Post Office Telecommunications Journal

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Contents

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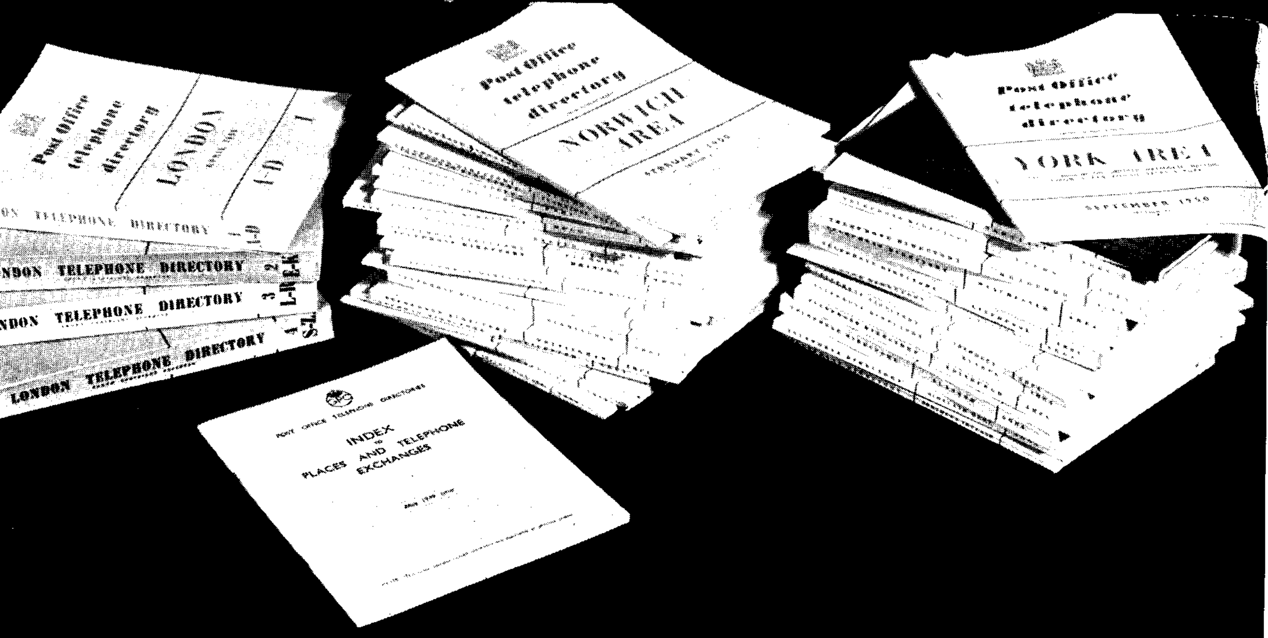
Comment

FOR MANY PEOPLE THROUGHOUT THE WORLD the sea holds a great attraction or, at the least, a strong interest, originating perhaps in our national heritage, history and family and friendly associations overseas.

For people dealing with communications, the sea has provided a field of absorbing interest, both in the development of under-water cables and, later, radio communication with ships on passage.

In an age of mechanisation and rapid technical progress, ship communications have not been slow to profit. Lifeboat and ocean liner alike have benefited. Direction finding, radar and automatic devices have added to the safety and regularity of sea movement. Radio-telephone and -telegraph have improved social and commercial facilities for those who travel in ships.

Throughout its history, ship communication has held to a strong tradition of service and pride of craft, born of the sea itself and of the early pioneers in this sphere of radio. To one of these, Commander Loring, whose death occurred recently, we pay tribute elsewhere in this issue of the Journal. Compared with his early days, coast stations and ship installations—the terminal links in sea communication—show little in their modern form of the stations of twenty years ago, which in their turn had little to show in common with the earliest stations. One feature remains practically unchanged, however—the Morse operating key of the telegraph transmitter. Maybe this rather insignificant looking piece of equipment, together with the human touch bringing it to life, hold the service to its traditions. Maybe it is the sea.



The Telephone Directory Service

by Geo. A. Bennet,

Inland Telecommunications Department

THE PROVISION AND MAINTENANCE OF A satisfactory number information service, though essentially merely an adjunct to telephone service proper, is in itself a pretty big undertaking—one, perhaps, that deserves a little more publicity than is usually accorded to it. It is hoped to refer, in a later article, to the oral Directory Enquiry (DQ) service, but meanwhile let us turn the spotlight on its visual counterpart, the Directory. It has been claimed that the telephone directory is the most frequently consulted of all works of reference, and this might well be so (though in view of many of the enquiries received by the Directory Enquiry service the Administration no doubt wishes it was consulted even more often than it is!); but how many of the millions who do refer to it give a thought to the care and labour that have gone into its publication—to the vast organisation that has been needed for its compilation, production and distribution?

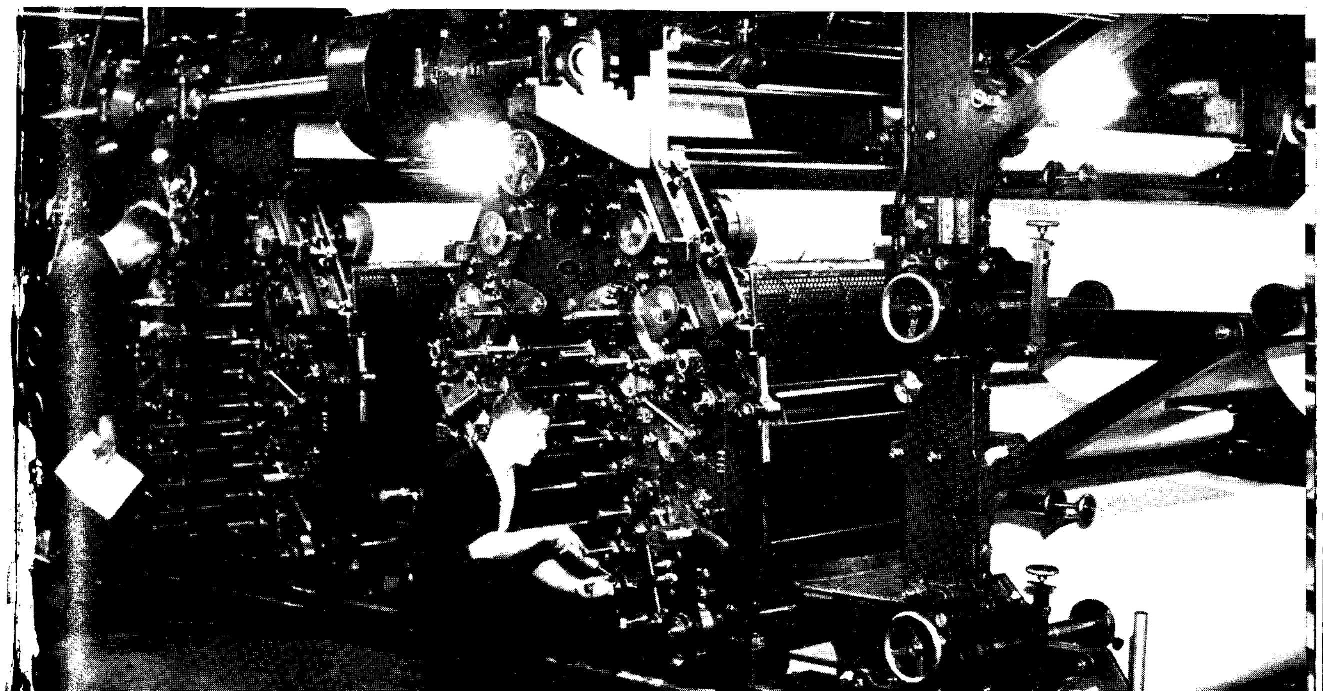
On this last point alone, few Post Office activities call for such a degree of co-operation between different units as does the publication of the telephone directory—the *Telephone Managers' Offices* for actual compilation of directory matter and for the preparation of the individual delivery particulars; the *Supplies Dept.* for the collation of estimates and the preparation of distribution schedules; the commercial *Advertising Agents* for the preparation of display advertisements; *P.O. Headquarters* for the editing of "preface" matter in accordance with current policy; *H.M. Stationery Office* for the actual printing; the *Motor Transport Branch of the P.O.E.D.* for the transport of the directories from the printing works to the numerous local distribution points; and finally the *Postal Services* for the individual delivery of directories to subscribers and recovery of the obsolete copies. All this has to be fitted in to a strict time schedule to eliminate all possible delays and thus ensure that when the subscriber receives his new directory it is as complete and up to date as it is humanly possible to make it!

How big a task this all amounts to might be gleaned from the illustration at the head of this article, which represents just one copy of the national directory with its 60-page Index—the complete work being divided into 50 territorial sections, the size of each section depending on the nature of the area served. The Hull and District section (in the illustration, the "odd man out", near the top of the right-hand pile) is the only section not printed by H.M.S.O. The need for dividing the directory into sections and limiting distribution to a local basis is only too obvious; the cost of providing every one of the three million telephone subscribers in Britain with such a vast pile of "literature" would be quite prohibitive; but even if this were not the case, there would be few subscribers who would welcome such a lavish supply of number information. Fortunately, the bulk of subscribers' information needs is limited to points within the local area.

Even though the amount of printed directory matter distributed is thus severely restricted, the task of issuing directories is a colossal one. About 8,000,000 telephone books (as the man in the street likes to call them) are printed and distributed in the course of a year, over half that number being bulky tomes of a thousand or more pages, and weighing some 3 lb. apiece. The printing alone is an immense job, requiring for each annual issue almost 10,000 tons of paper. The directories are printed in a similar way to newspapers, on big rotary presses (Fig. 1) of the type found in the larger newspaper offices. One of these machines at the H.M.S.O. Printing Works at Harrow, where all the directory sections (with the exception of that for the Hull Corporation system) are produced, is capable of printing more than 16,000 pages a minute, 64 pages being printed simultaneously. Despite this truly astonishing output, it yet requires a period of many weeks just to run off all the copies needed of *one* of the four parts of the London directory—and several such machines are employed!

The actual printing is far from being the greatest part of publication, however, even as far as the Stationery Office is concerned. Here is a brief de-

Fig. 1. Directories are printed on big rotary presses, which turn out about 16,000 64-page folded sections in an hour.



scription of the main processes involved in the publication of a telephone directory. A more detailed description was given in Post Office Green Paper No. 44 (January, 1939).

Directories have their birth in the Telephone Manager's Office, where copy for the next issue is prepared. All amendments (additions, deletions, and corrections to existing entries) are entered on what is called a "paste-up" (Fig. 2). This is a sheet, bearing one column of entries of the previous issue, with wide margins on which the amendments can be entered. This work of correction and compilation is a continuous process, carried out daily as amendments arise, right up to the stage of what is termed the "closing date", i.e. the date when a new directory goes to press.

The paste-up copy is sent direct to the printers, where the type for each and every column of the previous issue has been kept in metal trays, or "galleys" (Fig. 3). The work of setting the new edition can thus be limited to extracting the type for deleted entries and inserting that for new entries, the latter being prepared on Monotype or Linotype machines. Although a fair amount of capital is locked up in maintaining this enormous quantity of standing type, the arrangement is obviously cheaper and quicker than resetting the whole directory each time re-issue is effected, provided the amendments are not too numerous. This factor, incidentally, renders it difficult to introduce suddenly any major alteration in the arrangement of entries or in the size of type; a major change in make-up would involve scrapping all the existing type and resetting it in the new format—a task not only costly but one requiring some time to carry out.

Fig. 2. Additions, deletions and amendments to directory copy are entered daily from the particulars shown on the individual installation advice notes

When the compositors have carried in the necessary amendments, and proofs have been taken and checked, the type from the galleys is paged up, together with any blocks for display advertisements, and locked securely in metal frames, or "formes" as they are termed. There is quite an art in this paging-up operation, as advertisers naturally want their displays on the same page as their normal entries, whilst it is also desirable to avoid having to split a small grouped entry, for example, between two pages or even columns. To achieve an attractive and well-balanced layout, resort has sometimes to be made to the inclusion of "buffer-ads"—usually official admonitions to post early and suchlike. The formes are then sent to the foundry for the casting of the cylindrically-shaped plates, or "stereotypes", from which the actual printing is done.

The rotary printing presses, to which reference has already been made, not only print up to 64 pages at a time but automatically deliver them as folded sections. Most directories, however, consist of a number of such sections, so before the finished article is available the various sections have to be collated in proper sequence, bound and covered. This is all effected in one operation by another ingenious machine (Fig. 4), whence the copies are ready—after trimming and bundling—for despatch to local distribution points. Special arrangements have to be made, of course, for the binding of the stiff board and cloth-covered editions required for use at official information points, call offices etc.

The completed directories are taken in bulk from the printing works by 5-ton lorries to the local distribution points (Head Post Offices, Engineering Depots etc.), but prior to this stage an addressographed card has been prepared in the T.M.O. for each subscriber in the area, showing the address and the number of copies to be delivered. These cards are sorted by the postal staff, who carry out the actual delivery, into convenient "walk-order", and delivery to the individual subscribers commences just as soon as the first supplies are received. So well integrated is the organisation that, though it takes a small army of postmen about two months to deliver each part of the London directory to the million or so subscribers in the area, the last copy has barely come off the press by the time that distribution is completed.

It may well be asked "Is all this effort worth it? Need directories be published at all, or—if they

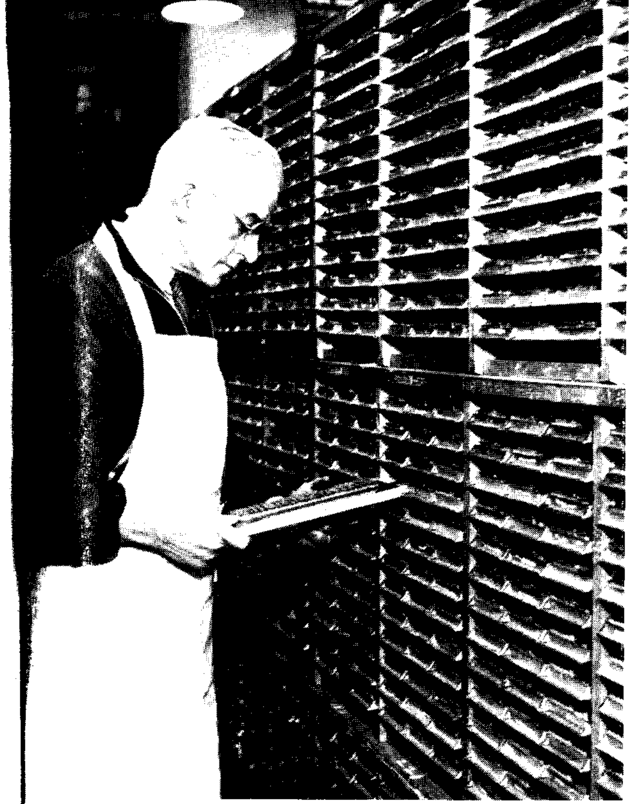
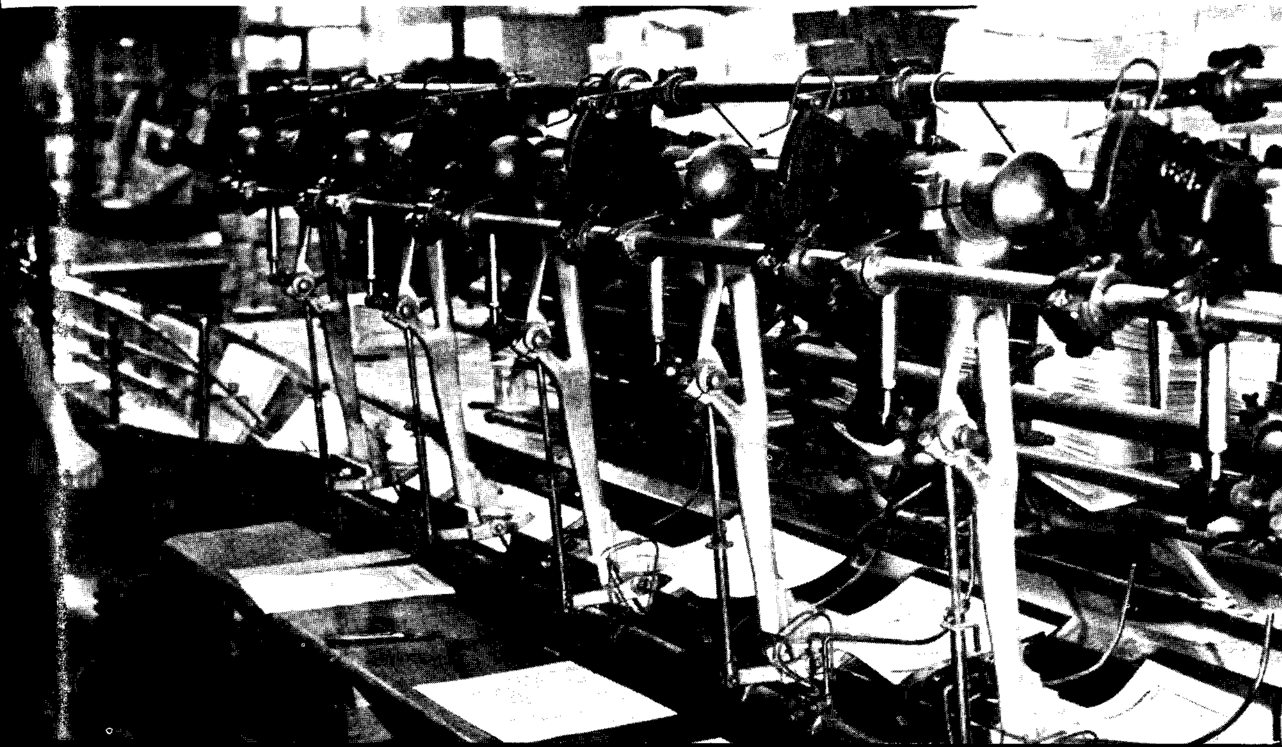


Fig. 3. To avoid having to reset the directory each time it has to be issued, type is kept standing at the H.M.S.O. works. Each tray, or "galley," represents one column of type—and there are over 50,000 of them !

must be—need they be issued so frequently or cover so wide an area?" The answers to these questions lie in the effect any withdrawal or curtailment of directory matter would have on the oral DQ service, and in what would be the result financially. These are matters which, it is hoped, may be discussed in a later article, but as far as directories are concerned one thing is fairly certain—some adjustment to the size and distribution of the London directory is inevitable in the near future. This 4,000-page section has grown too big to remain much longer a convenient and economic instrument of number information.

ig. 4. The several sections required to make up a particular directory are automatically collated and bound in one operation by this ingenious machine



From left to right: H. W. MOGG, Senior Traffic Superintendent; G. E. PHILLIPS, Chief Clerk; S. J. SMITH, A.M.I.E.E., Telephone Manager; J. G. MANNING, Senior Sales Superintendent; D. B. AFFLECK, A.M.I.E.E., Area Engineer.

