Call Offices

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A description is given of the modern developments in the design of call office equipment and circuits.

Introduction.

THE general term, Call Office, covers all installations at which originated calls are paid for by the caller at the time the connexion is set up. The call office may or may not be equipped with a coin box. The latter type consists of a simple telephone of the microtelephone type, the call being obtained and the fee collected and recorded by the attendant. The disadvantage of this type of call office, in so far as it is available for public use only during the hours that the attendant is present, is recognized and the erection of call office kiosks, affording continuous service, either in addition to or in replacement of the existing arrangements is proceeding rapidly. By the end of this year the large schemes for the extension of the public call office service, now in progress throughout the country, should be completed, and by then the inhabitants of even the smallest hamlet in Great Britain, will, by means of its call office kiosk, be able to enjoy the same facilities afforded by the telephone as the inhabitants of the large cities.

Passing from the simplest type of installation, that of the kiosk on the quiet village green in the remote corners of the country, where the traffic carried may not average one call per week, the range extends to the very large suites of call office cabinets in the metropolis, which during the busy hours of the day provide some of the most heavily worked circuits on the whole telephone network.

The nature of the traffic carried varies from the usual everyday personal or business call to the extremely important emergency call in respect of fire, police and ambulance services. The public call office is still the principal and in many cases the only means of speedy access to these vital services, and it is found that as between the busy call office and one comparatively isolated and little used, the latter carries by far the greater proportion of calls of an emergency nature; also, the latter class of call office carries a far greater proportion of calls originated by persons unused to handling a telephone.

From the foregoing it will be appreciated that the process of establishing a normal call from a call office should demand as little as possible in the way of additional operating on the part of the caller to that which would normally be required for a similar call from a subscriber's installation and less, if possible, for emergency calls. Although development of call office equipment has by no means reached finality, the desired conditions are reasonably met in the new call office equipment.

In addition to the service aspect, it is recognized that a call office kiosk or cabinet, in presenting a high standard in so far as appearance is concerned, is one of the best possible publicity mediums, by virtue of the fact that it is the main point of contact between the telephone service and the non-subscriber. The call office equipment has therefore been redesigned and a new wallboard of exceptionally pleasing appearance introduced. These developments in equipment and layout, combined with the Jubilee kiosk[1] designed by Sir Giles Gilbert Scott, constitute a very definite step in the improvement of the appearance of public call offices.

New Layout arrangements for Public Call Offices.

The new wallboard, which is illustrated in Fig. **1**, is designed in the modern black and silver style, being constructed of bakelite-faced plywood with stainless steel fittings. Bakelite-faced plywood, a laminated board or plywood to which is cemented a facing of thin bakelite sheet, is a comparatively

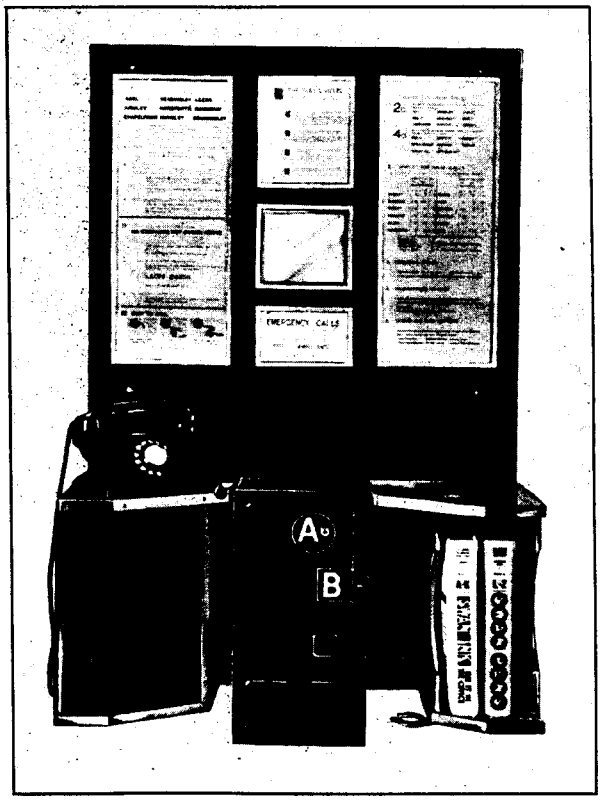


FIG. 1.—WALLBOARD ASSEMBLY.

new material and, except in so far as it has been used in some examples of modern shopfitting, this is perhaps the first time it has been introduced as a utility item for general use on a large scale. Bearing in mind the rough treatment which the call office equipment has to withstand at times, and the com-

[1] Kiosks. F. J. Judd. *P.O.E.E.J.*, Vol. 29, page 175.

paratively exposed conditions of a kiosk subjected to the extremes of temperature and humidity throughout the seasons, this material will undoubtedly be subjected to very exacting tests and it will be interesting to note how it stands up to the demands made upon it.

The complete wallboard is in two parts. The upper part carries the instruction card in the frame on the left, the tariff card in the frame on the right, a publicity notice in the frame at the top centre, a mirror in the centre and the emergency call notice with, in the case of the manual (CB) system, the emergency calling button in the frame at the bottom centre. All these frames are made of stainless steel and in view of their special construction will be dealt with in greater detail later.

The lower part of the wallboard carries a receptacle on the left, in which callers may temporarily deposit parcels and a receptacle on the right to hold the directories. The back of this part of the wallboard and the sides of the two receptacles are of ebonized wood. The bottoms of the two receptacles have the words PARCELS and DIRECTORIES respectively embossed thereon. The top of each receptacle is of bakelite-faced plywood with a nosing of stainless steel. A stainless steel fitment in which a caller may rest a pipe or cigarette, with an open grille through which the ash can fall is let into the top of the parcels receptacle and a hook to support an umbrella is fixed to the underside of the bottom of the directory receptacle.

In order that the joint between the upper and lower parts of the wallboard should be as unobtrusive as possible it is arranged that this is behind, and about half an inch below, the top of the receptacles and coin box. An accurate joint is ensured by means of a tongue on the upper part which fits into a corresponding groove on the lower part; lateral movement of the two parts is prevented by a dowel in the centre of the tongue and groove.

