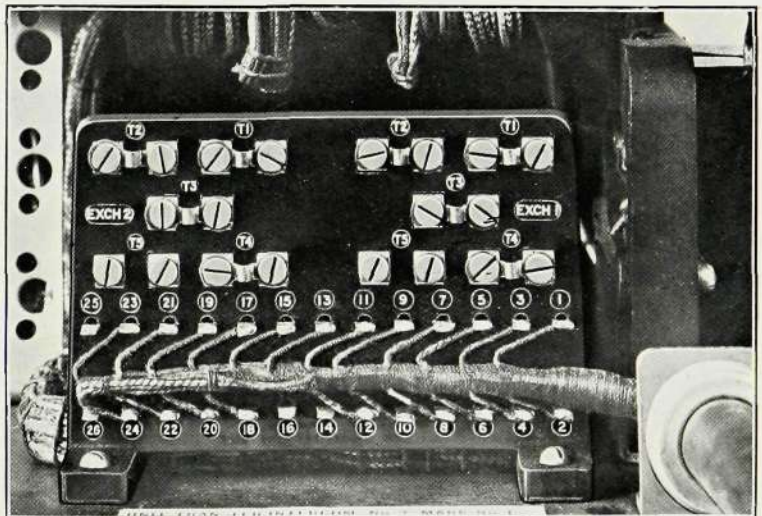


Fig. 5—Transfer Unit (N9001) Terminal Block

providing a suitable battery supply from the main exchange. If such a supply can be obtained from the main exchange then standard C.B. units can be used at the

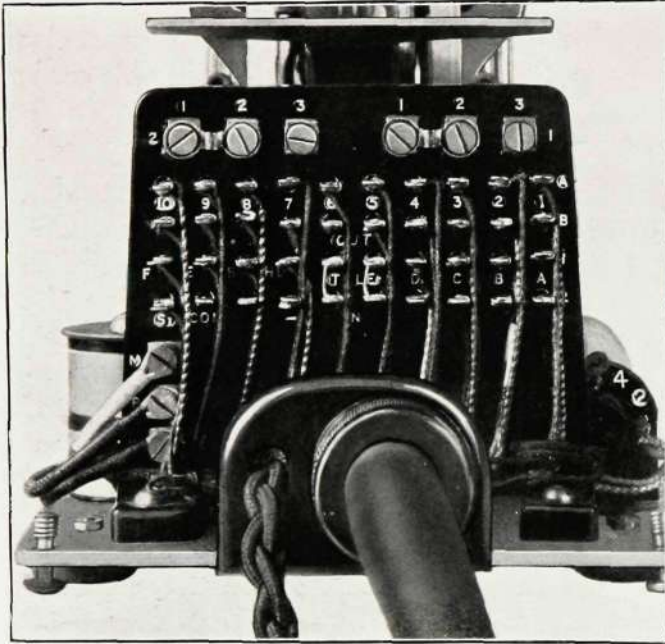


Fig. 6—Terminal Block of a 10 + 2 Instrument

subscribers' premises, and a special unit fitted at the main exchange to give the correct call and clear conditions depending on the type of L.B. exchange.

If the main exchange is fed by primary cells it is not practicable to provide the battery supply from this source, so that a local battery must be provided and L.B. units installed. These units are similar in external appearance to the C.B. units but the equipment is not standardized. When L.B. units are required, each installation is examined in detail by the Ericsson research and engineering departments and units are designed according to the prevailing local exchange system, namely, C.B.S. No. 1, C.B.S. No. 2, C.B.S. No. 3 or magneto. When working to a magneto public exchange a special magneto auxiliary unit is fitted at the main exchange to provide the necessary ringing current.

Thus it can be seen that both calling and clearing is carried out in the same manner irrespective of the type of public exchange, i.e. automatic calling and clearing is given even on magneto systems. This is a great advantage inasmuch that on magneto working it is quite common for the subscriber to fail to give the ring off when an exchange call is concluded. On the Ericsson system a through clear is given by replacement of the hand microtelephone.

While the above brief description gives the broad outline of L.B. working, the system is so flexible that it can readily be adapted for any particular local conditions.

