THE ETELCO BULLETIN

No. 38
JANUARY, 1959

Editor : S. DENTON.

CONTENTS

Published by

Etelco LIMITED

TELEPHONE WORKS,
BEESTON, NOTTINGHAM
Telephones : Beeston 254831 (6 *Lines*)

Head Office :
22, LINCOLN'S INN FIELDS, LONDON, W.C. 2
Telephones : Holborn 6936 (5 *Lines*)
Telegrams : Ericlond, London

TWO-TONE GREEN

LACQUER RED

TWO-TONE GREY

THE

'ETELPHONE'
COLOUR RANGE

CONCORD BLUE

TOPAZ YELLOW

BLACK

U.D.C.621.395.61.

THE *'ETELPHONE'

W. SINCLAIR — Apparatus Engineering Department

Many new features are embodied in our latest telephone. Improved methods of construction and the choice of materials which are durable but can be given a superior finish and colour have resulted in the production of an instrument of very attractive form and appearance. The dial markings have been laid out so as to improve their legibility, and new types of desk and handset cord can be fitted. The Etelphone is provided with a regulator which compensates for the effect on the transmission performance of variations in the line length. Among the special features which can be provided on request are means for adjustment by the subscriber of the loudness of the bell, and a dial lock to prevent unauthorized calls from being made. The instrument can be supplied as a table or a wall mounting telephone, and a version with tropical finish is available.

THE 'Etelphone', latest addition to the Company's range of telephones, meets a demand for an instrument which is pleasing in appearance, available in a wide range of light-fast, attractive colours, has outstanding technical performance and is suited to modern manufacturing techniques.

Since the Company in conjunction with the British Post Office introduced the P.O. 300-type telephone in 1936, there has been steady development of most of the component items until, at the present time, only the transmitter remains substantially unaltered. Throughout this period, however, the main external lines and the internal layout have remained unchanged, so that the time was ripe for a new look at the subscribers' set as a whole. The first reported reactions to the instrument in Britain, the Commonwealth and many foreign countries have been so favourable as to promote a real confidence that it will be a worthy successor to the twenty-three-years-old P.O. 300-type.

Up to the present, British telephones of moulded type have been made in compression moulded thermo-setting plastics, although thermo-plastics have been used to provide a limited colour range. The new instrument, particularly in the design of the handset, exploits the possibilities of injection moulding. Its simple lines, which are largely functional in their derivation, are seen to advantage in Fig. 1 and present a pleasing appearance which blends readily with a wide variety of styles.

The legibility of dial numbers and letters is vastly improved by the exterior designation ring. On C.B. telephones an attractive dial dummy with a label for the subscriber's number, replaces the dial.

The mechanical design of the set presents many novel features. Notable among them are the way in which the same basic instrument is used as a table set

Fig. 1—The 'Etelphone'—Auto Two-tone version with coiled cord

**Trade Mark*

Fig. 2—The ' Etelphone ' Auto Wall Type

or for wall mounting, (see Fig. 2), and the simple manner in which the case is attached. It is freed from the base by releasing two screws without inverting the instrument and may be lifted off to give easy access to all the components without affecting the working of the set. The whole internal arrangement is designed to facilitate maintenance operations.

The provision of an ' off-hook ' position for the handset is a useful feature on a table telephone and essential for a wall telephone. Figs. 3 and 4 show these positions on the Etelphone. In Fig. 3 also may be seen the metal carrying handle across the cradle.

Fig. 3—' Off-hook ' Position of Handset

MOULDINGS

Modern plastics are extensively used in the construction of the major components. The materials have been selected after comprehensive tests and investigations in our Laboratories. These have been supplemented by a series of field trials conducted in collaboration with customers at home and overseas during the last few years. Reports submitted by a number of Administrations on the performance of telephone instruments employing a variety of plastics under differing climatic conditions have provided valuable information on the relative merits of the materials, and this has largely influenced the selection of the plastics used for the Etelphone.

The handset and case are injection moulded from Diakon, a pigmented thermo-plastic acrylic resin which combines high quality finish and general appearance with durability. This plastic is particularly satisfactory in withstanding tropical conditions where high humidities and temperatures prevail. The mouldings have good impact strength and possess considerable hardness and abrasion resistance, so that the characteristic high polish is maintained.

No metal inserts are incorporated in the handset or case, a feature which has been a principal design

Fig. 4—' Off-hook ' Position' Wall Telephone

objective. The form is therefore one of robust simplicity, with consequent advantages in the stability and technical properties of the mouldings. The outer surfaces are free from recesses, while the smooth profiles of the handset and case facilitate cleaning.

The instrument base is moulded from high impact polystyrene which combines mechanical strength with excellent insulating properties. This material does not become corroded and therefore has advantages over metal. Again, the material and form of the base were determined after extensive trials under practical conditions which have been conducted for several years.

The Company has installed modern equipment and plant for the production of all the telephone instrument mouldings, which are subjected to close technical control to ensure uniform high quality. Strict attention is also given to the internal mouldings, in which nylon, polyvinyl chloride, clear acrylic resin and phenolic mouldings of various types are used. Each of these plastic applications has been the subject of close technical study.

Colours

The telephone is available in a wide range of colours, the standard shades being Black, Ivory, Topaz Yellow, Concord Blue, Lacquer Red, Two-tone Grey and Two-tone Green.

Behind this simple fact lies an extensive programme of painstaking development to establish a sufficient degree of control over the moulding of colours to ensure that not only will the various parts of instruments be produced in matched, light-fast colours, but that replacements also will be accurate in shade. To do justice to this development work would necessitate a separate article, but it is worthwhile to give a brief review of what has been entailed.