PETERBOROUGH TELEPHONE AREA

Although Peterborough is well known for its Cathedral, the Peterborough Telephone Area has many other claims to fame. Here is Bourne, birthplace of Hereward the Wake and the B.R.M. car; Oundle Public School; and the sands of bracing Skegness.

Other towns in the Area include Boston, famous for its lantern-towered church, "Boston Stump"; St. Ives, with its chapel in the middle of the bridge over the River Ouse; and Wisbech, inland port on the River Nene.

The varied industries of the Area include the manufacture of agricultural machinery, steam rollers and Diesel engines. Natural resources include large brickyards, ironstone workings, cement works and the finest arable land for root crops in Britain.

Here is the country of potatoes and sugar-beet and strawberries, of vast expanses of tulip fields around Spalding and of long straight "drains", which draw anglers from all parts of Britain.

The Royal Foxhound Show and Peterborough Agricultural Show attract large crowds to Peterborough every summer and call for the provision of many temporary exchange lines.

The Area contains some 2,051 square miles. It has Ermine Street as its backbone, from Caxton Gibbet in the south-east to Gonerby Moor in the north-west. It contains 124 exchanges, 91 per cent. of them automatic—the largest percentage in the Provinces. They serve 26,848 exchange lines and 44,069 stations. Mole-drained cable runs for miles through the rich black Fen soil, linking many isolated farmers with civilisation. The total staff numbers 714.

LONDON TELECOMMUNICATIONS REGION, WEST AREA

The West London Area, a territory of 124 square miles, extends from London's famous Marble Arch to the lesser-known peaceful surroundings of Egham in Surrey and Harefield in Middlesex.

It includes such well-known places as Kensington, with its great stores, world famed museums, colleges and the Royal Albert Hall, and artistic Chelsea, with its Royal Hospital and Army Pensioners. The Area is bounded on the southern side by the historic Universities Boat-Race course. Olympia and Earls Court, homes of famous exhibitions and annual events, beloved by Londoners, present their own special problems. The British Industries Fair, the Royal Tournament, the Amateur Athletic Championships at the White City, the Chelsea Flower Show and Rugby International Football at Twickenham are some of the more important events staged in the Area.

The B.B.C. Television Studios at Shepherds Bush, the British Film Industry at Ealing and Denham, and the vast industrial factories of the Great West Road are among the more important installations maintained. At the end of the West Road lies London Airport, to which come the aircraft of all nations, transporting the peoples of the world to the hub of the British Commonwealth.

32 Exchanges, of which 26 are automatic, provide service over the 136,000 lines to close on a quarter of a million telephones, producing a revenue of over £3,000,000 annually.

The total staff numbers 3,700. The Area Headquarters is at Acton.

Left to right: (*standing*) C. N. SMITH, A.M.I.E.E., Area Engineer (Maintenance); A. D. NEATE, B.Sc., A.M.I.E.E., Area Engineer (Construction); A. B. COOPER, B.Sc., A.M.I.E.E., Area Engineer (Installations); F. F. MEYER, Chief Traffic Superintendent; S. P. WILSON, M.S.M., Chief Sales Superintendent; (*seated*) LT.-COL. J. C. ROWE, T.D., Deputy Telephone Manager; G. J. MILLEN, A.M.I.E.E., Telephone Manager; MISS C. A. DEUCHAR, Chief Clerk.

Submerged Repeaters on No. 4 and No. 5 Anglo-Dutch Cables

by D. C. Walker, B.Sc.(Eng.), A.M.I.E.E., Engineer-in-Chief's Office

A TELEPHONE REPEATER IS A DEVICE WHICH amplifies both directions of the speech signals and was common in the early days of audio-frequency telephony. However, it is now more usual to have separate go and return paths with (unidirectional) amplifiers. The advent of the carrier system enabled many speech channels to be transmitted simultaneously over the same conductors (by transposing the audio-frequency channels to other bands in the frequency spectrum). With such systems one must either have separate go and return paths or employ different frequency bands for the two directions of transmission ("split-band" method). Sometimes, on "split-band" system cables, intermediate amplification is obtained by repeaters consisting of a combination of directional filters and amplifiers. It is such a unit, adapted for working in submarine coaxial cables, which forms the subject of this article.

While on land circuits one can usually site the repeater stations at the optimum spacing, the usual practice on submarine cables has been to employ shore repeater stations only. This practice restricts the number of circuits available. The advantages of employing intermediate submerged repeaters has been known for many years, but their introduction has awaited the development of sufficiently reliable components. Thus a review of the alternative methods of increasing the circuit capacity of a route—say from this country to the Continent (or to Ireland)—will be of interest.

With a non-repeatered cable, high transmitting powers (from the shore repeater stations) were often involved, in order to attain the maximum number of channels with a given limiting signal noise ratio. The maximum transmitting power, although ultimately limited by the power handling capacity of the cable, is usually determined by considerations of the operating and maintenance costs (and to a lesser extent by difficulties in the design) of the high power feed-back amplifiers. A substantial increase in the circuit capacity of a route can thus be obtained only by (1) laying more cables, (2) introducing extra large diameter cables such as the recent 1.7 inch polythene cables to Holland and Belgium, or (3) inserting one or more submerged repeaters in existing cables. Although on capital cost submerged repeaters offer the cheapest solution, their maintenance cost becomes the deciding factor. The cost of replacing a faulty repeater is high and the interruption to traffic for several days may be serious. Thus the repeaters must be made extremely reliable and with a long life (say at least five years) in order to be a really economical proposition for a multi-repeater scheme.

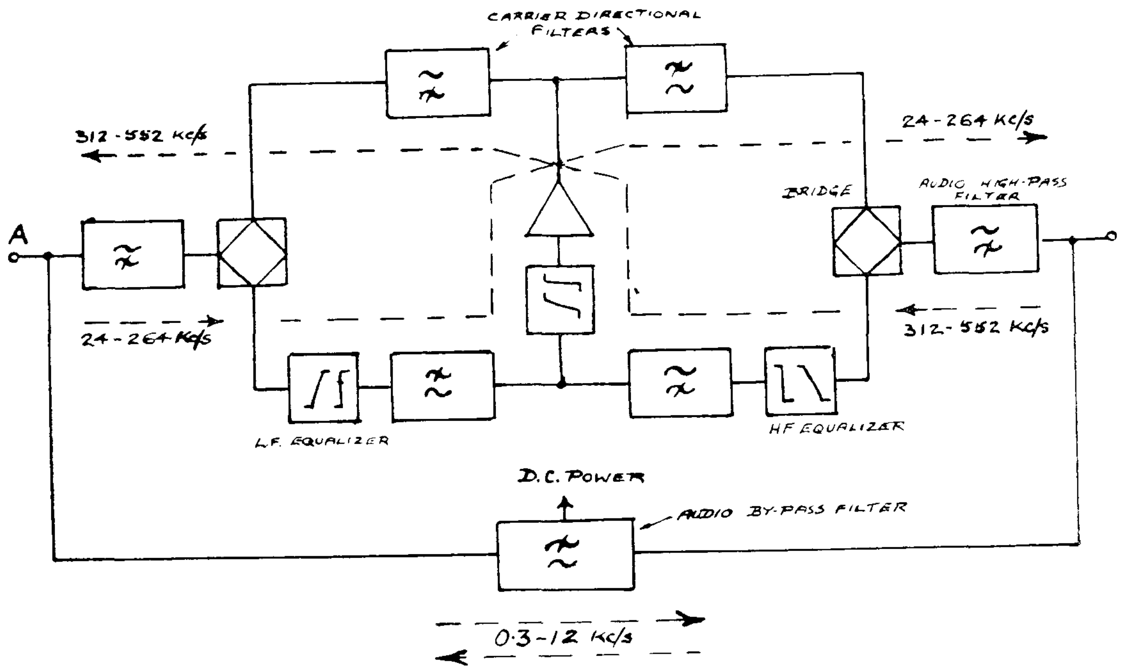
The G.P.O.'s first submerged repeater was laid in 1942 in the Holyhead-Port Erin cable and another repeater was installed in a cable to Germany in 1946. These were both single repeater schemes and amplified only in one direction of transmission. The Anglo-Dutch scheme is the first of a number of multi-repeater schemes planned, and thus the equipment has been standardised for cables laid in shallow waters (up to 200 fathoms in depth). Up to ten repeaters can be used in tandem, spaced at about 16 nautical miles on 0.62 inch paragutta dielectric coaxial cable, or at 19 nautical miles on 0.62 inch polythene coaxial cable. The repeaters for paragutta cable differ in gain/frequency response from those for polythene cable but have the same maximum gain.

The Anglo-Dutch No. 4 and No. 5 cables, between Aldeburgh on the Suffolk coast and Domburg on the island of Walcheren in the Netherlands, were originally laid in 1937. They are of paragutta and about 82 nautical miles long. Each has been equipped with four repeaters which increase the circuit capacity about five-fold. The No. 5 cable was brought into traffic in February, and the repeaters laid in No. 4 in September, 1951. The repeaters for both schemes were manufactured by Siemens Bros. to a Post Office design.

Standard Repeater Scheme

A split-band system, transmitting a super-group in each direction (24-264 kc/s one way and 312-

552 kc/s the other), was adopted, so that a single cable can carry 60 circuits; any of these, of course, can be used for V.F. telegraphy. Normally the high frequency band is transmitted towards England, *i.e.* in the Domburg-to-Aldeburgh direction, in the present system. The repeaters amplify in both directions and give a gain frequency response which is the inverse of the cable loss and rises to 60 db. at the highest working frequency (552 kc/s). The system of directional filters and equalisers with a common amplifier is shown in the illustration.



SCHEMATIC OF SUBMERGED REPEATER

In addition to the carrier transmission paths, facilities for locating cable and repeater faults are essential. An unamplified audio path up to 12 kc/s enables impedance frequency measurements to be made to locate cable faults, but it also serves as a "speaker", which is particularly useful when working with the cable-ship during installation. A pulse technique, utilising the carrier frequency bands, is employed for locating repeater faults (see later).

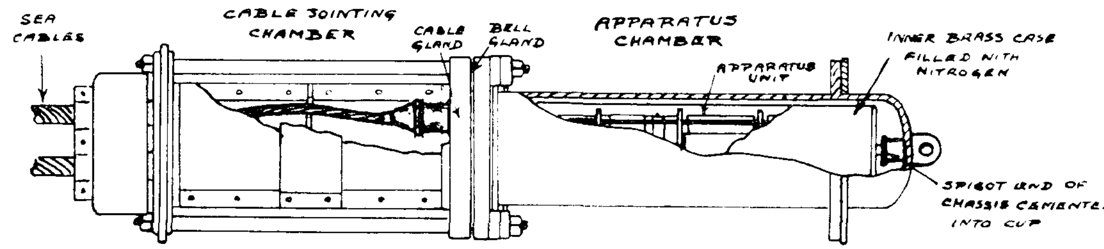
Construction of a Repeater

The submerged repeater is contained in a galvanised steel case, 9 ft. 4 in. long and weighing approximately 20 cwt. in air. Only about half of the total volume contains electrical equipment, the other half being a cable jointing chamber. The two sea cables enter at one end and are jointed (on board ship) to stub cables, which pass through glands into the apparatus chamber. This chamber and its simple gutta-percha ring seal are designed to withstand a working pressure of 500 lb. per sq. in. (equivalent to the sea pressure at a depth of nearly 200 fathoms).

As an extra precaution against the ingress of a very small quantity of water, the apparatus proper is contained in an inner sealed container which is filled with dry nitrogen gas at atmospheric pressure. The electrical equipment is associated with the inner cable conductor and may be worked at a high voltage to earth; thus the insulation between the equipment and repeater case is designed to withstand 3,000 volts (D.C.). The insulation resistance must also be high if the repeaters are not to mask incipient faults that may develop in the cable.

A great deal of care has to be taken with the selection and acceptance testing of the electrical

components, and in some cases extended trials under working conditions are necessary. It is intended that these tests shall eliminate any components liable to catastrophic failure due to faulty manufacture and also those components with inevitable deterioration (e.g., valves) which exhibit signs of premature failure. For example, valves are run for an ageing period of about three months and from the test results a selection is made of the valves exhibiting longer life characteristics. Commercial valves (from a particular batch of the type



LONGITUDINAL SECTION, SHOWING CONSTRUCTIONAL DETAILS

used) were employed in the Anglo-Dutch system and their estimated life is at least five years. The Post Office has under development special valves with even longer life for use in future systems.

Power Supply

The repeaters are energised by D.C. from one shore station. In each repeater, the valve heaters and a resistance which provides the H.T. supply are in series with the centre conductor of the coaxial cable; current is fed from the power unit through this conductor and all the repeater power circuits, returning *via* sea earth-plates to prevent electrolytic corrosion of the cable. Positive polarity is applied to the centre conductor, as this is less liable to produce breakdown than negative polarity —a phenomenon noticed in the early days of deep sea telegraph cables and which led to the "sealing battery" technique.

On the Anglo-Dutch System, the supply is from an electronically controlled constant current power unit and a current of 0.715 amperes at 1,200 volts is normally supplied from England. The current is stabilised to within ±3 per cent, as the valve life is a critical function of the heater current. However, this constant current facility protects in particular the repeater valves, should a short-circuit fault develop in the cable, and also allows the faulty system to be energised from one of the shore stations while pulse measurements are made to locate the faulty section of cable.

Fault Finding

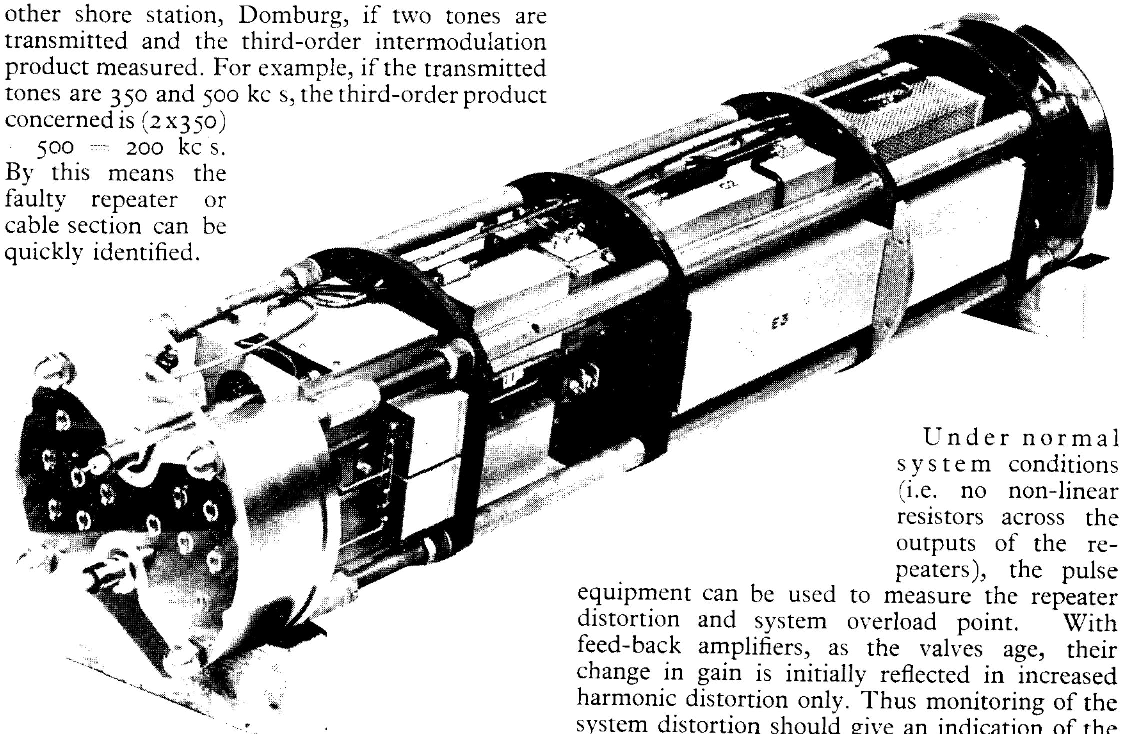
To assist in locating transmission faults, an indirect measurement can be made of the output levels from the repeaters by the following novel pulse technique developed by the Post Office. Non-linear resistors are switched across the outputs of all repeaters by a temporary reversal of the line current. A tone of (say) 150 kc/s pulsed at 250 c/s transmitted from Aldeburgh then produces a third harmonic pulse of 450 kc/s at each repeater output. These pulses, being in the frequency band transmitted in the reverse direction, are amplified and returned to Aldeburgh with a time delay appropriate to the repeater position. They are displayed on a cathode-ray tube and each individual pulse can be compared with a standardising pulse. Thus these reflection pulses, which are indicative of the

GENERAL VIEW OF A REPEATER

output levels of the repeaters, can be calibrated on installation, so that any subsequent changes are easily located and measured.

A similar measurement can be made from the other shore station, Domburg, if two tones are transmitted and the third-order intermodulation product measured. For example, if the transmitted tones are 350 and 500 kc/s, the third-order product concerned is (2 x 350) − 500 = 200 kc/s. By this means the faulty repeater or cable section can be quickly identified.