In common with the instruments and units, special type junction boxes have been designed giving excellent facilities for cross

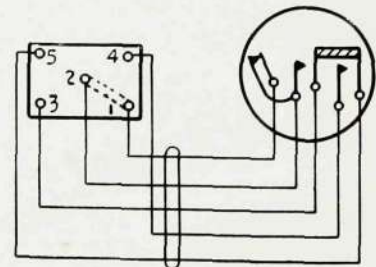
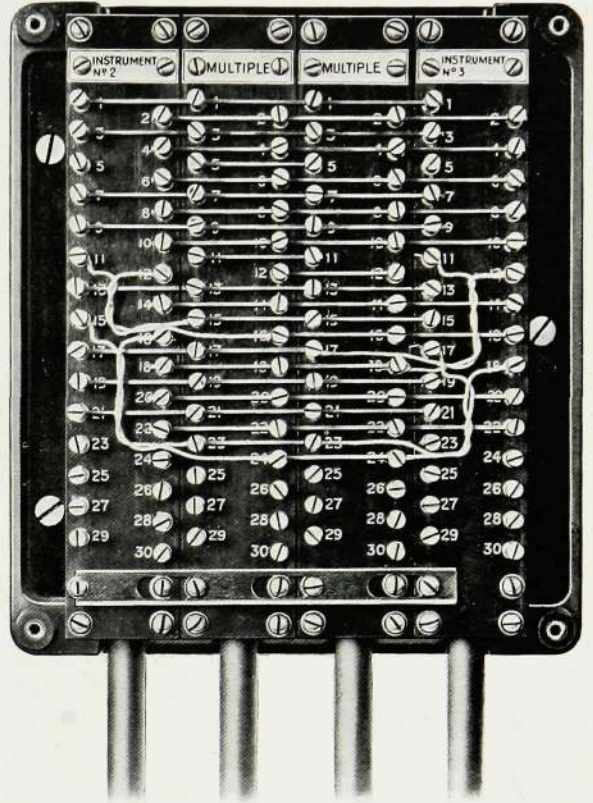


Fig. 7—Cord Connections when a Dial is fitted. Strap 1-2 removed

connecting the various cables. These boxes are made up in two sizes, 30-way and 48-way, the former being used throughout the five line system and also as an auxiliary box when required on the ten line system,

which is normally served by the larger size. The smart and pleasing external appearance of the moulded bakelite cases is shown in figures 8 and 9. Provision for the termination of four multiple cables is provided and the lids of the boxes have thin bakelite "break-ins" which may readily be removed to permit the entry of the cable at either end of the box. A further deviation from standard multiple boxes of the past has been incorporated, in that the cables are terminated on individual terminal strips and the necessary commoning done by means of special square-section bare wire supplied with the boxes. When jumper connections are required they are carried out in switchboard wire, a typical example of a completed box being shown in figure 8. Each of the four terminal strips may be individually removed from the moulded base and if desired the cable can be connected to the underside prior to being cleated down. Cable bonding clamps on the underside of the strips are connected by means of the bonding strip (figures 8 and 9) on the upper side, and where the cables are led in at opposite ends of the box the two bonding strips should be connected by suitable switchboard wire. Three point fixing of the base plate is standardized and together with the three rubber feet allows the mounting of the box on uneven surfaces without any undue strain on the bakelite moulding. Separate cellastoid labels are supplied as required for designating the various cables.

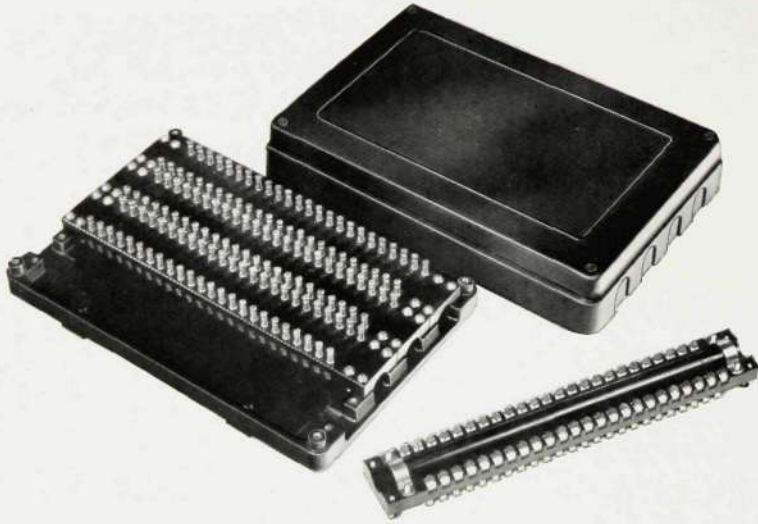
Two special sizes of cable have been introduced for the system: N3390 being for 12 pair and N3391 for 20 pair. These cables are to British Post Office specification and consist of twisted pairs of conductors, No. 23 S.W.G. having a uniform coating of pure tin, enamelled, the covering of each individual conductor being two