The coin box is fitted in the centre of the wallboard, the top being level with the top of the two receptacles, forming in effect a shelf across the whole width of the kiosk. This shelf is at such a height that the top of the directories receptacle can conveniently be used by the caller as a writing desk.

The telephone, which is of the microtelephone type, is secured to the top of the parcels receptacle in the following manner. The base, which is without the usual four rubber feet, is first screwed to the shelf through four suitably placed holes. The body of the microtelephone is then screwed to the base by means of two trapped screws in the base, access to these screws being gained by two clear holes in the shelf. It will be appreciated that for maintenance purposes it is not necessary to remove the base; the body of the microtelephone is readily removed from the base by releasing the two trapped screws.

Apart from the lead-covered leading-in cable, the cord from the telephone is the only wiring passing behind the wallboard. This cord is of the tough rubber covered type and, in view of the past difficulties experienced in some localities due to low insulation, it is considered that this arrangement is a marked improvement and should materially assist in maintenance.

In order to provide an adequate safeguard against theft and as breakages are not anticipated to be frequent, the frame carrying the mirror has been secured by screws passing completely through the wallboard and nutted at the rear. The other frames have been specially designed with a view to affording the easiest possible means for the replacement of the various notices consistent with a reasonable safeguard against interference by unauthorized persons. An important point which has received careful consideration in the design of these frames is the prevention, so far as possible, of the entry of dirt and damp, which was more or less inevitable with the old type wood frames with the opening at the top. The construction of these frames is illustrated in **Fig. 2.**

(a) and (b) are two strips of channel brass which are screwed to the wallboard horizontally, (a) at the top and (b) at the bottom levels of the frame. The notice, glass and pasteboard backing sheet slide into these channels from the side. Over the whole of the foregoing assembly is placed a stainless steel cover in the form of a surround. It will be seen that this surround has two dowels riveted to the inside of the top edge which register with two holes in the top of the channel (a). The surround is first hung on the top channel and then pressed home over the bottom channel. In so doing the two projections on the bottom edge of the surround engage and lock on the steel spring catch in the bottom channel. This catch is in fact a double catch in so far as it is fixed at its centre with both ends free, each engaging independently with the relative pin in the surround. Two small holes are provided in the bottom of the surround to afford access for the release of the spring catch. It will be appreciated that the provision of a double catch, both sides of which must be operated together to release the surround, materially reduces the risk of unauthorized interference with the notice. To facilitate the removal of the surround, the key

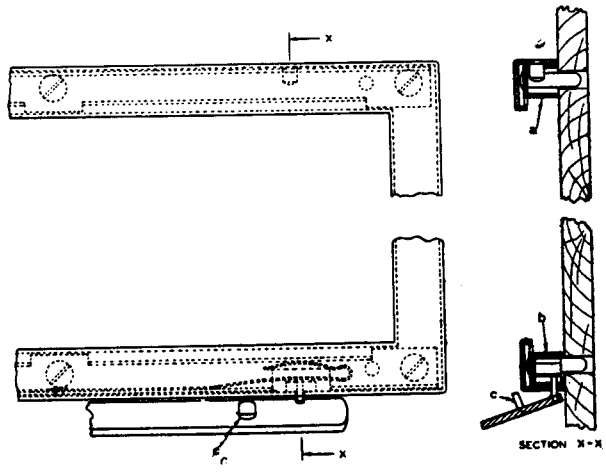


FIG. 2.—CONSTRUCTION OF NOTICE FRAME.

shown at the bottom has been introduced. This key, made of mild steel, has two pins which register with the corresponding holes in the bottom of the surround. An upward pressure with this tool will release both sides of the spring catch and easing the surround forward enables it to be readily removed. In order to safeguard against the risk of scratching the surface of the wallboard when using this tool the two projections (c) are provided. These projections engage on the front of the surround and thus the back edge of the tool is kept clear of the wallboard.

To change a notice card, the surround is first removed as indicated above and the card bent forward and withdrawn. To fit a new glass, it is necessary to unscrew and remove the top channel.

The special emergency notice for manual (CB) systems is by virtue of the information it conveys, required to be displayed in a prominent position and, in addition, in as close proximity to the emergency press button as possible; to meet these requirements the label has been designed to surround the press button.

This arrangement precludes the use of any form of protective covering and the notice must therefore be of a durable nature. The use of the more usual forms of engraved notice with coloured filling suffers from the disadvantage of discolouration and falling out of the filling and recourse has therefore been made to a comparatively new material. The material chosen is laminated bakelite having a black upper surface on a white base. The lettering appears white on a black background by engraving completely through the black upper surface to the white base below.

The notice has a hole in the centre through which passes the barrel of the press button and to enhance further the appearance of the assembly the brass flange of the press button is covered with a stainless steel cap.

In the design of the new wallboard endeavour has been made to obscure, as far as possible, all items of equipment with which the caller is not directly concerned. The apparatus usually mounted in the bell set and the auxilliary apparatus required for prepayment coin box working on the manual (CB) system and certain U.A.X. systems is now mounted inside the coin-box. (These items will be dealt with in greater detail later). There are, however, two items, the protector, and the local speaking battery for CBS systems, which are not readily adaptable for mounting in this manner. The protector, when required, will be screwed to the right and near to the top inside the parcels receptacle. As this item is already in a black material and harmonizes reasonably well with the general appearance of the layout, no further covering is considered necessary. The local speaking battery must, of course, be protected against interference and at the same time it must be unobtrusive. These two factors have been met by mounting the battery at the rear of the parcels receptacle behind an ebonized wood partition. The battery normally consists of two dry cells type DR2, but where transmission requirements necessitate it, i.e., for long lines, etc., three cells are provided. The receptacle accommodates two cells in the normal upright position but when three cells are used, they must be placed on their sides, one above the other. Since the bottom of this receptacle is metal covered a rubber mat is provided on which to stand the battery in order to ensure adequate insulation.

Coin-Boxes.