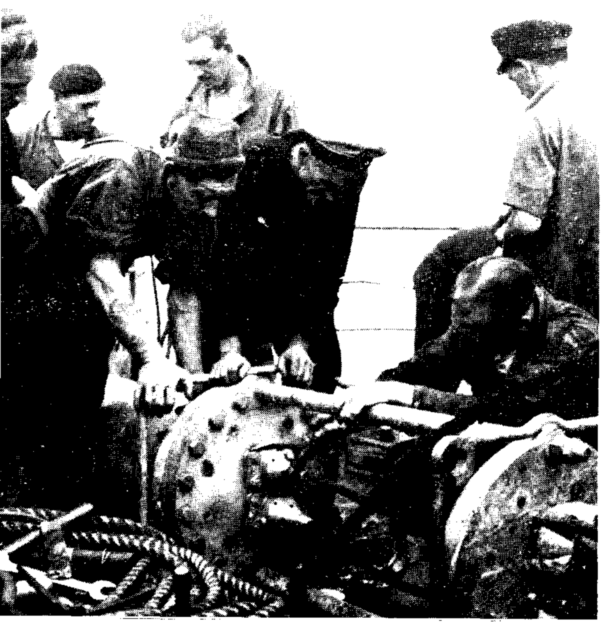
THE ELECTRICAL EQUIPMENT



Under normal system conditions (i.e. no non-linear resistors across the outputs of the repeaters), the pulse equipment can be used to measure the repeater distortion and system overload point. With feed-back amplifiers, as the valves age, their change in gain is initially reflected in increased harmonic distortion only. Thus monitoring of the system distortion should give an indication of the ageing of valves and also forewarning of the failure of a repeater. In certain circumstances, the test can be made by merely removing one group of the system from traffic.

If the fault is proved to be in the cable, then normal cable techniques can be used to locate it. For this purpose an audio path up to 12 kc/s has been provided (through the by-pass filters on the repeaters), so that the impedance/frequency response can be measured. A correction must be made, however, for the phase shift in the repeater filter.

TERMINATING SEA CABLES

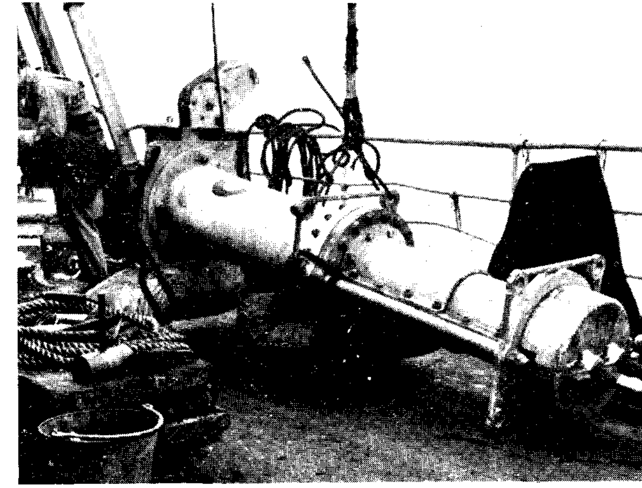


Repeater Laying Operation

It is important that the repeaters be sited accurately, otherwise excessive noise or distortion is liable to occur. Unfortunately the cable loss per mile is often not known with sufficient accuracy, as individual cables vary, particularly at high frequencies, where the dielectric loss is becoming important. For this reason, the repeater positions are fixed by the cable loss near the highest working frequency and not by cable lengths. Thus the repeaters must be laid working from the Domburg station. Owing to appreciable changes in loss with temperature, allowance must be made for the sea temperature at the time of laying and the whole system must be designed to cater for the annual variations of cable loss.

A typical procedure for the laying of one repeater was:—The ship navigated to the correct geographical position, grappled and cut the cable. Attenuation measurements at 500 kc/s were made from Domburg to the ship. If repeaters intervened, then these had to be energised from Domburg and power filter units used on the ship. Usually the loss was more than estimated and then the requisite correction length of cable (to give the required attenuation within ± 1 db.) was cut off the Domburg side and stock cable added to the Aldeburgh side in a simultaneous operation. The correct position having been arrived at, the Domburg side of the repeater was jointed first. Further measurements were made between Domburg and the ship through the repeater before jointing the Aldeburgh cable. Final check tests were made between Domburg and Aldeburgh before the repeater was actually lowered overboard, and these were repeated as soon as it reached the sea bed.

The carrier frequency measurements enabled the output level of each repeater at any frequency

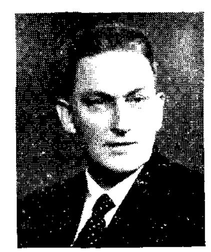


READY FOR SERVICE

to be related to the shore terminal level. Naturally other measurements, such as insulation resistance, were also made during the laying.

Repeater laying operations require a relatively calm sea. The time spent on laying several repeaters can thus be considerable if the weather is unfavourable. On the first Dutch scheme, the actual time spent in laying each repeater was two days—one day for locating the position and the next for inserting the repeater. Replacement of a repeater would occupy less time as there are no cable length adjustments and the cable is slack. However, it is hoped that such operations will be comparatively rare.

Retirement from the Editorial Board



Sir Archibald Gill, B.Sc.(Eng.), M.I.E.E.

Dr. W. G. Radley, C.B.E., Ph.D., B.Sc., M.I.E.E.

Sir Archibald Gill, Engineer-in-Chief to the Post Office, retired from the public service on the 30th September, 1951. With his retirement we lose Sir Archibald from the Editorial Board, of which he has been a member since the earliest days of the Journal.

Sir Archibald will be greatly missed both by his fellow-members on the Board, where his wide experience and wise counsel have been invaluable, and by the general reader, who will remember his two articles in the opening issues of the Journal on "Engineering Developments". In those he demonstrated a remarkable skill in making clear, in simple language, even the more complicated problems and technicalities. With him in his retirement go our best wishes, and our gratitude not only for his services, but also for the warm humanity which he brought to bear on any problem put to him.

We have been fortunate to secure, as successor to Sir Archibald on the Editorial Board, Doctor W. G. Radley, C.B.E., Ph.D., B.Sc., M.I.E.E., who has been appointed Engineer-in-Chief to the Post Office. We welcome him very warmly to the Board.

Coin Collecting Boxes — How They Work

by C. W. Arnold, A.M.I.E.E., and R. T. A. Dennison, A.M.I.E.E.,
Engineer-in-Chief's Office

IN MARCH, THE POSTMASTER-GENERAL announced in the House of Commons that it was proposed to increase the local fee for a telephone call from a coin-box installation from 2d. to 3d. Many readers of this Journal who deal with call office calls as part of their official duties or who use call offices as members of the public, may be interested to know something more about how a coin box works.

All coin collecting boxes in use in this country are of the multi-coin variety and there are two main basic types, namely prepayment and post-payment. In the former, the coins are inserted before the call is set up, while in the latter the converse is the case. Each of these basic types has two versions, one designed for the public call office and one for use with subscribers' telephone installations. The main difference between a coin box used in a public office and that provided for subscribers' installations is in the design of the cash compartment. Both the main basic types are readily distinguishable from each other by the provision of "A" and "B" buttons on the prepayment type, whereas buttons are not provided on the postpayment type.

As will be evident from the titles of the two types, the operating procedure differs. For example, with the prepayment type of box, the local fee has to be inserted before attempting to make a call. There is an exception to this, however, when an emergency call or the service of an operator is required. These services are obtained by dialling 999 or "O" before inserting coins, or, in a manual exchange area public call office, by pressing an emergency button.

The engineering codes allocated to the two basic types are: prepayment—"Box Coin Collecting No. 14" and postpayment—"Box Coin Collecting No. 16". Reference will be made to these two codes throughout the explanation. Variations in each of the basic types have been given lettered suffixes to the main number. For example, a prepayment box as used in a public call office is coded 14D and a prepayment box used at a private installation is 14E. Boxes 14D, 14E and 16B are illustrated in Figures 1 to 3. Figure 4 is a view of Box No. 14D with the front removed and the mechanism swung out to expose the bell set. It will be seen that No. 14D is slightly longer than No. 14E. This difference is in respect of the cash compartment only, the public box, No. 14D, having a very robust cash compartment, whereas for subscribers' installations No. 14E has a more simple arrangement in the form of a strongly constructed cash drawer. This latter box also incorporates facilities for standing it on a table or fitting to a wallboard. The subscriber holds the keys for unlocking the cash drawer.

All coin collecting boxes in use in this country are designed to accept pennies, sixpences and shillings. In manual exchange areas, signalling to the operator can proceed only after insertion of the correct local fee in pennies. In auto-exchange areas, a "unit-fee" number can be dialled only after inserting the requisite number of pennies.

Each coin collecting box comprises:

(a) An outside case or container, known officially as "Box CC Part—Container No. 8A" (public) or "10A" (subscriber). This container provides a housing for the mechanism and also incorporates the cash compartment. A raised engraved mounting indicating the correct slots for the various coins is fixed to the top of the container. In the prepayment types, "A" and "B" in white appear on the front to indicate the relative positions of the buttons.

(b) A complete mechanism. The coin slots are part of the mechanism frame and are exposed through a rectangular aperture in the top of the container.

Prepayment Mechanism No. 14 (Figure 5) provides for the following:

(1) Pennies, sixpences and shillings are accepted, checked for size and allowed, if correct, to pass into the cash compartment. If not correct, the coins pass into the refund chute.

(2) The first coin inserted renders the transmitter of the telephone inoperative until button "A"

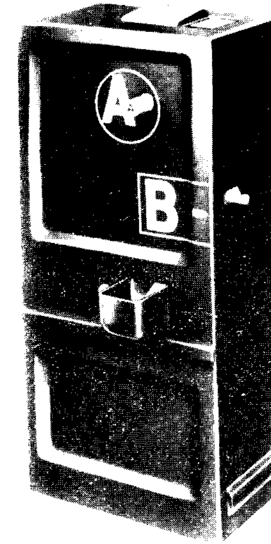


FIG. 1. BOX 14D

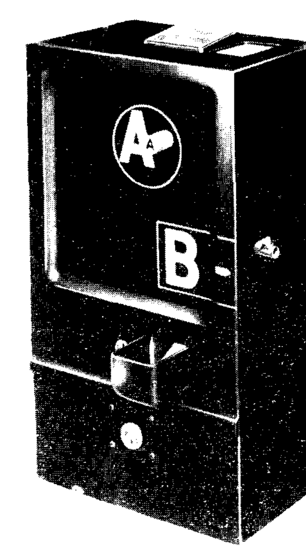


FIG. 2. BOX 14E.

FIG. 3. BOX 16B

is depressed and also shunts the receiver to prevent it from being used as a transmitter.

(3) Dialling or signalling is prevented until the full local fee is inserted in pennies.

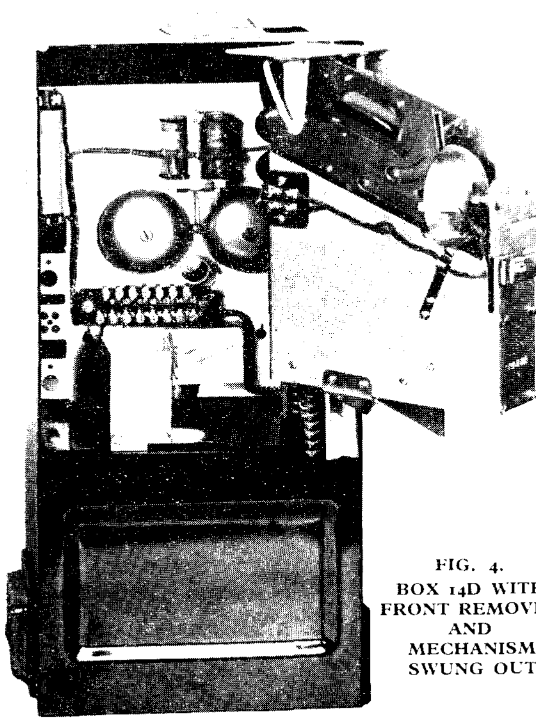


FIG. 4. BOX 14D WITH FRONT REMOVED AND MECHANISM SWUNG OUT

(4) Audible distinguishing signals are given to the operator, so that a check can be made of the number and denomination of coins inserted for toll, trunk etc. calls.

(5) A safeguard is provided against conversation taking place in the event of the fee being refunded (button "B" operated).

Very briefly, the action is as follows. A penny inserted in the appropriate slot operates the coin slot crank arm, which in turn operates a set of springs to render the telephone transmitter inoperative and shunts the receiver to prevent its use as a transmitter. The penny now passes down a coin chute and rolls along an inclined plane, past a coin check gauge. If the coin diameter is less than a specified minimum, it will fall into the refund chute. If the diameter is correct, the penny will continue past the check and after striking the appropriate gong it will drop into a coin suspense chamber, known as a "swinging container", and come to rest on one end of a balance arm projecting into this. The balance arm is designed to operate on a "centrally pivoted scale" principle, having on one end a balance weight so adjusted on the balance arm as to prevent the latter from operating until overcome by the weight of the local fee in pennies resting on the opposite end. Therefore, the first penny to fall on the end of this balance arm will not operate it and it is necessary to insert a second penny (three, after the 1st October) to

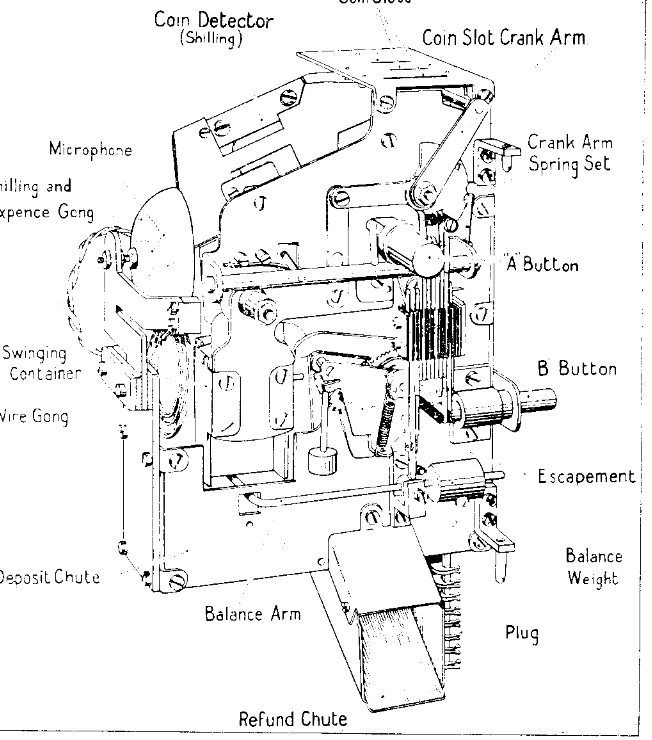


FIG. 5. MECHANISM No. 14

operate it fully. The inertia gained by the falling penny will give a downward thrust to the balance arm, but with the balance weight correctly adjusted the arm will immediately return fully to its normal position of rest. The full operation of the balance arm renders the dial operative in automatic systems or completes the signalling circuit in C.B. manual systems, by the operation of a set of springs. Sixpences and shillings follow very similar courses but strike a separate gong giving a higher pitched note, a sixpence striking the gong once, and a shilling twice. A specially adjusted microphone is located near the coin gongs and transmits the gong sounds to the exchange. Special care has been taken to make this microphone reasonably immune from all other sounds and to take it out of circuit at all other stages of the call. The pennies are now held in suspense on the balance arm and their subsequent movements are determined by operation of button "A" or "B" by the caller.

After the dialling of the required number, if automatic, or completion of the call by the operator in the C.B. manual case, and assuming the called line to be free, the called party answers. Conversation cannot take place, however, until the "A" button is operated, when the crank arm and associated spring set, which had previously been moved by the insertion of the first coin, are restored to the normal position. The transmitter in the telephone is thus made operative again. The operation of button "A" also causes the "swinging container" to swing towards the left hand side of the mechanism, so that its lower end is placed over the chute giving access to the cash compartment. Coins held in suspense on the balance arm are also moved and consequently fall off the balance arm, down the chute and into the cash compartment. The balance arm, relieved of the coin weight, restores and the dial (or signalling) condition is removed.

If, however, the call is not successful, the caller can get his money back by pressing button "B". This causes the coin container to swing to the right; the coins are then released and slide down a chute to appear in the small cup in the front of the box. At the same time, a small clockwork mechanism, controlled by a pendulum, is set in motion for a period of 5 to 7 seconds—it can be heard ticking. The purpose of this is to disconnect the line for a short time, so that on an automatic call the exchange apparatus is released or, on a manual call, a clearing signal is given to the operator, thus ensuring that another call cannot be set up without re-insertion of the fee.

Postpayment Mechanism No. 16 (Figure 6) provides for the following:

(*a*) Pennies, sixpences and shillings are accepted, checked for thickness and diameter, and if satisfactory passed into the cash container. Coins are not held in suspense in the postpayment type of mechanism.

(*b*) The microphone used for relaying the distinctive tones is inoperative until a coin is inserted and is then in circuit for the small interval of time, $1\frac{1}{2}$ to 2 seconds, during which each coin travels from the slot to the cash container.

To make a call with this type of mechanism in C.B.S. 1, 2 and 3 areas, it is necessary only to lift the receiver and wait for the operator to answer. In magneto areas, the hand generator must be cranked additionally. Coins must not be inserted until they are asked for by the operator. When the fee is eventually inserted, the coins are passed through the appropriate slots, one coin at a time. Each coin in turn will operate the crank arm. Attached to this arm is a small clockwork pendulum-controlled escapement mechanism. This controls a set of electrical contacts, which are used to open the circuit of the microphone used for the transmission of the coin denomination tones. The microphone will remain in circuit for $1\frac{1}{2}$ to 2 seconds after the insertion of a coin.