**Fig. 8—A 30-way Junction Box Strapped and Cross-connected for Instruments Nos. 2 and 3 in Fig. 12. See also Fig. 13**

lappings of cotton laid on in opposite directions. Standard colours are used for the outer cotton lapping and a helical lapping of white tape laid over the outer layer of conductors, the whole cable being waxed and lead sheathed over all giving an external diameter of approximately  $\cdot 52''$  for the 12-pair and  $\cdot 64''$  for the 20-pair. At this point it may be well to stress the necessity of a twisted pair cable in order to ensure that cross-talk is reduced to a minimum. When the smaller size cable is led into the larger size box it is necessary to pack the cable with a thin lead strip in order to obtain a satisfactory bonding grip.

The layout of an installation will naturally



**Fig. 9—A 48-way Junction Box with Cover and One Strip removed**

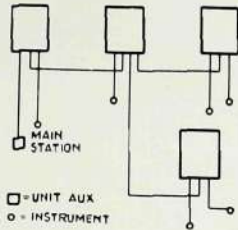
depend to a great extent on the particular design of the establishment, and this should be given careful consideration with a view to obtaining the most economical cable runs, etc. If a system is not fully equipped in the first instance, provision should be made for extending the multiple to further junction boxes. Two typical layouts for 5 and 10-line systems are shown in figures 10 and 11.

In order to illustrate how the details necessary for the cross connections of the junction boxes are obtained, a pictorial diagram of a 5-line system comprising 5 internal extensions and 1 external extension (No. 5) is given in figure 12, the junction boxes being designated with the figure numbers described hereafter. Figure 13 shows in detail the cross connections necessary to serve instruments No. 2 and 3 (see also figure 8). In both cases terminals Nos. 11 and 12 (HL and R) on the instrument strips are connected to the multiple pairs corresponding to these particular instruments, i.e. No. 2 to 15 and 16, and

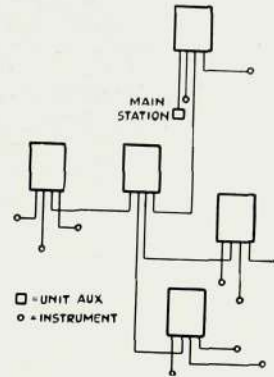
No. 3 to 17 and 18. Thus it can be seen that on a normal 5 and 10-line installation the A and B terminals on the instrument strip, corresponding to the station's own number, would be disconnected from the main cabling. When a 6th or 11th station is fitted this particular pair of terminals is connected by switchboard wire to the 12th or 20th pair of the multiple cable, and the terminal strip serving the additional station has its HL and R terminals (Nos. 11 and 12) strapped to the 12th or 20th pair as shown in figure 14. The main station junction box is represented by figure 15. In addition to the multiple and instrument cables this box feeds the auxiliary unit and, if desired, a second choice master station auxiliary unit as shown dotted in figure 12. An external extension is included in the layout in lieu of No. 5 internal station and is connected to terminals 29 and 30 of the auxiliary unit strip. The HL and R of this auxiliary unit (terminals Nos. 11 and 12) are strap connected to No. 5 pair of the multiple cable. Normally an internal extension is rung by the application of an earth to the

' B ' line at the calling station, thus operating the D.C. buzzer of the instrument. In the case of the external extension, which is fitted with a polarized bell, it is necessary to convert the application of the earth into a suitable ringing current. This is done by

When certain special facilities are required at any particular station, modifications are made to the junction box strappings.