The multi-coin box, which permits the insertion of fees up to any amount, thereby enabling a caller to make toll and trunk calls without the assistance of an attendant, is the standard for all coin box installations. With the exception of a few call office suites where trans-continental and trans-Atlantic calls involving very large fees are handled, and some special suites such as those serving stock exchanges, where special operating procedure is required due to the nature of the business transacted, the services of an attendant have been abolished.

The multi-coin box is available in two types, the prepayment coin box which is the standard for use on automatic and manual (CB) systems, and the postpayment coin box which is the standard on all local battery systems.

With prepayment working on an automatic system the insertion of two pennies in the coin box, in advance, enables the caller to dial any number within the local fee area and the call is completed automatically without the assistance of the telephonist. Toll and trunk calls are obtainable via the manual board telephonist by dialling " O." No money is inserted before dialling " O," the whole of the fee for these calls being inserted at the request of and under the supervision of the telephonist. Emergency calls are also obtained by dialling "O" but no charge is, of course, made in respect of these calls.

On the manual (CB) system it is necessary to insert two pennies to call the exchange for all calls except emergency calls. Emergency calls are obtained by pressing the special emergency call button which causes a distinctive calling signal to be displayed on the exchange switchboard. All calls are completed manually, the telephonist checking the insertion of the additional fee required for toll and trunk calls.

On local battery systems, prepayment working offers no advantage over postpayment working. Any small saving which might be effected in operating costs would not compensate for the provision of the more complicated and expensive prepayment box. In postpayment working, it is not necessary to insert any portion of the fee in order to call the exchange, the whole fee being inserted at the request of and under the supervision of the telephonist after she has obtained the wanted party and is holding that party in readiness to complete the connexion.

As previously stated the apparatus normally mounted in the bell set and such auxiliary apparatus as is required for manual (C.B.) and certain U.A.X. systems, are now mounted at the back of the mechanism compartment of the coin box.

To effect this modification four new bell sets have been introduced, for

(a) automatic systems (other than U.A.X.'s Nos. 5 and 6).
(b) U.A.X. Nos. 5 and 6 systems.
(c) C.B. exchanges.
(d) C.B.S. exchanges.

Each of these units is completely self contained and inter-changeable, utilizing the same mild steel mounting plate. The bell set required for use in C.B. areas is shown in Fig. **3.** This feature of interchangeability is of particular value at the time of the conversion of the exchange system of working. As an instance, the conversion from manual (C.B.) to automatic working can be made by the substitution of the C.B. bell set by the automatic bell set and the provision of a dial.

It will be observed that three key hole slots are provided in the mounting plate and these are so placed as to engage with three screws in the back panel of the coin box used for mounting the unit.

Fig. **4** shows the prepayment multi-coin box as used on public call offices in automatic and manual (C.B.) areas; the bell set shown mounted at the rear of the coin box is that used for automatic systems other than U.A.X.'s Nos. 5 and 6. In this coin box, as in all coin boxes used on public call offices, the cash is withdrawn by means of a sliding plate in the bottom of the cash receptacle. This plate is secured by means of a combination lock let into a recess on the left-hand side of the box.

FIG. 3.—BELL SET FOR MANUAL C.B. SYSTEM.

In the corresponding coin box for use on sub-

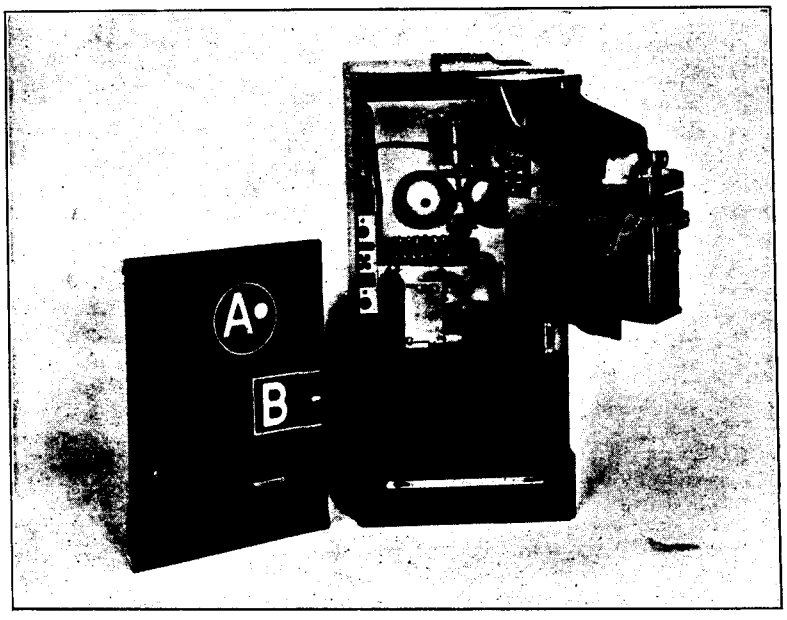


FIG. 4.—PREPAYMENT MULTI-COIN BOX.

scribers' circuits the cash receptacle is in the form of a drawer. This arrangement is necessary as the coin box is often required to be secured to the top of a desk or table. The drawer is secured by means of a padlock.

The postpayment multi-coin box used on C.B.S. 1, 2 and 3 systems is generally similar. Only one bells set is used, the necessary circuit modifications being made on the connexion strip.

Prepayment Mechanism (Fig. **5.**)

On the top of the mechanism is a plate having three slots through which coins are inserted.

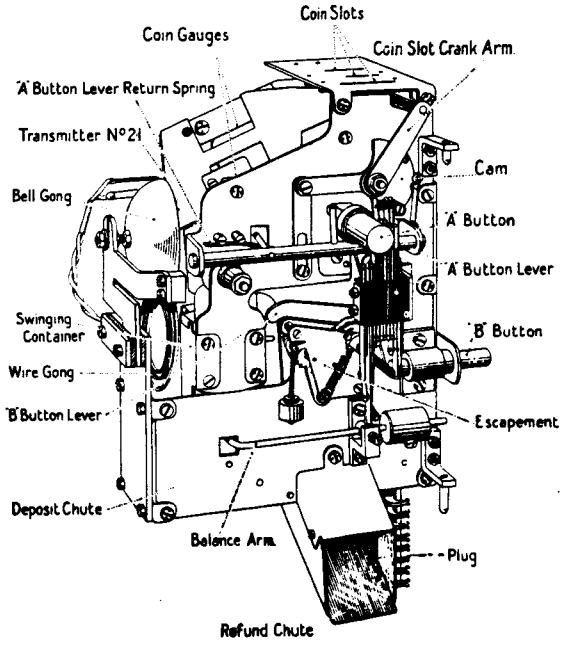


FIG. 5.—PREPAYMENT MECHANISM.

