Post Office Telecommunications Journal

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Vol. 4 *FEBRUARY, 1952* *No. 2*

Comment

The Right Hon. the Earl de la Warr, Postmaster-General
Photo. Fayer

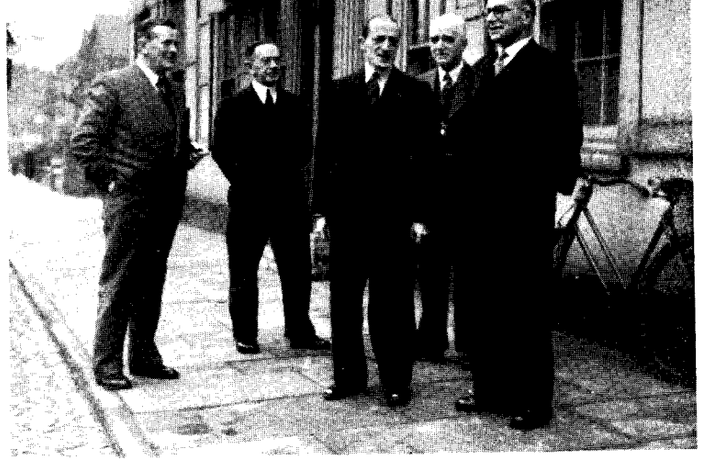
I HAVE ONLY QUITE LATELY become closely associated with the activities of the Post Office and, therefore, acquainted with its Telecommunications Journal. The Editor has asked me if I will write, in this issue, a few words of introduction under this heading of "Comment" and I gladly do so.

This Journal is, I know, a comparatively new venture, this particular edition being, in fact, the first one in its fourth calendar year. It provides one medium by which many members of our staffs are kept informed of the scientific and technical advances which affect our great Department.

The editorial aim has been to steer a middle course between the needs of the non-technical and the highly technical and to present matters in such a way as to be acceptable to readers in the widely varying ranges of staff throughout the Post Office. It has, I know, been the intention not only to show the practical and far-reaching results of the efforts of those who possess a wide knowledge of telecommunications, but to encourage the interest of those who are learning.

These are sound and useful ambitions and I hope the Journal's activities may flourish.

De La Warr



Left to right: J. M. MARKEY, M.B.E., Area Engineer; W. A. BROOKES, Chief Clerk; H. A. CLIBBON, A.M.I.E.E., Telephone Manager; H. COOPER, Senior Sales Superintendent; W. I. HOPKINS, Chief Traffic Superintendent.

YORK TELEPHONE AREA

The York Area, a territory of 2,500 square miles, extends from approximately Harrogate and Ripon in the west to the Yorkshire Coast in the east. It includes, in addition to the historic city of York, with its incomparable Minster and City Walls, such well known resorts as Bridlington, Harrogate and Scarborough, which are very popular not only with holidaymakers, but for large conferences and sporting events, which call for large-scale special arrangements. Apart from the places mentioned, the Area is mainly rural, with agriculture one of the chief occupations.

The important port and fishing centre of Hull lies in the Hull Corporation Telephone Area, the last of its kind in the country, but the disposal of the heavy traffic to and from the Corporation telephone network is via the Hull Post Office Trunk Exchange. This bring problems of its own, quite outside the routine of normal Area working.

The Area contains 127 exchanges, 88 per cent. of which are automatic. They serve 33,934 exchange lines and 54,875 stations. The total staff numbers 887.

MANCHESTER TELEPHONE AREA

Metropolis of the North, hub of the Lancashire textile industry (the largest permanent single export activity in the country)—MANCHESTER. A great inland City, which, by the construction 50 years ago of the 35-mile Ship Canal, became one of the principal ports of Great Britain. Manchester does not thrive on cotton alone: coal, steel, engineering, chemical and allied industries contribute to make it one of the great workshops of the world.

Apart from the "Manchester Guardian", six national newspapers publish their northern editions in this city and we must mention such other famous institutions as the Hallé, the Free Trade Hall, Old Trafford and that playground of the North, Belle Vue.

The Manchester Telephone Area, with the twin cities of Manchester and Salford as the focal point, covers 822 square miles. Oldham and its mills to the north; Northwich with its vast I.C.I. chemical plant to the south-west; Macclesfield, the silk town, due south; to the south-east, over the wild Derbyshire Hills, Buxton Spa, and at the bleak north-east tip of the Area, Holme Moss Television Station.

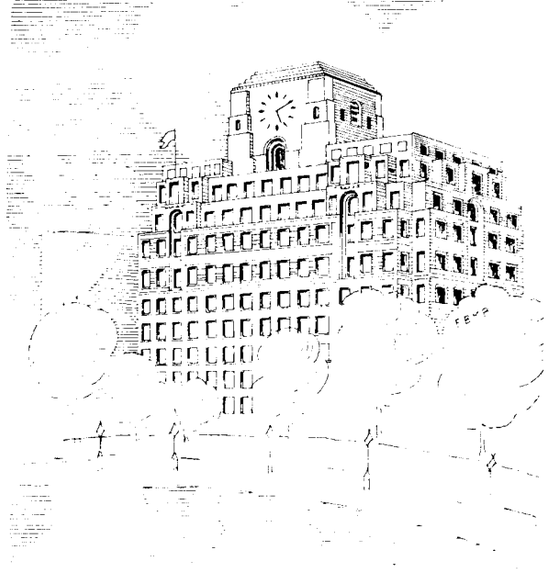
There are 86 exchanges, of which 63 are automatic, serving 234,500 stations, with half a million miles of wire, of which only 35,000 miles is overhead.

The total staff (including telephonists) exceeds 4,300 and the annual revenue is £4,000,000.

From left to right: (*seated*) F. HORNSBY, Chief Sales Superintendent; MISS M. L. RALPH, Secretary; N. F. SEPHTON, M.I.E.E., Telephone Manager; R. J. STAFFORD, Deputy Telephone Manager; F. WARREN, Area Engineer (Maintenance); (*standing*) A. F. GAMMON, Chief Clerk; R. G. GREEN, Area Engineer (Works); H. A. MARCHANT, Chief Traffic Superintendent; J. DUFF, Area Engineer (Designs and Estimates); W. S. SYKES, Chief Traffic Superintendent; W. OWEN, Area Engineer (Installations).

The Telecommunications System of Shell-Mex and B.P.

by Major E. B. M. Beaumont, B.Sc. (Eng.), M.I.E.E., London Centre Area



SHELL-MEX HOUSE IS THE LARGEST OFFICE building in London, and its dignified bulk is a Thames-side landmark, occupying the site of Sir Robert Cecil's house of A.D. 1598 and the Hotel Cecil of 1895. It commands a view of an extensive arc of the Thames, the hills of Surrey and Kent and the heights of north London (an advantage which the Communications Department has seized in devising a ship-to-shore ultra-short-wave radio control for its Thames tankers).