Acrylic resin is basically colourless, transparent, and unaffected by exposure to the sun. The required shades are produced by the addition of pigments, and the fastness of the colouring therefore depends primarily on this processing.

Until recently the manufacture of coloured acrylic compounds has been undertaken by the supplier of the plastic materials, and the moulder has been mainly concerned with the techniques of the injection moulding processes. Any adjustment made to the colours or type of pigments has therefore been remote from the moulder, with consequent delay and difficulty. The Company has installed a relatively new ' dry-mix ' process which has been adopted for the colouring of Diakon for Etelphones. The acrylic resin is supplied in a new and very finely divided form. Carefully selected pigments are incorporated into this polymer by tumbling in specially constructed barrels so that uniform dispersion of the pigments is achieved. The moulding powder thus prepared provides a number of advantages in the close control and adjustment of the shades, especially when used in conjunction with appropriate injection moulding equipment. Pigments can be selected which are specially suitable for the injection processes and have properties most advantageous to the finished product in terms of fastness to light and stability under adverse conditions.

The long-term maintenance of colour is very important to the user Administrations, and the standard of colour fastness achieved is very high. The minimum standard

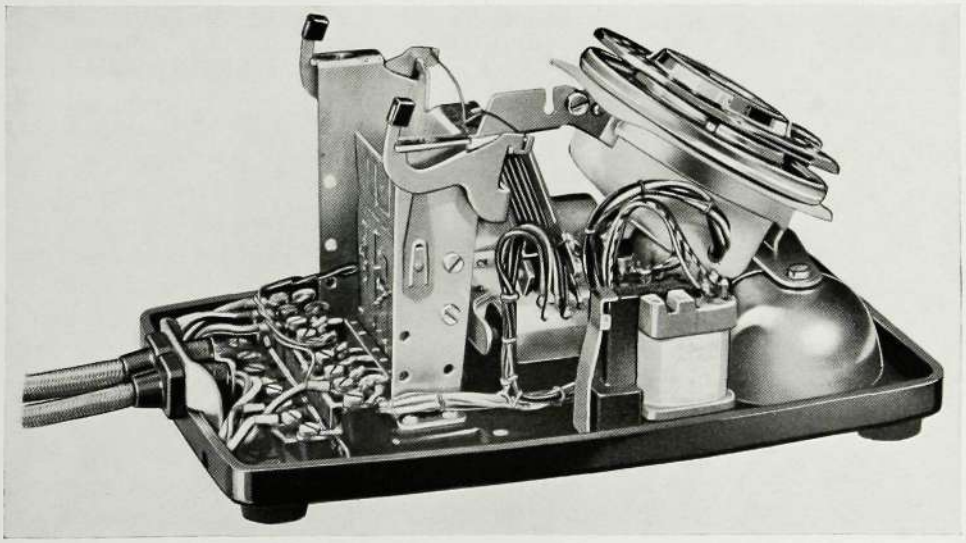


Fig. 5—Base Assembly

of No. 7 in accordance with B.S. Specification 1006 is maintained, and this has been confirmed by exposing the material to natural sunlight during tests extending for some years. A No. 7 degree of fastness ensures absence of fading for indefinite periods under normal conditions of use within the office or home. These results are achieved by the application of high-grade pigments throughout the whole range of shades.

The colours have been carefully developed in co-operation with the Council of Industrial Design and will harmonize with most schemes of internal decoration.

Internal Layout

All the components are assembled on the moulded base, (see Fig. 5), and constitute a functional unit completely independent of the case. The shape of the base, which is formed to locate and support the components, considerably enhances the natural strength of the material, the insulating properties of which allow inset terminals to be used. A generous number of terminals have been provided to cater for the many special requirements of our customers. A terminal and three recesses provided behind the induction coil are used for anchoring the dial connections when no dial is fitted, in which case the impulse spring connections are commoned at the terminal, and the tags on the wires from the other three springs pressed into the recesses.

The use of fixing screws has been avoided wherever possible, the main bracket being riveted to the base and the induction coil and capacitor secured by clips. The dial mounting bracket is shaped to hook in the plate above the bell domes and is held at the top by a single screw. The only screws on the underside of the base are two fixing the ringer unit, and the heads of these are sealed to avoid confusion with the case fixings.

An automatic regulator unit which controls the performance of the instrument on short lines, is plugged into a moulded socket centrally located between the sides of the main bracket, (see Fig. 5). For tropical conditions an alternative unit secured by screws is used and connections are made to terminals in the base of the unit by means of flexible leads fitted with spade tags. The regulator is described in greater detail later.

Lengthy experiments using various materials were undertaken to determine the best shape and moulding material for the feet, so as to eliminate any chance of their causing pressure marks or stains on furniture. The feet are pressed into holes in the base, certain sections of which are made thin so that they can be cut or pressed out to permit entry of additional cords that may be necessary if, for example, a second receiver is used.