These slots are just large enough to permit the insertion of a penny, a sixpence and a shilling respectively. Coins larger than the correct denomination or mis-shapen coins cannot be inserted and in order to guard against wear, with consequent variation in the gauging, this plate is made of tool steel.

Each of the slots is situated over an inclined coin guide which carries a gauge to check against coins smaller than the correct denomination. To illustrate the action of these gauges the penny guide and gauge are shown in detail in Fig. **6** It will be observed that the guide is inclined in two directions, the inclination downwards causes the coin to roll past the gauge and the tilt backwards ensures that the coin, which is given an initial inclination by the tilting plate at the top of the guide, is bound to make contact with the gauge. The aperture formed by the gauge is the minimum acceptable diameter of the particular coin concerned; acceptable coins will,

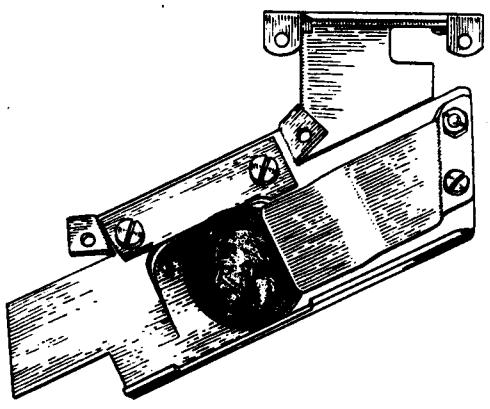


FIG. 6.—PENNY GUIDE AND GAUGE.

therefore, be supported past the gauge, whereas smaller coins will fall through. Rejected coins, that is coins which have fallen through the gauge, are returned to the caller via the refund chute on the front of the coin box.

Directly below the coin slots is a crank arm. The first coin inserted operates this arm which causes a cam to rotate and operate spring assembly No. 1. The cam is retained in the operated position by a flat steel spring furnished with a roller engaging in a recess in its periphery.

At a short distance from the end of the coin guides are fixed the gongs which, in conjunction with the coin box transmitter, transmit distinctive sounds to the telephonist to permit a check of such additional fees as may be required for toll and trunk calls. The distance between the gongs and the coin guides is slightly greater than the diameter of the coins and they will, therefore, fall past the gongs. The momentum gained in rolling down the inclined guide, however, ensures the coins striking the gongs before falling.

The coin box transmitter is a simple microphone button modified for this particular purpose by substituting a thin ebonite diaphragm in place of the usual mica diaphragm and packing the granule chamber full and tight with carbon granules. The button is thereby made practically unresponsive to speech, functioning only in response to mechanical vibration. The button is fixed inside the bell gong used to transmit the silver signals; a sixpence strikes the bell once on the bottom edge, a shilling, by means of a double guide, is caused to strike the bell gong twice, first on the top edge and then on the bottom edge.

Alongside the bell gong and at the end of the " penny " guide is fixed a wire gong; each penny inserted strikes this wire gong once. This wire gong is rigidly fixed to the same mounting as the bell gong and the vibrations of the former are transmitted to the coin box transmitter by vibration of the mounting. As the bell gong emits a high-pitched note and the wire gong a low-pitched note, distinctive signals in the form of one high-pitched note for a sixpence, two high-pitched notes for a shilling and one low-pitched note for a penny are transmitted to the telephonist.

It will be noted that the whole of the gong assembly is mechanically insulated from the remainder of the coin box. This course is necessary in order to guard against the voice of the caller being picked up by the coin box transmitter. In the early types of prepayment coin box it was found that a conversation of a reasonable commercial standard could, in some circumstances, be carried on even with the telephone transmitter short-circuited. It was at one time thought that this was due to the caller's voice reaching the coin box transmitter via the refund chute. Exhaustive tests, however, proved that the real cause was the vibration of the casework, in response to the caller's voice, being transmitted to the coin box transmitter, the response of the coin box transmitter to direct sound pressure being practically negligible. The obvious remedy was to insulate the gong assembly mechanically and it is, therefore, now mounted on pads of soft rubber with rubber collets and washers on the fixing screws.

Each coin after striking its respective gong falls down the swinging container and comes to rest on the balance arm.

The balance arm performs two functions, the first of which is to check the correctness of the initial fee, i.e., 2d., for local calls. To do this it is adjusted by means of the sliding weight so that it will just operate with the weight of two well worn pennies. The second function of the balance arm is to support all coins inserted and to hold them in suspense until the fee is deposited and conversation with the called party is established by depression of button A or the call abandoned and the fee refunded by depression of button B. The operation of the balance arm operates spring assembly No. 2.

The "A" button operates the A button lever which restores spring assembly No. 1 and also causes the swinging container to swing to the left over the deposit chute. In so doing all coins held in suspense are tipped off the balance arm and caused to fall through into the cash compartment. The release of the coins from the balance arm allows it to return to its normal position, thereby restoring spring assembly No. 2.

The depression of the "B" button operates the B button lever which causes the swinging container to swing to the right, and all coins held in suspense are caused to fall into the refund chute and are returned to the caller. The release of the coins from the balance arm allows it, as before, to return to its normal position and to restore spring assembly No. 2. The B button lever also operates the portion of the A button lever which restores spring assembly No. 1.

In addition to the foregoing, the " B " button operates spring assembly No. 3. The restoration of this spring assembly is controlled by the escapement mechanism which, by means of a pendulum bob, is adjusted to restore in approximately seven seconds.

Post-payment Mechanism. (Fig. 7.)