It is one of the many large organisations served by the London Centre Telephone Area, and as an example of the effective marriage of private enterprise with state service and of the application of common sense to the solution of a problem in communications, the system evolved over the years could not be bettered. It uses an extensive system of telephonic and telegraphic private wires; it serves a staff of 15,000 and its network spreads to over sixty sub-headquarters and refineries and depots in the outskirts of London and other parts of the United Kingdom. The nerve centres of the system are the telephone private branch-exchange and the teleprinter switchroom and these are supplemented by a ship-to-shore radio-telephone service, by an internal pneumatic message-tube system and by a wire-recording system in conjunction with a private automatic house-telephone exchange. The welding of these units into one highly efficient whole, by means of which to facilitate commercial activities involving hundreds of millions of pounds annually, is an interesting study in collaboration between customer (Shell-Mex) and consultant-supplier (the Post Office and other contractors).

The Telephone Switchboard

This is a 14-position P.M.B.X.1A and was brought into service in September, 1950. It superseded a 12-position non-standard C.B. No. 1 exchange which had previously served the British Post Office as "Riverside". Impetus for the change was provided by the optimism generated by the ending of the war, the Company foreseeing many proposed new ventures, and an increase in commercial and private motoring giving rise to an expected increase in calling-rate. An analysis of the traffic showed that, initially, 640 extensions, 50 incoming and 50 outgoing exchange-lines and 50 private wires would cater for the situation, and the subscriber proved to be more than co-operative in providing three adjoining rooms on ground-floor level: one room for the necessary equipment, relay-sets, distributing frame, power supplies, rectifiers, batteries etc.; an adjacent room 50 ft. by 28 ft. for the switchroom and the third room for use as an operators' rest-room.

These are decorated in cream, picked out in peach and with grey doorframes. The floor has pale-brown cork squares and the ceiling is pale cream with perforated acoustic absorbent panels (Pakstyl) overall. In the telephonists' retiring room, duck-egg blue predominates for the walls and lockers, with dark-brown carpet and lino, and beige loose-covers for the Chesterfield, easy chairs etc.

The lighting problem was simplified to a large extent by virtue of having diffused daylight from an extensive light-well. This eliminated the complication of glare, and as far as can be judged for the particular situation and scheme of decoration, the

combination of indirect daylight and indirect tungsten electric lighting has proved an acceptable solution. The illumination advised by the Telephone Manager was seven foot-candles at keyboard level.

At the subscriber's request, the switchboard was arranged in the form of a shallow horse-shoe. The cabling is enclosed at floor-level beneath a removable platform to avoid the usual overhead iron racking. One position is used for trunk and toll calls, six positions for outgoing, one position for private wires and six positions for incoming calls. Free-line signalling is provided for 40 circuits on the outgoing positions only (10 circuits per panel). An Enquiry Table designed and constructed by the subscriber is staffed by two operators and there are two Enquiry circuits multipled throughout the suite, incorporating alarm and flashing circuits, and also giving a broadcast facility between operators and the Enquiry position. Monitoring is from this position. (See Figure 1.)

The "trunk-offering" facility, which is not normally available on the P.M.B.X. 1A switchboard, has been made possible by the use of modified Pegs No. 20A (one per position). The switchboard is equipped for "through clearing", but the extension telephones are fitted with press-buttons to enable the operator to be recalled during the progress of a call, if necessary.

Teleprinters

The Shell teleprinter organisation is divided into two parts; Inland Communications, which are handled from Shell-Mex House, and Overseas Communications, controlled by the Cables Department at St. Helen's Court, London, E.C.3.

Very briefly, the British end of an overseas communication is established using either the Post Office Telex Service to the 500 or so subscribers available; private wires from St. Helen's Court to Stanlow, Shell-Haven or Richmond; or the private wire network terminating in Shell-Mex House (over one tie line) as shown in Figure 2. The overseas connection is by way of Continental Telex to The Hague, Brussels, Paris, Prague etc; four private wires to The Hague; two private wires to Cable and Wireless; or two lines on a time-rental basis in Atlantic cables for calls to New York and beyond. There is also one direct circuit to the Central Telegraph Office for Post Office traffic. This article, however, is mainly concerned with inland communications.

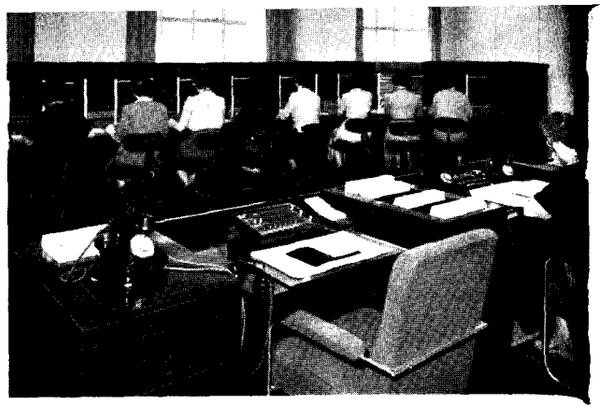


FIG. 1. ENQUIRY TABLE, SHOWING BUCKETS FOR DIRECTORIES, WITH SWITCHBOARD IN BACKGROUND

Shell-Mex House Teleprinter Organisation

This meets the inland-teleprinter requirements as well as serving as a termination for linking the Shell-Mex private-wire teleprinter network to St. Helen's Court, if required, for overseas messages. The equipment in Shell-Mex House is in a light and airy room on the fifth floor. The whole of the room is treated with perforated acoustic absorbent panels, and the decoration is in off-white semi-matt enamel. The lighting is by pendant indirect fittings, using tungsten lamps to supplement the generous daylight.

There are twenty-five extension teleprinters (connected to the teleprinter switchboard) and three Telex machines all employing Post Office Teleprinter 7B. There are also seven Creed perforators, one Post Office perforator, nine Post Office reperforators and eighteen automatic transmitters. One group is arranged as a duplex circuit, which is used via the teleprinter switchboard as a duplex transmitter-receiver working to Shell-Haven or to any other suitable terminal point. (It is significant, however, to note that duplex working over long lines is not favoured commercially, because Tariff "B" rates apply; and this makes it cheaper generally, therefore, to use two individual private wires charged at Tariff "A" rates.)

The teleprinters are assembled mainly in groups of three, each group possessing also two auto-transmitters and one reperforator which can be connected individually to any one teleprinter by means of a key.

The machines are mounted on special hard-wood benches so as to give about a 20 per cent. closer spacing than normal Post Office practice. In

addition, a group of three keys is brought to the front of the bench for switching-in the reperforator or auto-transmitters or to give a clear. This concentration of equipment permits two operators to attend a group of six machines and contributes considerably to the efficient use of circuits.

The benches are arranged in two parallel lines on either side of a moving band for messages. The top band is used for conveying incoming "live" messages and the lower band, travelling in the reverse direction, for passing "dead" messages to the filing section. (See Figure 3.)