Cradle Switch

For the standard of reliability demanded of the modern telephone, adequate provision must be made to prevent failures due to the occasional adverse coincidence of dimensional divergencies within the normal tolerance limits set by sound manufacturing techniques. The use of plungers in the case to operate an internal switch from replacement of the handset has been found as a system to be susceptible to difficulties on this account. A fresh approach to cradle-switch operation and case fixing has effectively

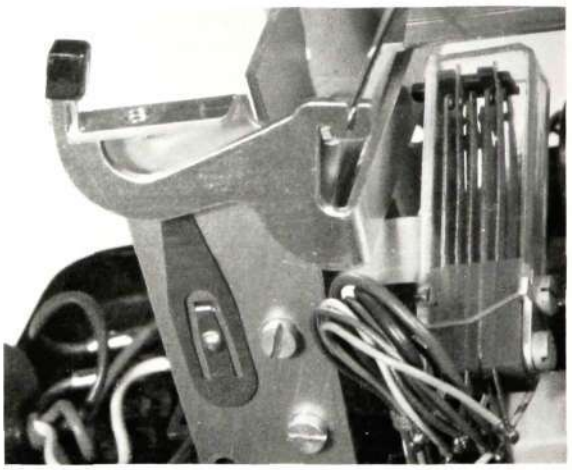


Fig. 6—Switch and actuating bracket

eliminated these variations, giving a corresponding reduction in fault liability. The switch actuating bracket, (Fig. 6), is carried on two knife-edge bearings to minimize friction and is retained by a light wire spring which also biases the bracket to the ' off-hook ' position. Arms concentrically radiused round the pivotal point carry moulded tips which project through the case. The arms move in slots in the main bracket to guard against lateral distortion and to ensure adequate clearance when the case is in place.

A latch spring is fitted to lock the actuating bracket in the ' on-hook ' position when the case is removed. In Fig. 7, part of the bracket has been cut away to show clearly the operation of the latch. Release is effected by slight pressure on the moulded tips of

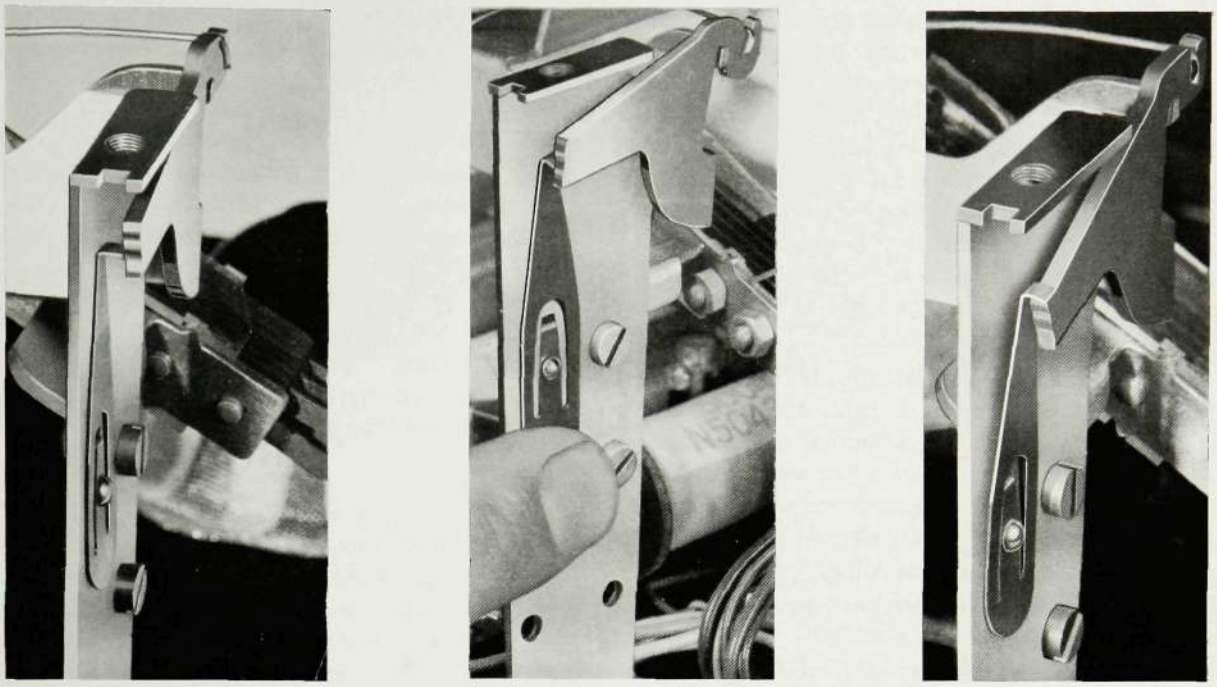


Fig. 7—Operation of latch to hold the switch in the 'on-hook' position when the case is off

the bracket; thus the telephone is restored automatically to the 'off-hook' position when the handset is replaced, even if the case is fitted with the latch in operation.

The switch contact springs are protected by a transparent cover and the assembly secured to the main bracket by two screws which permit easy adjustment relative to the actuating bracket. A comb lifting plate ensures the correct sequence of contact operation and bears directly on the forward portion of the actuating bracket. The individual springs are divided from the root into parallel twin leaves and the independent action of each contact gives an improved performance without critical adjustment. Palladium has been chosen for the contact material because experience has shown its superior qualities compared with silver, for example, in locations where the atmosphere contains traces of combustion products. As the contact assembly and actuating bracket are on the same mounting, the cumulative effect of manufacturing tolerances is reduced and the full movement of the bracket can be used. The mechanical advantage so obtained allows high contact pressures to be employed, notwithstanding the use of a light handset.