Space will not permit a detailed description of all the circuits and mechanical devices in the complete

range of coin boxes, but in order that the reasons for the basic operations already described may be fully appreciated, the circuit principles for the prepayment box as designed for use in an automatic area are shown in Figure 7.

Referring to Figure 7, the insertion of the first penny operates, by means of the crank arm, a set of springs, which at 1A shunts the receiver to prevent it from being used as a transmitter and at 1B short-circuits the transmitter of the telephone handset to prevent premature conversation and removes the short-circuit from the coin-tone microphone.

The insertion of the final penny, by virtue of the added weight, will operate 2A, thereby removing the short-circuit from the dial impulse springs I), thus allowing dialling operations to proceed.

When the called subscriber answers, the pressing of button "A" restores 1A, 1B, 1C and 2A, thus permitting the conversation to proceed.

In the event of the call not maturing, owing to the called party's either being engaged or not answering, the caller may obtain a refund of the fee by operation of the "B" button. Spring sets 1A, 1B, 1C and 2A will then be restored, as when the "A" button was used. In addition, springs 3B will break and remain open for a period of between 5 to 7 seconds, until the escapement mechanism closes them. This ensures that the exchange connection is released and prevents the caller from setting up a second call without paying again.

Emergency calls, by dialling "999", and calls to the operator for assistance, by dialling "O", are made without inserting coins. A special fitting is provided on the dial which, when "O" or "9" is dialled, causes spring D1 to break and remove the short-circuit from the dial.

The telephone call office undoubtedly performs a great public service and probably never more so than at the present time. Considerable thought and ingenuity have gone into its design in order to safeguard the public from the effects of malicious damage and the Post Office from fraudulent use. In addition to giving the public a high standard of service, whether it be from a call office in a remote country village or in the heart of a busy city, it is necessary to have under constant review new improvements and developments which may possibly be incorporated into the present design. At the present time the following developments are on trial or under review:

(1) Cash containers of a type which seal themselves automatically as they are withdrawn from the cash compartment of a public coin box.

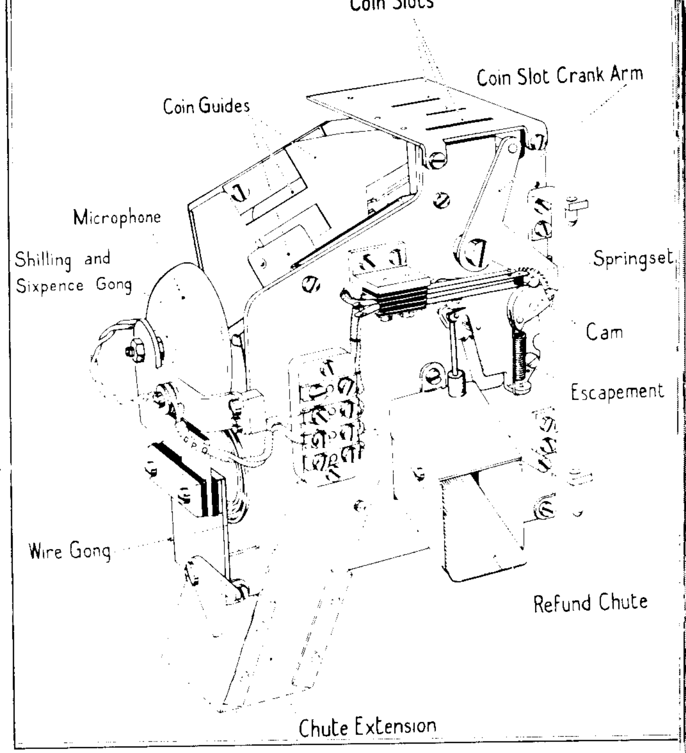


FIG. 6. MECHANISM No. 16

(2) Improved methods of collecting cash from the present form of cash compartment.

(3) Instrument cords with better wearing qualities.

(4) Wiring with improved insulation.

(5) Strengthening of various parts against malicious damage.

(6) Rust prevention on the surfaces of the containers.

(7) Directory holders.

Conversion of Coin Collecting Boxes for Increased Local Fee

To implement the proposed change of local call fee in a reasonable time, with the minimum inconvenience to the public and disturbance to the normal business of the telephone service, necessitated extremely careful planning and organising. The actual work of conversion involved appreciable numbers of staff in both the engineering and non-engineering divisions. Some idea of the magnitude of the work can be gauged by the fact that approximately 104,000 coin collecting boxes were involved. A visit had to be made to each installation by an engineering officer to make the necessary alterations, and in some cases (mainly postpayment installations) by a non-engineering officer, to change the notices as in (3) below. The non-engineering work included (1) possible revision of all coin box subscribers' telephone agreements;

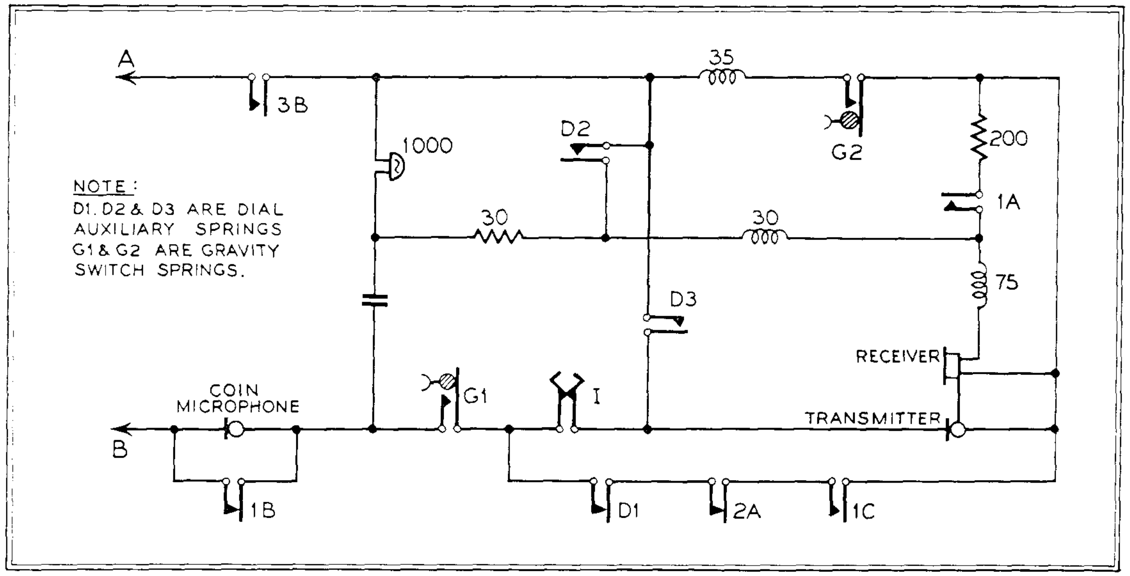


FIG. 7. PREPAYMENT COIN COLLECTING BOX—ELECTRICAL CIRCUIT SCHEMATIC

(2) drafting and printing revised tariff and instruction cards for all public call offices; (3) arranging to place a preliminary notice in every call office as or immediately after the changed fee became operative; and (4) arranging for more frequent collections, since the cash containers will fill more quickly. On the engineering side, the work involved both prior to the operation date and after has been substantial.

From a study of the various ways and means, both from the economic standpoint and that of manufacturing convenience, and bearing in mind that the engineering operations, in the majority of cases, would have to be carried out on site, a modification to the existing box by a change in weight to counterbalance three pennies instead of two was the most attractive and simplest scheme. It ensured that multi-coin boxes of most early designs could be satisfactorily converted, leaving only a relatively small number to be replaced owing to age. From what has been said above, the reader will no doubt appreciate that the design of the coin-box mechanism is such that the weight of the pennies is used to initiate a local call and the number of pennies required for the local call determines the heaviness of the balance weight which is fitted at the end of the balance arm opposite to the coins.

With the increase of the local call fee, the response of the balance arm to the weight of three pennies instead of two is much more critical and it is obviously most desirable that the mechanism shall operate with three old light-weight pennies but not operate with two brand new heavy pennies. These limits of weight are much closer than the differences between two and one similar pennies and it has been necessary therefore to specify more precisely the adjustment of the associated spring set.

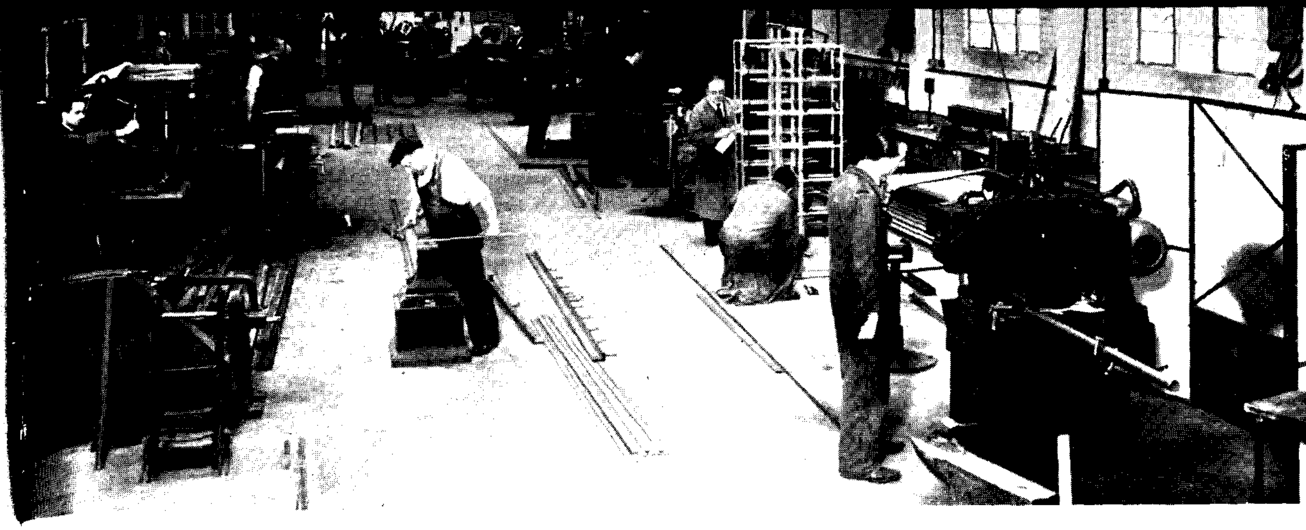
The initial engineering task was of the order of 100,000 man-hours, with additional time in the Supplies and Factories Departments for the conversion of approximately 40,000 boxes in new and old stock.

The actual work to be carried out in the field on each mechanism was:

(1) To replace the existing balance weight of $1\frac{1}{2}$ oz. by one weighing $2\frac{1}{8}$ oz.
(2) To readjust the spring set controlled by the balance arm by means of test weights.
(3) To carry out comprehensive tests with the exchange testing officer, to check the operating adjustments under all conditions, using coins.
(4) To read the meters, where this is not performed by traffic staff.

Fortunately the supply position of all other items required for the conversion was good and sufficient quantities were available for use, but it was necessary to have manufactured in a very short period 150,000 balance weights and 4,500 test weights.

This has been an extremely interesting job, requiring the closest co-operation of all concerned to ensure that public service should be maintained during and following the conversion.



The L. T. R. Power Section

by A. E. Penney, M.I.E.E.,

London Telecommunications Region

EVERY LARGE ORGANISATION, nowadays, whether it be a multiple stores business, a factory or a telephone service, inevitably has engineering plant that has to be designed, installed and maintained. This plant will usually comprise lighting, heating and ventilating systems and lifts. If raw materials or finished products have to be handled in large quantities, conveyors and similar devices are also involved. The raw material of our service, however, is electricity from the mains, much of which has to be converted to direct current at a low voltage. The Power Section, which looks after these two aspects of the Region's work, is therefore in a very similar position to the engineering department of any large concern.

In provincial Areas, the power staff is small and is usually organised under the control of an Assistant Engineer in the Area office, but in the L.T.R., with its many large buildings, power work employs a staff of some 700 and this staff is centralised in the Power Section, with a Senior Executive Engineer in charge.

The variety of the work of the Section can be seen from the trades employed: general, electrical, battery, lift and gas fitters, carpenters, French polishers, painters, wiremen, glaziers, plasterers, bricklayers and stokers.

The variety of the plant maintained is even wider. For a number of reasons, there are no Post Office designs for such things as lifts, boilers etc. and usually a need is met by purchasing a good-class commercial article. Much of our plant has a long life and as a result, over the years, we have accumulated a large number of makes and several different patterns from any one maker. The problem of keeping such plant in repair can be met only by having a workshop that can turn out at short notice and economically a part for almost anything from a lift to a gas cooker. Mass production methods would be quite inappropriate and the visitor to the Power Section workshops at Cornwallis Road, Islington, will see no conveyor belts or other adjuncts to repetition work. Modern lathes, milling machines, drills, cutting machines

ig. 1. The general fitting shop. (Another view appears at the head of this article.)

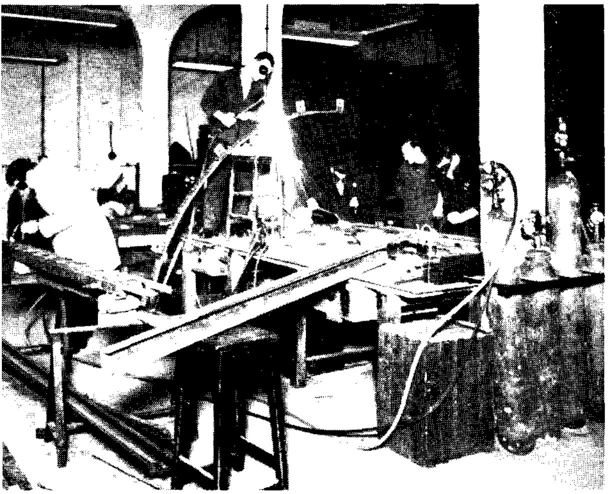
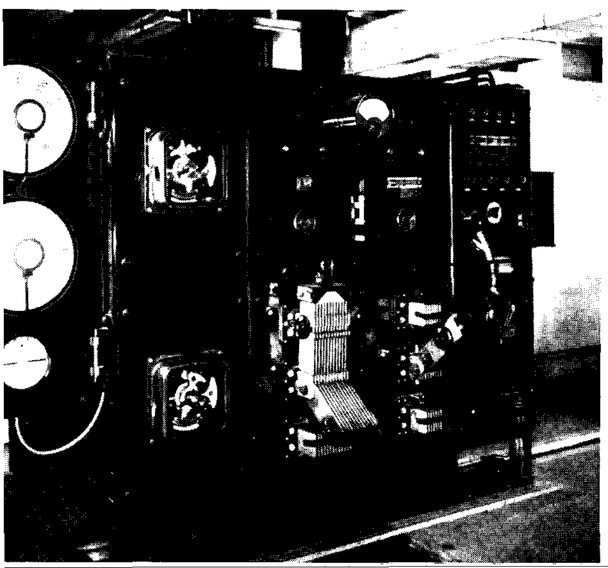


Fig. 2. Welding a rack

ig. 3. A power switchboard made in the Power Section workshops



and welding plant can meet nearly all our needs. Figure 1 and the illustration at the beginning of this article show the general fitting shop. The lathes can turn parts up to 30 inches in diameter and 72 inches long. These enable the armatures of most of our generators and motors to be mounted for turning worn commutators.

The workshops produce large quantities of iron racking for supporting telephone cables in exchanges and P.B.X.s. To achieve the maximum economy in labour in making these racks, which look rather like iron ladders, every effort is made to meet demands from a small number of standard designs of racks, joints and binds; and jigs are used to hold the "rungs" accurately in position during welding, which is carried out in an annexe to the main shop. As no two exchanges are identical, each rack has still to be tailored to fit and this restricts the extent to which standardisation can be carried. Figure 2 shows a rack being welded.

In one of the shops, exchange power-plant switchboards are made. Nearly all telephone exchanges were originally equipped with two batteries, but developments have enabled these to be reduced to one without reducing the standby power available in the event of a failure of the mains. The new system of working, in addition to saving one battery, results in an appreciable increase in the life of the other and (with the present price of lead batteries) effects very substantial economies. However, it requires a complete reconstruction of the power plant, and a large programme of conversion to single-battery working is being carried out by the Power Section. Figure 3 shows a typical switchboard made in the workshops for one such conversion.

In the woodworking shop, shown in Figure 4, telephone operating switchboards are made to meet special requirements and old switchboards are renovated for re-use. Another important task is the making of non-standard telephone cabinets for situations where architectural considerations are important and the cabinets have to match closely their surroundings, e.g., at important Post Offices and railway stations. (Recently 15 cabinets with ornamental mouldings to the architect's design were made for Victoria Station and the space required in the workshop for erecting these cabinets in one suite was itself a serious problem.) Although necessarily much of the work is done by hand, machines are used for cutting mouldings, mortices, tenons and simple forms of dovetail joints.

Dividing the woodworking shop is the French polishing bay, where traditional methods are still used extensively. Substitutes that can be sprayed on are available, but for renovating and other work, where an old surface has to be matched, the craftsman more than holds his own and his polish remains unbeaten for hard wear.

The shortage of timber in recent years has increased the demands on the workshops for repairs and renovations of many items, notably jointers' handcarts, and a small shop is set aside for this work, which often involves completely dismantling and rebuilding a handcart, using as much of the old materials as possible.

One of the less spectacular and attractive tasks is the repair and replating of exchange batteries, which involves the handling of sulphuric acid and acid-soaked plates. A small shop deals with all such work that can be taken to Cornwallis Road: the larger batteries are dealt with *in situ*.

Presses for straightening bent plates were designed and made by the Section. Seams in the lead battery boxes and the connections between the plates and the connecting bars that support them are made by "burning" or welding the lead and the skill involved in making a complicated joint is at once apparent to an onlooker.

Nearly everything despatched from Cornwallis Road has to be painted and both brushing and spraying are employed in the paint shop. Synthetic paints are used in the spray-guns and have proved satisfactory. Space is not available for the extra plant necessary with cellulose sprays.