The endeavour underlying the arrangement of the equipment and the determination of the proportion of teleprinters, auto-transmitters, reperforators and associated equipment is to occupy the long-distance lines fully, i.e. for one hundred per cent. of the rented time. What seems at first sight to be over-liberal quantities of perforated slip awaiting auto-transmission, or alternatively over-liberal provision of perforators as opposed to direct transmission of messages, in fact proves to be a means of providing a sufficient reserve of messages awaiting transmission to ensure a very near approach to the desired fully efficient use of circuits (without, of course, involving appreciable delay in overall transmission).

Teleprinter Switchboard

The teleprinters are connected to a 70-line two-position Post Office teleprinter switchboard, which in turn is connected to six provincial teleprinter switchboards at Glasgow, Newcastle, Manchester, Stanlow, Cardiff and Bristol, to two tape-relay stations at Leeds and Southampton and to 35 other points giving service to sixty-odd offices, depots and refineries. This switchboard has "engaged" signals for the reperforators, a facility which is extra to standard. (See Figures 2, 5, 6 and 7.)

Certain specified circuits which carry sufficiently heavy traffic are plugged through semi-permanently in the apparatus room, so by-passing the switchboard but retaining full flexibility should it be required. All circuits are wired through test-panels in a separate apparatus room staffed by Post Office Technical Officers for maintenance and testing, and the fault system follows general Post Office practice, in which the subscriber diagnoses at the first stage, issues a docket and receives a duplicate docket back with duration times entered. The original docket goes to the Service Section at London Regional Headquarters for use, e.g., if a claim for rebate matures.

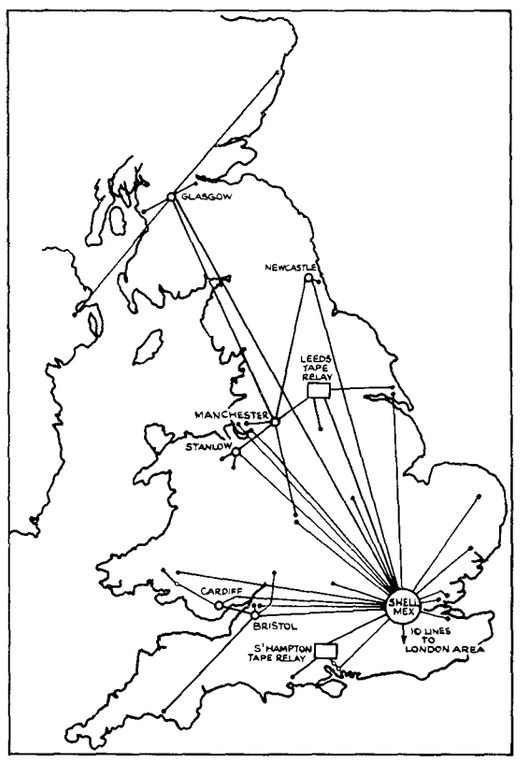
Teleprinter broadcast is provided by a panel on the switchboard by means of which twenty lines nominated by the renter are switchable to any machine in the room or to any circuit connected to the board, and two combinations are possible simultaneously, i.e. two broadcasts at any one time.

Traffic Control

An equivalent of 10,000 average messages are passed per day, and to direct this traffic expeditiously and economically a team of three has been devised by Shell-Mex—a "co-ordinator" and two teleprinter-switchboard operators.

All incoming messages are received at the "live" end of the message conveyor from the machines by a Timing and Record Assistant and are stamped with the time and recorded numerically for traffic statistics. Necessary copies are taken by rolling the message in contact with a dampened tissue, after

FIG. 2. TELEPRINTER NETWORK



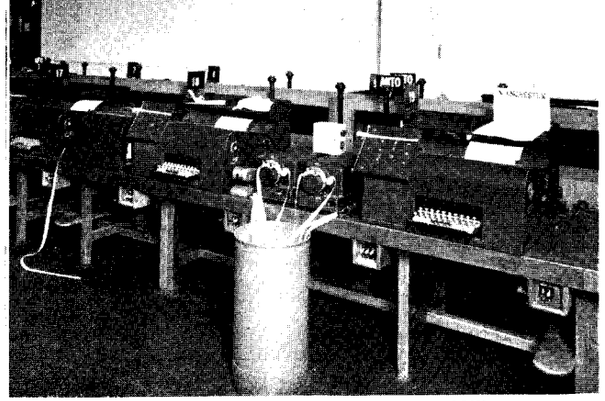


FIG. 3. TELEPRINTER GROUP

which they are despatched by pneumatic tube to the department(s) concerned. For outgoing messages, following their transmission, the original and copies will again be stamped with the time, the original to be filed and the copy to be sent back to the originating department (generally within 30 minutes).

The Co-ordinator sits immediately behind the Timing Assistant (see Figure 4), at a table specially designed with pigeon-holes on three sides, near the live end of the conveyor belt. He distributes all outgoing messages, after timing and recording, by assigning them in due turn to a particular circuit. He refers to a plan of the teleprinter system, with movable coloured buttons showing the prevailing state of the various stations as connected to the extension teleprinters, and then gives instructions to the operators, over-riding the normal supervisory signals of the teleprinter switchboard. The two operators consequently function as a super-intelligent switching point under the direction of the co-ordinator. His instructions are given orally by microphone. The operators, unlike automatic switches, accept them, comment on them or criticise them, also by microphone. In particular, they advise the co-ordinator of the state of circuits which happen to be carrying "through" traffic outside his own control. The messages are passed by microphone from the co-ordinator and received on a loud-speaker at the teleprinter switchboard. The operators reply by speaking into a double-sided microphone with a narrow angle of reception, the axis of which is at right-angles to that of the loud-speaker. The co-ordinator's loud-speaker is screened from his own microphone, and the amount of feed-back or background noise in

FIG. 4. TELEPRINTER SWITCHROOM, SHOWING CO-ORDINATOR, TIMING AND RECORD OPERATOR AND CONVEYOR BELT. CEILING FINISH AND LIGHTING *(Photo. by courtesy of Shell-Mex)*

this two-way microphone loud-speaker circuit is negligible, thanks to careful choice of characteristics of microphones, loud-speakers and amplifier and to their relative positioning. Communication from the co-ordinator to the teleprinter operators and vice versa is by Morse key, on an omnibus circuit working into loud-speakers at a frequency of about 500 cycles per second.

Having assigned a suitable circuit and agreed with the operator, the co-ordinator passes the message or order via one of his two circulating clerks to the relevant teleprinter operator and brings his own plan up to date by moving the coloured buttons suitably.

Transmission of Orders

"Orders" are transmitted over the network by using Teleprinter 7B sprocket-feed machines, which issue manifold order forms.