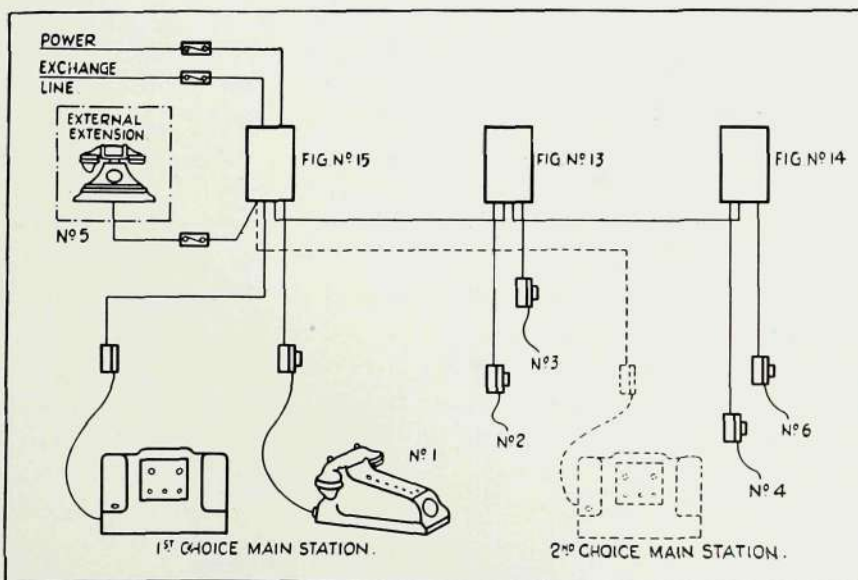
**Fig. 10—Typical Layout of a 5-line System**



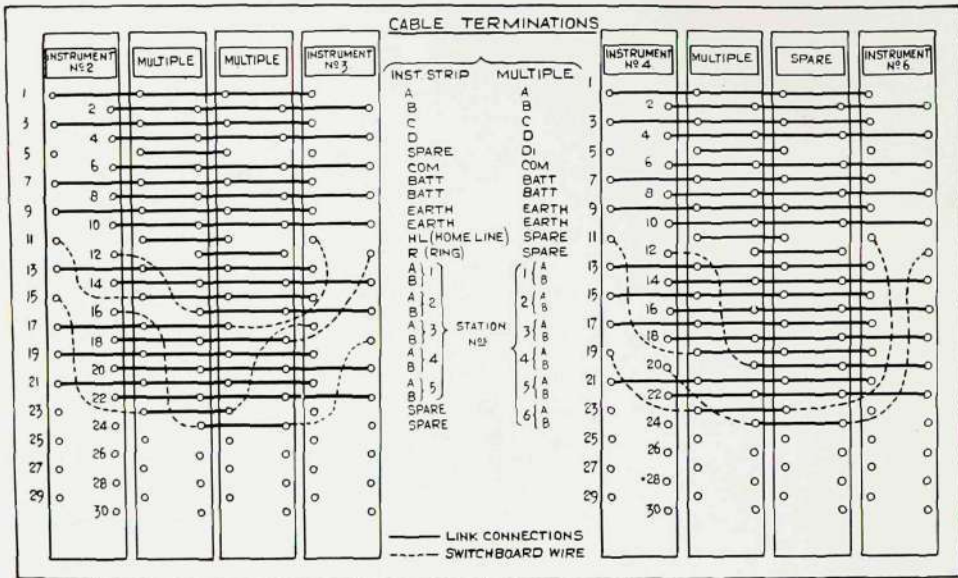
**Fig. 11—Typical Layout of a 10-line System**

the external apparatus unit which, as far as the cross connecting for HL and R is concerned, becomes equivalent to No. 5 instrument. The exchange line is also terminated on the main junction box.