In addition to painting the products of the shops and the many items sent in by the Areas for renovation, the paint shop sends out teams with mobile spraying plant to redecorate kiosks. The teams redecorate regularly only a small proportion of the Region's 7,000 kiosks, the bulk of which are painted under contracts, but they serve a useful purpose in trying out new finishes and provide information regarding costs. Figure 5 shows a team at work. The masks on the glass are held in place by springs pressing against the metal frames.

The interest in kiosks does not end with repainting. Power Section staff visit every kiosk at about ten-week intervals and give attention to door hinges, restraining straps, spring closers, glazing and lighting. Some 18,000 panes of glass are

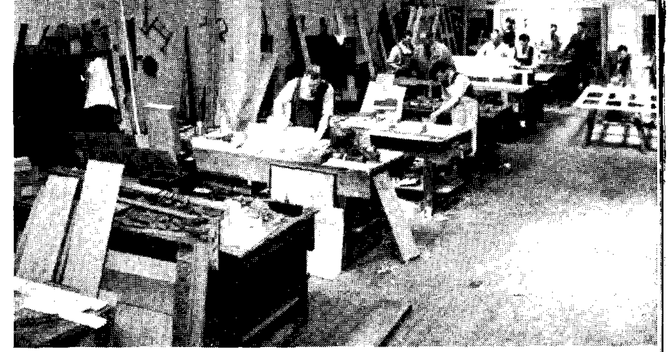


Fig. 4. The Woodworking Shop

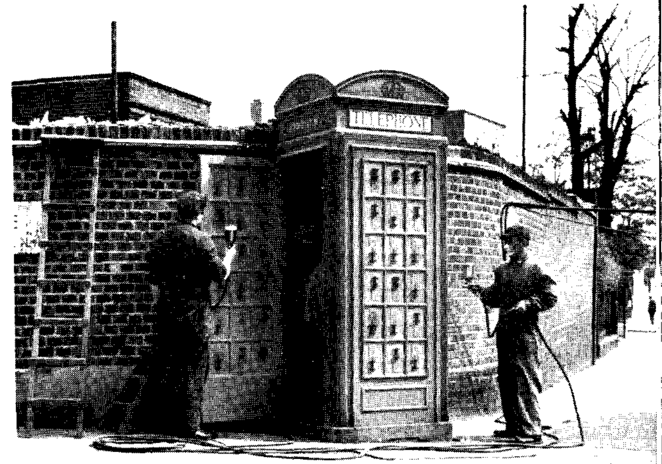
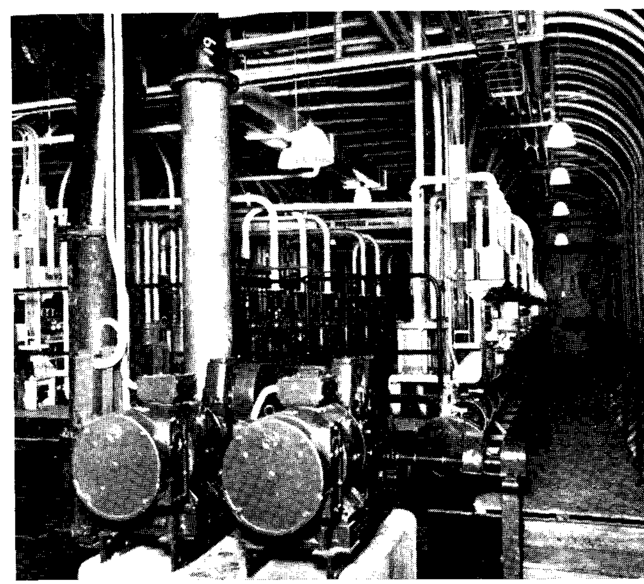
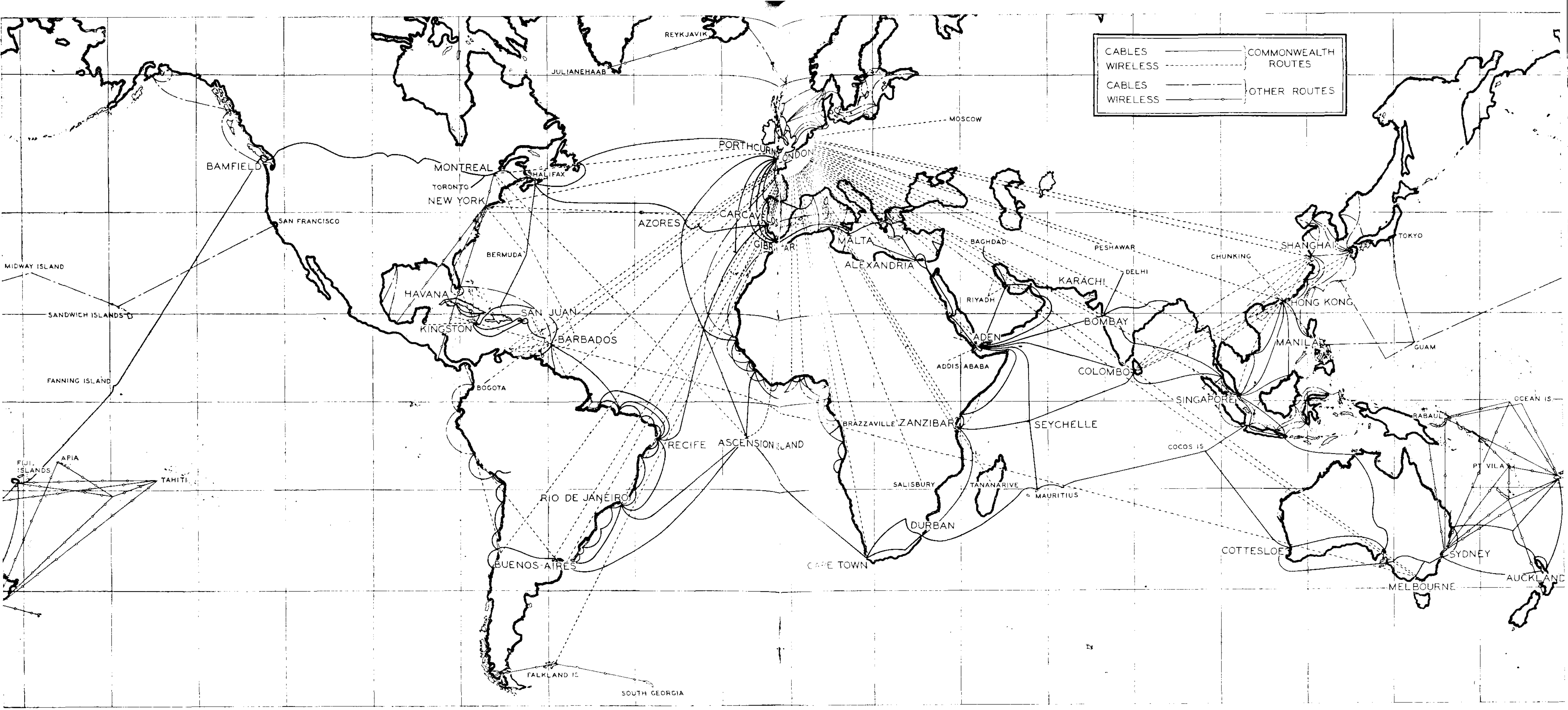


Fig. 5. Painting a kiosk with the spray-gun

Fig. 6. Pneumatic tube equipment for the C.T.O.





pulses and retransmit them, undistorted and at full strength. This automatic, instantaneous system, as opposed to the older manual reperforated tape transmission, did nothing to vary the circulation arrangements, but it made possible the linking of cables into chains of any required length, giving immediate communication between the terminals. It also further reduced the staff at the regenerator stations to mere skeletons of their original strength, thus effecting economies in transmission costs, which made possible the introduction of the low rates charged for overseas telegrams to-day.

The Principal Cable and Radio Routes

In considering the question of traffic routing, one must appreciate that there are considerable differences in the speed of transmission over various cables, dependent on the sizes of core and the respective lengths. The linking of several cables together to form a cable chain has therefore to be arranged with care. As the speed of a chain is governed by its slowest link, it would be wasteful, of course, to link a fast section with a slow one. If this cannot be avoided, then the fast cable is channelled to form two circuits, one of which is worked at the speed of the slower cable associated with it in the chain, and the other circuit, generally at the same low speed, is used between the cable stations at each end of the fast cable, thus avoiding any waste of traffic capacity.

Another interesting use of channelling is that employed to provide direct circuits from London to Rio and Buenos Aires, where the circuits are channelled on one chain of fast cables from London to Ascension Island, where they divide and continue on separate slower cables direct to Rio and Buenos Aires.

Channelling is, in fact, one form of multiplex working, a term more commonly used outside the Cable and Wireless service.

Channelling is also used on most of the main radio circuits in this servi·e. Its purpose is either to provide two separate circuits to meet the requirements of traffic circulation or, in the case of a point-to-point radio circuit, such as London—Bombay, it enables the fast radio transmission to be divided into two or more slower circuits, which can be more easily handled by the operators, although giving the same total traffic clearance.

The basic cable chains, each formed of one link, which are essential for normal circulation, are:—

London—Montreal, via the Azores; London—Rio; London—Buenos Aires; London—Capetown; London—Carcavelos; London—Malta; London—Singapore; Carcavelos—Malta; Malta—Bombay; Malta—Karachi; Malta—Colombo; Bamfield—Auckland—Sydney; Durban—Cottesloe (Perth); Singapore—Cottesloe; Montreal—Barbados; New York—Barbados—Recife; New York—Havana—San Juan.

The last two are worked in conjunction with the Western Union Telegraph Company. Other local chains in use are too numerous to detail in this article.

Under the chain arrangement, traffic can be sent directly between terminals or, by the use of selector and restorer signals, dropped automatically at stations on the route.

Developments since the War

Before the 1939-45 war, the wireless circuits played little part in the chain system which was applied to the cables. They were used almost entirely for exchange of traffic directly between two terminal points.

The vastly increased traffic of war-time, however, and the difficulties of repairing and renewing the cables during the war years caused enormous developments in the wireless system.

New circuits were opened to supplement or replace the original cable chains which had become unequal to the loads they had to carry or which were perhaps entirely interrupted and, in war conditions, often unrepairable, and these wireless circuits continue in operation.

Others were developed as relay as well as terminal services, such as the London—Barbados circuit, which carries the West Indian traffic, relays London to Melbourne or Montreal and sometimes bridges an interruption in the direct cable route between North and South America. Some were solely relay circuits, notably the London—Ascension circuit, which at various times links London with New York or Montreal.

The system of interpolating a wireless circuit into the cable chain or vice versa has been considerably developed and is now in use regularly to and from some of the busiest and most important points on the system.

Alternative Routes

From the foregoing and from a perusal of a map of the system, it will be seen that a number of routes are available for traffic in all main directions. For example, the following are the different ways in which a message can be sent from London to Australia.

1. Direct wireless to Melbourne. This can be in an easterly or westerly direction, according to prevailing conditions.
2. By wireless to Melbourne, linked at either Montreal, Barbados or Colombo.
3. London—Montreal cable, Montreal—Bamfield landline and Bamfield—Sydney cable. This route can be varied to London—Montreal cable, Montreal—Melbourne wireless or London—Montreal wireless, Montreal—Bamfield—Sydney landline and cable.
4. London—Singapore cable, Singapore—Cottesloe cable. The London—Singapore cable is, on occasions, regenerated to Cottesloe, making a direct London—Cottesloe link.
5. London—Capetown cable, Capetown—Durban landline, Durban-Cottesloe cable.
6. London—Zanzibar wireless, Zanzibar—Seychelles—Cottesloe cable.

The first consideration in deciding the route by which traffic is to circulate is the fastest clearance at any particular time. Secondary considerations are the transit taxes incurred, i.e. costs imposed by foreign administrations at certain points on the cable routes.

Although care must be taken to avoid the payment of unnecessary transit taxes the primary consideration is always to dispose of traffic to the best advantage of the customer.

All the circuits are operated under agreements or licences, many of them containing obligations or restrictions which must be observed in the circulation of traffic.

The Time Element

Hours of working on all the telegraph circuits, hours of opening and closing of branch stations, holidays and special arrangements, changes in time G.M.T. to B.S.T. etc., must be taken into account.

Full advantage must be taken of the difference of time all over the world and preference given to that traffic which is first due for delivery. As New Zealand time, for instance, is normally twelve hours in advance of the time of this country, a part of the peak load in London which accumulates in the evening must be delivered in New Zealand within a few hours to be ready for the opening of the morning business and so must be cleared first. Next come Australia, Japan and China, followed by Malaya, Ceylon, India, East Africa, Near East, Egypt and the Mediterranean, South and West Africa. Again, as American time is four or more hours behind that of Britain, traffic for all parts of America can still be delivered that length of time after business closes in London to be in time to meet the American business hours of the same day; thus immediate attention must be given to all American full-rate traffic at the London peak period.

Throughout the day this time question must be constantly in mind in order to ensure delivery during business hours and also to avoid unnecessary congestion of main routes.

In the homeward direction a similar routine applies, the traffic from New Zealand being cleared first, followed by the Australian and Far East, so that the main routes are left reasonably clear for each area in its turn.

It follows that although this outline has considered the question from London's point of view, similar conditions arise on all parts of the system at their respective busy periods, causing cross streams of traffic which must be allowed for in the general control by London.

Coping with the Load

Apart from the circulation over the system, there is the exchange of traffic with other Administrations and Companies to be taken care of: exchange points of importance are London, Azores, Malta, Barbados, Manila etc.

By careful management and in good conditions, the system can be made to deal with the greatly increased load which it has been called upon to carry in the post-war years.

Unfortunately, conditions are not always good. The cable system is still suffering from the abnormal conditions of the war years, when renewals were often out of the question and the post-war shortage of materials which prevents sufficient cable being available to make the cable system as it should be; in these conditions interruptions occur more frequently than would normally be expected.

A break in one of two or three cables, such as the four sections in the Red Sea, can always be overcome by channelling and the through chains maintained, although some loss of speed may result. Two such interruptions are more serious; three are critical and alternative routes must be found.

Interruptions on single cable routes always call for alternatives. For example, a break in the Durban—Cottesloe chain would result in Australian traffic to South Africa circulating over one of the many routes to London, thence on the London—Cape chain.

Wireless is used to cover interruptions in a great number of cases but is itself subject to fading, sometimes prolonged and paralysing, such as that which occurred last winter. When wireless fading occurs at times when a few main line cables are also interrupted, much thought and ingenuity are necessary to provide alternative routes.

There must be close liaison at all times between Head Office and the London Station and watch kept upon the traffic on hand not only in London but at all the main stations.

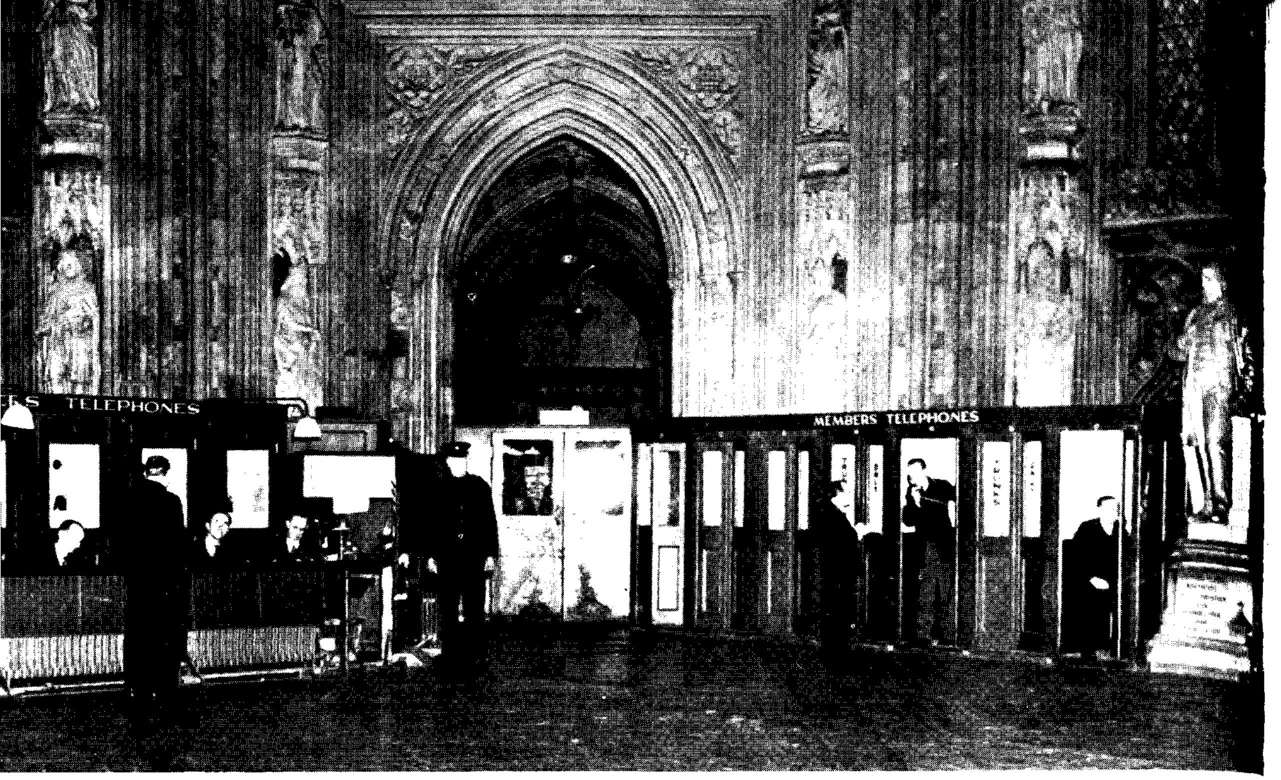
The great consolation in modern telegraphy is that with the ingenious devices now in use, many of them the work of the Company's engineers, distance is no object. Some years ago a workman in Moorgate drove a pickaxe through a cable under the road and cut off all cable communications with most of the world. At the time an urgent message to a cable ship at Gibraltar was waiting to be sent; it was put on the beam to Melbourne. There it was sent by landline to Cottesloe, thence by cable to Singapore and finally dropped at Gibraltar on the direct cable chain only a matter of seconds later than had it been sent over its normal route.