The accurate placing of the text on to the order form demands extremely expert operating, requiring as it does "double tabulating", i.e. vertical and horizontal. The manuscript or typewritten order, as received by the operator, is simultaneously tabulated and punched by him on to "slip", which is fed almost immediately to a sprocket-feed machine for transmission. This gives a local 3-part copy, i.e. in London. At the receiving end, a 6-part copy is prepared normally, plus any additional copies, by using a reperforator, so obtaining the necessary consignment vouchers, weight-notes etc. for each delivery specified. The advantages of compiling and transmitting the orders using teleprinters can well be imagined, saving, as they do, a good deal of clerical labour and giving prompt transmission of advices for execution, with particular advantage in allocating the necessary transport. The Post Office indeed might well consider, in normal times, using some such system to transmit Advice Notes direct to Installation Offices on receipt of a subscriber's instructions in the Telephone Manager's Office.

Pneumatic Tubes

Linked with the moving band in the teleprinter room is a Lamson pneumatic tube system connecting over 30 points to a central station, and this tube system ensures a speedy service for messages,

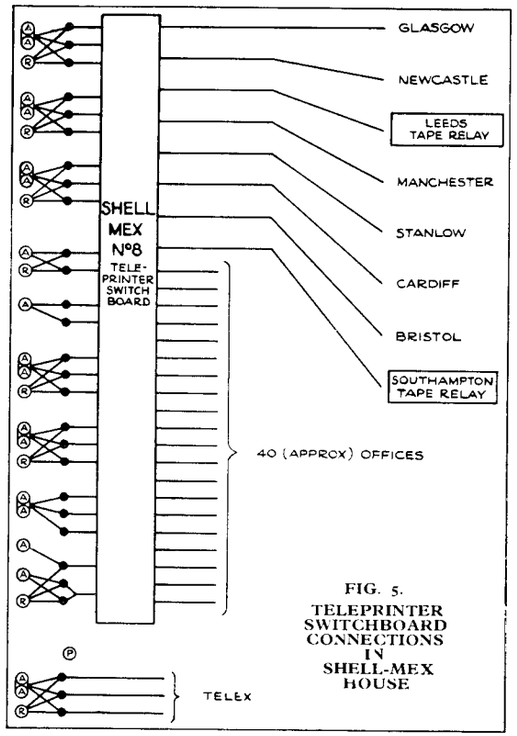


FIG. 5. TELEPRINTER SWITCHBOARD CONNECTIONS IN SHELL-MEX HOUSE

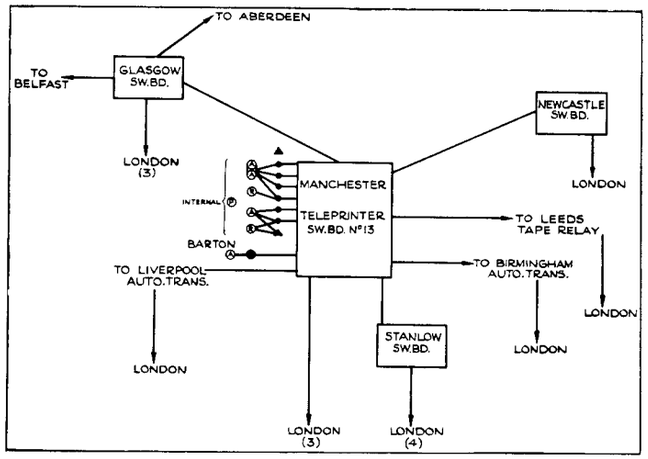


FIG. 6. TYPICAL PROVINCIAL OFFICE SWITCHBOARD

teleprinter messages and other documents between the various offices, so dispensing with the laborious and wasteful use of human messengers and reducing to an economic amount the proportion of teleprinter message-time absorbed in handling at the terminal office.

Wire Recorders

Wire recorders have been installed primarily for the convenience of the sender, to relieve departments of writing messages and for the dictation of ordinary typing. One result is to provide a means of smoothing the flow of teleprinter traffic, thus materially helping to achieve the target of 100 per cent. occupied circuit-time on long and costly private wires.

In common with all other systems offering reliable dictation as an alternative to handwriting, once confidence has been engendered and practice obtained, wire recording proves extremely popular and quickly saves its cost in executives' time. Messenger-time is saved, in addition, by wire recording over telephone lines.

Access to the wire recorders is obtained by dialling on the Siemens private automatic telephone exchange or, in the case of departments outside Shell-Mex House, by connecting them through the Post Office telephone switchboard (TEMple Bar 1234) to the "Telecord" service, which uses Dictaphone technique. Recordings are played back by operators who cut the messages direct on perforated tape, which is fed to a transmitter at a suitable time.

A further development of the versatile wire recorder is of some interest. It is being installed by the Communications Department for a number of different services, secretarial and otherwise. This offers many novel facilities, including absent-subscriber service, which enables an official, on returning from absence, to receive messages verbatim and viva voce.

Radio Communications

A fleet of tankers is deployed round the shores of Great Britain for fuelling the ships of customers. From time to time it becomes necessary to divert these tankers from their orderly course to meet exceptional demands. Two methods are employed. The first is to use the Post Office ship-to-shore radio service for instructing captains of vessels at any point; the second is to use the Marconi 10-watt ultra-short-wave telephone set installed on the roof of Shell-Mex House. This covers a radius of about 30 miles on a wavelength of under two metres. It is not secret, of course, but it provides reliable two-way telephony and is in frequent use. A similar system controls the Company's tankers in the Mersey and operates from a station in Liverpool.

Conclusion

This successful use of Post Office facilities—private wires, teleprinters and their combination with less orthodox instruments as described briefly in the foregoing article—has been made possible only by the the closest collaboration between the Post Office, which provided instruments and lines of high quality and reliability and advised on their use, and the renter's Communications Department, which has shown great foresight and ingenuity in the field of telecommunications. Shell-Mex were one of the first to use the teleprinter to transmit commercial intelligence calling for a high degree of accuracy, installing one circuit between London and Birmingham in 1933. (This was shown in "Post Office in Pictures" of October, 1935.) It is indeed a far cry from that pioneering circuit to the highly complex and advanced network which spreads its arteries over Great Britain and the Western World to-day.

The author gratefully acknowledges to Shell-Mex and B.P. much data and a photograph they have provided for this article and the assistance they have given, through their Communications Manager, Mr. E. E. Fidler, who was responsible for instituting the system and organising its expansion.

FIG. 7. TELEPRINTER SWITCHBOARD, SHOWING MICROPHONE AND LOUDSPEAKER

A Museum of Telephone Switchboards

by C. T. M. Farmer,
Inland Telecommunications Department

IN 1948 A SOCIETY—LATER TO BE KNOWN AS THE Ergonomics Research Society—was formed, which had for its object the study of equipment design in relation to the human beings who would have to use or operate such equipment. The Deputy Treasury Medical Adviser was closely associated with this society and, when their first symposium was being planned for 1951, Post Office Headquarters was approached with a request to arrange coincidentally an exhibition of telephone switchboards. It was thought that such an exhibition, covering a period from the end of the nineteenth century to the present day, would effectively illustrate the relative parts played by evolution and intentional design in the development of equipment.