With this simple coin box it is necessary only to check each coin inserted and indicate to the telephonist the denomination of each coin accepted. Accepted coins fall direct into the cash compartment, rejected coins being returned to the caller via the refund chute.

The coin slots, guides, gauges, gongs and coin box transmitter are precisely the same as and perform similar functions to those in the prepayment box.

The coin slot crank arm is, however, directly engaged with the change-over spring assembly and escapement mechanism. As each coin is inserted it engages the coin slot crank arm which, in turn, operates the change-over spring assembly. The spring assembly returns to normal under control of the escapement mechanism in $1\frac{1}{2}$ to 2 seconds.

To enable the postpayment coin box to be used in conjunction with the new wallboard, and also in order to accommodate the bell set inside the coin box, it has been necessary to make use of the large outer case, as used for the prepayment box. In fitting the postpayment mechanism, which is smaller than the prepayment mechanism, in the large case, a gap is left between the coin chute and the aperture through which coins are deposited in the cash compartment. A coin chute extension, to bridge this gap, has therefore been introduced and this is screwed to the mechanism in the manner shown in Fig. 7. Although the top fixing lug on the postpayment mechanism is in the same relative position as the top lug on the prepayment box, the positions of the bottom lugs do not correspond. The bottom lug on the postpayment box is, however, in the same relative position as the "B" button on the prepayment box and as the aperture for the "B" button in the casework needs to be covered, it has been possible to introduce a simple fitment which serves both as a means of blocking the "B" button aperture and also as a support for the bottom lug on the postpayment mechanism.

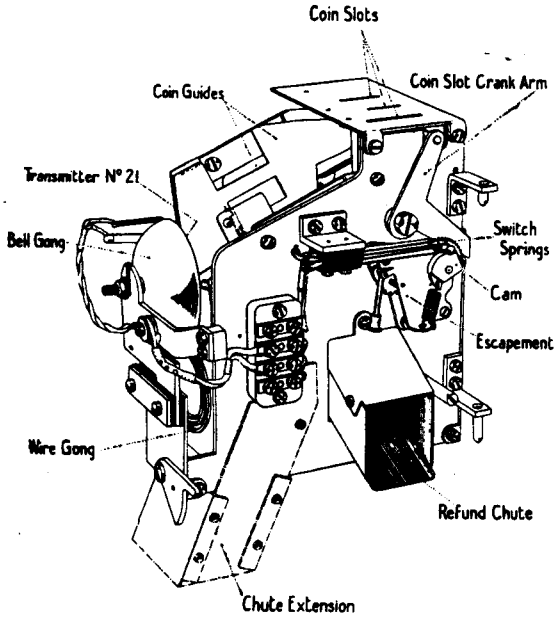


FIG. 7.—POSTPAYMENT MECHANISM.

Fraud Preventive Devices.

It is a well known fact that a receiver will function very satisfactorily as a transmitter and advantage has sometimes been taken of this fact to avoid the deposit of the calling fee. It is difficult to degrade the transmitter effect of the receiver without also degrading its performance as a receiver but after exhaustive tests it has been found that a 200 ohm non-inductive shunt placed across the receiver while the money is in suspense effectively bars the use of the receiver as a transmitter for average line conditions, although its fraud preventive value decreases on very short lines.

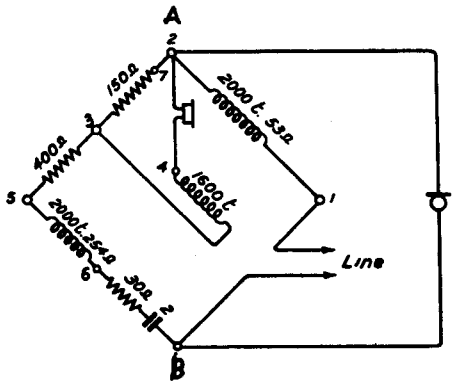
One very important factor which must not be overlooked in fraud preventive devices is the relation between the possible loss in revenue due to perpetration of the fraud and the cost of providing a preventive device. A preventive device has been developed for every known type of fraud, but the relation between the losses and the cost of the device does not always warrant the expense, or the resultant complication of the mechanism or circuit, which would result from its inclusion.

Transmission Circuits.

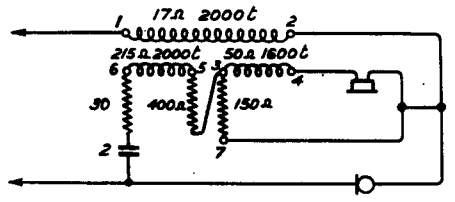
The transmission circuit for automatic and manual (C.B.) systems employs the new arrangement for the suppression of side-tone, which is of even greater importance in call offices than in subscribers' stations in view of the noisy situations in which many call offices have to be placed. Very often the more desirable the site for a call office both from the viewpoint of meeting the public need and from its revenue earning capacity, the more serious is the effect of extraneous noise, and the provision of some form of side-tone suppression becomes a necessity if satisfactory working is to be maintained.

A comprehensive explanation of the new anti-side-tone arrangement would be somewhat complicated and would need to be dealt with mathematically and this is perhaps outside the scope of an article of this nature. A simple, non-mathematical, explanation can, however, be arrived at if the essential portions of the circuit only are considered in the form of a " bridge," as indicated in Fig. 8a.

Both the inductive and non-inductive windings are wound on the same core; the complete item being known as the anti-side-tone induction coil. In Fig. 8a the resistance shown against each winding is its A.C. resistance at 800 c.p.s. Fig. 8b, which shows the coil in its conventional form, should enable the " bridge " to be readily comprehended when considering the complete circuits dealt with later; in this figure the resistance shown against each winding is its D.C. resistance. Referring to Fig. 8a and considering the transmitter as a generator of alternating current, the current generated will divide at the points A B between the two paths 2-3-5-6-two μF condenser and 2-1-line. If the impedances of the two paths are identical the currents will be



(*a*) Theoretical Circuit.



(*b*) Practical Circuit.