CASE

The case is fixed to the base assembly by two screws which are conveniently located at the top. Their removal can be effected without inverting the instrument or disturbing any adjustment. As shown in section in Fig. 8, these screws pass through the carrying handle and lock the case moulding firmly to the main

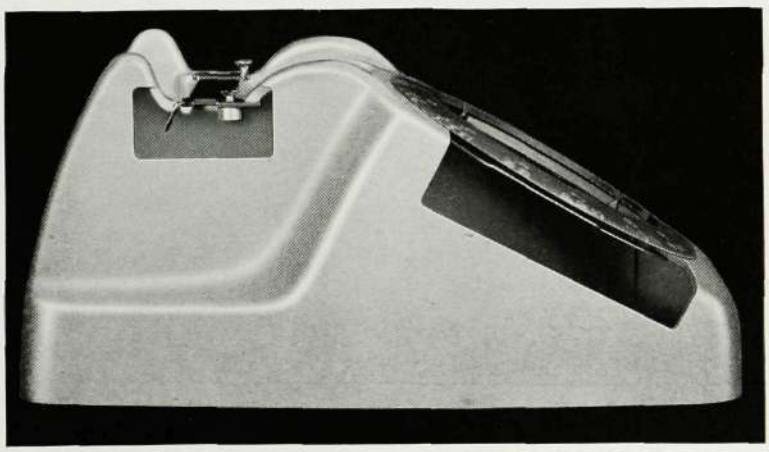


Fig. 8—Case, sectioned

internal bracket so that alignment of the moulded tips on the switch actuating bracket with the holes in the case is automatically ensured. The lifting forces on the handle are taken directly to the internal bracket without strain on the moulding, and any forces due to impact are taken at a very strong section. A number of projections are formed inside the lower edge of the case to give additional support and limit movement. Should a customer not require the carrying handle it can be replaced by a separate small plate under each fixing screw.

So that it may be easily changed, the number ring for the dial is clipped to the case. This method of fixing also allows considerable latitude in the relative positions of the case and dial. Alternative marking to suit customers' requirements is easily provided, as the number ring is moulded in transparent material and the marking is screen printed on the under-face, which is subsequently finished to suit the colour scheme of the telephone. The form of the cradle is such that the handset is received and correctly positioned, no matter how carelessly it may be replaced after use.

Dial

Pending the completion of current development work on a new dial which is being designed expressly for the telephone, the standard B.P.O. No. 12 trigger dial is fitted. A cover, vacuum formed from p.v.c. sheet, is clamped between the frame of the dial and its mounting bracket. In addition to protecting the dial contact springs, the flange of the cover rests against the telephone case and seals the space between dial and number ring.

Ringer

A new type of ringer has been developed which utilizes the latest ceramic permanent magnet material and a pressed iron frame to obtain stable performance with simplification. It is completely interchangeable with the B.P.O. Type 59A ringer and is fitted with a simple wire biasing spring when required to stop bell tinkle on party-line working.

Induction Coil

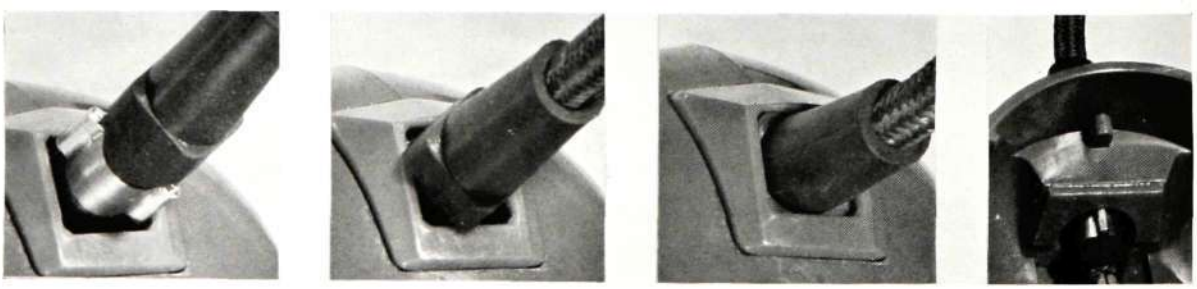
The induction coil is wound on a thermosetting plastic bobbin. The ends of the coil are joined directly to tags embedded in the bobbin cheeks so that the use of flexible end wires and internal joints is avoided. The grain-oriented silicon-iron laminations provide an efficient closed-loop magnetic core of small dimensions. Separate carbon resistors are used for the side-tone balance network, instead of non-inductive windings on the coil as heretofore.

Cords

Several new types of cords using p.v.c. insulated tinsel conductors have been developed for use with the Etelphone. Since previously established types can also be used there is considerable freedom of choice. In one of the varieties, the tinsel conductors are strengthened by a high-tenacity rayon core and insulated with high-grade p.v.c., giving a surface which is very easy to keep clean. One alternative to this has the outer sheath of braided nylon instead of p.v.c., the inner construction being the same.

Unless otherwise specified, the cords will be p.v.c. sheathed and coloured to match the handset, the desk cord being straight and the handset cord coiled. Alternatively, where it is desired to simplify problems of replacement, the same type of cords can be supplied but coloured ' Grebe ' for all colours of telephone. ' Grebe ' is a silver grey shade ideally suited to harmonize with all instrument colours. A second alternative offered is that of straight cords for both the handset and the desk but sheathed in Grebe nylon braid.

