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Editorial

PLANNING AHEAD

Telecommunication plays an increasingly vital part in the life of today, and service in the field of communication is a service to the community and an important one, hence, as an organization we must make continued demands upon our research and development engineering groups to establish new techniques, to develop new projects, to make proper use of new materials, to improve factory processes and methods and to maintain the excellence of our products. All sections of the technical organization are involved, from the worker on a pure research project to the methods man dealing with practical problems on the production line.

In common with other organizations, we emerged from the war period to meet and overcome special difficulties arising from the need to re-deploy our technical resources, to augment inadequate equipment and to build up new technical teams.

Our development policy is a continuously progressive one designed to use new materials and new ideas at a level commensurate with the magnitude of our organization and past achievements.

The research laboratories have been extended and the transmission, carrier, and general laboratory groups reorganized. Additionally, a new and much more comprehensive process engineering laboratory has been built up and we are engaged upon the complete reorganization of our factory production units. The results of some of these efforts are now apparent in the form of new devices, improved processes and reduced manufacturing times. There are many such developments to come and we look towards the future with a measure of sober confidence based upon past performances and the knowledge of the improvements we have initiated.

A New Supervisor's Desk for Auto/Manual Exchanges

TELEPHONE instruments, switchboards, and electrical and mechanical devices directly associated with the process of establishing and maintaining telecommunication, are naturally objects of frequent research and a considerable amount of publicity.

The not-so-important supervisory items receive comparatively little attention, so long as they are reasonably free from serious defect, the present standard British Post Office type supervisor's desk constituting an example. This desk, illustrated in Fig. 1, is of familiar pattern, having changed very little in the course of many years. It is not unlike a small switchboard and cannot be said to be either æsthetically impressive or technically ideal, although it has sufficed for its purpose.

A new desk, manufactured by the Company, is undergoing field trial at Riverside, one of the London auto-manual exchanges, with the object of its becoming the future standard design, and from the illustration in Fig. 2, it will be apparent that it differs considerably from its predecessor, the most noticeable change being the elimination of the high turret which formerly restricted the supervisor's field of vision.

The general appearance has been greatly improved without introducing useless, dust-harbouring ornamentation, so that it more nearly resembles the desk of the business executive.

At the present time, the British Post Office is experimenting with the exterior finish of switchboards, the orthodox mahogany and red fibre being replaced by light-coloured wood and green fibre, therefore the finish of the desk will be arranged to match the associated switchboards, for example, supervisors' desks made of beech are in process of manufacture for one of the Company's contracts, whereas the one here described is of polished mahogany, conforming to the existing manual positions.

The desk is some eight inches longer but of less depth than the present standard, so that there is very little difference in the amount of floor space occupied. The overall dimensions are 5′ 2″ x 2′ 4½″ x 2′ 10″ high and the mahogany finish is well " set-off " by a shallow black plinth, a black equipment panel and the ebonized wood handles of the drawers, of which there are six, compared with the three formerly provided ; thus

Fig. 1—The Present B.P.O. Standard Supervisor's Desk.

Fig. 2—Front View of the New Desk.

despite the absence of a pigeon-holed turret, there is no lack of filing accommodation. The centre drawer of each set has a lock, and above the drawers on each side of the knee-hole is a pull-out table covered with brown linoleum similar to that on the desk top, where there is a centre equipment housing, or turret, flanked by filing compartments. The turret is hinged at the bottom front edge to allow the wiring side of the equipment to be exposed when it is swung forward. Suitable stops are fitted to prevent the equipment coming into contact with the desk surface when the turret is opened.

As practically the whole of the circuit apparatus is located in the auto switchroom, very little accommodation is required at the rear of the desk where there are three compartments ; one directly below the turret and shown open in the illustration (Fig. 3), and one on each side at the back of the drawers. Access to the latter is obtained by removing panels inside the knee-hole.

Viewed from the rear, the left-hand enclosure, which contains no equipment, has a hole in the floor for cable entry and another into the centre compartment, where the desk wiring is terminated on a moulded bakelite connection strip supported from two L-shaped brackets, and where three similar brackets carry two mounting plates on which are fitted a high-speed relay with two resistors under one cover, and a transformer. This compartment also has battery jacks on the right, a brass earth terminal strip on the left-hand wall, and a hinged door shown fully open in the illustration but which normally has a retaining chain. Provision is made for wires to pass into the right-hand enclosure, on the floor of which are screwed a buzzer and a terminal block with a bakelite cover.

The desk has capacity for the following circuits, not all of which, however, are shown equipped in the illustrations :—

Bothway to auto (2), bothway to monitor's desk, bothway to exchange superintendent,

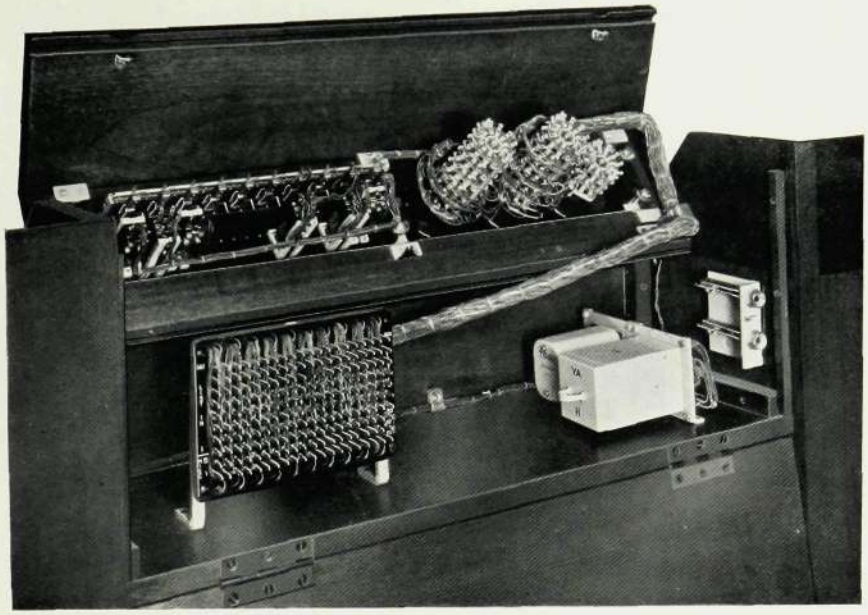

Fig. 3—Part Rear View of Desk with Turret Open.

incoming from manual (2), listening-in, directory enquiry, instruction (2), buzzer and call bell, awaiting calls, and fire alarm circuits.

It will be observed that there are no cords and plugs on the desk, all connections being set up via the keys and switches in the centre panel. This has the advantage that when the listening-in equipment is in use, only the person at the desk knows which operator is under supervision, whereas it is possible, with the existing scheme to discern from a distance into which jack the listening-in plug is inserted. The connections are established by pre-setting the "Yaxley" switches mounted in the turret. Each switch is fitted with a disc, numbered 0-9 round its circumference, and fixed to the shaft so that the digits appear consecutively in a small window above the switch as the shaft is turned. From left to right the three switch readings represent, respectively, the hundreds, tens and units digits of the number of the switchboard position being supervised ; therefore, either two or three switches may be required, depending upon the numbering of the positions ; for example, in this country it is customary to use three digits when there is more than one suite of boards, i.e. 101, 102, 103, etc. for one suite, 201, 202, 203, etc., for the next, and so on, even though the total number of positions may be less than 100.

On the right of the switches in Fig. 2 are lever keys on a common mounting fitted with metal designation strips at the top and bottom and surmounted by a lamp strip. The key in the right-hand end position is for the fire alarm and is denoted by red enamel on the keyplate.

The only other front equipment is the instrument jack which, with an associated metal rectifier, occupies the same relative position as before.

In Fig. 4 are shown the listening-in circuit switch connections suitable for an exchange with a single suite of up to 80 positions. Only two switches are necessary and when these are pre-set a circuit is prepared from resistance battery through