Any station may be "barred direct access" to the exchange lines (except at the discretion of the master station) by a modification of the strap connections on the junction box serving the multiple to



**Fig. 12—Pictorial Diagram of a 5-line System with One External Extension**

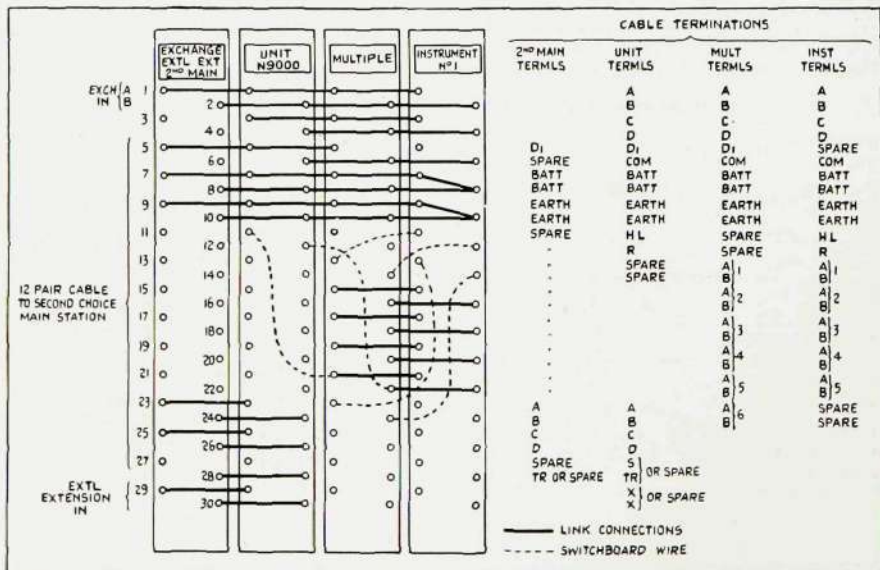


**Fig. 13—Commoning of Terminal Block for Instruments 2 and 3 in Fig. 12. See also Fig. 8.**

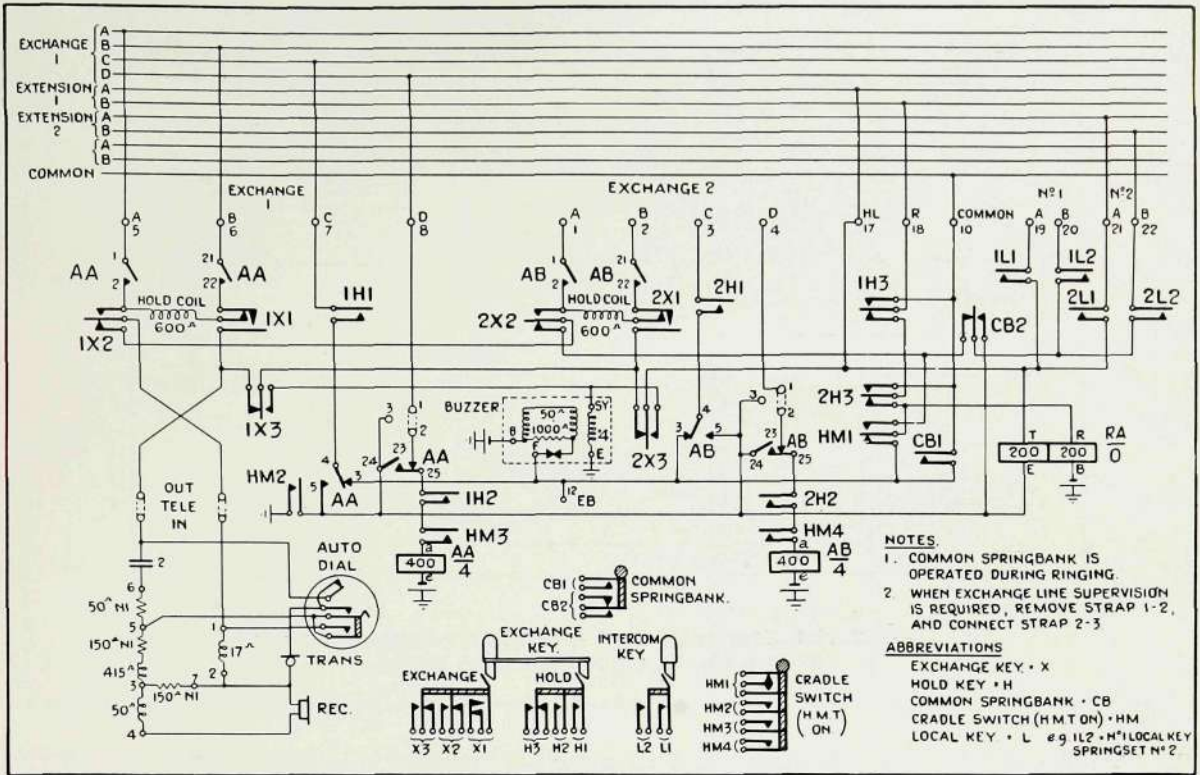
**Fig. 14—Commoning of Terminal Block for Instruments 4 and 6 in Fig. 12**