Rubber grommets are fixed to the ends of the cords to prevent strain on the connections. A forked



(*a*) (*b*) (*c*) (*d*)

Fig. 9—Showing method of securing the cord to the handset

(d) is an internal view. Others are external

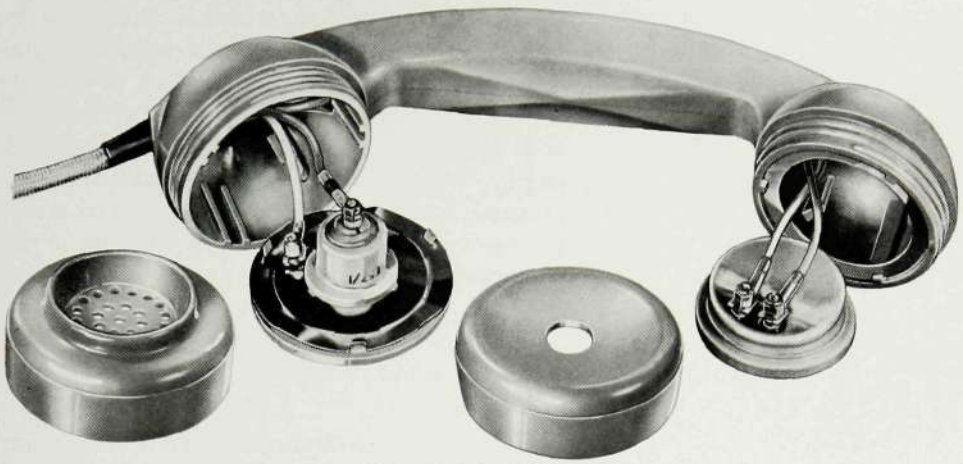


Fig. 10—The Handset

plate located by grooves in the grommets and holes in the base secures the cord to the telephone. At the handset end a metal ring is clinched over the grommet, and projections formed as the ring is fixed are used to secure it to the handset by a bayonet action which is shown in detail in Fig. 9.

Handset

The shape of the new lightweight handset, (Fig. 10), is both aesthetically pleasing and practical. The broad rectangular section and lateral contours of the handle form a shape which snugly fits the hand so that the transmitter is automatically held in the position of maximum efficiency. Wide-pitched special threads are moulded on to the handle, providing positive fixing for the earcap and mouthpiece without auxiliary locking devices. The transmitter and receiver are both inset capsules. They are self-locating and rest on spring rings which tension them against the caps and ensure correct mating of the mouldings under all conditions. The transmitter is the well known British Post Office Type 13, whilst the rocking armature receiver is the same as that used in the Type 1000 telephone and described in Bulletin No. 35, July 1957.

Circuit

Fig. 11 shows a typical circuit for the Etelphone. Variants of this are of course available to suit special requirements. The circuit uses a conventional hybrid transformer with a fixed balance network to reduce side-tone, and includes a regulator which is described in detail below. Four components are employed in the balance network (the ringer capacitor has a dual function) to obtain the best side-tone network ; this arrangement has the advantage that the connections within the instrument remain the same for different line conditions.

Regulator Network

The Etelphone is the first of the Company's sets to be fitted with a performance regulator. Recent developments in telephone instrument design have increased the sensitivity of the transducers so that the length of line can be increased without sacrificing the performance, or alternatively, the gauge of cable (and therefore line cost) reduced. Because of the success of these developments, a subscriber on a short

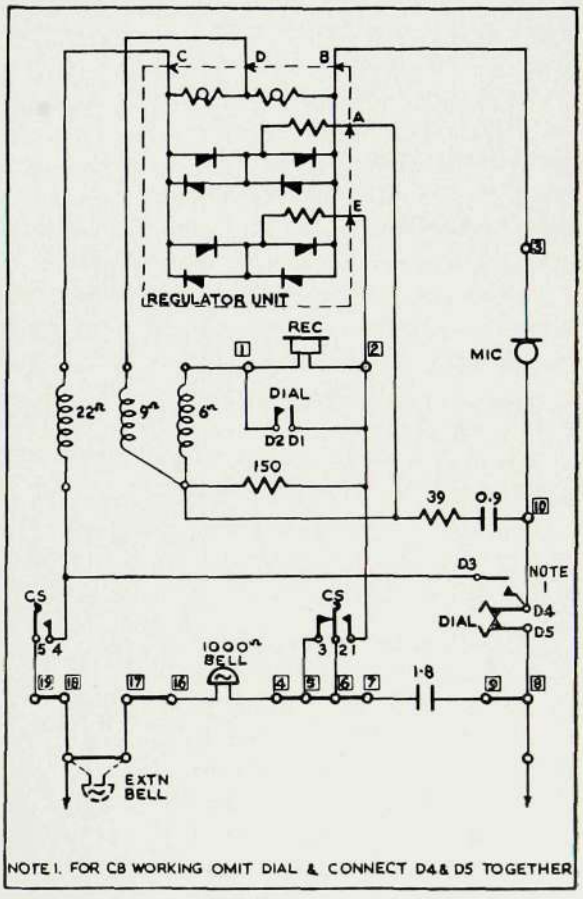


Fig. 11—The Telephone Circuit including Regulator Unit

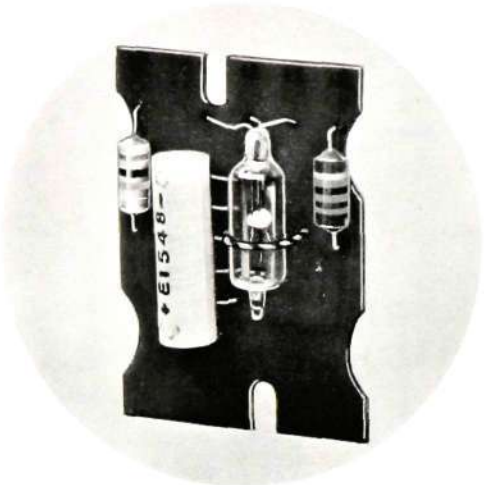


Fig. 12—Regulator Unit

line may now be embarrassed by the high efficiency of his telephone. Furthermore, a subscriber on a P.A.B.X. with a short local line and a long exchange line may be troubled by a considerable difference in level between local and exchange calls. The regulator has therefore been introduced in the Etelphone to reduce the sensitivity on short lines without affecting that on long lines.