In addition to the actual circulation work, there is the study of projects to improve or modernise the working from the traffic angle, as well as the examination of the need for provision of extra circuits or apparatus throughout the system.

Arrangements have to be made for any necessary terminal connections to cover local distribution such as landlines, telephones, telex and pneumatic tubes or private wires to customers and the supply of teleprinters to such customers on a hire basis.

Allied to circulation matters is the notification of circuit data to the International Telecommunication Union for publication as well as the supervision and upkeep of the London Station master circulation book.

(This article was compiled in the office of the Traffic Manager, Cable and Wireless, Ltd.)



Telecommunication Services in the Houses of Parliament (II)

by M. A. R. Kenyon,

London Telecommunications Region

(In our last issue, Mr. Kenyon dealt with the period from 1877 to 1938.—Editor)

World War II

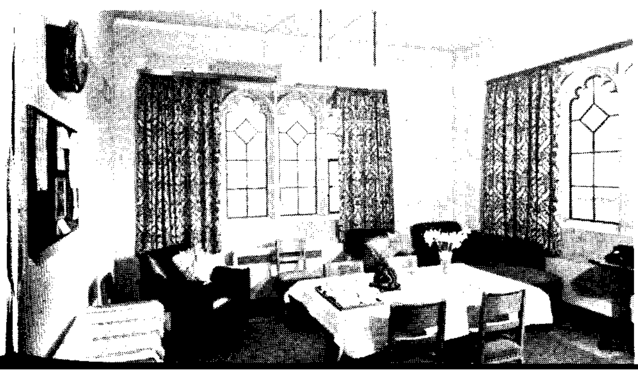
DESPITE THE SATISFACTORY STATE OF affairs in 1938, the outbreak of World War II found the Houses of Parliament ill-prepared telephonically for the emergencies of the impending conflict. A proposal had been made in November, 1938, shortly after the very first broadcast—Mr. Chamberlain's "Peace in our Time" message—from the Palace of Westminster, that owing to the vulnerable position of the P.B.X., a small emergency switchboard should be installed in protected accommodation on the ground floor of the Palace. Progress, however, was retarded by circumstances beyond the control of the Post Office, and London experienced its first air raid warning before the installation—two 10 - 50 65 positions—was commenced and, within a matter of days, completed in September, 1939.

During the next six years, telecommunication services in the House were to prove of primary importance to the nation's war effort; and in a House of Commons which, as Mr. Churchill has said, "proved itself the strongest foundation for waging war that has ever been seen in the whole of our long history", the Post Office traffic and engineering staffs shared an honourable record of patient endeavour and of ever-increasing effort to maintain the high standard of service demanded.

Within the first six months of war, the vulnerability of the main P.B.X. and the demands placed upon it gave rise to considerable apprehension and the Lord Great Chamberlain was asked whether suitable protected accommodation could be provided for an enlarged suite. It was hoped, by this means, to provide full service at all times and so avoid the unsatisfactory necessity of restricting service during "imminent danger" periods, when the main P.B.X. was vacated and a restricted service was given from the emergency switchboard. The 1940 "Blitz" more than justified the apprehension expressed. The accommodation negotiations, however, were not concluded until December, 1940, by which time the Houses of Parliament—which were to be damaged by air raids on fourteen different occasions—had suffered three major bomb incidents and for a period the P.B.X. had been deprived of its emergency outlets to Victoria (automatic) Exchange. A service complaint, lodged at the time, received in answer the typical British understatement: "Under the conditions which have existed during the past few months, occasional delays in answering have been unavoidable." The main P.B.X., situated on the Upper Committee Corridor since 1911, was eventually closed in September, 1941, and a new P.B.X., comprising six C.B. No. 9 positions eqquipped for 80 exchange lines and 520 extensions, was opened. This installation, sited on the ground floor in the State Offices Court, satisfied requirements in the Palace until the end of the war. Indeed, with the addition of one position in September, 1946, it proved adequate until October, 1950, when, in conjunction with the opening of the new House of Commons, a new P.B.X. was installed.

While negotiations were proceeding in 1940 regarding the re-siting of the P.B.X., the Government decided that in the event of the Palace of Westminster suffering damage, Parliament should continue to be accommodated in London. Arrangements should be made for two temporary Chambers to be set up at Church House, in Dean's Yard,

Telephonists' Rest Room *(Crown copyright)*



House of Commons, morning of 11th May, 1941

New P.B.X. switchroom, House of Commons *(Crown copyright*

Call-office suites in the new House (*Crown copyright*)

adjacent to Westminster Abbey, and the Post Office was asked to install telephone equipment to cater for service at the alternative accommodation. On the 14th October, 1940, Church House was struck by a bomb, but, although the building was severely damaged, the incident proved that the structure could withstand the impact of a direct hit, and the plan to make the premises—known throughout the war as "The Annexe"—an alternative meeting place for Parliament went ahead.

As an urgent measure, a non-standard P.B.X. comprising three 10–60 180 positions, specially designed at P.O. Headquarters, was installed and brought into use when Parliament first held a sitting at Church House on the 7th November, 1940—the first time in 259 years that Parliament had sat in any other place other than the Palace of Westminster. The frequency and duration of temporary migrations to Church House, however, increased, as "incidents" followed one upon the other, and it soon became apparent that something more than a skeleton replacement of the telephone service in the Palace was essential. The original switchboard was replaced, early in 1941, by five C.B. No. 9 positions; eighteen call-offices concentrated on a 10–50 65 switchboard were installed to serve the Members; satisfactory telecommunication services were provided to meet the needs of the Press; and gradually the Church House service developed towards a complete alternative of that in the Palace itself. The last sitting of Parliament in Church House was on the 3rd August, 1944, and throughout the four years, during which it was used as an alternative meeting place, uninterrupted telephone service was afforded to the Lords, the Commons and the permanent officials of both Houses, according to circumstances, from either the main P.B.X. or the Church House P.B.X. or, for a time prior to September, 1941, the emergency switchboard in the Palace.

In the heavy air raid on the night of the 10th-11th May, 1941, the Palace of Westminster was damaged extensively. At least twelve incidents were recorded in various parts of the building, three people were killed, a bomb passed through the floor of the Lords Chamber, and the Commons Chamber was entirely destroyed by fire. This catastrophe, in itself a national disaster, evoked from Mr. Churchill, at the very next meeting of the Commons, the defiant statement that another and third building was being prepared to house the Government in case anything should happen to Church House. This statement referred to premises, later known as "Annexe II", for which telephone requirements were actually decided the next day, 12th May, 1941, and where the five-position C.B. No. 9 switchboard *in situ* was eventually modified to provide facilities similar to those at Church House. Fortunately the occasion to use "Annexe II" never arose.

As an immediate result of the destruction of the Commons Chamber, the Peers sought and obtained permission from the King to place their Chamber at the disposal of the Commons and to install themselves in the King's Robing Room. These arrangements, which were to continue for nine years, gave rise to the removal of the suite of eleven attended call-offices from the Members' Telephone Room to the Central Hall of the Palace—a location nearer to the Lords Chamber—and necessitated, at the same time, the installation of a suite of four call-offices adjacent to the King's Robing Room for the use of the Lords. Additionally some 40 telephones were installed in the temporary accommodation allocated to the Press.

When the removal of the Members' call-office facilities from their Telephone Room to the Central Hall was effected in the summer of 1941, the telephone attendants found themselves established in surroundings which are perhaps best described in the following extract from Fell's Guide to the Palace of Westminster: "It (the Central Hall) is an octagonal apartment, 75 ft. high and 60 ft. across. It has a vaulted stone roof and supports the central tower of the Palace. The roof contains upwards of two hundred and fifty elaborately carved bosses, the panels between the ribs being filled with Venetian mosaics. Four arched doorways, with statues

of kings and queens on either side, four arched windows of tinted glass and four large mosaic panels above the doorways are the chief features of the Hall. The west doorway leads to St. Stephen's Hall, the south to the House of Lords, the north to the House of Commons, the east to the dining rooms and libraries". It was here at the very heart of affairs, amidst the subdued excitement of visitors and constituents waiting to see their Members of Parliament and the hustle and bustle of Members and other officials going about their business, that for nine years, in war and peace, a group of telephone attendants gave exemplary service to the Members and earned from Stanley N. Evans, M.P., in his Christmas "anthology" of 1949, the tribute: "Telephone calls between the House of Commons, New York, Amsterdam, Brussels, Paris, Heckmondwike and Oswaldtwistle are a daily occurrence, and Ernest Life (a telephone attendant at Westminster for over thirty years) is typical of the nine telephonists, who combine efficiency with cheerfulness to an extraordinary degree".

Entrance to new Members' Telephone Room (*Crown copyright*)

Reconstruction

Private Branch Exchange Arrangements.—The report of the Select Committee set up by the House of Commons in 1943 "to report upon plans for the rebuilding of the House of Commons and upon such alterations as may be desirable while preserving its essential features" was accepted by the House on the 25th January, 1945. The Select Committee's proposals in relation to the provision of telephone facilities included the replacement of the P.B.X. The installation of the new switchboard was commenced in March, 1950, and the new P.B.X. comprising 13 C.B. No. 10 positions was brought into service on the 4th September, a few weeks prior to the opening of the rebuilt House of Commons by His Majesty the King.

The new switchboard, the first lamp-signalling type to be installed in the Palace, has capacity for 120 exchange lines and 1,000 extensions. At present (September, 1951) it carries 42 direct exchange lines, 17 private wires, 46 external and 619 internal extensions. Service is provided not only for extension and call-office users in the Palace but also, by external extensions, for the secretarial staff out-housed at No. 5, Old Palace Yard. Direct access is available via private wires to most of the important Government establishments, e.g. 10, Downing Street, Cabinet Offices, Treasury etc. Trunk subscriber lines to the Royal suite at the London Trunk Exchange provide an expedient for the completion of Members' trunk calls and other trunk calls of an urgent nature. Access to the public network is by way of routes to the Whitehall and Victoria exchanges, incoming service being provided by a group of 20 lines on the former. The primary number, Whitehall 6240, originally allocated in 1931, has been retained.

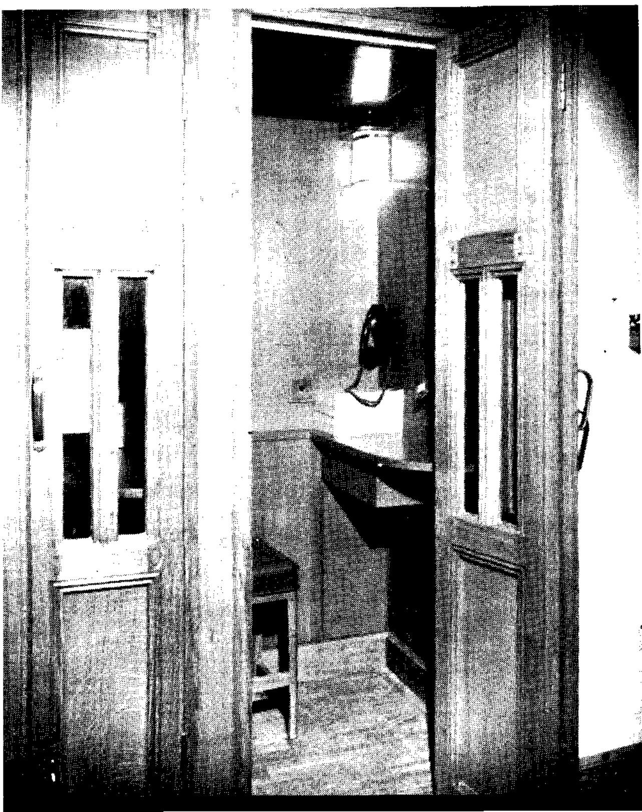
The commodious switchroom with its adjoining apparatus room and well-appointed welfare quarters came as a direct contrast to the cramped conditions of the war-time arrangements: to-day, in a rest room furnished in keeping with the style of the new building, the staff relax, past improvisations forgotten, in the comfort of modern fluorescent lighting, heating units and air-conditioning plant. It is perhaps unfortunate that the larger switchroom does not inspire, to the same degree, the sense of intimacy peculiar to the smaller war-time accommodation. Nevertheless, the traditional atmosphere of the House is ever present and the Supervisor and her staff of fourteen telephonists maintain a well deserved reputation for the truly democratic and efficient service rendered to Lords and Commons alike.

Members' Telephone Arrangements.—The proposals in respect of the provision of attended call-office suites for the use of Members in the new House of Commons were perforce limited by the lack of suitable accommodation; both the Select Committee's original proposals and those subsequently accepted by the House were criticised as inadequate. Negotiations continued until 1949 before a compromise was reached. Meanwhile, to meet the increased telephonic needs of the new Membership, which followed the 1945 General Election, the temporary telephone arrangements in the Central Hall had been expanded to a suite of twenty-two attended call-offices.

The Post Office considered that to satisfy the Members, who have always shown a marked preference for attended call-offices, where they have personal attention, the ideal arrangement would be the provision of not less than twenty attended call-offices in one suite as near as possible to the Commons Lobby. There was insufficient ground-floor space available for this arrangement, however, and the required facilities have been provided by suites of telephone cabinets distributed over three floors of the new House.

The Members' Telephone Room, which has been redesigned since it was last used in 1941, is situated on the principal floor adjacent to the Commons Lobby and provides facilities for the more urgent type of traffic. The attendant is provided with a 3 + 9 12 cordless switchboard and exercises control over trunk and toll calls, on which he obtains "duration and charge" information for the purpose of collecting or debiting appropriate fees. The cabinets on the ground floor, one floor below the Chamber, are arranged corridor-fashion in suites of 8 and 10 respectively. The attendants on duty are responsible for the operation of the Incoming Message Service, but to the Members it is the "local call" suite. The lower ground floor suite of eight cabinets is unattended. A suite of six multi-coin box cabinets is also available on this floor for the use of Members and the secretariat.

Interior of cabinet in the new House *(Crown copyright)*



The style of the new House has been maintained in the panelled oak doors and bronze fitments of the cabinets and, in order to combine efficiency with comfort, special attention has been given to the disposition of the telephone and dial, the interior furnishings and the lighting, ventilation and air-conditioning devices. Maximum quietness has been achieved by sound-proofing the cabinets.

Press Facilities.—Parliamentary reporters who come to the new Press Gallery of the House of Commons with memories of their former home find that a complete transformation has been wrought and that the new gallery is higher, wider and more handsome than of old. Much the same might be said of the telecommunication facilities provided for the Press in the new House; and when, to-day, one views the new Press rooms with their rows of modern telephone cabinets and other facilities for the transmission of news, it is difficult to conceive the immeasurable advance made since the days of the long and sometimes bitter struggles of the Press for the right to convey parliamentary news to the public.

The new Press Gallery is divided into two levels and immediately behind each level is a spacious reporters' (Press) room. The lower level and its adjoining reporters' room, on the fifth floor, is used by the United Kingdom Press, Hansard and the B.B.C.; the upper, on the sixth floor, by the Dominion, Colonial and foreign Press. The provincial Press has accommodation on the seventh floor, and Hansard—or the "Official Report", as the publication is officially known—has a suite of offices on the eighth floor. In all, 55 private wires, twenty multi-coin box circuits and seven extensions from the main P.B.X. have been provided to meet requirements, and the necessary telephone cabinets have been installed in the Press Rooms, in the adjoining "Press" corridors and in offices on the seventh and eighth floors. Additionally ten teleprinters have been housed in cubicles in the "Press" corridor adjoining the Upper Press Room. Facilities available include direct access to Reuters, News Agencies, head offices of the national Press and, via the multi-coin box circuits, the public network. The P.B.X. extensions terminated on a suite of cabinets on the eighth floor are used by secretaries and typing staff to receive instructions and dictation from Members.

A House of Commons Press Room, immediately behind the Press Gallery *(Crown copyright)*

In common with all other cabinets used for incoming calls, the private-wire cabinets are fitted with external lamp calling signals.

House of Lords Arrangements.—Never so exacting as the Commons in their telephonic needs, the Peers, who, after ten years' "exile", returned to their renovated Chamber at the end of May, found that their telephone facilities had been considerably augmented. The single call-office previously at their disposal in the Peers Lobby has been replaced by a suite of three call-offices with direct exchange line facilities for local calls, and an additional suite of three call-offices, served by extensions from the P.B.X., is being provided for their use in the Royal Gallery. As before, the telephone attendants' booth, which is situated in the Peers Lobby, will house two P.B.X. extensions for the use of the Peers on outgoing trunk and toll calls and for the receipt of incoming telephone messages, which, with the characteristic democratic familiarity of the Upper House, the attendant delivers orally to their Lordships.

Public Facilities.—A total of 25 prepayment call-offices, with direct exchange line facilities, are sited in corridors and rooms to which the public have access.

Conclusion and Acknowledgment

Seventy years have elapsed since the telephone was first installed in the Palace of Westminster. In this article and the one in the previous issue of the *Journal*, an attempt has been made to outline the development that has taken place since the installation of the very first telephone, which at the time was one of a few hundred in the United Kingdom, and to convey a sense of the atmosphere and the circumstances in which the telecommunication services have expanded during the years to meet the needs of the Mother of Parliaments. In this attempt I have received advice and much helpful criticism from many sources, for which I tender thanks. In particular, my thanks are due to Lt.-Col. C. R. Lane, Assistant Traffic Superintendent, L.T.R., Miss L. M. Mitchell, P.B.X. Supervisor, House of Commons, and Mr. E. G. Life, Telephone Attendant, House of Commons, for supplying information and details of telecommunication arrangements in both the old and the new House of Commons.

Title illustration shows Members' call-offices temporarily housed in Central Hall of Palace of Westminster, 1941-1950).