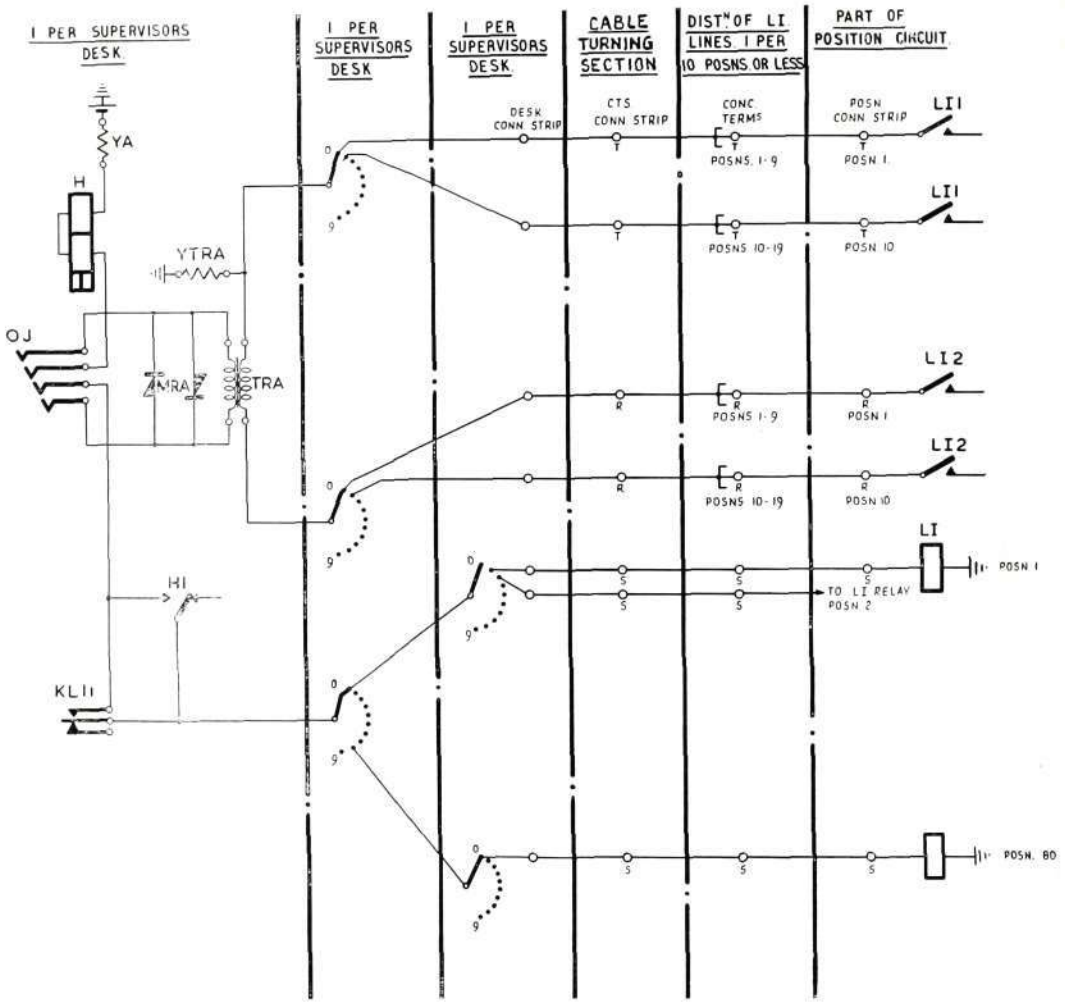

Fig. 4—Listening-in Circuit Switch Connections.

high-speed relay H, supervisors jack, non-locking "listening-in" key, and via the switch contacts to earth on the listening-in relay of the position concerned, so that when the key is operated, H is energized and locks through its own contact to maintain the circuit until either the supervisor's plug is removed or the switches are reset. It will be appreciated that the number of switch banks will vary according to the contact capacity demanded by the particular circumstances and that the object of using a high-speed relay is to ensure that the circuit is broken immediately the supervisor alters the position of the switches, thus preventing the operation of other LI relays during the changeover.

Reference has been made to the apparatus associated with the desk being located in the auto room. It is arranged in standard formation on four relay plates on the miscellaneous apparatus rack and is comparable with the equipment at the rear of the present desk, however, even with this rear capacity some of the relay equipment for the present desk is on the M.A.R.

The existing circuits have been modified and the position circuit has become redundant but apart from the fact that the trunk offering facility is not provided, there is little change in the circuit capacity of the desk, nor in the operating procedure, other than that mentioned.

The Development of Step-by-Step Auto Exchanges for New Zealand

Introduction.

STATISTICS published from time to time, showing the telephone density relative to population in various countries, reveal that the people of New Zealand have been " telephone-minded " for many years, partly due, no doubt, to the physical features of the islands ; therefore, it is not surprising that telecommunication requirements were given early consideration by the authorities after the enforced curtailment of development occasioned by the war.

In Bulletin No. 20 there appeared an article dealing with New Plymouth exchange, the contract for which was received early in 1946. Later in that year the Posts and Telegraphs Department (N.Z.P.O.) commenced work on the drafting of specifications covering the general requirements for future multi-office exchanges in the large towns.

The N.Z.P.O. decided on the standardization of equipment and facilities, thus ensuring an ultimate reduction in the number of types of apparatus in use, with a consequent easing of maintenance and replacement problems. Having agreed to standardize on 2000-type step - by - step equipment, it was then necessary to arrange for the gradual recovery of other types, including rotary.

One of the first problems to be faced was that of interworking between existing rotary and new step-by-step exchanges, and an article in Bulletin No. 20 gave a description of how this problem was solved.

A twenty-year plan for the Wellington and Auckland areas was prepared, and contracts were placed for equipment associated with the first stages, the Company being entrusted with orders for new exchanges at Haitaiti and Karori in the Wellington area ; Mount Roskill, Highbury and St. Heliers in the Auckland area, and extensions to the Central exchanges in these two areas.

In general the requirements conform to British Post Office (B.P.O.) standards for non-director main and satellite exchanges, and this article gives an outline of some of the more important differences.

Release Conditions.

B.P.O. practice is to make the release of a connection dependent on the calling subscriber, i.e. " calling party release," which has the merit of being simple in application, but the disadvantage that the called subscriber can be held engaged at the will of the caller. Furthermore, in the event of the latter clearing first, the called subscriber seizes another first selector, receives dial tone, and on replacing the handset causes the selector to step to level one and release, thus creating artificial traffic and imposing additional wear on the switch.

One alternative to " calling party release " is " last party release " in which the connection remains held until both subscribers have replaced their handsets. In this case the artificial traffic to the first selectors is avoided and also there is the advantage that in the event of a subscriber receiving a

malicious call, its origin can be traced if the handset is kept off its rest. The main objection to this method of release is that all selectors in the established connection, together with the two subscribers, are held engaged until both handsets are replaced, an arrangement which may cause switches to be held unnecessarily.

In both calling and last party release, inconvenience can be caused to a subscriber because of the failure of another to restore the handset at the conclusion of a conversation. Alarm circuits, are, of course, provided to indicate that a subscriber is being held, but during periods when an exchange is unstaffed it may be some considerable time before any action is taken.

The remaining alternative, " first party release," where the first party to replace the receiver releases the connection, avoids the possibility of one subscriber being able to hold another engaged and also ensures that the switching train is not held unnecessarily, but it re-introduces artificial traffic to the first selectors. The N.Z.P.O. has adopted a compromise scheme which eliminates the " other party held " difficulty and avoids imposing artificial traffic, the arrangements being as follows :—

If the calling subscriber replaces the handset first, the switching equipment is released, with the exception of the final selector which is held by the called subscriber, thus the calling party is free to make or receive further calls.

If the called subscriber releases first, the final selector frees his line, enabling further calls to be originated or received, but the switching train remains held until released by the calling subscriber. If, after one of the subscribers has cleared, the other holds the connection for a period of 6-12 minutes, an alarm is given.

With this system of release, the holding of the connection is vested in the calling party until the called party answers, the latter's answering loop condition causing circuit changes in the final selector to enable release to be effected from either end, as described above.

When the called party answers, it is possible that the handset may not be removed cleanly from its rest, resulting in intermittent looping of the line wires. This may persist for a second or so before a steady loop is maintained, and, unless a delay is introduced in the final selector to cover this period, circuit changes may be brought about by which the connection is inadvertently released before conversation has commenced. Several methods of introducing this delay were tried and finally a scheme was produced which utilizes the DA and DB relays, provided in the final selectors for ultimate metering requirements, in conjunction with the 3-second S and Z pulse cam on the ringing machine. The relevant portion of the final selector circuit is shown in Fig. 1 and functions as follows :—

Contact B4 provides the holding earth for H, HR and F relays.

When the called party answers, D4 closes the circuit of DA to the S pulse cam so that DA operates with the pulse and locks via DA1 and D1 operated. DA2 connects the 500-ohm windings of DA and DB in series with the Z pulse cam.

From the Z pulse, DB operates and locks via B4 and a second 500-ohm winding of DB to 1000-ohm battery, DB1 having

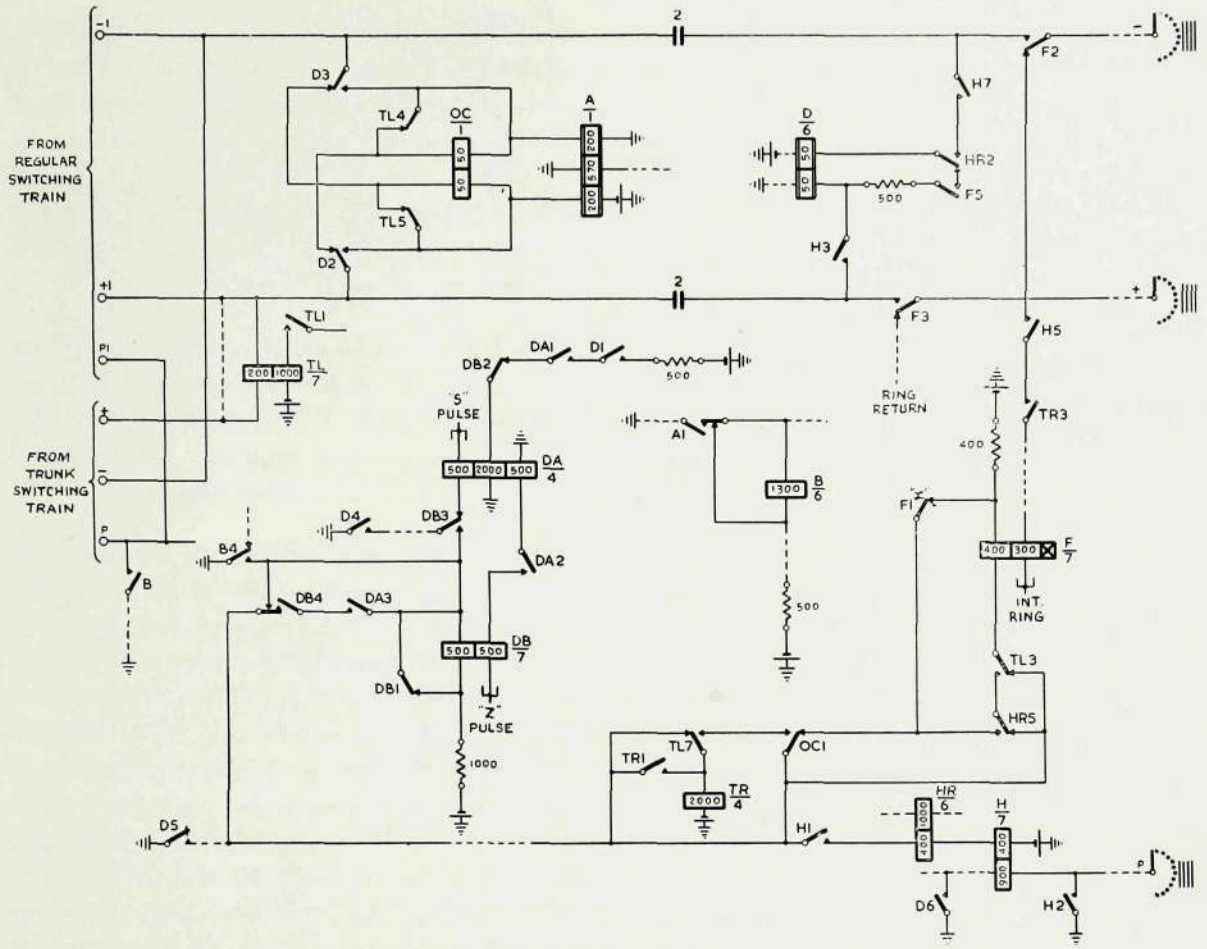

Fig. 1—Skeleton Circuit of Combined Regular and Trunk Final Selector.

removed the short circuit from this winding. Contact DB2 opens the holding circuit for DA, but the relay remains held for the duration of the Z pulse and then releases. With DA3 normal and DB4 operated, the hold circuit for relays H, HR and F is transferred from B4 (controlled by the calling subscriber) to D5, (controlled by the called subscriber), thus the replacement of the handset by the latter will release D, H, HR and F and enable his line to be freed from the connection.