We, in Headquarters, readily agreed to undertake the job and it was not until later that we began to realise what difficulties could be encountered.

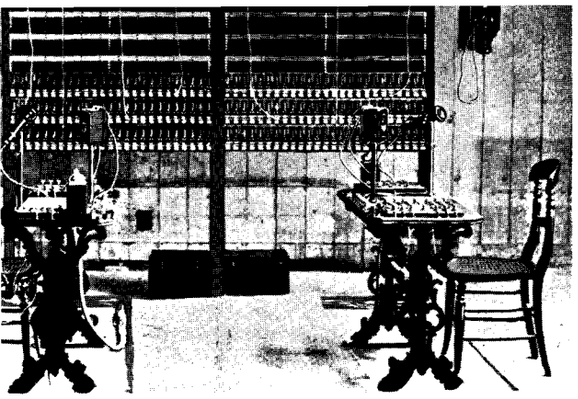
The first and obvious step was to decide what might be wanted by the staff of the Region which was to run the exhibition, and for this we had recourse to a number of volumes in the Headquarters library, a battered but invaluable copy of Rg 38 Part III, which provided a series of pictures and diagrams of all current designs of manual switchboards, and, with the willing co-operation of the Engineering Department, a library of some 50,000 photographs.

The story of the exhibition and its eventual success is outside the scope of this article, but the preliminary work for it, much of which was done at Headquarters, demonstrated only too clearly that once a switchboard or telephone instrument of obsolete pattern is withdrawn from service it disappears. Each piece of equipment which is not needed for re-issue is, very properly, put through a process known as "cannibalisation", in which it is broken down to its component parts, and these, where usable, are either sold or put into stock as replacement items for working apparatus. We found, to our dismay, that hitherto no attempt had been made to keep one whole example of each standard item for historical purposes.

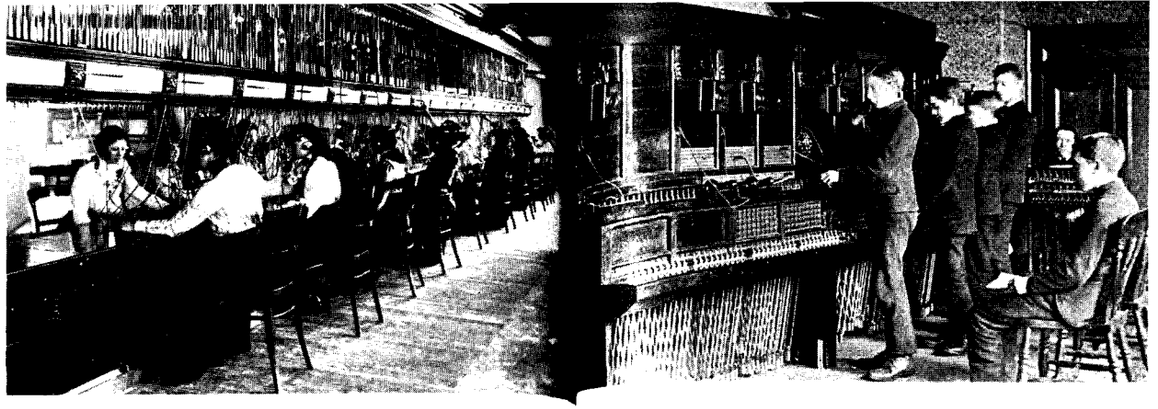
It was thus, early in 1951, that the idea of setting up a Museum of Telephone Switchboards was born. Our primary interest, at that stage, was naturally centred on switchboards used in public exchanges, but later it seemed a logical step to include in our plans such associated apparatus as operators' chairs and operators' and subscribers' instruments, all of which have improved and developed to a remarkable degree during the last 70 years.

The first public telephone exchange in this country was opened at No. 36, Coleman Street, London, in 1879. What has happened to that two-position, slipper-jack switchboard of supreme historical interest is anyone's guess. It certainly has not been possible to trace it through official channels. During the ensuing 20 years, the telephone grew rapidly in popularity and numbers of local companies were established, opening their own exchanges. It is difficult to assess this growth accurately, but by the turn of the century there must have been in the neighbourhood of 1,000 working public exchanges. Certainly all the major towns in the country achieved some kind of telephone communication and the design of switchboards and instruments made rapid strides. As far as we can tell now, most of these boards followed broadly two basic principle designs (peg switching and cord switching), but rarely were two identical. Of particular interest were some flat-multiple, call-wire exchanges, of which Liverpool (1884) and Glasgow (1890) were two examples still remembered by the operators who worked in them. Unfortunately only one member of this redoubtable vanguard to the ever-increasing army of telephone switchboards can be found to offer its mute testimony to the industry and ingenuity of those early days.

Magneto exchanges of recognisable design have been making their appearance since 1885, and a

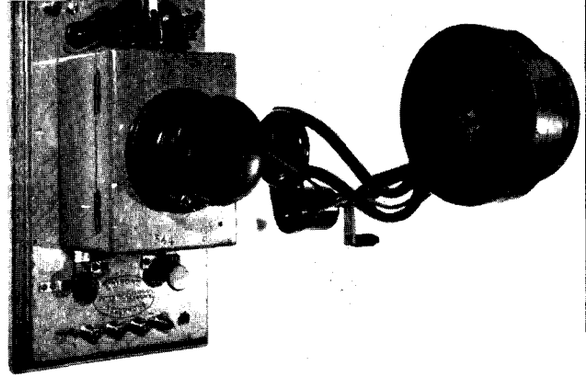


First telephone switchboard in Great Britain, 1879



Glasgow Central, the first multiple switchboard, 1880

Sunderland, switchroom with boy operators, 1883



Edison Company's telephone with chalk cylinder receiver 1879

C.B. exchange, of roughly C.B. 1 layout, was opened at Bristol in 1900. While C.B. boards are generally still plentiful, there is a very real danger that the earlier types of magneto boards will follow the slipper-jack and call-wire boards into the Nirvana of forgotten equipment. Indeed it would not be an impossible situation in 198- to find the entire country equipped with sleek, enamelled, cordless switchboards, with not a single relic of the "good old days" left with which to draw comparisons or perhaps to relearn a few long-forgotten lessons.

The realisation of this danger gave considerable impetus to the project of setting up a museum, and, while it is our misfortune that the idea was conceived too late to preserve some of the earlier types of boards, action can be and is being taken to protect from the scrapheap at least one specimen of each major design at present in service.