The Post Office Ship-Shore Services

by W. Williamson,

Overseas Telecommunications Department

THE POST OFFICE BECAME INTERESTED IN a new method of "signalling without wires", as it was then called, when a young Italian named Marconi presented a letter of introduction to the late Sir Wm. Preece, the Engineer-in-Chief of the Post Office (Figure 1). This was in March, 1896, and during the following year experiments in which the Post Office co-operated were carried out on Salisbury Plain and between Lavernock, in South Wales, and the island of Flatholm, in the Bristol Channel. It is not generally known that before this time Sir Wm. Preece had carried out experiments over a number of years using the "conduction" principle. (This made use of the conductive properties of sea water for passing signals over distances up to a few miles.)

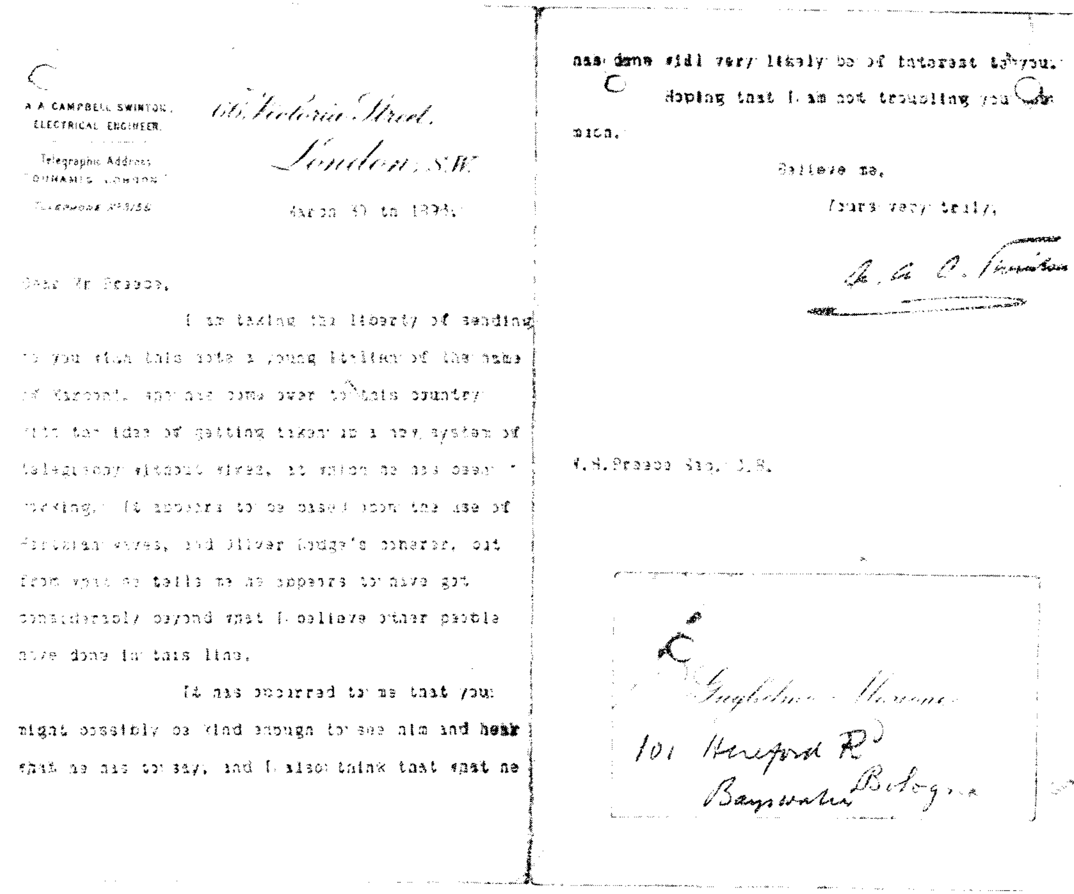
In 1898 wireless equipment was installed on board the East Goodwin lightship off Ramsgate and at the South Foreland Lighthouse and thus was established the first link between a ship at sea and a station on land. Subsequently the Marconi Company and Lloyd's equipped a number of stations around the coast with wireless transmitters and receivers for the exchange of telegrams with ships. At this time the fitting of wireless was not compulsory, but a few shipowners, seeing the advantages of being able to communicate with their ships when some distance from the coast, made arrangements with the Marconi Company for equipment to be installed (Figure 2) and for trained operators to be carried as members of the crew. Many of the operators were Post Office telegraphists who were attracted by the new service; they were given a short period of training before proceeding to sea.

It was not until much later that the Safety of Life at Sea Convention made recommendations that all sea-going vessels of 1,600 gross registered tons or over should be equipped with wireless telegraph apparatus. At more recent conventions, the recommendations have specified the power and type of equipment to be installed on ships of different classes. At the present time there are over 50,000 ships of various nationalities equipped with wireless telegraphy or radio-telephony apparatus, the ranges of which vary from the 150—200 miles of the small coasting vessels and fishing craft using radio-telephony to the world-wide communications of liners and the larger cargo vessels using high frequencies.

By Act of Parliament in 1904, the Postmaster-General became the licensing authority for all stations equipped with wireless telegraphy apparatus and no station in this country or in a ship of British registry may now be equipped with wireless telegraphy or radio-telephony apparatus except under his licence.

In 1909 the coast stations, which at the time were operated by the Marconi Company and Lloyd's, were taken over by the Post Office, and this may be said to be the beginning of the present radio services. The stations were:—Caister (Norfolk) GCS, North Foreland GNF, Niton (Isle of Wight) GNI, Lizard GLD, Seaforth (Liverpool) GLV and Cullercoats GCC. There were also two stations in Ireland, which have only recently been transferred to the Irish Republic. All these stations, with the exception of Lizard and Caister, are still in operation and in addition stations have been established at Burnham (Somerset), Oban, Wick, Portpatrick, Stonehaven, Land's End and Humber (Lincolnshire).

There was only a comparatively small number of ships equipped with wireless in 1909 and the


A. A. CAMPBELL SWINTON, ELECTRICAL ENGINEER.
Telegraphic Address "DUNAMIS, LONDON"

66, Victoria Street, London, S.W.

March 30 th 1896.

Dear Mr Preece,

I am taking the liberty of sending to you with this note a young Italian of the name of Marconi, who has come over to this country with the idea of getting taken up a new system of telegraphy without wires, at which he has been working. It appears to be based upon the use of Hertzian waves, and Oliver Lodge's coherer, but from what he tells me he appears to have got considerably beyond what I believe other people have done in this line.

It has occurred to me that you might possibly be kind enough to see him and hear what he has to say, and I also think that what he has done will very likely be of interest to you.

Hoping that I am not troubling you too much,

Believe me,

Yours very truly,

A. A. C. Swinton

W. H. Preece Esq. C.B.

Guglielmo Marconi
101 Hereford Rd
Bayswater
Bologna

Fig. 1. Marconi's letter of introduction and visiting card

traffic handled at the stations varied widely, according to the whereabouts of these ships. Several days would pass with little or no traffic being handled, followed by a very busy period as ships came within range of the station; the range was about 200—300 miles. The staff at most of the stations was an overseer in charge and 3 or 4 operators who combined the duties of radio operator and land line telegraphist.

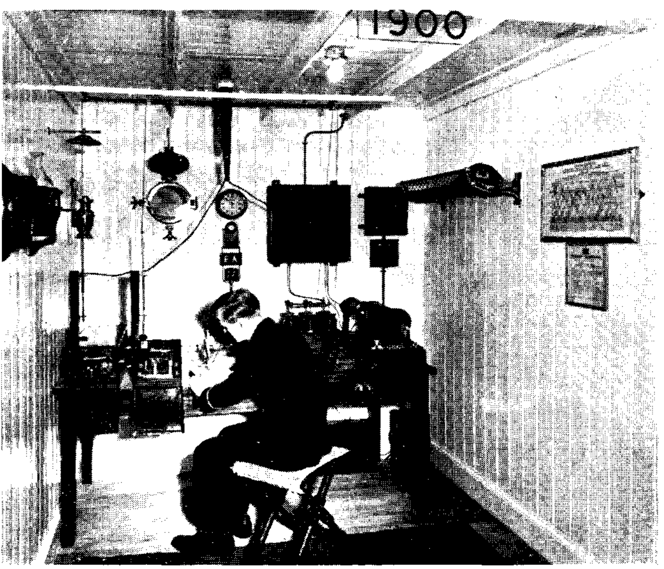
The equipment was primitive compared with present-day standards and consisted of induction coils and Leyden jar condensers discharging across a fixed spark gap in series with the aerial and earth. The power supply was usually from secondary cells, but one or two stations situated in isolated districts used batteries of Leclanché cells as the prime source of power.

The developments in wireless during the first World War and the increasing number of ships fitted necessitated expansion at the coast stations and this was reflected in the traffic loads and the number of stations and operators employed.

The equipment had by now become more efficient, but the spark transmitter was still almost universal and the thermionic valve was in most cases used merely as an amplifier of signals detected by a crystal. The development of continuous-wave working by the larger ships was catered for by a special service operated from a station near Devizes, in Wiltshire. This station used frequencies between 110 and 160 kc/s (1,875—2,730 metres) and the range was 1,500 to 2,000 miles compared with the 150—300 miles of the short range stations where spark transmitters were still used. The longer ranges encouraged passengers to send radio-telegrams when several days from port. By 1925 the increase in traffic was becoming difficult to handle and the service operated from Devizes, where transmitters and receivers were in the same building, was transferred to a new station at Burnham, the receivers being located in this station and the transmitters (which were remotely controlled from Burnham) being later transferred to a new station at Portishead, 20 miles away. This permitted several ships to be dealt with simultaneously and from this time ship-shore service may be said to have developed along two separate lines, (a) short-range service, including distress, from the normal coast stations and (b) the world-wide service from Burnham Portishead.

Short Range Services

There are eleven short-range coast stations provided with equipment having a range of 300 miles or more; their working areas overlap. They are open day and night and maintain a continuous listening watch on the two international distress frequencies of 500 kc/s for the larger ships using wireless telegraphy and the Morse signal "SOS", and 1,650 kc/s for calls from the smaller ships such as coasters and fishing craft using radio-telephony and the spoken word "Mayday". Commercial traffic is dealt with on other frequencies assigned by agreement among the countries of Europe.



Figs 2 and 3. Ship's radio equipment, 1900 and 1950

(By courtesy of Marconi International Marine Communication Company).

Distress and Casualty Services

The most important feature in the work of the coast stations is the distress watch and all other work is suspended immediately "SOS" or "Mayday" is heard. The action then taken at the station is as follows:—

While copying the distress message, the operators at all stations hearing the call take a directional bearing on the signals from the ship. When the position of the ship is known, one station, usually that nearest to the ship, takes control of all signalling. The other stations pass details of the bearing to the controlling station, where the position is checked. During this time, the second operator (there are usually only two operators on duty) has been advising the coastguard, who alerts coast watchers and arranges for the most suitable lifeboat to be launched. Nearly all R.N.L.I. boats are equipped with radio-telephony apparatus, which enables them to maintain contact with the coast station while at sea. This is particularly valuable for passing instructions after the boat has been launched and where the vessel in distress has drifted from the original position. The coast station also advises the Admiralty Naval authorities, in case H.M. ships are in a position to render assistance, and Lloyd's in London, who advise salvage tugs. Some of the coast stations, acting directly on Lloyd's behalf, inform specified tugs immediately a casualty occurs.

In the meantime the operator on wireless watch sends a special signal, which actuates equipment on the larger ships, causing alarm bells to ring on board. He follows this by transmitting the details of the distress and concludes with "ships in the vicinity please indicate position". By now normal signalling will have ceased and those ships that are within reasonable distance of the position of the casualty will advise the station of their position, course and speed and in some cases the time they could arrive. The coast station operator estimates which ship could reach the casualty earliest, taking into account the speed and type, and, if no indication has been received that this ship is proceeding, informs her that she appears to be the nearest but leaves any action to the discretion of the master.

Land's End Radio, at the western approaches to the Channel, plays a very important part in the safety of shipping and has been known to handle as many as nine distress cases simultaneously.

A typical example, taken from an actual case, of the value a directional bearing may have in providing speedy assistance to the crew of a wrecked ship, is shown in Figure 4. The ship was on passage from the Irish Sea to a Channel port and owing to dense mist had apparently drifted some miles eastward of the track vessels usually take. At about 2.30 a.m. one August morning, with visibility only a few yards, the operator on watch at Land's End heard "SOS am ashore position unknown". A directional bearing was taken and plotted on the station chart; the intersection of this line with the coast gave the position of the ship. This information was passed to the coastguard and the ship was found wedged under the cliffs on a very remote part of the coast. All lives were saved by means of ropes thrown from the cliff top, but the vessel rapidly broke up and became a total loss.

Medical Service

Another service that is becoming increasingly useful to seafarers is known as "Medico". This is a free service arranged by the Post Office, by means of which medical advice may be obtained in the case of illness or accident to anyone on board a ship at sea. The normal practice is for the master of a ship to send a free message to the coast station, giving as much information about the patient as possible. This is passed, by arrangement, to the local hospital and advice is given by return. Where radio-telephone equipment is fitted on the ship, the master can be connected directly to the hospital.

Traffic Services

All stations handle radio-telegrams to and from ships at sea. In addition, there is a service of ship letter telegrams from ships to places on land; these are posted from the terminal radio station. Traffic loads vary considerably, according to the position of the station. Land's End, at the entrance to the English Channel, and Wick, in the north of Scotland, are the busiest of the short-range stations. The former deals with ocean-going ships of all nationalities proceeding up and down Channel, while the traffic at Wick consists chiefly of messages to and from trawlers on the fishing grounds near Bear Island and in the White Sea. Wick also operates a limited service on high frequencies with the long-distance trawlers.

Radio-Telephone Services

All coast stations except Burnham and Oban provide a telephone service between ships equipped with radio-telephone apparatus and subscribers on land. A duplex service similar to the normal telephone service is available at many stations, but at others the operator has to switch from "transmit" to "receive" when the speaker says "over".

Broadcast Warnings

Broadcasts to ships of information about navigational dangers, gale warnings and weather bulletins are made by all stations except Oban. The broadcasts are made at fixed times, but gale warnings are transmitted immediately they are received at the station.

The Long-Distance Service

When the service from Devizes was transferred to Burnham in 1925, three transmitters and three

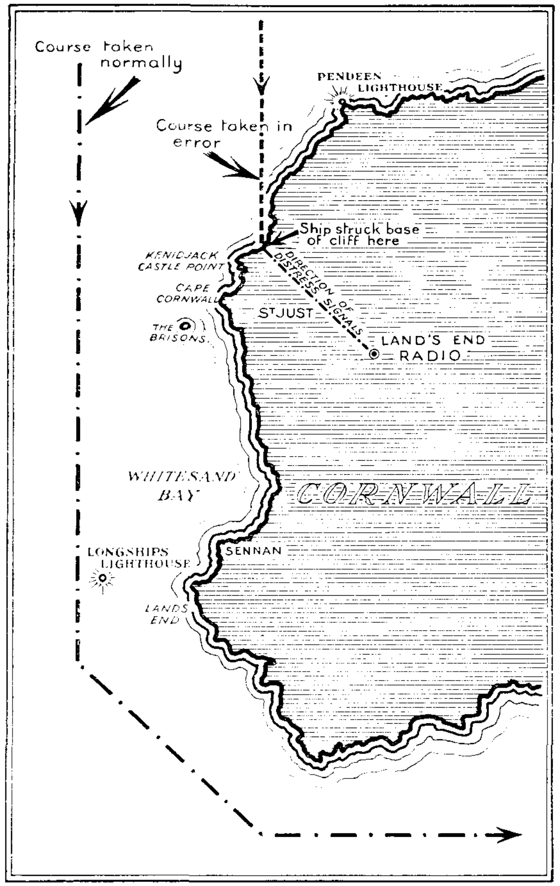


Fig. 4. Direction-finding equipment saves lives. (See text)

receivers were installed, operating in the band 110—160 kc/s. The first high-frequency receiver and transmitter was provided in 1926 and from this small beginning the service grew until by the outbreak of war in 1939 the paid traffic load had reached 3½ million words a year, which needed 15 receivers at Burnham and 6 transmitters at Portishead.

The method of working ships was on the direct-communication principle. Ships were called in traffic lists at two-hourly intervals and on communication being established traffic was exchanged by the up-and-down method of working. Ships could call Burnham at any time and it was quite usual to see adjacent receivers handling traffic with a whaler in the Antarctic and a ship in Chinese waters.

Some of the communications in which the high-frequency service was directly concerned in saving life and property at the distant ends of the earth may be of interest.

In the days before the war, the Falkland Islands Research Ship *Discovery II* usually spent many months each year in Antarctic waters. During the flight of the American explorer, Admiral Byrd, over the South Pole, disaster came when the aeroplane crashed near the fringe of ice on the side of the Pole opposite to the American base. Supplies were sufficient for only a few days and as the sea journey would have taken many weeks the position seemed hopeless. After some effort, Burnham contacted the *Discovery II*, informed her of the disaster and enquired whether she could assist. The ship, which at the time was only a few hundred miles from the crashed machine, rescued the American flyers in a very short time.

Another interesting case was that of the vessel which ran aground some hundreds of miles up the river Amazon. The ship was out of range of the local stations in the area and could not make contact with the shore. The distress message was passed directly to Burnham on high frequency and then forwarded by cable to the local sea rescue organisation.

Post-War Services

Owing to propagation conditions, it is difficult if not impossible to provide full 24-hour communications with ships in some of the more distant parts of the world by direct working. When the ship-shore services were resumed at the end of hostilities, a new system of working traffic with ships was arranged among the countries of the Commonwealth.