This arrangement ensures that any flicking of D during the answering period will not cause the release of the connection until after the operation of DB, cessation of the Z pulse, and release of DA. The S and Z cam timings are arranged so that a minimum delay period of 3 seconds is assured and this is regarded as sufficient to cover the worst cases of unstable answering loop conditions.

Trunk and Toll Offering.

B.P.O. practice is to route calls from an operator over the normal switching train but should the desired subscriber's line be engaged, the operator can employ special switching equipment to "break in" for the purpose of offering a trunk call, identifying for fee collection purposes, and check testing in the event of difficulty being encountered in establishing access over the

normal switching train. The operator cannot, however, establish a connection over the special switching equipment comprising trunk offering distributors to the banks of which are connected trunk offering final selectors provided on the basis of one per final selector group.

Instead of this trunk offering arrangement the N.Z.P.O. specifies a separate trunk switching train accessible only from the manual board, the traffic from which merges with the regular traffic at the final switching stage. In each final selector group there are regular, and combined regular and trunk switches, the former being accessible from first choice outlets of regular penultimate selectors and the latter from the late choice outlets, which are also commoned to the trunk penultimate selector outlets ; thus, the whole of the final selectors in each group are available to subscribers, while the operators have access to a few combined regular and trunk finals which provide the following facilities :—

(*a*) Means of discriminating between calls from a regular subscriber and an operator.

Reference to Fig. 1 will shew how the discrimination is effected.

Calls received via the trunk train will result in relay TL being operated, and in contacts TL4 and TL5 removing the short circuit from differentially connected relay OC which controls the following :—

On calls from an operator to a disengaged line the ringing of the called subscriber's bell is under the control of the operator. Examination of Fig. 1 will shew that interrupted ringing is not connected until contact TR3 is closed and that relay TR is dependent on the operation of OC, thus, when the called subscriber is to be rung, relay OC must be actuated. This is achieved by the momentary operation and release of a key which causes earth to be applied to one line, thereby operating and releasing relay OC. Contact OC1 operates TR which locks via TR1, and TR3 connects ringing to the called subscriber.

Calls from the regular switching train are connected direct to relay A, and TL is not energized ; relay TR actuates before the line is tested and ringing is connected automatically as soon as H operates.

(*b*) If the called subscriber is engaged, the operator can gain access by using the key to bring about the operation and release of relay ' OC ' and the operation and locking of TR, as described in (*a*) but, in addition, since H and HR are normal, OC1 operated and HR5 normal, the short circuit across F is removed and this relay operates. Contacts F2 and F3 connect the negative and positive lines through to the called subscriber's line and conversation is made possible. Contact F5 operates relay ' D ' and contacts D2 and D3 reverse the lines to the manual board thereby extinguishing the supervisory lamp.

It will be noted that with the functioning of relay D, contact D6 connects earth to the operating winding of relay H in series with the called subscriber's P wire ; hence, when the called subscriber's line becomes disengaged, relay ' H ' will operate and render the line busy, contact H1 operating HR. Contact H2 engages the called line, HR2, H7 and H3 release relay D and connect it to the line wipers. The release of contacts D2 and D3 restores to normal the negative and positive lines to the switchboard, and the supervisory lamp glows. The operator now causes relay OC

to function, as before, and, since HR5 is operated, relay F releases and connects ringing to the called subscriber.

When the called party answers, relays F and D are again operated, this time by the called subscriber's loop, and D2 and D3 reverse the lines to the operator for supervisory purposes. If the called subscriber clears, the operator can re-ring by operating and releasing her key, thereby operating and releasing OC to cause the release of F.

Discriminating Selector Repeater. (D.S.R.).

In satellite exchanges, the D.S.R. must be able to respond to a train of impulses and then restore its wipers to their normal 'home' position in readiness for a following impulse train, this operation being performed during the inter-train pause. With the pre-2000 type selector this can be achieved easily, as the wipers are spring-returned to the end of the level dialled, and drop vertically direct to their 'home' position. For the 2000-type switch where the wipers have to be stepped to the end of the level before dropping and returning to the 'home' position, the release time is somewhat lengthened, and, in the case of upper levels, may exceed the normal inter-train pause. In this event, part of a following impulse train may be lost before the switch wipers have fully restored, with the result that a wrong number will be obtained.

In the early stages of the introduction of the 2000-type selector, the B.P.O. used pre-2000 type selectors for all D.S.R.s, to overcome the difficulty mentioned above, but later, because of multi-metering requirements, a scheme was developed, and has since been adopted by the B.P.O. for all satellite type exchanges, enabling the 2000-type selector to be used as a D.S.R. The scheme is, however, an elaborate one because of the complex metering requirements in the United Kingdom and was considered unsuitable for New Zealand.

As the N.Z.P.O. were desirous of having 2000-type selectors for all switching stages, it became necessary to consider how these could be utilized as D.S.R.s without the risk of subscribers obtaining wrong numbers, yet maintain the degree of simplicity and economy demanded by the facility requirements.

Several schemes were reviewed, including that introduced by the Company for Australia, whereby the selector wipers are automatically stepped to level one on seizure of the switch, the impulse train, or trains, during discrimination, being directed to the rotary magnet to move the wipers over the level one bank contacts, so that release for digit absorption purposes is always from this level and is consequently effected well within the permissible time limit of the inter-train pause ; however, it was finally decided that the following scheme would best meet the needs of the N.Z.P.O.

The 2000-type selectors used for the D.S.R.s are provided with a specially wound rotary magnet ensuring faster operate and release times, and hence a much faster speed of free hunting, so that by combining this feature with careful circuit and relay design, the switch wipers can be restored to normal from any level within the permissible inter-train pause. The term " free hunting " refers to the movement of the wipers under release conditions only. During the search for a free outlet it is necessary to slow down the speed to enable the testing relays to function correctly, the

switch, therefore, has a fast " free hunting " speed used during release, and a slower searching speed brought about by applying a shunt across the rotary magnet.

Other features which the N.Z.P.O. require on D.S.R.s and which differ from B.P.O. practice are :—

(*a*) On a local call the transmission bridge is switched out of circuit, the negative, positive and 'P' wires being extended straight through to the next switching stage. One of the reasons for this is to allow automatic revertive calls to party line subscribers.

(*b*) 200-outlet selectors are used instead of the usual 100-outlet. This is desirable because, in general, the number of lines and the originating traffic in the satellite exchanges in New Zealand are greater than is usual in the United Kingdom. The use of the larger bank capacity enables economies in switching equipment to be made.

(*c*) The use of a transformer-type bridge in place of the condenser or " Stone " bridge, as described below.

(*d*) Provision for ultimate multi-metering in the manner described under the heading " Metering ".

TRANSFORMER TYPE IMPULSE BRIDGE.

Impulse repetition in non-director areas is performed by auto-to-auto relay sets at main exchanges and by D.S.R.s at satellite exchanges. At present the B.P.O. use a condenser or Stone transmission bridge in these cases, with a 3000-type impulsing relay to repeat the impulses from the calling to the called side of the bridge.

The N.Z.P.O. were faced with the necessity for impulsing over somewhat longer routes than is usual in local areas in this country, yet the conditions were such that they did not justify the use of voice frequency or other costly signalling systems ; therefore, it was decided to adopt a scheme, developed by Messrs. Siemens Bros., using a high-speed relay in conjunction with a transformer-type bridge.

With a Stone bridge, the associated relays must be of high impedance for speech transmission purposes, but this condition is opposed to the requirements for satisfactory impulsing, since the rapid growth and decay of the impulse currents are retarded. Furthermore, when impulsing is taking place, the potentials across the line condenser are subject to changes due to induced potentials from the relay coils. With each change of potential, currents flow through the condensers, pursuing paths through relay windings associated with the local bridge and also affecting the operate and release conditions of the relays in bridges of adjacent sections of the lines over which impulsing is taking place. Thus it cannot be assumed that the impulses in one section of the line are passed forward to the next section by a simple relaying action, and each section of the line cannot therefore be regarded individually. The various sections over which repetition is required must be treated as a whole when assessing the line limits over which impulsing is possible.

With a transformer-type bridge, no energy is passed from the section of the line over which impulses are being received to the section over which they are being relayed, therefore the form of the repeated impulses is dependent entirely on the action of the relaying contact. In addition, the necessary impedance for speech transmission purposes

is provided by the transformer, thereby enabling a high-speed relay of low impedance to be used for impulse repetition.

By this means the line limits specified by the N.Z.P.O. have been met without difficulty.