Figs. 13a and 13b

Loudness Efficacy compared with Line Length

200 + 200 *ohm non-ballast bridge and* 50 *volt*, 600 *ohm junction*

Briefly, the action of the regulator is as follows :— rectifier units are connected across one winding of the induction coil and the transmitter, also across the transmitter through the ringer capacitor. The line current flows through a resistance lamp and applies d.c. bias to the rectifiers. The magnitude of the bias, and hence the impedance of the rectifiers, varies with the line current, which in turn depends on line resistance. The shunting effect of the rectifiers thus increases as the line resistance falls, so that the sensitivity of the telephone is controlled in such a way as to compensate for the change in level with line length. The regulating effect is increased by the resistance lamp, which has a non-linear characteristic, its resistance falling as the current increases so that the rectifier bias increases more rapidly than the line current. The rectifier unit across the coil winding controls both transmission and reception performance, whilst that across the transmitter limits transmission only.

An alternative method of regulation using silicon carbide discs has not been used in the Etelphone as

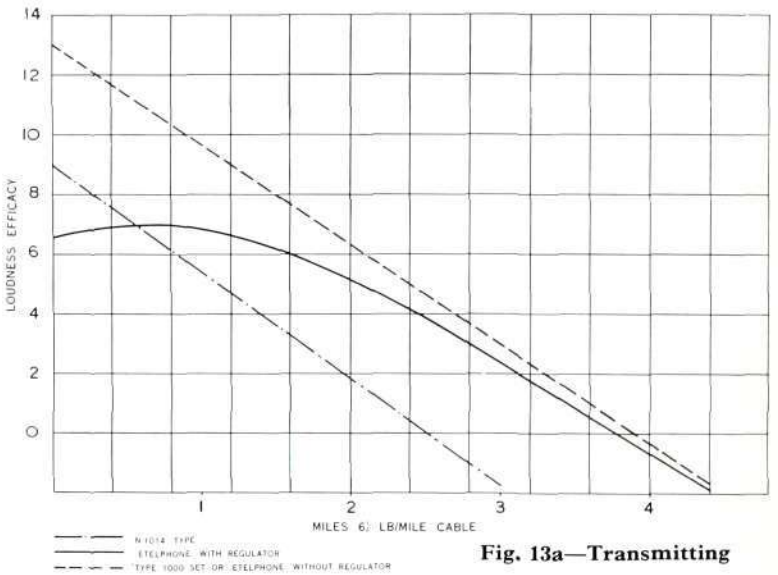


Fig. 13a—Transmitting

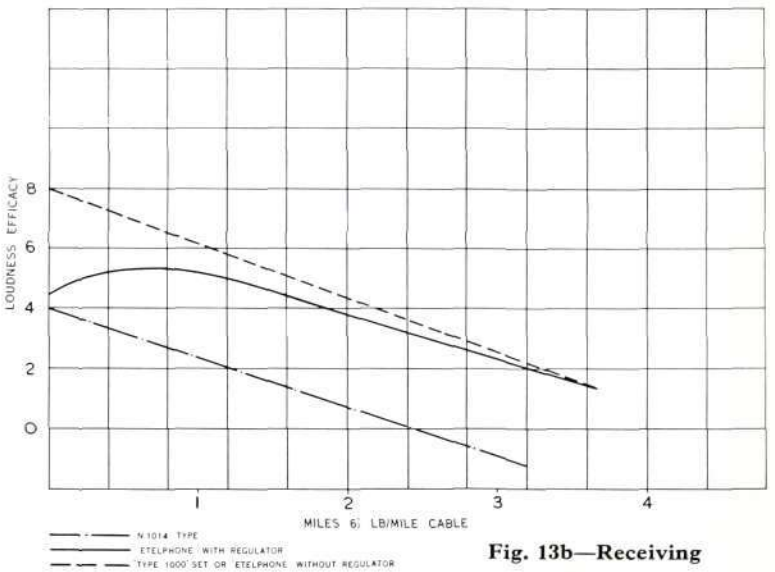


Fig. 13b—Receiving

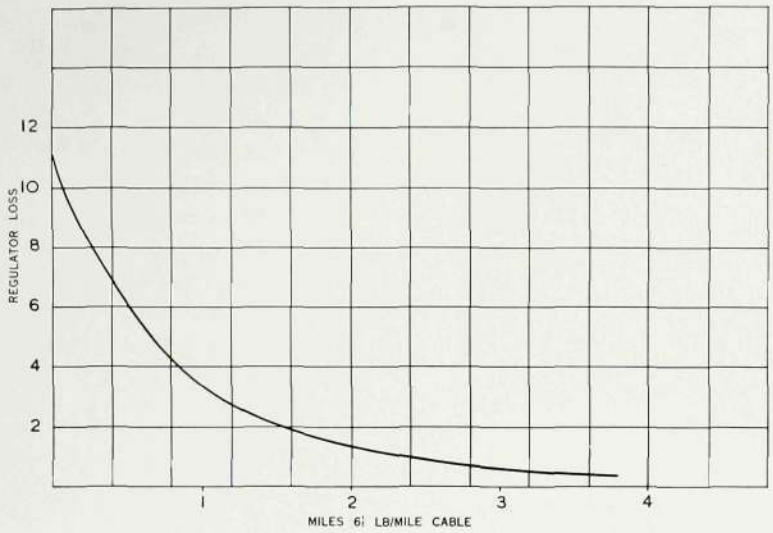


Fig. 14—Side-tone (Regulator Loss / Line Length)
200+200 ohm non-ballast bridge—50 volt, 600 ohm junction

it is very dependent on the resistance of the transmitter, which during the life of the telephone may alter sufficiently to upset the regulation. The rectifier-lamp regulator does not suffer from this disadvantage.