the barred station. By reference to the instrument circuit figure 16 it will be seen that the operation of the instrument line relay depends upon an earth being supplied over the D wire. To prevent the operation

of this relay in order to bar direct access to the exchange line, it is only necessary to remove the earth from the "D" line of the particular instrument in question. The 'D' line of the instrument is strapped on



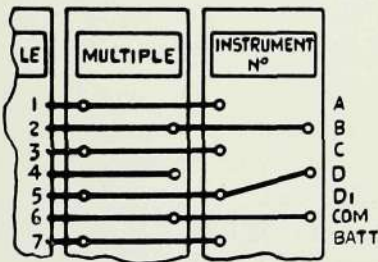
**Fig. 15—Commoning of Terminal Block for the Main Station in Fig. 12**



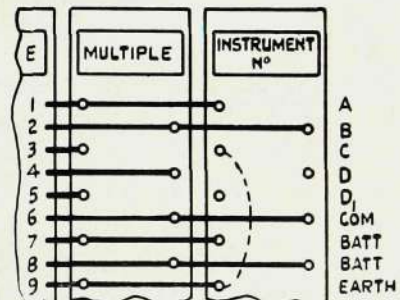
**Fig. 16—Circuit Diagram of the Telephones**

the junction box to the 'D<sub>1</sub>' line, to which an earth may be applied at the discretion of the main station by depressing the push button provided on the main station auxiliary unit. This junction box connection is shown in figure 17.

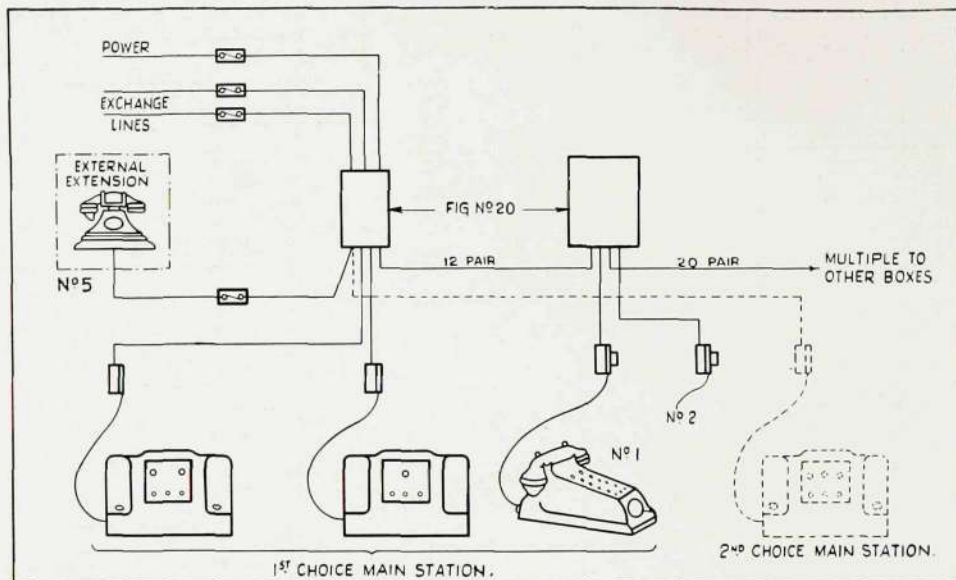
When it is desired to completely bar a station from the exchange service the multiple wires C, D and D<sub>1</sub> are not cross connected to the multiple strip and the C wire of the instrument is permanently strapped to earth as shown in figure 18.