METERING.

In the B.P.O. system, single metering is used for local calls and multi-metering for calls outside the local fee area.

In New Zealand, at present, a system of flat rate rentals applies within areas covered by common linked numbering schemes, and in the majority of cases it is unnecessary to record local calls on the subscriber's meter. There are, however, exceptions to this rule and it has been necessary to arrange that single metering can be introduced on certain routes within a linked numbering scheme, as determined by the first digit dialled. Furthermore, to allow for any change in tariff which may occur later, all circuits have been designed so that single metering can be applied to all local calls.

Provision has been made whereby, at a later stage in the programme, multi-metering can be introduced for calls dialled outside a linked numbering scheme. This will be effected by allocating a prefix digit, or digits, for such external calls, the next impulse train, or trains, being used to route the call to the desired exchange and to set the conditions at the originating exchange for registering from one to four meter impulses.

In the case of main exchanges the problem is a simple one, as the relay sets associated with the level, or levels, having access to exchanges outside the linked numbering scheme will be arranged to provide the necessary metering conditions.

At D.S.R. exchanges, the dialling of a digit covering a route over which multi-metering is required will cause the selector to search for, and seize, a multi-metering relay set. Subsequent impulse trains will be repeated over the junction in the usual manner, and to the multi-metering relay set. When the called subscriber answers, this relay set will control the operation of his meter in accordance with the fee for the routing train dialled.

The necessary meter pulses will be derived from cams on the ringing machines. This differs from B.P.O. practice, where separate machines are provided for meter impulses.

DIALS.

The B.P.O. dial is numbered 0, 9, 8, etc. to 1, in a clockwise direction, ten impulses being transmitted when dialling 0, 9 when dialling 9, and so on.

In New Zealand, the dials are numbered 0, 1, etc. to 9, in a clockwise direction, ten impulses being transmitted when dialling 0, 9 when dialling 1, 8 when dialling 2, and so on, to meet the requirements of the existing rotary type exchanges.

In order to avoid unnecessary changing of equipment during conversion to step-by-step, the N.Z.P.O. have decided to standardize the dial as now in use.

SUBSCRIBER'S LINE CIRCUIT.

In B.P.O. exchanges, if all outlets from a subscriber's uniselector are engaged, the switch continues to drive until a free outlet is encountered, the calling party being instructed to wait for dial tone before commencing to dial.

The N.Z.P.O. require that if all outlets from a subscriber's uni-selector are engaged :—

(*a*) The uniselector shall stop on the 25th outlet and transmit " overflow tone " to the caller.

(*b*) The condition shall be recorded on a traffic meter.

(*c*) A visual and audible alarm shall be given.

TONE ARRANGEMENTS.

A comparison between B. P. O. and N.Z.P.O. practice is shewn in the following table. In addition, the N.Z.P.O. do not require a lamp flash to be given to operators when a busy or subscriber engaged condition is encountered on all outlets.

Tone	N.Z.P.O.	B.P.O.
Dialling Tone	400 cycles per second continuous	33 cycles per second continuous
Ringing Tone	400 cycles per second modulated at 16-2/3.	133 cycles per second modulated at 16-2/3.
Busy Tone (called subscriber engaged)	400 cycles per second .5 seconds " on " .5 seconds " off "	400 cycles per second .75 seconds " on " .75 seconds " off "
Overflow Tone (All outlets engaged)	900 cycles per second .5 seconds " on " .5 seconds " off "	Ditto
N.U. Tone	400 cycles per second .075 sec. on .1 sec. off. .075 sec. on .1 sec. off .075 sec. on .1 sec. off .075 sec. on .4 sec. off	400 cycles per second continuous

Other differences between B.P.O. and N. Z. P. O. requirements, mentioned in Bulletin No. 20, include the provision of automatic party-lines to accommodate up to 10 stations per line, a decentralized I.D.F., and uniselectors of a more modern design which require less space and make possible the accommodation of 300 subscribers circuits per rack instead of the usual 200 circuits. There are, of course, many other differences of less importance but which are not within the scope of this article.

The main work of design has now been completed and some of the exchange equipments mentioned in the opening paragraphs have been delivered to site, while others are in an advanced stage of manufacture. The policy of planning well ahead has enabled a degree of standardization which will ensure that future orders can be tackled expeditiously and with a minimum of engineering difficulty. The Company is glad to have been able to make a contribution towards the development of the equipment and wishes the New Zealand Posts and Telegraphs Department every success in its big undertaking.

A New Single-Channel Carrier Telephone Equipment

GENERAL.

CASES frequently arise where an extra telephone circuit is needed over a trunk route served by a few open wire lines, but where the amount of traffic does not justify the cost of additional expensive line equipment. In these circumstances a single channel carrier telephone system is an ideal way of providing the extra circuit, as the cost of such equipment makes its use economical over distances as short as fifty miles, and the amplification is sufficient for lengths up to five hundred miles, dependent on the quality and structure of the lines. Longer distances may be covered by the use of suitable repeater equipment at intermediate points.

Experience in the manufacture of single channel equipment during the war, when stipulations regarding size, reliability and simplicity of maintenance were extremely important features of specifications, showed that a new type of single channel telephone terminal could be made which would be much smaller than the conventional arrangement and yet would maintain a high standard of performance with comparatively infrequent attention after installation. The equipment described makes use of these wartime developments.

OPERATION.

The system provides the usual carrier channel with filters for separating the physical circuit, which remains available for normal use. A single carrier frequency of 6 kc/s is used for both directions of transmission, the upper sideband being transmitted in one direction and the lower sideband in the other. The carrier and unwanted sidebands are suppressed. As the system does not transmit carrier, the problem of frequency difference between the two terminal oscillators has been solved by combining two iron-dust-core toroidal coils and a silvered mica condenser in such a way that a frequency stability better than $2\frac{1}{2}$ c/s has been achieved over a temperature range of 30°C. This stability is sufficient to avoid distortion in the demodulated speech at the receive terminal and the necessity for synchronization is avoided. A suitable band width of 300 c/s to 2700 c/s is transmitted.

Experience has proved that a transmitting level of +18 db to line gives a good signal-to-noise ratio over a reasonable length of line and without undue cross-talk between two systems on the same pole route. At full gain, an input speech signal at zero level will be transmitted to the line at a level of +18 db, but under some conditions it is necessary to transmit at a lower level and this is provided for by attenuation pads which enable the level to be reduced in three successive steps of 6 db.

In the receive direction, with full gain, a level of −30 db produces an output to the switchboard of −4 db. This means that a circuit having an overall equivalent of −4 db can be attained over a line with an attenuation of 48 db.

The transmit and receive levels having been quoted without reference to frequency, it is necessary to provide facilities for dealing

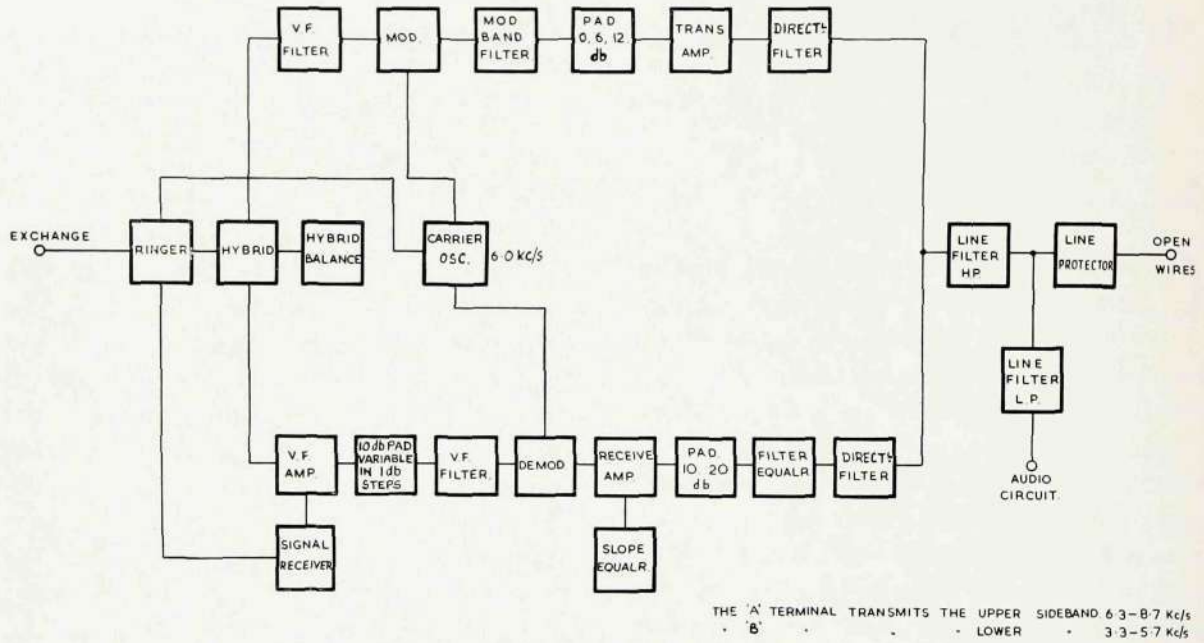

Fig. 1—Block Schematic of Terminal Equipment.

with the variations in line attenuation with frequency and weather conditions. The higher frequencies are always attenuated more than the lower frequencies and the difference is even more pronounced in wet weather. To counteract this it is arranged that the gain of the receive amplifier compensates for the changes in line attenuation. Five different gain slope characteristics are provided to cover a range from 0 db to 2 db per k/c, in steps of 0.5 db per k/c.

TRANSMIT.

The circuit of the terminal equipment is conventional and is shown in block schematic form in Fig. 1. The exchange switchboard line is connected via the ringer to the two-wire side of the hybrid transformer which separates the circuit into the transmit and receive paths. As with all hybrid transformers, a network is required at the other two-wire point to balance the impedance of the switchboard line and circuit.