Fig. 15—Gauze Covers on base

The construction of a regulator unit is shown in Fig. 12. A printed circuit carries the components and also provides connection points for the contacts in the socket in which it is fitted. An off-centre locating slot prevents the incorrect insertion of the unit. To enable the telephone to be used without a regulator, a shorting strip is printed on the end of the printed circuit panel opposite to that which is normally plugged in. In the event of a component failure it is possible to reverse the panel, which removes the regulator from the circuit and makes the necessary alternative connections automatically.

Performance

As the performance of this telephone is, except for the regulator, the same as that of the Type 1000 which has been described in bulletin No. 35, it is only necessary to discuss the modification to which the regulator gives rise. Fig. 13 shows the curves of the transmission and reception performance of Type 332 (P.O.) and Type 1000 telephones and of an Etelphone fitted with a regulator. The curves are on a loudness basis and show that the transmission performance of the Etelphone on long lines is the equivalent of the Type 1000, and on short lines is similar to that of the P.O. Type 332. Fig. 14 shows the side-tone improvement due to the regulator.

Tropical Protection

The Etelphone is available with full tropical finish. All metal parts are specially protected, coils impregnated and openings limited to prevent the entry of insects. Fig. 15 shows gauze covers fitted over holes

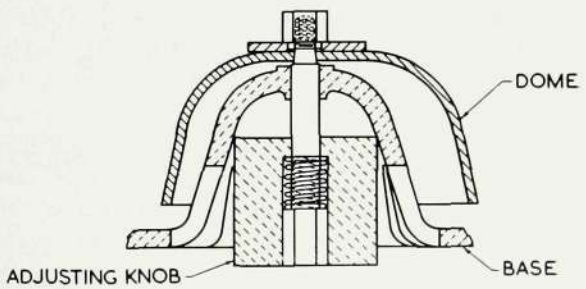


Fig. 16—Adjustable Dome Assembly

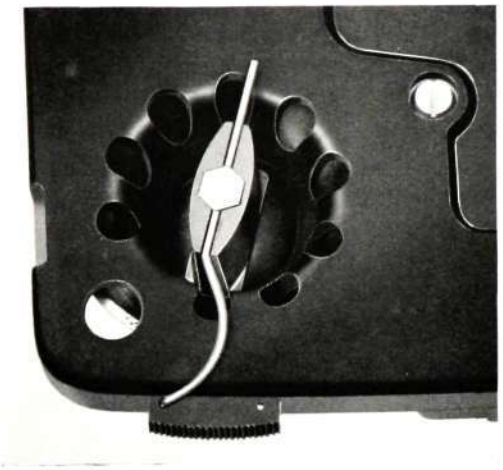


Fig. 17—Volume Control knob

in the base. A slotted press button dummy can be fitted to the case to give additional ventilation when necessary, but the air flow allowed by the clearance round the cradle switch actuating bracket arms is usually sufficient.

Optional Features Available

Bell Volume Adjustment

There are many situations in which it is advantageous to have the loudness of the bell under the subscriber's control. Calls for maintenance staff to adjust volume can be costly in a widespread network. In offices containing many telephones, it is useful to be able to adjust each instrument individually so that no confusion arises and the minimum of disturbance is caused. Parents of young children will readily appreciate the convenience of being able to quieten the bell at night. On the Etelphone, provision can be made for external control of the bell volume by the rotation of one eccentric dome after the ringer has been suitably readjusted. Fig. 16 shows a cross-sectional view of the adjustable dome assembly. The metal strap across the domes has a large clearance hole at one end and the normal screw and nut are replaced by a shouldered nut and long stud which are locked to the dome but rotate freely in the base. A moulded plastic knob is mounted on the stud and pressed against the base by a spiral spring in order to retain the adjusted position. Fig. 17 shows the adjusting knob with an extension to the side of the base ; in this way volume control can be made without moving the instrument. The loudness may be reduced over a range of approximately 15 db.

Shared Service

A shared service adaptor, Fig. 19, can be fitted to the main bracket by a single screw which is captive in the unit, and flexible leads terminating in spade tags are used for connection to terminals on the base. A rectifier, which was an essential part of the previous shared service units is no longer necessary because of the use of a high-speed micro-switch. The need to provide variable marking and colour has been met by making a detachable face for the press button. (Fig. 18). Marking is printed on the underface and finished in a colour to suit the telephone.

A locking switch similar to the shared service unit is also available. Pressure downwards on one end of the press button will operate and lock ; release is effected by pressure on the opposite end.

Dial Lock Switch

To prevent the origination of unauthorized calls, a special lock switch can be fitted. Fig. 20 shows the method of mounting the switch on the bracket across the ringer dome. A hole is drilled in the case to allow entry of the key.

Wall Mounting

As stated earlier, the Etelphone is available as a wall telephone. The conversion of the table instrument is a very simple matter and only entails the use of a new cradle bracket in place of the carrying handle on the case and turning the dial and number ring through 180 degrees.