Fig. 8.—Anti-Side-Tone Telephone Circuit.

equal and in phase—and as the two 2,000t windings are in opposition—no E.M.F. will be induced in the 1,600t winding. However, as the line impedance varies considerably, the currents in the two 2,000t windings will not be exactly equal, or in phase, and some degree of side-tone will persist. In order therefore to effect a further reduction, the lower end of the 1,600t winding is tapped to a point 3 and the P.D. developed across the resistance 2-3 will cause a current to flow in the receiver path. The current flowing in the receiver path due to the P.D. across 2.3 and the current induced in the 1,600t winding by the out-of-balance conditions of the bridge will oppose each other and it is assumed, with the particular values used in the design of this coil, that these two currents will be as nearly as possible equal and opposite, thereby reducing the side-tone to a minimum. The function of the condenser in the " bridge " is to ensure that the current flowing in the path 2-3-5-6 has a negative angle. This factor, bearing in mind that with very few exceptions the current from line has a negative angle, is essential in order to ensure that the current in each arm of the " bridge " shall be in phase.

As regards the reception of speech incoming from line, the received current, ignoring the shunting effect of the transmitter which is small and has little effect on the overall performance, will take the path 1-2-3-5-6. In this direction the two 2,000t windings assist each other in inducing an E.M.F. in the 1,600t winding. The path for the receiver and the 1,600t winding is completed *via* the non-inductive winding 2-3; the two currents in the winding 2-3 due to the current received from line and the induced current through the 1,600t winding are in the same direction.

The following table shows the number of db's reduction in side tone when using the anti-side-tone induction coil as compared with the telephone No. 162, each being connected to similar lines of various types.

Junction.	Type.	Local Line. Resistance. 350 ohms.	176 ohms.	80 ohms.
		db	db	db
Non-reactive Z_0=600 ohms.	non-reactive	− 9	−11	−11
	10 lb. cable	− 3	−12	−10
	20 lb. cable	− 3	− 7	−13
20 lb. cable	non-reactive	−12	− 9	−10
	10 lb. cable	− 1	.0	− 7
	20 lb. cable	− 3	− 4	− 5

Tests under working conditions, with average amounts of noise picked up by the transmitter, show that the reduced side tone effects an improvement in reception compared with a telephone No. 162, equivalent to a reduction in line attenuation of about 3 db. There is also the psychological factor, in so far as the reduced side-tone causes the speaker to speak more loudly, which results in a further improvement amounting to 2 to 3 db.

The transmission circuit arrangements for the local battery systems employ the normal three-winding induction coil which can be considered as an auto-transformer, the three windings being arranged to match as nearly as possible the impedances of the line, receiver and transmitter respectively. No attempt is made in this arrangement to effect suppression of side-tone; the need for such a device is however recognized and will, no doubt, be incorporated later when the development work now proceeding is completed.

Circuit Operation.

Automatic System. (*Fig.* 9)

To originate a local call the user removes the microtelephone and inserts two pennies in the " Penny " slot. The insertion of the first coin causes the crank-arm to operate spring assembly (1).

(1)A serves to shunt the receiver with a 200-ohm resistor, thereby degrading the receiver to such an extent as to prevent its misuse as a transmitter when the call has matured.

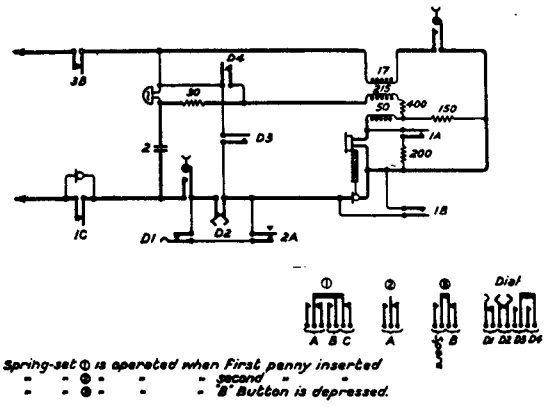


FIG. 9.—PREPAYMENT CIRCUIT, AUTO SYSTEM.

(1)B short-circuits the transmitter to ensure that transmission is not possible until the springset has been restored to normal, i.e., by operation of the "A" button.

(1)C opens the circuit of the coin-box transmitter to enable the operator to check the denomination of coins should the caller desire a trunk or toll call.

The second penny—by its added weight—operates the balance arm and effects the change-over of spring assembly (2).

(2)A removes a short-circuit from the dial impulsing springs to allow dialling to proceed.

The caller proceeds to dial the required number, and while the dial is off-normal contacts D3 and D4 close.

D3 short-circuits the telephone circuit.

D4 short-circuits the bell *via* the 30-ohm resistor to avoid bell tinkling.

In addition, D3 and D4 complete a spark quench circuit for the dial impulsing springs by connecting the 2 μF condenser and 30-ohm resistor across D2.

On hearing the wanted subscriber answer the caller will depress button A to deposit the calling fee. This action allows springsets (1) and (2) to return to normal, thus restoring the circuit for transmission purposes to the equivalent of a subscriber's standard termination.

Ineffective Calls.—When a call cannot be completed, e.g., line engaged, the caller will, on receiving busy tone, depress button B to recover the suspended coins; this action will restore spring assemblies (1) and (2) and operate spring assembly (3), which is held in the operated position for approximately 7 seconds by the action of a mechanical escapement; during this period a disconnexion of the line at 3B allows the exchange apparatus to restore to normal.

" Deposit-free " Calls.—A call to the manual board operator for inquiries, etc., may be made by dialling " O " without the insertion of coins.

Due to the special cam provided on dials fitted in call offices, the spring set D1 is operated when the dial is fully rotated (i.e., when dialling "O"), thereby removing the short-circuit across D2. In these circumstances the precautionary measures taken by arranging the operation of spring sets (1) and (2) are unnecessary.

With some U.A.X.'s which employ the standard auto circuit, the numbering scheme is such that calls outside the unit fee area are obtained by dialling a level other than " O " and a special cam fitted to the dial of call office circuits permits the operation of the dial auxiliary springs (D1) on the dialling of any predetermined number.

C.B. (Manual) System. (Fig. **10.**)

As in automatic areas the subscriber removes the microtelephone and inserts two pennies to effect a call.

The first penny operates the crank arm, which, in turn, operates spring assembly (1).