Next in the transmit path is the voice frequency filter which limits the speech band width passed to the modulator to 2700 c/s. The modulator is of the ring bridge small metal rectifier type fed from the carrier frequency oscillator. Carrier suppression is achieved mainly in the modulator by using balanced sets of aged rectifiers. The modulator band filter selects the appropriate side band which is raised to a level of approximately + 20 db by the two-stage transmit amplifier. The latter is very stable in performance in spite of wide variations in supply voltages and changes in valve characteristics ; moreover, all forms of distortion are reduced to a very low level.

The directional filter, consisting of a low and a high-pass filter, separates the transmit and receive sidebands and routes the former to line via the line filter which also has a low and a high-pass section and segregates the two-wire carrier and physical circuits.

RECEIVE.

The incoming sideband is passed through the high frequency section of the line filter and is then diverted by the directional filter into the receive path of the system. At this point a filter equalizer is introduced to correct the extra losses which occur at frequencies near the edges of bands passing through the filters in both terminals.

Following the equalizer is an attenuating pad for adjusting the level fed to the high frequency receive amplifier to a value which would be received over the longest line workable by the system. This attenuator is also used to balance out variations in line losses due to climatic changes.

The receive amplifier now raises the level of the sideband to a value suitable for demodulation. The demodulator is similar to the modulator, but the input is a sideband and the output contains the original speech passed by the voice frequency filter which suppresses any vestigial carrier frequency and the useless upper sideband.

An attenuator of 10 db, variable in 1 db steps, and an audio frequency amplifier, raise the received speech level to cover the losses in the receive path, and give the required level at the switchboard.

SIGNALLING.

On receipt of a 20 c/s ringing signal from the switchboard or subscriber, a relay is operated in the terminal equipment to change the frequency of the carrier oscillator by 500 c/s and feed its output into the transmit amplifier at a predetermined level, the frequency being raised or lowered to agree with the sideband transmitted. At the receive terminal, a demodulation frequency of 500 c/s is produced ; a ringing receiver which is incorporated with the audio frequency receive amplifier accepts this frequency and the operation of a relay feeds a 20 c/s ringing current to the switchboard or subscriber.

APPARATUS.

The aim in the construction of this equipment has been to keep the size as small as possible consistent with reliable performance under wide variations of climatic conditions. For instance, the filters, which, as previously stated, comprise silvered mica condensers and iron-dust-cored toroidal coils, are rigidly mounted in cases hermetically sealed after being filled with dried air. Fig. 2 shows a typical filter assembly before sealing. Transformers are either treated similarly or are varnish impregnated.

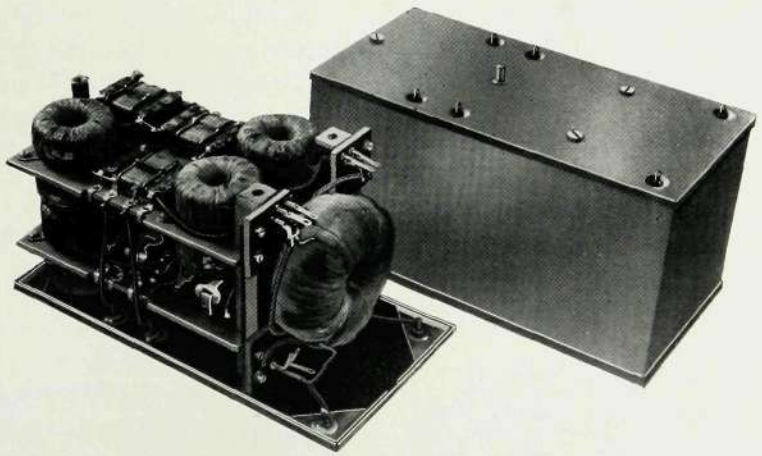

Fig. 2—Typical Filter Assembly.

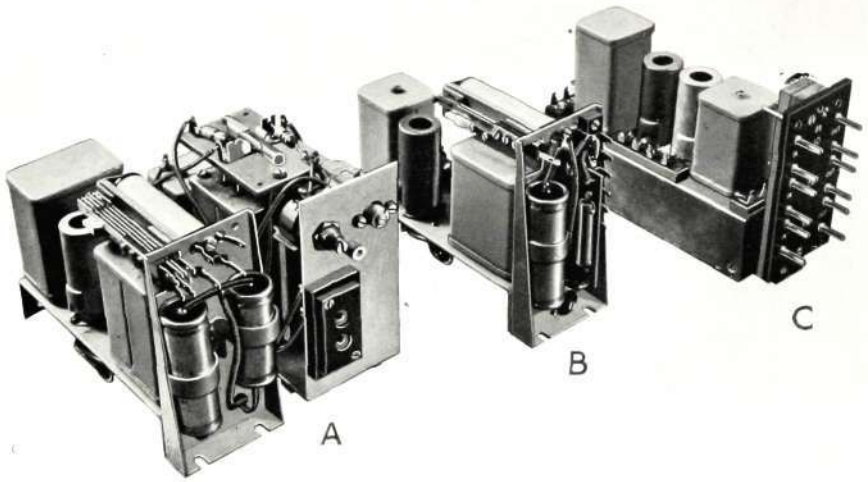

Fig. 3—Typical Assemblies
(A) Oscillator (B) V.F. Amplifier. (C) Line Amplifier.

The amplifiers and oscillator are built up in the form of small compact units, as shown in Fig. 3, making maintenance or replacement quite a simple process. The amplifiers used in transmitting and receiving the sidebands are similar in gain and performance, but the receive amplifier includes the slope compensating network. The gain of each amplifier is 76 db but this is reduced by negative feedback to 48 db, to give stability and freedom from distortion. The gain of the audio-frequency amplifier, which also operates in the ringing receiver circuit, is 35 db.

The components are mounted on panels, the total terminal apparatus consisting of five such panels arranged as shown in Fig. 4 in an overall height of $23\frac{3}{4}$ inches. The complete terminal weighs little more than 100 lb. and is normally mounted in a wall cabinet but may also be supplied with suitable covers and fitted on a standard rack nineteen inches wide.

Power Supply, Alarms and Testing.

An a.c. mains rectifier unit provides the necessary filament, anode, and relay currents. Provision is also made for a small rotary converter, operated from a local battery, to be automatically switched in if the mains supply should fail, the return to mains working on restoration of the supply also being automatic. The total consumption of one terminal is approximately 60 watts.

Failure of the mains supply releases a relay which extinguishes a supply supervisory lamp and closes a local audible alarm circuit. Alarm type fuses provided in the main h.t. circuit also operate the local alarm.

A multi-contact switch and an indicating meter are provided for measuring, at appropriate points of the circuit, h.t. volts, total h.t. current, relay supply volts, filament supply volts, and mains supply volts ; there are also three ranges for level measurements which are carried out by utilizing a short patching cord and U link connections.

Carrier Repeaters.

Where the attenuation of the lines is too high for satisfactory working, a repeater is installed at an intermediate station to

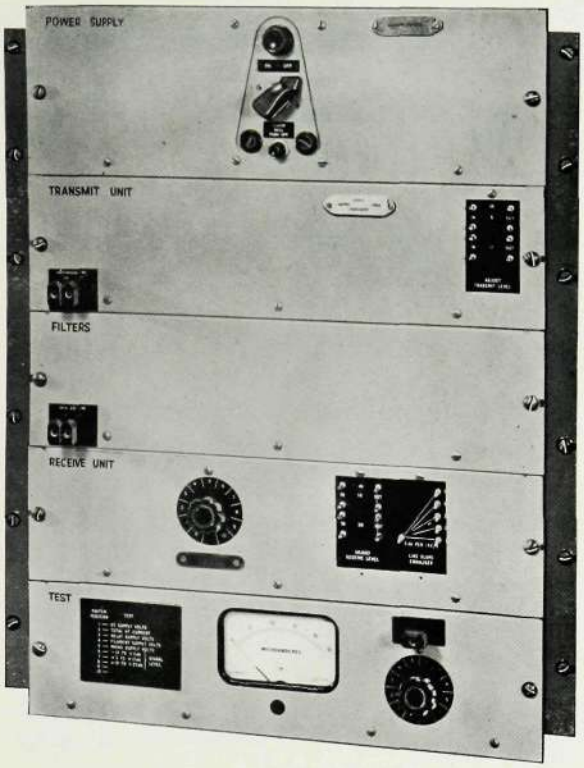

Fig. 4—Terminal Equipment.

provide the extra gain required. Line and directional filters divide the circuit into the audio channel and the two directions of transmission of the carrier channel. Line amplifiers with slope equalizers, similar to those used at the terminal, provide an available gain of approximately 45 db, therefore, with an output level of +18 db, the minimum receive level will be −27 db, thus one repeater practically doubles the range of the system. Corresponding increases in range are obtained by the use of further repeaters.

By-Pass Unit, Phantom Working and Inert Working.

Where a two-wire line is broken at an intermediate station or exchange and it is necessary to maintain continuity of the carrier circuit, a by-pass unit consisting essentially of two terminal line filters is fitted. The filters, which are connected back to back, provide a through circuit for the carrier current telephony while the physical circuit is fed through to the intermediate station and back to line again via the low-pass sections of the filters.

When the carrier equipment is applied to a side circuit of a phantom group, the introduction of the line filter in one side circuit necessitates the fitting of an equivalent network in the other, to maintain the balance necessary for phantom working. Suitable coils are available for this purpose, but where two similar carrier systems are used on the side circuits, the line filters automatically provide the balance. Filter balances are also available for use with V.F. repeaters.

Under certain circumstances it may be an advantage to be able to operate a carrier system over lines which terminate at a station without a power supply, i.e. " inert " working. This involves the use of terminal equipment without valve amplifiers or oscillators ; the carrier must therefore be transmitted at a fairly high level to provide the inert terminal with sufficient power for its modulation and demodulation stages. With this arrangement a −5 db circuit can be obtained over lines having an attenuation of 14 db.