A bracket which is secured to the wall, hooks into holes in the base from which the rubber feet have been removed. The lower fixing is by means of a

Fig. 18—Press Button Label Construction

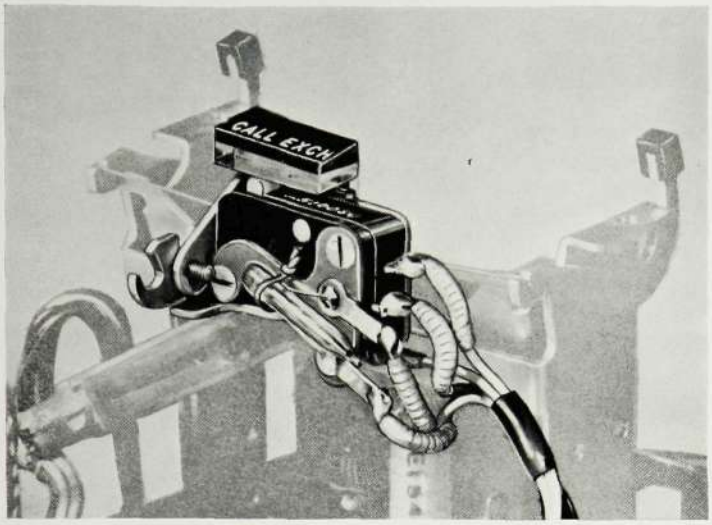


Fig. 19—Shared Service Adaptor

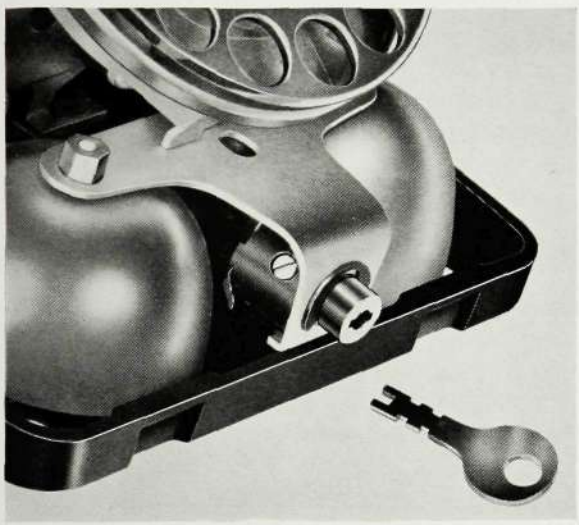


Fig. 20—Dial Lock Switch

single screw which passes through a bracket fitted to the base and is vertically in line with the top fixing screw in the wall bracket.

Handset with Amplifier

Amplified reception is particularly helpful to subscribers who are hard of hearing, but can also be of advantage to all users in noisy locations. An amplifier which is built into the handle of the handset, see Fig. 21, uses a single junction transistor, with operating power derived from the telephone line current when used with automatic and central battery systems and from the transmitter battery in local battery and magneto systems. The maximum gain of the amplifier is over 20 db. and can be adjusted by the subscriber by means of a miniature edgewise volume control which projects slightly from the handset. Sound output from the receiver is limited at a predetermined level to prevent damage to the user's hearing from clicks and transient noises. The amplifying handset is connected to standard types of Etelphones by means of the usual cord, and no changes are necessary within the instrument.

Future Developments

A further extension of the facilities provided by the Etelphone is visualized in the provision of Plan switching arrangements which are in course of development.

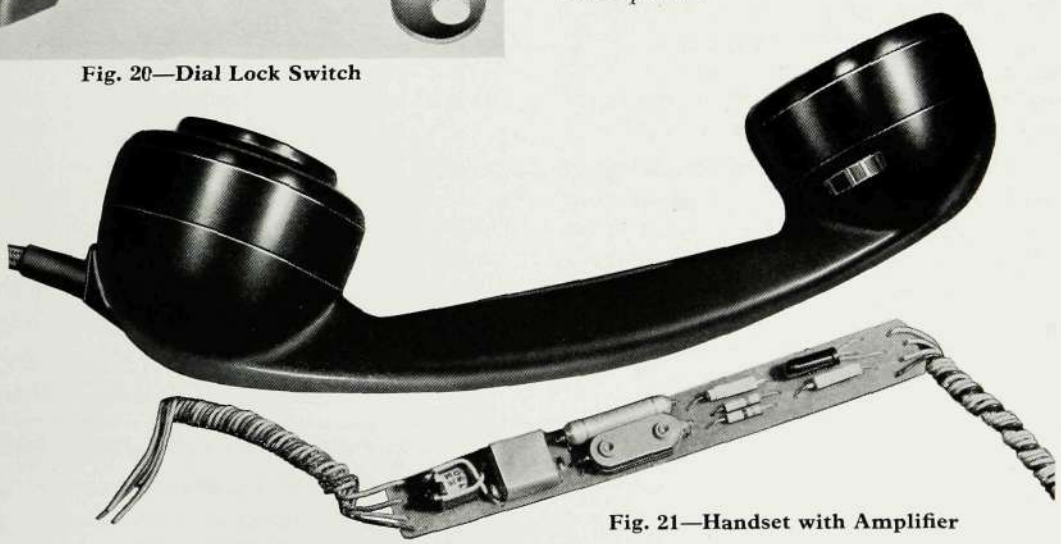


Fig. 21—Handset with Amplifier

ACKNOWLEDGMENTS

The Etelphone is a development of the Telephone 706 designed for the B.P.O., and Post Office Engineers were responsible for numerous and considerable contributions to the design which are duly acknowledged.

The tropicalised version of the instrument was developed in conjunction with Messrs. Preece, Cardew and Rider and acknowledgment is made to the assistance received from Sir Norman Frome and his staff.