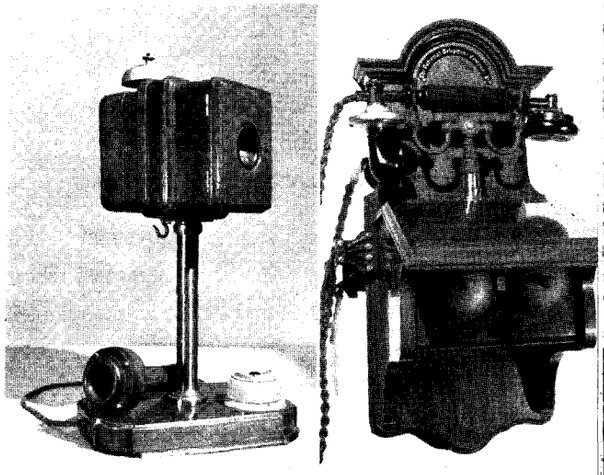
We have already secured one peg-type board (*circa* 1880) as a gift from Messrs. Ericsson Telephones, Ltd., and have located two subscribers' instruments known to have been in use since the first decade of the century. The National Telephone Company switchboards recently recovered from Broadstairs and Birchington and a magneto L.D.20 and a C.B.S. 11, still in use, provide further examples of the early days of the service and we have earmarked them for the museum. There are still many gaps to fill, however, before our march of progress reaches even standard C.B. working.

The ultimate conception is to present a complete picture of the development in switchboard and instrument design from the earliest possible date to the cordless board. It is hoped that each exhibit will be wired up and in working order. If possible, each board will have at least two subscribers' telephones of appropriate vintage working on it and connection between many of the boards themselves should be feasible. It is also intended that the exhibits should be supplemented by a series of photographs to show general working conditions at the time and the layout of the switchrooms.

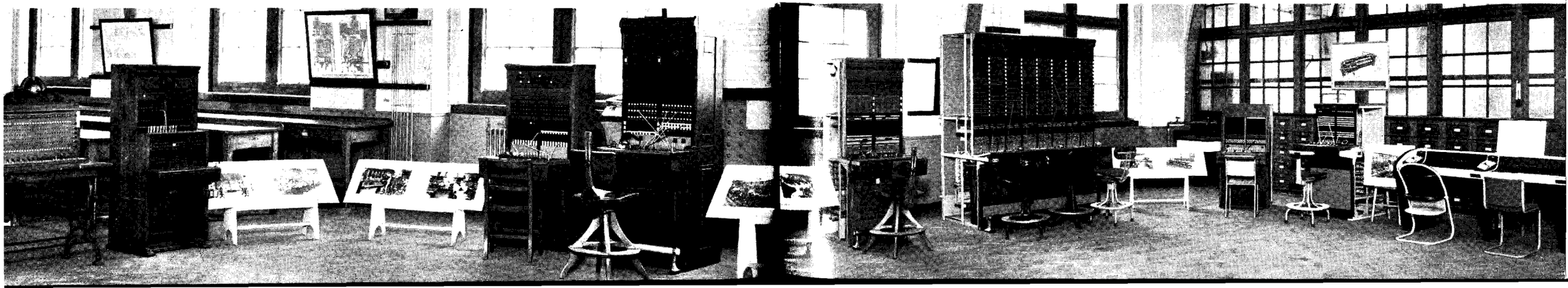
If our other plans go well, there would still remain the question of accommodation. In the centre of London, and especially in Headquarters Building, space is far too precious to be allocated for a museum and at present all that can be done is to search for and earmark suitable exhibits and store them, when available, against the day when they can be displayed in all their glory. In the meantime, the really big problem is to locate whatever vintage equipment has up to now escaped the hands of the "cannibals". At present we are limiting our search to switchboards known to have been in use or manufactured prior to 1910 and any operators' or subscribers' instruments of antiquarian interest.

While official instructions can develop a system for inspecting the items of equipment returned to Stores, intelligent interest in the project by officers of all ranks and grades in the field would be likely to produce more immediate and more far-reaching results, and any assistance which will help us in the location of these "antiques" or in the collection of odd bits of interesting historical data will be appreciated.

Any information of this nature will be welcomed by the author at G.P.O. Headquarters.



Left: United Telephone Company's table instrument (Blake's transmitter), 1880. *Right*: Ericsson C. B. S. wall-type instrument, 1900



Exhibition of switchboards, arranged in 195 at Birmingham University

The public counter, Bradford office

Cable and Wireless Serves The Wool Trade

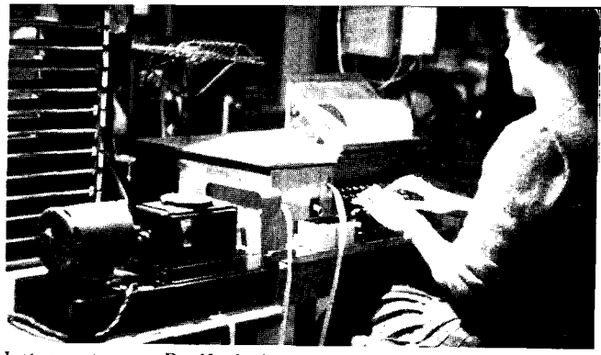
by R. J. G. Blackett and W. Browning, North Eastern Region

IN 1950 OVER 23,000,000 OVERSEAS TELEGRAMS were handled by the British Post Office Cable and Wireless Services. One would naturally expect to find that the major portion of overseas traffic is to and from Greater London: in fact, London accounts for 75 per cent. of the total. There is also a sufficient amount of traffic arising from most of the other major population centres to justify the establishment in these centres of specialised overseas telegraph offices. The size of any one of these offices depends not only on the population served, but also upon the overseas trading interests of the community. Thus, while most overseas telegraph traffic originates in the larger industrial centres of Manchester, Liverpool and Birmingham, next in importance is Bradford, Yorkshire, the centre of the world's wool trade, although Bradford ranks only twelfth amongst the cities of the United Kingdom. The key position occupied by the Bradford Cable and Wireless office in the world's trade in wool makes it an ideal example of the axiomatic relationship between trade and communications.

Until the industrial revolution, the weaving of wool was England's greatest manufacturing industry and the development of agriculture was for centuries greatly influenced by its requirements. It gave the impetus to our overseas exploration and carried our seamen and merchant adventurers across the seven seas and the five continents, to Moscow and the strange and splendid lands of the East. The Industrial Revolution finally made the West Riding of Yorkshire paramount over its East Anglian and Devonshire rivals in the wool trade and between 1831 and 1931 the population of Bradford increased from 23,000 to 300,000. In 1948, woollen manufactures in the West Riding were worth some £335,000,000 and £95,000,000 in value of the output was exported.