Conclusion.

The single channel carrier equipment described, has all the necessary facilities for efficient operation, is very compact, easily transported, and simple to install and maintain. It is tropically finished and the cost is low compared with that of constructing and maintaining physical lines, therefore it is economical and suitable for use in any part of the world.

Steel-Framed C.B. P.B.X. Switchboards

SHORTAGES of materials during and since the war have given impetus to investigations into the use of alternatives, and to means of effecting economies in such materials, a case in point being the substitution of steel for much of the seasoned timber normally used for telephone switchboard carcases.

The idea of, so-called, all-metal switchboards is by no means new, such boards were used during the war, being specially constructed to suit conditions which would not be met in ordinary circumstances, and for that reason they were not perpetuated.

Switchboards of large type are almost invariably built on an angle-iron or similar strong metal framework, to ensure rigidity, but in the case of smaller P.B.X. boards of the type described here, the extensive use of metal is rather unusual.

This lamp signalling C.B. P.B.X. switchboard is of a type manufactured by the Company in considerable quantities for the Australian Posts and Telegraphs Department and was supplied in the first instance in 1947.

The design effects a considerable saving in timber and also permits an advantageous re-arrangement of the interior equipment in comparison with boards previously made, partly due to the fact that the front, rear, and side panels are all removable, a circumstance which greatly facilitates assembly, inspection and maintenance.

The framework comprises three main assemblies, viz., right and left-hand sides and key and plugshelf frame. The sides are rectangular welded structures made of channel-section pressed steel on which are transverse metal bars for supporting relay set shelves, and vertical bars for carrying fuse panel and terminal blocks. Top and bottom rails are welded to the two sides to form a rigid chassis to which is bolted the key and plugshelf framework (also a welded pressed steel assembly) and the pressed steel top.

The wooden portions of the switchboard are mainly resin-bonded plywood, hardwood being used only where necessary, thus, the removable side, front and rear panels, and the apron bottom of the keyshelf, are all of plywood, while the lock rail, key and plugshelf, cord connecting blocks and reinforcing battens for the sides, are hardwood.

The front and rear panels have hand recesses, the former being fitted with a $\frac{1}{8}$ inch thick cork linoleum kicking panel on the outside, and leather-covered felt on the inside to act as a cushion against the swing of the cord weights. A similar cushion is provided on a partition separating the weights from the rear equipment. The front and rear panels are placed in position in the same way as the ordinary lift-out door.

Fig. 1.—N.341A Type Lamp Signalling C.B. P.B.X. Switchboard.

Wood screws are used to fix the wood parts of the key and plugshelf assembly which is of orthodox design. The keyshelf is hinged and is provided with a locking stay. A covering of black fibre protects the top surface as may be seen in Fig. 1 which is a front view of the switchboard.

There is space in each of the two front equipment panels for fifteen half-inch lamp or jack strips, giving capacity for the following circuits mounted in sequence from the bottom upwards :—

(*a*) 20 night switching circuits (10 per panel).

(*b*) 15 auto exchange lines, 3 C.B. or magneto tie lines and 2 cord test jacks.

(*c*) 100 (nominal) 80 (actual) extension lines.

The board is wired for the full complement of circuits, irrespective of the amount of equipment fitted, the capacity for item (*c*) being regarded as 80 for this purpose, although the extra 20 circuits can be included when necessary. Extension of the equipment is greatly facilitated by this arrangement of pre-wiring. It will be observed that only 30 extension lines are equipped on the switchboard in the illustration.

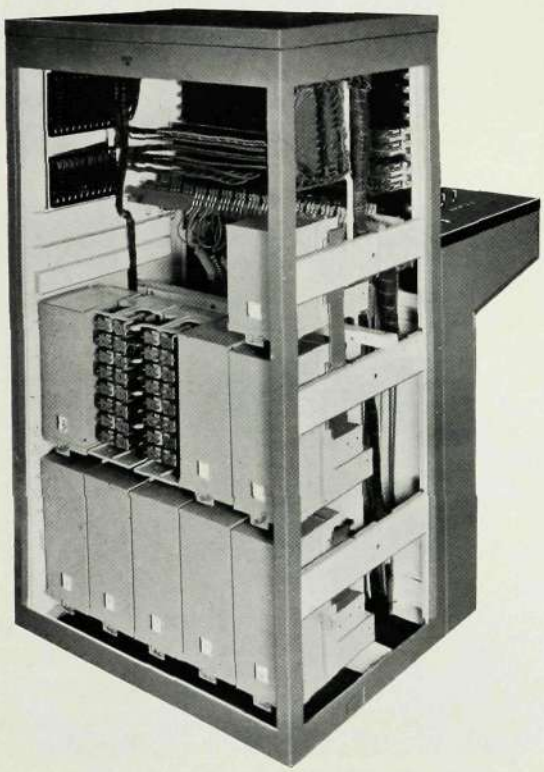

Fig. 2.—Rear View of Switchboard.

At the top of the panels are fitted pilot and fuse alarm lamps, and plunger keys for night alarm and power generator connections, while above these, on the metal framework, are a pressed steel notice frame for an instruction card, and a battery cut-off switch.

Drillings for sixteen cords are provided in the plugshelf, although only twelve cord circuits are shown equipped in Fig. 1, the unequipped positions being fitted with dummies, as are also the vacant supervisory lamp positions on the keyshelf. Two double-throw keys on a common mounting plate are associated with each cord circuit and are designated respectively, Ring Front —Speak, Ring Rear—Dial and Hold, from front to back ; in addition, a coupling key is fitted in front of the automatic dial at the extreme right, while the lock rail has an "alnico" generator mounted at one end, and twin, 4-point operators' jacks at the other, this completing the equipment of the key and plugshelf. For the size of the board, the interior capacity in terms of relay equipment is remarkably large, due to the fact that the apparatus is mounted on jack-in units, the utilization of which is of advantage both in the factory during the initial assembly and wiring of the board, and also in connection with maintenance repairs and extensions. The units are mounted on shelves supported from the transverse bars at the side and are arranged as shown in Fig. 2, the single relay set in the top position accommodating telephone circuit and miscellaneous apparatus, and the ten sets below, all having bases of 16-relay capacity, being allotted to cord circuits (4 per base) and tie line circuits (3 per base) in the upper row, and exchange line circuits (3 per base) at the bottom.

Flg. 3.—Extension Line Lamp Strip with Resistors at Rear.

At the top left in Fig. 2 are terminal blocks for line and miscellaneous circuit terminations, thus, as the cable entry is directly below at the bottom of the board, and the side panel is removable, connection of the external cables is much simplified. A second hole is provided on the opposite side for interconnections between adjacent boards, or as an alternative entry, and is fitted with a cover when not in use.

The fuse panel, which is located at the top right, opposite the terminal blocks, can be swung round into alignment with the relay sets when it is necessary to replace a fuse.

The board is designed for 40-50 volt working with 6-volt lamps which require the introduction of resistors in the extension line circuits. These resistors are mounted on the lamp jack strips, in the manner shown in Fig. 3, an arrangement which effects economy in both wire and mounting space. The resistors are British Post Office type No. 112, each consisting of two windings connected in series and terminated so that one can be strapped out when necessary, to adjust the current flowing through the lamp on high-resistance lines.

The finished switchboard presents a neat and attractive appearance, as the metal work is painted with light brown enamel and wood parts are stained to match.

The interior is enamelled white, thereby lightening the work of the maintenance officer in every sense of the word.

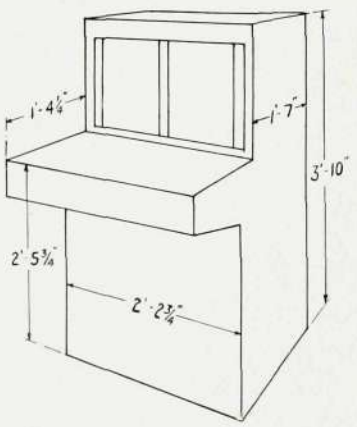

Fig. 4.—Overall Dimensions of the Switchboard.

The overall dimensions are much smaller than is usual with boards of this capacity, as may be noted from Fig. 4, and this will have a strong appeal.

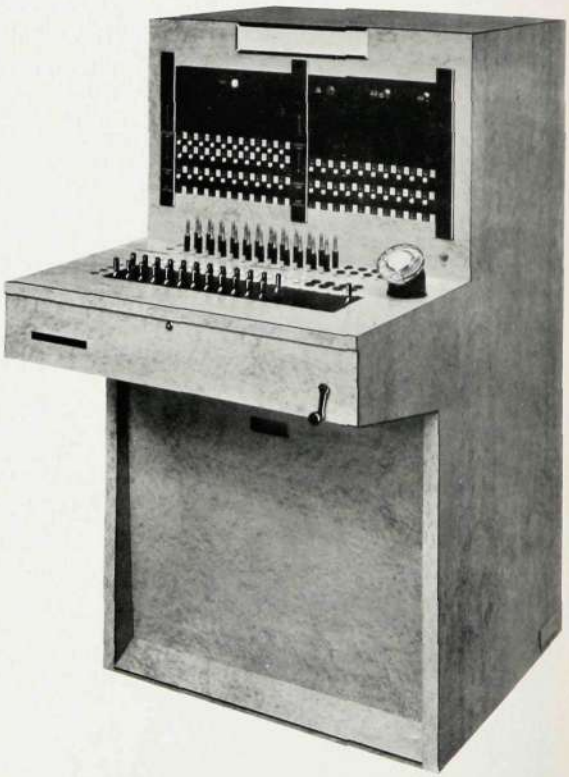

Fig. 5.—Switchboard similar to Fig. 1, but with Plastic—covered Plywood Frame.