(1)A shunts the receiver thus avoiding its misuse as a transmitter.

(1)B prepares the " calling " earth circuit.

(1)C removes a short-circuit across relay T and the coin box transmitter.

The additional weight of the second penny on the balance arm effects the operation of spring set (2).

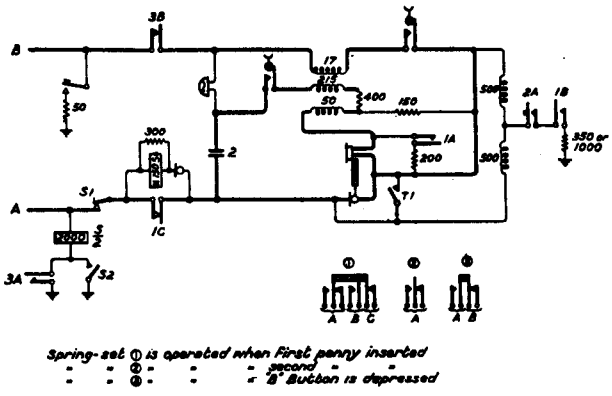


FIG. **10.**—PREPAYMENT CIRCUIT, MANUAL C.B. SYSTEM.

(2)A completes the calling earth circuit (which was prepared by 1B) and applies earth *via* the bridging coil to the A and B lines.

The B line earth serves to operate relay LR at the exchange. Relay X will not operate in series with relay LR due to the presence of a resistor in the earth connexion at (1)B.

*LR*1 *via* X1 completes a circuit for the calling lamp.

The operator inserts the answering plug of the call office cord circuit (Fig. **11**) into the answering jack, thereby operating relay CO from battery on the cord circuit plug sleeve. CO1 serves no purpose; CO2 disconnects the circuit of relay LR and thereby breaks the calling lamp circuit. Relay LA operates from the telephone loop to battery *via* RA and at LA1 completes a shunt across the answering lamp to effect supervision. (The polarized relay T at the call office will not operate to battery on the B line.)

The earth condition on the line applied by the coin box spring sets still persists, but due to the combined resistance of the bridging coil and resistor (in earth lead) relay LA is not affected by this condition.

The operator throws the cord circuit speak key to ascertain the number required by the caller; at this stage the " out of balance " condition which would exist had the calling earth been applied to the B line only, is avoided by the balancing earth on the A line. It is, primarily, for this purpose that the calling earth is connected to both lines.

Having ascertained the number required the operator completes the connexion by inserting the calling plug into the multiple jack. Relay SA operates to earth *via* the wanted subscriber's CO relay.

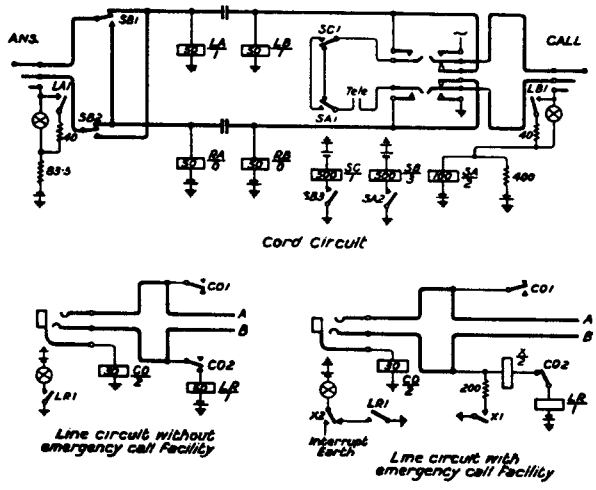


FIG. 11.—CORD AND LINE CIRCUIT, MANUAL C.B. SYSTEM.

SA1 disconnects the operator's telephone circuit.

SA2 completes a circuit for relay SB.

Relay SB operates.

SB1 and SB2 change over to reverse the direction of current flowing around the telephone loop.

SB3 completes a circuit for relay SC.

SC1 completes the operator's telephone circuit which was disconnected on the operation of SA1. The disconnexion of the operator's circuit during the operation of relay SB avoids the reception of a distressing click which would be given in the operator's receiver by the momentary disconnexion and reconnexion on the answering side of the transmission bridge, caused by the operation of contact units SB1 and SB2. The operation of relay T at the call office is effected by the reversal of current from the cord circuit, and T1 short-circuits the caller's transmitter.

The operator rings the wanted subscriber in the usual way and the latter, on answering, is heard by the caller. The calling subscriber, however, cannot reply due to the transmitter being short-circuited by the operated contact of the relay T. As stated on the instruction card, conversation is made possible by depressing button A; this action serves to deposit the suspended coins into the cash-box and, in addition, to restore to normal the spring-sets (1) and (2).

(1)A removes the 200-ohm shunt from the receiver to restore this part of the circuit to normal.

(1)B and (2) A remove the calling earth from the A and B lines.

(1)C short-circuits relay T and the coin-box transmitter.

Relay T releases and at T1 removes the short-circuit from across the transmitter, thus completing the restoration of the circuit to normal.

Ineffective Calls.—When a call cannot be completed the caller will depress button B to recover the suspended coins, thus restoring spring sets (1) and (2) to normal and operating—for approximately 7 seconds—spring assembly (3).

(3)A completes a circuit to allow the operation of relay S from battery of the cord circuit over the A line.

(3)B disconnects the B line thereby releasing relay LA to give a clear to the operator on the answering supervisory lamp.

Relay S operates.

S1 disconnects the A line from the telephone circuit.

S2 completes a locking circuit for relay S to make this circuit independent of the "seven second" operated 3A.

Relay S remains operated until the operator withdraws the cord circuit plug from the jack to restore the circuit to normal.

Emergency Calls.—Certain calls from public call offices, e.g., fire, etc., are permitted free of charge. In this case it is not necessary for the caller to insert coins; the call may be made by depression of the emergency button. It is essential that the operator should be able to discriminate between this type of call and an ordinary call, in order that fraudulent use of the circuit may be avoided. For this reason relay X is connected in the calling circuit in series with relay LR. Operation of the call office emergency button connects a low resistance (50-ohm) calling earth to the B line to operate relays X and LR.