The Long Distance Area Scheme, as the system is called, is restricted to ships of the British Commonwealth of Nations and the method of operating can be briefly described as follows. The world is divided into eight Areas, each having its own transmitting and receiving stations. Traffic in the direction "to ships" is circulated to the station in the area of which the ship happens to be sailing. It is transmitted by that station in the form of broadcasts, which are made at four-hourly intervals (0000 G.M.T., 0400 G.M.T., etc.). A message is transmitted in the first broadcast after receipt at the station and repeated in subsequent broadcasts for 24 hours or until acknowledged by the ship, but

the average number of transmissions per message works out at only 1.7. Ships notify Burnham, the central routing point in the scheme, of changes of area and position. These are entered on a card index which provides a ready reference for routing traffic. The cards also show the call sign, type of equipment and hours of watchkeeping of the relative ship. Communication between area stations is effected over the Admiralty network and is free of charge.

The service to and from foreign ships and from aircraft in flight is still operated on the direct-communication principle.

Under the Area scheme, a ship with traffic for delivery to an address in the United Kingdom will call Burnham, but any area station may accept the traffic and pass it to Burnham over the Admiralty network.

The equipment at Burnham and Portishead was inadequate to handle traffic under the new scheme and a major reconstruction was carried out between 1946 and 1948. The new station (Figure 5) has been equipped with 32 communications receivers of the Marconi C.R. 150 type, while a staff of 115, in which is included a small contingent of naval telegraphists, is required to handle the yearly traffic load of nearly eight million paid words. The number of transmitters has been increased to 13, eight of which are arranged to provide two-channel working.

The Control Room at Burnham (Figure 6) is particularly interesting, as it is here that the routing and circulation of messages to and from ships in all parts of the world is dealt with. Wall maps painted on sheet steel, one of which is 35 feet wide and 16 feet high, show the shipping and air routes. Facilities are available for indicating the position and the direction in which a ship is sailing, by means of magnetic markers.

There is still a thrill in searching for calls and never knowing from which corner of the seven seas the next message will be received.

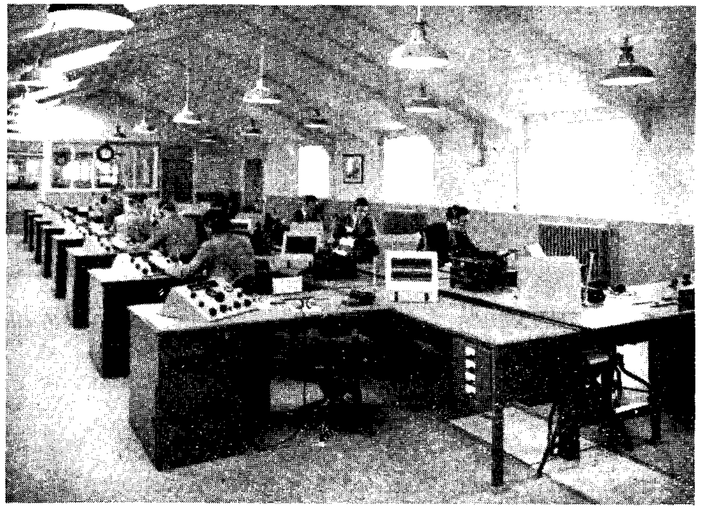
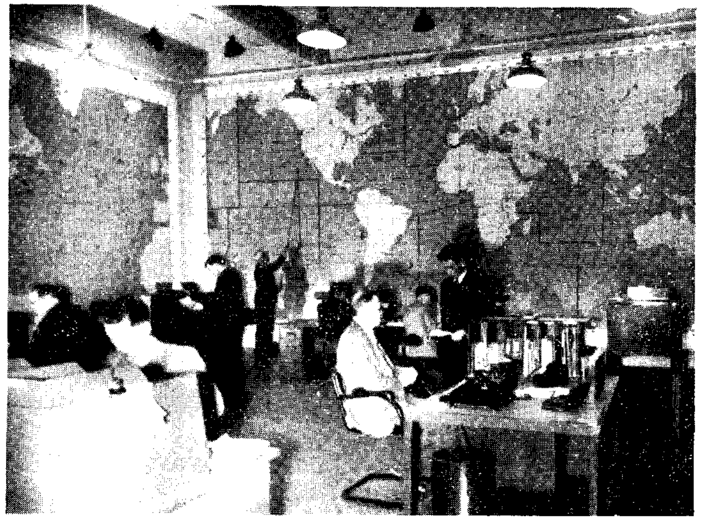


Fig. 5. A receiving wing at Burnham

Fig. 6. Burnham Control Room (*Photo.: Central Office of Information*)



NOTES AND NEWS

Blind Telephonists - Clyde Radio-Telephone Service - Rubber Mudguards - Testing Stroboscopes - Iraq Radio-Telephone Service - Extension of Through Dialling, etc.

Blind Telephonists.—Blind telephonists are employed on the switchboards of some Government Departments, local authorities and commercial offices.

They can perform all the duties normally appropriate to switchboard work, including recording and transmitting messages and telegrams and keeping records of telephone calls. They are fully trained in the use of Braille and typewriting and are able to maintain Braille directories for reference purposes.

The total number at present employed in Government Departments is 110 and a survey is being made of private branch exchanges operated by the Post Office, to determine the possibility of increasing this number.

* * *

Public Mobile Radio-Telephone Services.—The Post Office has been asked to provide a radio-telephone service for the use of shipping in the Clyde. A preliminary search for sites has been made. Such a system has been open to commercial traffic on the Thames since July, 1949. (See "Calling up a Thames River Tug", in our issue of May, 1950).

* * *

Greetings Telegrams.—During August, 1951, the Post Office dealt with 504,020 greetings telegrams. This made a total of over 4 million greetings telegrams handled since the service was re-introduced on the 20th November, 1950.

* * *

Radio Equipment for Marine Applications.—H.M.T.S. *Monarch* has been fitted with the latest Post Office design of single-sideband equipment, including a 4 kW peak-power sender, the highest single-sideband sender afloat.

Tests have been carried out which show that by installing a 16 mc./s. low-power radio sender in a cable buoy and using a direction-finder in a cable ship, the direction-finder can be used to "home" on the buoy from a distance of 20 miles. If adopted, this is likely to facilitate the location of cable buoys, particularly in bad weather.

* * *

Post Office Transport.—Large numbers of moulded rubber front and rear mudguards, replacing the steel type, have been introduced on Post Office vehicles. It is anticipated that the frequency of repairs and replacements will be considerably reduced as a result.

* * *

Testing and Calibration of Stroboscopes.*—Apparatus developed by the Research Branch for testing stroboscopes is installed at Birmingham Test Section. It comprises a crystal oscillator controlling a 1,000 c./s. frequency and electronic counting and scaling units operated under thermostatically controlled temperature conditions. Overall accuracy is ±0.01 per cent. and stroboscopes passed for service are calibrated to an accuracy of ±0.2 per cent. of nominal frequency.

* Stroboscope: A device for viewing intermittently a mechanism in motion at high speed. When correctly adjusted to the required operating speed, the mechanism appears to be stationary or moving very slowly. The stroboscope is used, for example, in examining the performance of teleprinters.

* * *

Radio-Telephone Service between the United Kingdom and Iraq.—Direct radio-telephone service between the United Kingdom and Iraq was opened at 3.0 p.m. on the 1st August, when greetings were exchanged between the Assistant Postmaster-General, Mr. Charles R. Hobson, and Dr. Diajaffer, Minister of Communications and Works, Baghdad. Mr. A. M. Khederi, the Iraqi Minister in London, was present with the Assistant Postmaster-General at the opening ceremony and exchanged greetings with Mr. H. Beeley, Counsellor at the British Embassy in Baghdad.

The telephone service with Iraq will be available to the public daily, except Sundays, from 3.0 p.m. to 4.0 p.m., at a charge of £3 for a call of three minutes, plus £1 for each additional minute. The Report Charge (where applicable) will be 4s. od. Calls may be made to most of the principal places in Iraq, with the exception of Basra.

* * *

A Popular Service.—During the four weeks ended 12th September, 1951, telephone subscribers in London made 3,316,000 calls to "TIM", and since the introduction of the service in July, 1936, they have made a total of 373,749,000 calls.

The speaking clock service is available to subscribers in seventeen of the larger towns throughout the country and plans are in hand to extend the service to other towns.

Two speaking clocks, one at Holborn Exchange in London and the other in Liverpool, provide the service and all calls are connected to one or other of these.

* * *

"999".—The slogan "For Police, Fire, Ambulance, dial 999" was first used in 1937, when "999" service was set up in London. The service was extended to Glasgow in 1938. In the years since the war, service has been extended to nearly 1,700 automatic exchanges, including all the large exchanges and many small unattended ones in country districts. Altogether, "999" service is now available to more than 85 per cent. of the subscribers on automatic exchanges throughout the country.

* * *

Telephone Supply and Demand.—During the year ended 31st March, 1951, the number of telephones in use throughout the country increased by 254,659 to a total of 5,426,150. This magnificent achievement in the face of manpower and financial restrictions, however, was insufficient to meet the continuing heavy demand for telephone facilities. At the 31st March last, the number of outstanding orders for exchange service totalled 532,556.

Although the telephone density in the United Kingdom, measured in terms of telephones per head of population, has not reached the level attained in a number of other countries, the number of telephones per square mile in this country, which is 58.3, is the highest in the world.

The total number of effective telephone calls made in the year was 3,326 million, the number of trunk calls being 250 million. There were 1,245,147 outgoing calls to the Continent and 81,753 outgoing calls on the international radio-telephone services.

At the end of June, 1951, there were 17,298 telephone circuits over 25 miles in length in use in the public network. Of these, 84 had been installed in the year ended 31st March, 1951.

* * *

Cable and Wireless Services.—During July, 1951, the Post Office Cable and Wireless services handled a total of 1,788,190 overseas telegrams. Of these, 907,892 were outgoing and 880,298 were incoming.

Compared with July, 1950, the total represents a decrease of 2.8 per cent.

* * *

Broadcast Receiving Licences.—Approximately 12,434,900 broadcast receiving licences, including 915,200 television licences, were current in Great Britain and Northern Ireland at the end of July, 1951.

The monthly increase in television licences (18,200) was the lowest in any month since July last year, when the increase was nearly 17,000.

The sales of licences usually decline in the mid-summer months; this year there has been the additional effect of the increased purchase tax on receivers.

★ ★ ★

Telegraph Service.—During July, 1951, the first month since the introduction of the revised telegraph charges, the Post Office handled 3,595,335 ordinary inland telegrams. This total was slightly higher than that for the previous month of June, although it was lower than that for July of last year.

During the month, the national average time taken from the handing in of a telegram until sending out for delivery was 37 minutes, and until delivery at the address 50 minutes.

In the phonogram service, the average time from handing in to receipt at the delivery office was 23 minutes, and to delivery by telephone 31 minutes.

★ ★ ★

Extension of Through Dialling and Multi-Metering at Liverpool and Manchester

Liverpool.—The completion of an extension to the Liverpool Automatic Tandem Exchange has enabled a considerable amount of through traffic from manual exchanges to be diverted to automatic switching. On and from the 12th March, 1951, the switchboard operators at 22 manual exchanges were able to obtain access via the automatic tandem to 83 exchanges. The service has since been extended to a further three manual exchanges and the full scheme provides for 27 manual exchanges to have access to 148 exchanges. The automatic switching of about 20,000 calls daily has resulted in a saving of about 20 incoming positions at the Liverpool Joint Trunk Exchange.

The extension of the tandem exchange also provided for dialling by director exchange subscribers to exchanges in the 9½ mile to 17 mile belt, with the consequent introduction of fourth fee metering. The principle of using the first three letters of the exchange name as a code for dialling these exchanges was followed wherever possible, but in a number of cases the first two letters followed by an arbitrary digit has had to be used. Dialling from fringe U.A.X.'s to exchanges in the 2-mile circle was also introduced. The automatic handling of this traffic has effected a saving of a further nine positions at the Liverpool Joint Trunk Exchange.

Manchester.—When the Manchester Director Area was designed, its extent was limited to the 7-mile radius. No provision was made for multi-metering of calls from exchanges in the 2-mile circle or for metering of calls over three units from other exchanges in the Director Area. Modification of the director exchange equipment and a major extension of the automatic tandem exchange, recently completed, will provide facilities for dialling from director exchange subscribers to all but the smallest exchanges within 17 miles radius of Manchester.

Dialling by director exchange subscribers to all other exchanges in the 9½-mile circle has been introduced this year, thereby effecting a saving of approximately 19 positions in the Manchester Toll Trunk exchange. Later in the year, dialling from director exchange subscribers to some exchanges in the 9½ to 17 mile belt will be introduced, with a further saving of 16 positions.

The full scheme, which, it is hoped, will be completed by the end of 1953, will provide dialling from the subscribers on 33 director exchanges to 37 exchanges in the 9½-mile to 17 mile belt. A total saving of approximately 50 positions at the Manchester Toll Trunk Exchange will result.

★ ★ ★

Amendments to London Directories.—There is a constant flow of suggestions that economy could be effected by curtailing the general issue of London telephone directories and by giving the amendments, additions and deletions by means of supplements sent out at regular intervals. At first glance, the idea looks attractive, but on closer examination it is impracticable. About a quarter of a million alterations have to be made to the London directories yearly, and subscribers could not be expected to make the necessary amendments, nor would they be likely to look up the supplements every time they made a call. In the result, they might merely ring Directory Enquiry and so add to the burden of a staff already hard pressed.

★ ★ ★

Telephone Lines for Broadcasting. The Post Office provided 573 telephone lines for outside broadcasts of the B.B.C. during July, 1951. The number of lines provided in July, 1950, was 524.

Commander F. G. Loring.
O.B.E., M.I.E.E., R.N. (retd.)

by Lt.-Colonel C. G. Crawley, O.B.E., R.M. (retd.)
Inspector of Wireless Telegraphy 1930–44

Commander Loring was one of the veteran stalwarts of radio-communication and his death on the 7th September was sad news for many workers in that field of telecommunications, where his charm and ability had made for him many friends and admirers during the last fifty years.

Loring was born in 1869 and at the age of thirteen entered the Royal Navy. As a young lieutenant he was in H.M.S. *Victoria* in 1893 when she was rammed by H.M.S. *Camperdown* with grievous loss, and for saving two lives in that disaster he was awarded the bronze medal of the Royal Humane Society. Later he joined the Torpedo Branch and was quickly attracted by the idea of radio signalling, which was then being seriously considered.

Loring was keenly interested in this new radio work, with the result that in 1902 he was put in charge of the shore stations which were being erected by the Admiralty. Four years later he was a Naval delegate to the first international radio conference, held in Berlin. After continuing in charge of shore stations until 1908 and receiving the Admiralty's thanks for that work, he took up an appointment as Inspector of Wireless Telegraphy in the Post Office. This was a new post, necessitated by the decision that the Post Office should acquire from the Marconi Company the coast radio stations then operating for merchant shipping. His final retirement from the Navy took place in 1910.

At the Post Office, his principal work was the control of the coast stations, the inspection of ships' installations, the qualifications of marine operators and generally to advise on most radio matters. Loring's innate integrity and sincerity were the admiration of his staff, whilst his attractive personality made him many friends. These qualities, together with a shrewd judgment, were of great value on committee work, and in the Post Office he had much of this work to do. He was a delegate at the International Radio Conference of 1912 in London (where, incidentally, he was the first to suggest the use of SOS as a distress signal in place of CQD) and that of 1927 in Washington. He served, too, on the international "Safety of Life at Sea" conferences in London in 1914 and 1918.

In 1930, at the age of 60, Loring retired from the Post Office. Still as energetic as ever, he entered the service of the International Marine Radio Company in London, where before long he was made a director. Here his work was concerned wholly with the radiocommunication of merchant ships, and again his special flair for committee work became apparent. He was a representative of the Company at many international conferences—Copenhagen in 1931, Madrid in 1932, Lisbon in 1934, Bucharest in 1937, Cairo in 1938 and Stockholm in 1948. It was only last year that he retired from the service of the Company.

During the war, Loring was injured when his office in Kingsway was seriously damaged by enemy action. He then received a shock which had a lasting bad effect on his health, though his spirit was unfailing.

He had a distinct literary bent, which always gave an air of distinction to his paper work. When at sea in his early days, he used to write for a naval technical journal and was naval correspondent for the *Western Morning News*. A ghost story written by him had extraordinary success: after normal publication in a magazine, it was later re-published in four anthologies.

Loring was always associated with the sea, first with the Royal Navy afloat and ashore, and then with the Merchant Navy from his desk in a city office. His father, grandfather and great-grandfather were all distinguished naval officers and no doubt passed on to the "Skipper", as he was called by his close friends, a fresh, generous and broad-minded outlook. If I may close with a personal note, it is to say that I knew the "Skipper" intimately for nearly fifty years and remember him now as one of the finest men I have known.

Book Review

***GUIDE TO BROADCASTING STATIONS.* Sixth edition. Published August, 1951, by "Wireless World", Dorset House, Stamford Street, London, S.E.1 at 2s. 0d. (postage 2d.). Size 5½ in. by 4½ in. (D16mo). 94 pages.**

Despite the efforts of international bodies and representations from individual governments, the congestion in the long and medium wave broadcasting bands in Europe is eased but very little. There are at present nearly 200 stations working on unauthorised frequencies. Operating details of those stations and of the 350 or more authorised transmitters are included in the sixth edition of "Guide to Broadcasting Stations." This 94-page booklet also includes details of over 1,400 short-wave broadcasting stations operating in 117 countries.

All the stations are listed both geographically and in order of frequency and the details have been checked against the frequency measurements made at the B.B.C. receiving station at Tatsfield.

The list giving operating details of nearly fifty v.h.f. broadcasting stations in Europe gives some indication of the growth of this form of broadcasting since the publication of the last edition, which listed eleven. Details of fourteen European television transmitters and a number of Consol and standard frequency stations are also included.

Correction.—*In a short article in our August issue, it was erroneously stated that the new London Trunk Telephone Exchange was opened on the 30th April by Mr. Stokes. In fact, the opening ceremony was performed by Mr. Stokes' successor in office, Mr. Brown. This change, which took place immediately prior to the opening ceremony, was due to Mr. Stokes' assumption of office as Lord Privy Seal. —Editor.*

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Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Department.

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