The board is coded N341A type and has been supplied with equipment varying from 15 exchange lines, 80 extensions and 16 cord circuits, down to 6 exchange lines, 20 extensions and 8 cord circuits.

The Company has developed a switchboard of the same pattern and size, but with a resin-bonded plywood frame covered with an ornamental plastic known as Warerite. One of these boards is illustrated in Fig. 5, the finish in this case being imitation birdseye maple, while others in imitation walnut are in course of manufacture. It will be observed that the top and sides are not removable on this type of switchboard.

Modern Metal-Finishing Plant

BULLETIN No. 18, in dealing with the panclimatization of telephone equipment, referred in a general way to the plant and processes used for electro-deposited protective finishes. Increased production has recently necessitated a considerable extension to the metal finishing plant, comprising a new building and equipment.

In consequence of the varied nature of the processes, the department is arranged in sections, some of which deal with preliminary operations such as degreasing, surface preparation, and wiring, whilst the others carry out the actual plating.

All metal parts which are to be plated or enamelled are first subjected to solvent degreasing, and in order to meet our specialized requirements, plant has been designed to provide facilities for liquid or vapour cleaning on a continuous mechanized system. The machine for this purpose is totally enclosed and special devices are included which reduce solvent losses to the absolute minimum.

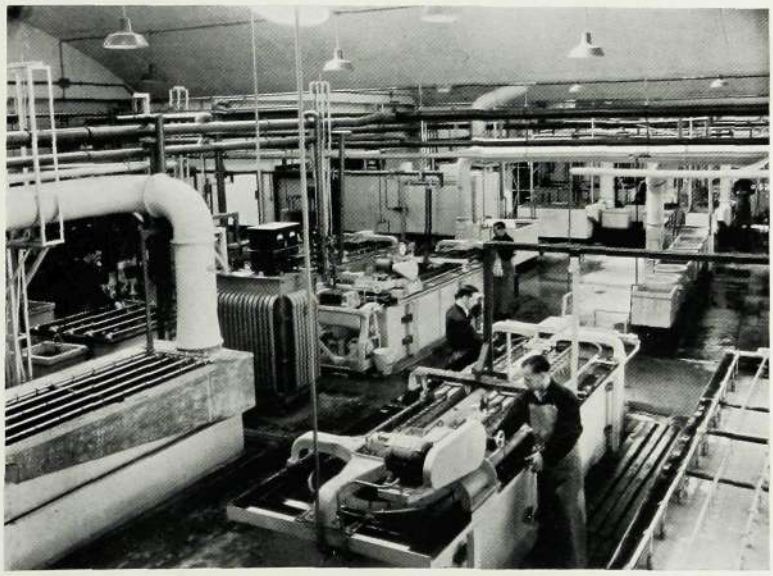

Fig. 1—Part of the Vat Room.

In the polishing and buffing group, all machines are equipped with individual exhausts and filters, an arrangement generally admitted to be superior to the manifold system, for efficient dust extraction and accessibility.

The new electro-plating equipment is of the most modern type and is housed in a concrete building which is specially designed for the purpose. The structure covers a floor area of approximately 7000 square feet and has a barrel-vault roof supported entirely from the walls, so that the interior accommodation is unrestricted and no obstacle is presented to the arrangement of the plant, part of which may be seen in Figs. 1 and 2.

Every effort has been made to provide superior working conditions for the operators, consequently, on entering the department one is immediately impressed by its lightness and cleanliness. The interior colour scheme, which is pale cream, enhances the excellent natural lighting from large side windows supplemented by circular roof lights. Other noticeable features are the freshness of the atmosphere and the absence of exposed ironwork.

The floor of the building is designed and prepared to suit the arrangement of the plant. Not only does it house the main supply services, but additionally, efficient drainage is provided for the rinsing waters, and suitable pits are constructed so that the vats are at a uniform working height.

The layout provides for a logical process sequence and at all points where acids or other chemicals are used, adequate exhausting arrangements and washing towers are

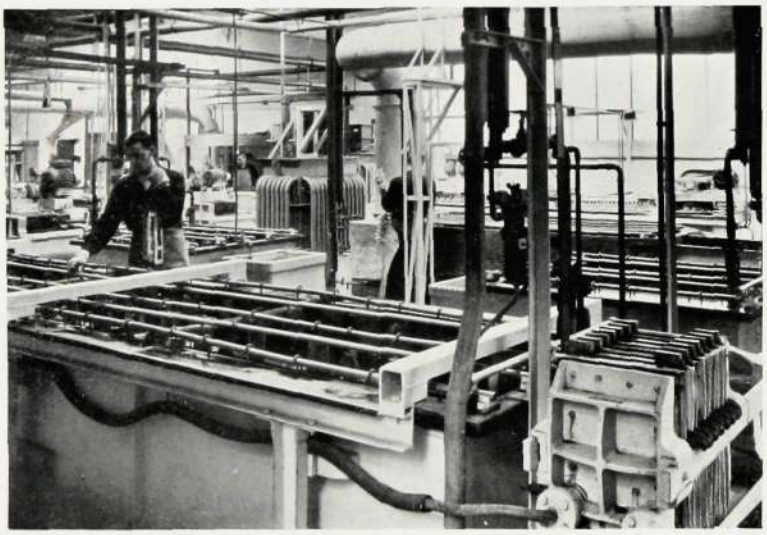

Fig. 2—Another View of the Vat Room.

installed. All vats which are operated at elevated temperatures are equipped with a highly efficient push-pull system of vapour extraction, (Fig. 3), which does not in any way restrict the working area. Briefly, this consists of a current of air flowing at relatively high velocity across the top of the vat in the direction of an extraction duct on the opposite side. The velocity at the surface of the liquid, however, is low. The net result is that there is a quite remarkable absence of vapour and odour.

The vats are supplied with power from individual transformer rectifiers which maintain precise conditions of voltage and current, and a central pumping system provides a means of emptying any vat so that periodic inspection and cleaning can be carried out.

The plating equipment conforms with modern practice and embodies apparatus for continuous filtering, agitating, and where applicable, close temperature control.

The plating processes are handled in three separate groups in accordance with a quantitative classification ; thus, one group handles small orders, or work of a special nature, another, orders of medium size, while the third or main vat room is allocated to the bulk work.

Very high standards are set by the specifications which prescribe the various finishes and processes ; therefore, associated with the department, is a modern laboratory for the routine analysis and supervision of the solutions, and for controlling the thickness and other characteristics of deposits. Checking is carried out on a continuous basis so that uniform, high standards are maintained.

Continual attention is devoted to the examination of raw materials and new processes which become available, a progressive policy which ensures that every advantage is taken of the latest deveopments in electro-plating technique.

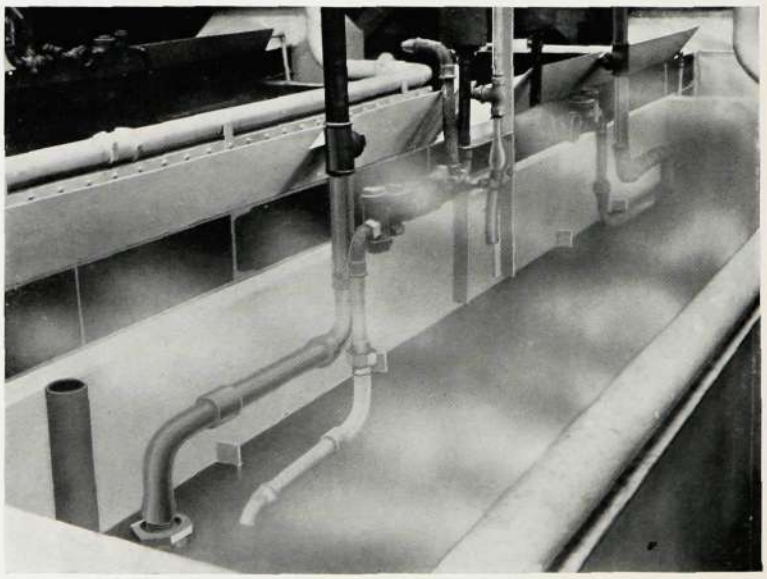

Fig. 3—Push-pull Steam Exhaust System.

Improved Moulded Case Wall Telephones

THE Company has recently introduced improved wall type equivalents of their now familiar range of moulded case table telephones, in order to cater for all conditions of use. These wall sets were to have been available soon after the introduction of the table sets and were, in fact, in an advanced stage of development when the war caused work to be suspended. In consequence of this delay it was not until last year that full production of the new wall instruments was attained.

Fig. 1—Auto Wall Telephone—Ordinary Working.

Although there exist dual purpose telephones suitable for use on table or wall, careful consideration of the arguments for and against this arrangement led to the conclusion that entirely separate designs were to be preferred, but at the same time, components should be made interchangeable as far as possible.

Instruments for ordinary or plan number working on automatic, manual C.B., or magneto systems have been developed and are typified by the illustrations in Figs. 1 to 3 which show, respectively, ordinary automatic, plan number automatic and ordinary magneto telephones. The C.B. instruments are similar in appearance to the automatic except that the dial impulse switch is replaced by a moulded disc, while the plan number telephones may have up to three buttons for operating various combinations of key switch units, the functions of the keys being indicated on a designation strip, as in Fig. 2.

Fig. 2—Auto Wall Telephone—Plan Number Working.

From the illustrations it will be observed that the casework is a one-piece moulding with the top portion shaped to form a robust cradle for the micro-telephone. It is made of highly polished plastic material

Fig. 3—Magneto Wall Telephone.

in any one of four fadeless colours—black, chinese red, ivory or jade green—to suit individual taste, and external metal parts are bright chromium plated. The glossy finish and absence of ornamentation facilitate cleaning.

The front wings of the cradle are specially shaped to hold the micro-telephone in a vertical position when necessary, as in Fig. 4, to enable the user to go from the instrument during conversation, without leaving the handset dangling by the cord, to its detriment, or alternatively, replacing the handset and operating the gravity switch, a procedure which would release the connection on systems having automatic clearing.