**Fig. 17—Connections of Instrument Terminal Strip to Bar Direct Access to Exchange Lines**



**Fig. 18—Connections of Instrument Terminal Strip to Totally Bar Exchange Service**



**Fig. 19—Pictorial Diagram of a 10 + 2 System showing the use of Two Junction Boxes for the Main Station**

This has the effect of giving the normal engaged signal if the exchange button is pressed in error. A similar earth strap is required on the second exchange line 'C' wire on a 10 + 2 system when only one exchange line is connected to the system.

The cross connecting of a 10 + 2 system follows the same principle as that of the 5-line, except that, at the main station it may be necessary to fit a 30-way auxiliary junction box in addition to the 48-way main box, owing to the number of cables to be accommodated. Such a case is illustrated in figure 19 where two auxiliary apparatus units are required in addition to the instrument. It will be noticed that the instrument cable is taken from the main box and the units from the auxiliary box. By this method the smaller type box can be used and connected by means of a 12-pair cable, the necessary cross connections being as shown in figure 20.

The power is normally obtained over a power lead from the public exchange but where this is not available a battery of primary cells or a trickle-charged accumulator set may be employed. The system is designed to operate on 24 volts but the factor of safety is sufficient to permit its use on any voltage between 18 and 28 volts. The maximum current consumption is approximately 1.3 amps. for a fully equipped (10 + 2) installation. A 10  $\mu$ F condenser should be connected across the power lead in order to reduce to a minimum any cross-talk due to battery feeder resistance.

On completion of the installation the apparatus should be disconnected by means of the plugs and jacks and the following tests applied. All the A lines should be commoned and tested to the B lines with a 250 volt megger, care being taken to remove the straps from the A and B lines of the battery and earth pairs. The pairs

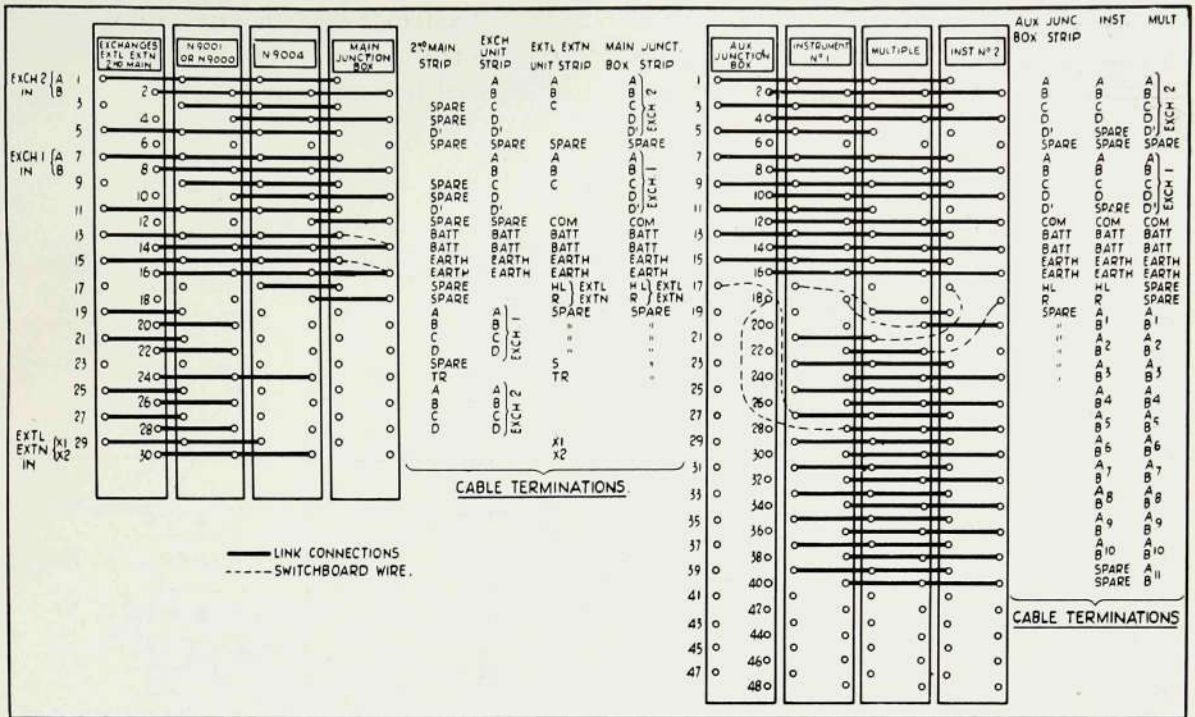


Fig. 20—Commoning of Terminal Blocks for the Main Station Junction Boxes in Fig. 19