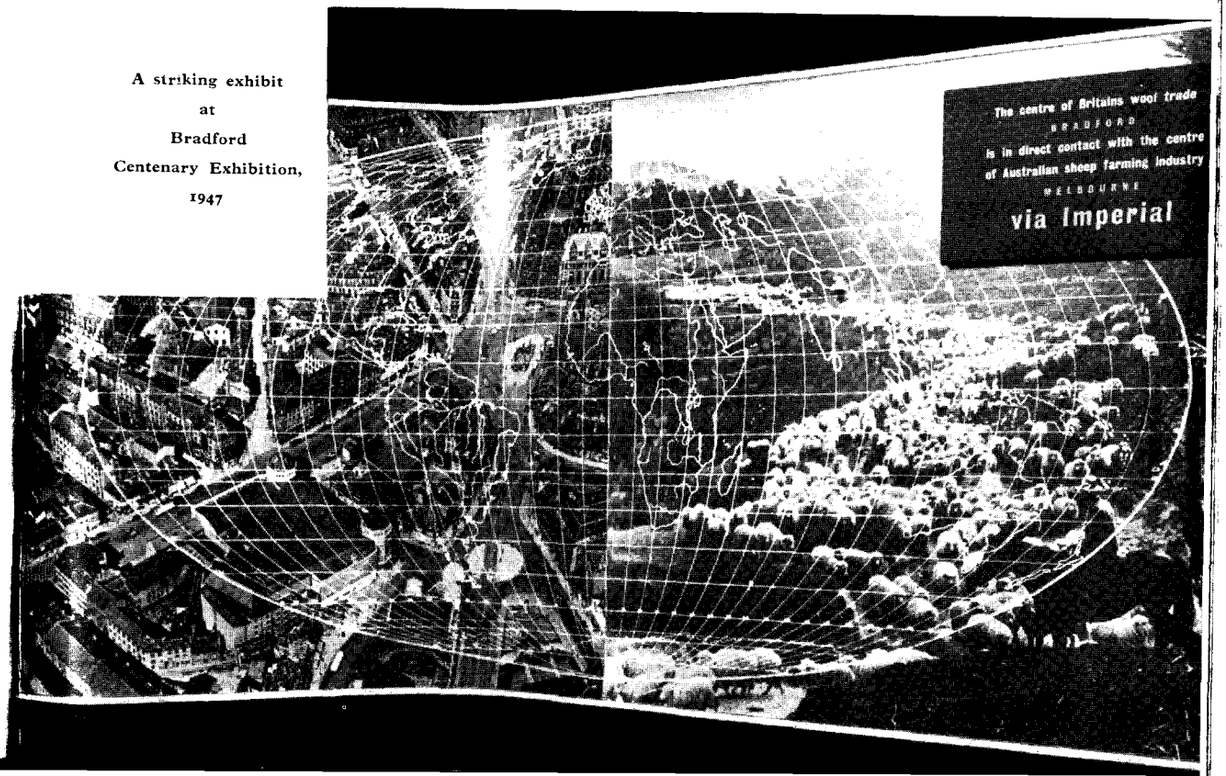
The inevitable outcome of the enormous increase in manufacturing capacity during the Industrial Revolution was that local sources of raw material became inadequate and Bradford began to depend upon the development of new territories overseas for the supply of wool. Thus, the wool trade became a great importing as well as a great exporting business. Australia, South Africa, New Zealand and the Argentine became the world's main wool-producing countries. Wool became almost as important to the life of these countries as it was to the West Riding. For instance, raw wool exports from Australia in 1949 represented rather under two thirds in value of the total exports of that country and the corresponding figure for New Zealand was about one third. Since the war, there has been little trade in wool with Argentina, and the West Riding is almost totally dependent for its raw material on the three great Commonwealth countries, of which the most important supplier is Australia.

As a natural consequence, bonds between Bradford and these countries are very close, and rapid and reliable communications between them are vitally necessary, particularly because of the development of a system of advance buying of wool. Volumes have been written about the wool trade, but briefly the story is as follows. The mill owner assesses his requirements for six to twelve months ahead and arranges to purchase them from the wool merchants on the basis of the samples they show him and the prices they quote. The wool merchants maintain representatives in the wool-producing countries to advise them of day-to-day trends in supplies, quality and prices. Almost invariably the merchants have contracted to sell the wool before they have purchased it and thus they gamble to a certain extent on their interpretation of reports from their buyers abroad.



Instrument room, Bradford, showing keyboard perforator and automatic high-speed transmitter

With the record wool prices reached at the last season's auctions and with the subsequent fall in prices during the first sales of the current season, these are both exciting and anxious days both in



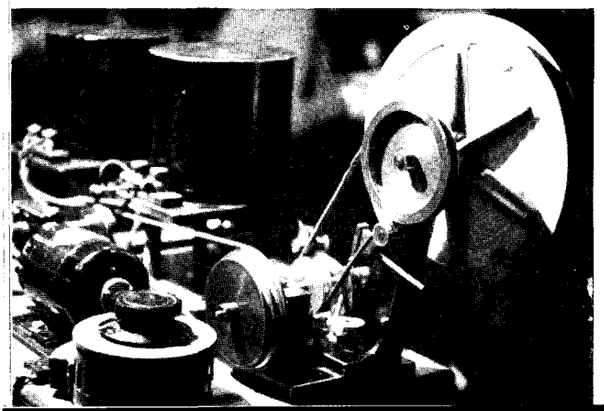
A striking exhibit at Bradford Centenary Exhibition, 1947

Bradford and in the Antipodes, where the wool is sold in the auction rooms at Melbourne, Perth and other major wool centres. It is in these auction rooms that the buyers representing the big Bradford wool firms sit and bid in competition with buyers from all over the world. Twelve thousand miles separate the men who are selling the wool and those who are buying for them in Australia, and to complicate matters there is a difference of up to 10 hours between local time in Australia and local time in the U.K. With fluctuating wool prices, it requires little imagination to visualise the vital role played by the Cable and Wireless office in Bradford. Very large sums can be lost or gained by the woolbrokers on comparatively small variations in price from day to day, or even from hour to hour.

The Bradford Cable and Wireless office, which is centrally situated in a modern building, accepts messages by hand at the spacious and handsomely fitted counter and by telephone in the phonogram room on the first floor. In addition, messengers collect cables from senders' premises. Great care is taken to advise senders of the most suitable rate to choose for their messages and every effort is made to establish a friendly and personal relationship with them. The manager is always ready to deal with customers' problems in his office immediately adjacent to the counter. The office serves not only Bradford, but other important wool towns such as Halifax and Huddersfield, and customers in these towns pass their messages to the office by telephone.

Once messages have been accepted, they are sent by hand from the phonogram room or by tube from the counter to the instrument room on the first floor. Here the telegrams are translated by means of keyboard perforators into the Morse code. These keyboard perforators are noisy little machines. They have a typewriter-pattern keyboard and on depression of a letter key, a series of holes corresponding to the letter in the Morse code are punched in a paper ribbon, known in the telegraph world as "slip". This paper ribbon is fed through an automatic high-speed transmitter associated with the telegraph circuit to Electra House, London. This circuit has a capacity of sending and receiving 180 messages per hour. The high-speed instrument also furnished a copy of the message as sent to line by means of an instrument known as an undulator, which gives a record of the Morse signals on a paper ribbon known as "undulator slip". Thus, any query can be quickly traced and any error rectified. In London, the high-speed receiving instrument has associated with it a "re-perforator", which issues a corresponding punched tape, which can be fed directly to the high-speed transmitter on the cable or wireless circuit to the distant country concerned. Australian traffic originated in Bradford retains its Bradford serial numbers throughout and vice versa. This system of "through" numbers puts Bradford virtually directly in touch with Sydney and Melbourne. Incoming traffic is received on a punched "slip" in a high-speed receiving instrument and the printed message is obtained by running the "slip" through an instrument known as a printer, which translates the Morse code into letters and figures. As a check, the undulator mentioned above also provides a tape record of the incoming Morse signals. Although the system described above has many attractive features, it has been decided recently to replace the high-speed instruments by teleprinters. Many will regret the passing of the old system, which has served the Bradford office so well, but much is to be gained by changing to standard teleprinter working, which is in line with modern practice and in present-day circumstances is more advantageous.