Fig. 4—" Personal Call ".

With the exception of the gravity switch plunger mechanisms, push key plungers, and the automatic dial or moulded disc, all components are mounted on a metal chassis which is fixed inside the case by means of captive-type screws, while a metal baseplate on which the casework hinges is provided for mounting the telephone on the wall. The hinges, one at each left-hand corner, fit snugly into recesses in the case and each is held by one captive screw. This method of fixing provides a ready means of removing the instrument from its backplate when in situ, and facilitates maintenance, since it is necessary only to disconnect the external cable and unscrew one hinge in order to lift off the case with component chassis, leaving the backplate and fixings undisturbed. Conversely, during installation, the instrument can be more readily fastened to the wall if the weight of the case and chassis is thus temporarily removed. A captive screw in a deep recess in the side remote from the hinges is used to lock the case.

The backplate has three deep indentations forming feet which hold the telephone well away from the wall and ensure firm seating without distortion on uneven surfaces ; also, twin circles of holes to provide outlets for the sounds from the ringer gongs. At the bottom centre of the plate is a hole through which the external cable is brought in, looped through and tied to a " U " plate on the chassis, then connected to the terminal block, in the manner shown in Fig. 5, so that the cable ends will swing with the case when it is opened and closed, a safeguard against the wires being strained or trapped between case and backplate. A diagram of the internal connections is fixed to the plate and preserved by a coating of clear varnish.

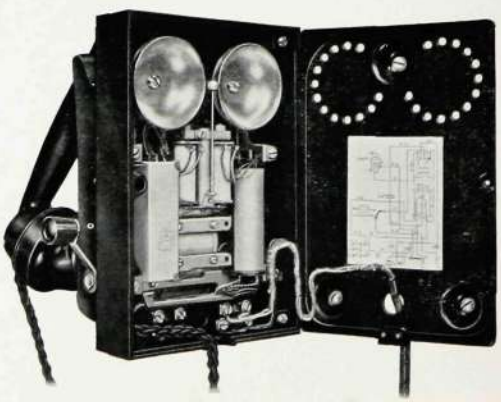

Fig. 5—Interior of Magneto Telephone.

The need for making the components of the existing table telephones and the new wall telephones interchangeable as far as possible, was, for obvious reasons, deemed of paramount importance, therefore this objective was kept well in mind during development, with the result that it is possible to take a complete chassis assembly from an automatic or C.B. table telephone of either ordinary or plan number type, and fix it into the casework of the appropriate wall instrument without alteration of any kind, moreover, the metal plungers of the gravity switch, and the plan number key buttons and label used on the table set are identical to those on the wall set. This interchangeability is of undoubted benefit to telephone administrations concerned with the storage of replacement spares.

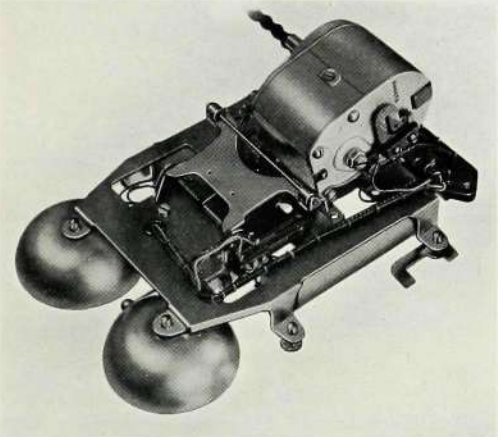

Fig. 6—Chassis of Magneto Wall Telephone.

The positioning of components in a magneto table telephone follows, of necessity, a rather stereotyped form, and the interior space shape cannot be simulated in a wall set without sacrificing, to a certain extent, the external symmetry, therefore it was not considered necessary to have an interchangeable chassis for the magneto sets. The components on the wall instrument chassis (Fig. 6) are arranged in a manner similar to those on the common battery counterpart with, of course, the addition of the hand generator.

Two types of magneto wall telephones are available ; one for general use, fitted with a standard " alnico " generator, and the other with a slightly larger " alnico " heavy duty generator for long or heavily loaded lines. The generator handle is at the lower right-hand side of the instrument and is sufficiently far forward from the wall to ensure ample clearance for the hand.

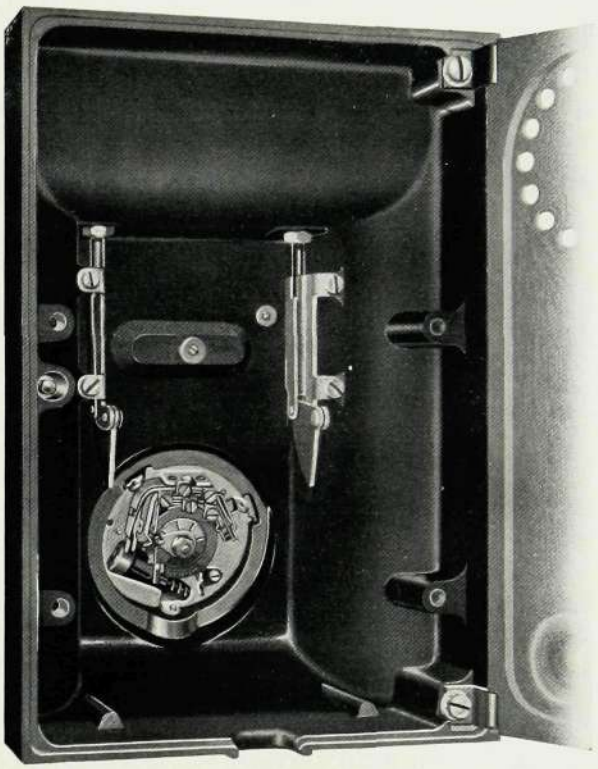

Fig. 7—Enlarged Interior View of Fig. 2 showing Plunger Quadrant Levers.

The gravity switch mechanism used in the new telephones is the Company's latest improved type designed for reliable working under adverse conditions. While being subjected to accelerated life tests in the laboratory the device completed more than one million operations without failure. The metal plungers each have a recess in the

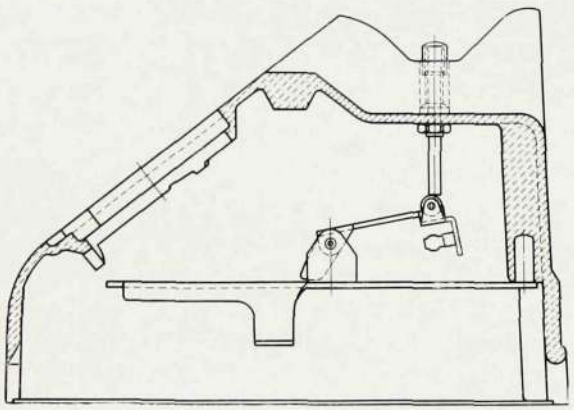

Fig. 8—Diagram of Roller Device in Table Telephone.

head into which the bearing bush extends, thus a shroud is provided to prevent the entry of foreign matter (through the holes in the cradle) which might obstruct the switch movement. The switch operating plate lever travel is at, approximately, 90° to that of the plungers the motion of which is transferred to the plate by means of sliding bars freely pivoted to quadrant levers clearly seen in Fig. 7. These engage rollers on the wings of the switch operating lever, or plate, mounted on the chassis, (see Fig. 6) and by this means, friction is reduced to a minimum. This plate lever with rollers is now standardized for use on all the Company's moulded case table telephones, the arrangement being as illustrated in Fig. 8.

In view of the many types of instruments, no attempt is made to reproduce here the respective wiring diagrams, nor is much to be gained from illustrating a selection of them ; it may be stated, however, that ordinary or special conditions can be met, thus, according to the requirements of the various systems, provision can be made for the inclusion of condensers, for the connection of an extension bell, etc. An example of this is given in Fig. 9, a schematic diagram of a magneto instrument in which the internal wires are looped at the points marked X to enable condensers to be connected when necessary, and in which dotted lines show the wiring for an extension bell.

For automatic telephones, facilities are given for mounting on the instrument terminal block a radio interference suppressor, in the form of a small, compact filter unit which absorbs the high frequency component of the dial impulses so that interference with radio communication is reduced to a minimum. It should be mentioned, however, that a suppressor is very rarely necessary.

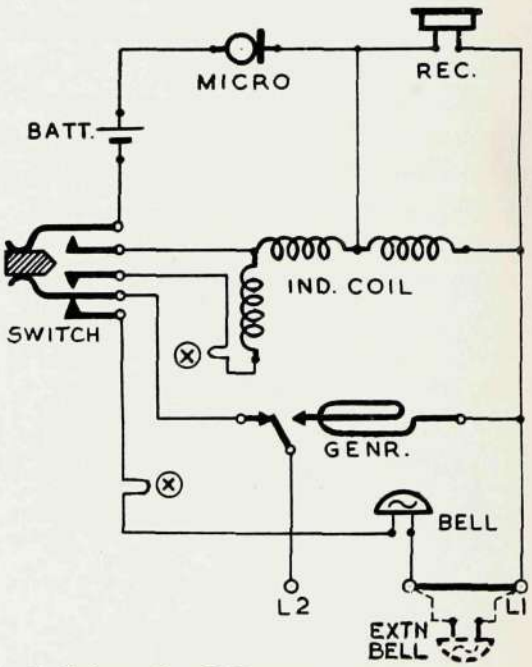

Fig. 9—Schematic of Magneto Telephone Circuit.

Instruments for use in temperate or tropical climates are available, the materials and finishes in the latter case being carefully selected and prescribed, coils impregnated and wiring P.V.C. insulated, also a dust cover for the dial mechanism can be fitted.

Every effort has been made to render the new instruments efficient, utilitarian and attractive while being reasonable in cost. It is confidently anticipated that they will prove to be as popular in their particular sphere as are their counterparts, the moulded case table telephones.