X1 completes a locking circuit for relay X dependent on CO2.

X2 connects the calling lamp to an interrupted earth to give a flashing signal. LR1 is rendered ineffective by the operation of X2.

Units Automatic Nos. 5 *and* 6. (*Fig.* 12)

The circuit conditions of these exchanges are such that it is necessary to dial two digits to gain access

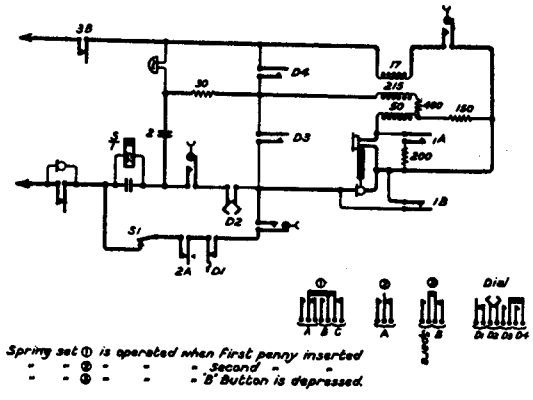


FIG. 12. —PREPAYMENT CIRCUIT, U.A.X's 5 and 6.

to the parent exchange and for this reason it is necessary to depart from the standard automatic circuit. For local calls, the circuit operation is identical with that of the automatic circuit; for calls outside the U.A.X. area, however, it is necessary to employ a relay to allow the transmission of a second impulse train.

The caller wishing to make a call over a junction dials the appropriate number as given on the instruction card, and operates, on the first digit, the auxiliary springs D1. This contact unit removes a short-circuit from the impulsing springs D2 and

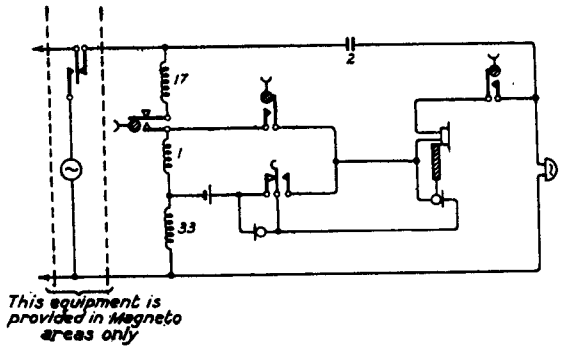


FIG. 13.—POSTPAYMENT CIRCUIT, C.B.S. 2 AND 3 AND MAGNETO SYSTEMS.

relay S. Relay S operates and, due to its slow release feature, remains operated during impulsing. While the dial is off-normal, the circuit for this relay, which operates from the U.A.X. battery, is completed *via* the off-normal springs D3 and 14; on return of the dial to normal the relay holds *via* the telephone loop. S1 operates to allow of the continued operation of relay S when the second digit to be dialled is numerically less than the first digit, i.e., when D1 will not be operated.

The fee necessary for the junction call is deposited under the direction and supervision of the operator.

Local Battery Areas.

The circuit arrangements for C.B.S. No. 2 and 3 and Magneto (**Fig. 13**), and C.B.S. No. 1 (Fig. **14**)

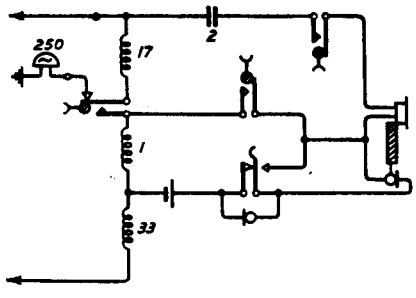


FIG. 14.—POSTPAYMENT CIRCUIT, C.B.S.1. SYSTEM.

are identical with those of a subscriber's direct exchange line with the exception that arrangements are made for the telephone transmitter to be put out of service and replaced by the coin box transmitter as each coin is inserted in the coin box.

All coin box fees in these areas are collected under the supervision of the telephonist; the action of inserting coins causes the crank-arm to operate the change-over spring-set which opens the circuit of the coin box transmitter and short-circuits the transmitter of the microtelephone. With the coin box used in these areas the coins are not held in suspense, but pass direct into the cash box. The necessity of coin control buttons, i.e., buttons A and B, does therefore not arise.

P.M.B.X. or P.A.B.X. Extension with Coin Box. (Fig. **15.**)

For these extensions a post-payment coin box (as used in local battery areas) is provided, and the circuit is arranged as for an ordinary extension with the exception that the insertion of coins effects the opening of the coin box transmitter circuit to permit the collection of coins under the direction and supervision of the P.M.B.X. or P.A.B.X. operator.

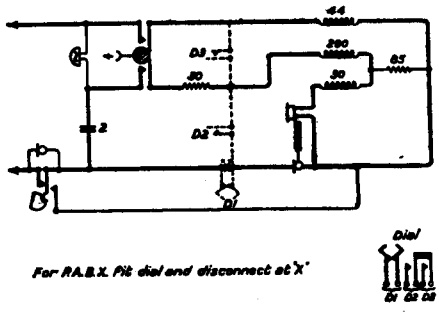


FIG. 15.—POSTPAYMENT CIRCUIT, P.B.X. EXTENSION, ALL SYSTEMS.

Reverted Calls.

Coin box circuits on all systems are closed with the normal bell arrangement in the disengaged condition to permit the acceptance by callers of "reverted calls." On reverted calls the caller answers and inserts the fee under the direction and supervision of the telephonist.

Conclusion.

Reference has been made in this article mainly to public call offices on direct exchange lines, but coin boxes are also provided on subscribers' circuits. The new wallboard is not fitted and the coin box differs slightly from the call office type having a drawer instead of the bottom opening for the collection of cash. In addition a large number of different arrangement is available for subscribers' plan number extensions with coin box. Space will not permit of these being described in detail but generally the aim in each arrangement is to provide the usual coin box facilities in addition to the normal facilities applicable to the particular plan number. In order to make the coin box service more attractive to subscribers, new types of coin box are in process of development and will probably form the subject of a further article at a later date.