should then be bunched together and tested to earth. Under both conditions the insulation resistance should not be less than 1 megohm. Continuity of the cables should be tested and also the efficiency of the bonding clamps to earth.

After jacking in the apparatus it is recommended that the following tests be made at each instrument :—

- (1) An exchange call to be made on each exchange line at each station.
- (2) A local call to be made to each station on the system.
- (3) A conference call to be made to include all instruments.

- (4) The exchange lines to be 'busied' and an engaged test made by depressing each exchange key.

A complete cabling diagram should be drawn out showing the cable runs and junction boxes, with details of the instruments fed from each particular box, and any special feature appertaining to an instrument. The diagram will definitely be of great assistance should it be necessary to locate any cabling faults which may arise after the system has been in service some time.

Finally, it cannot be too strongly emphasised that it is of the utmost importance to ensure that everyone concerned in the use of the installation shall be fully conversant with the facilities

available and the correct method of obtaining them. In this way the maximum efficiency will be obtained from the Ericsson

House Exchange System which undoubtedly represents the latest solution to the problem of internal telecommunication.

A complete list of the instruments, transfer units, junction boxes and cables is tabulated below :—

Code No.	Description.	Dimensions inches	Weight lb.	P.O. Code
N1668	C.B. Set for 1 exchange and 5 extensions	$6\frac{1}{2} \times 14 \times 9\frac{1}{2}$	$9\frac{5}{8}$	Telephone Intercom. No. 1
N1669	Auto Set for 1 exchange and 5 extensions	$6\frac{1}{2} \times 14\frac{3}{4} \times 9\frac{1}{2}$	$10\frac{1}{4}$	—————
N1670	C.B. Set for 2 exchange and 10 extensions	$6\frac{1}{2} \times 14 \times 9\frac{1}{2}$	$10\frac{1}{2}$	Telephone Intercom. No. 2
N1671	Auto Set for 2 exchange and 10 extensions	$6\frac{1}{2} \times 14\frac{3}{4} \times 9\frac{1}{2}$	$11\frac{1}{4}$	—————
N9000	C.B. Transfer unit for 1 exchange line	$7\frac{1}{2} \times 10\frac{1}{4} \times 8$	10	Unit Transfer No. 1.
N9001	C.B. Transfer unit for 2 exchange lines	$7\frac{1}{2} \times 10\frac{1}{4} \times 8$	12	Unit Transfer No. 2.
N9002	L.B. Transfer unit for 1 exchange line	$7\frac{1}{2} \times 10\frac{1}{4} \times 8$	10	—————
N9003	L.B. Transfer unit for 2 exchange lines	$7\frac{1}{2} \times 10\frac{1}{4} \times 8$	12	—————
N9004	External Extension Unit	$7\frac{1}{2} \times 10\frac{1}{4} \times 8$	13	Unit Transfer No. 3.
N9005	C.B. unit for 1 exchange and 1 external extension	$7\frac{1}{2} \times 10\frac{1}{4} \times 8$	14	Unit Transfer No. 1A.
N9006	L.B. unit for 1 exchange and 1 external extension	$7\frac{1}{2} \times 10\frac{1}{4} \times 8$	—	—————
N3310	30-way junction box	$8\frac{3}{4} \times 7\frac{1}{2} \times 2\frac{1}{4}$	4	Box No. 1.
N3311	48-way junction box	$12 \times 8 \times 2\frac{1}{2}$	6	Box No. 2.
N3390	12-pair lead covered cable	$\frac{1}{2}$ " dia.	—	Cable E and C 12 pr./10.
N3391	20-pair lead covered cable	$\frac{3}{8}$ " dia.	—	Cable E and C 20 pr./10.