The undulator



The messages are gummed on to a standard form, checked for any discrepancies and copied by a simple reproduction process. The messages pass to a circulating and addressing position, where those for hand delivery are enveloped, addressed and sent to the delivery room on the ground floor through a pneumatic tube, whilst those to be telephoned are passed by hand to the adjacent phonogram room. Messengers secure receipts, showing time of delivery, from recipients and these receipts, on return, are gummed to the local copy of the delivered message. In the phonogram room

(continued on page 68)

Long-Distance Radio-Telephone Circuits and the New London Radio-Telephone Terminal

by C. W. Sowton, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E., and D. B. Balchin, B.Sc.(Eng.), A.M.I.E.E.

Introduction.—The long-distance radio-telephone service between the United Kingdom and other countries was inaugurated in 1927 with the establishment of one circuit between London and New York, since when the service has grown until, by 1951, 41 circuits as shown in Figure 1 were in operation to various parts of the world.

The main purpose of this article is to describe the new Radio-Telephone Terminal (R.T.T.), which has recently been installed at Brent Building, London, N.W.2, replacing the first R.T.T. at Faraday Building. For the non-technical reader, however, a general picture of the system of long-distance telephony operated from this country will first be given, showing where the R.T.T. fits into that picture.

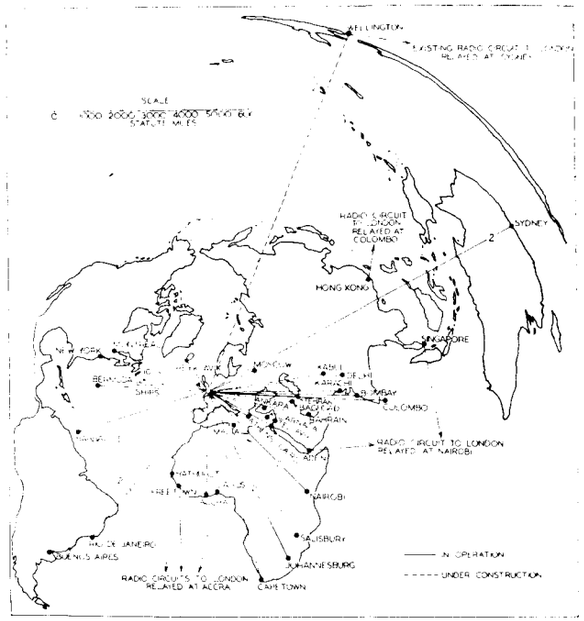
Radio-Telephone Circuits

A long-distance radio-telephone circuit between two countries requires separate and specially sited radio sending and receiving stations in each country, well separated to prevent the signals radiated by the sender from affecting the receiver.

The sending and receiving stations are connected to the R.T.T. by land lines equipped with repeaters, where distance renders this necessary. At the R.T.T., technical control and supervision of the radio circuits is provided, both automatically by special apparatus and by operators. The circuits are extended to the International Exchange, where connection with the inland telephone network is effected.

Figure 2 illustrates a typical circuit between the International Exchange in London and a similar exchange in a distant country. Signals over the inland telephone network arriving at the London International Exchange switchboard pass via the hybrid transformer to the transmit path of the radio terminal apparatus and continue by repeatered land line to the radio transmitting station, where the audio-frequency signals are translated to radio-frequency and "beamed" to the distant receiving station. There they are translated back to audio-frequency and pass over land lines to the distant R.T.T. and thence to the exchange. Signals from the distant exchange follow a similar but separate path between the

FIG. 1. RADIO-TELEPHONE CIRCUITS, JANUARY, 1951



hybrid transformers at the distant and near ends of the circuit. Different radio-frequencies are used for the two directions of transmission and the "go" and "return" channels of the radio circuit constitute a "four-wire" circuit.

Speech signals from subscribers arrive at the radio terminal at widely differing average levels, owing to the differences in subscribers' average speech strength and in the transmission losses of inladn connections. Superimposed upon these differences are the normal variations of volume in any one subscriber's speech. A radio-telephone transmitter which could provide over a long-distance circuit an acceptable signal-to-noise ratio with the lowest speech levels and yet not be overloaded by the highest speech levels would be of exorbitant cost and size and for most of the time would be operating inefficiently. If, however, the average modulation of the transmitter is maintained at a high and substantially constant level, a major economy in transmitter size and power can be obtained. This condition is achieved by inserting, in the transmitter path at the R.T.T., an automatic variable gain amplifier which maintains a constant-output speech volume over a wide range of input volume. This unit is known as a"transmit constant volume amplifier".

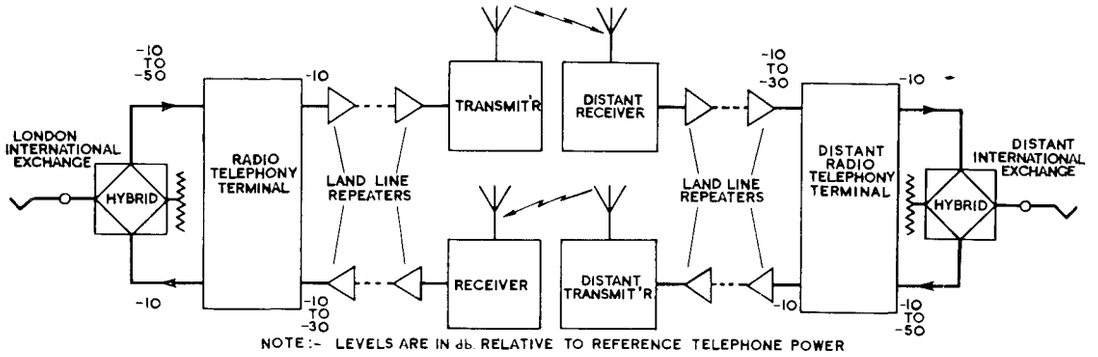


FIG. 2. BLOCK SCHEMATIC DIAGRAM OF LONG-DISTANCE RADIO-TELEPHONE CIRCUIT

Two systems of transmission are used, viz. double-sideband and single-sideband. In the double-sideband system a powerful carrier wave of constant amplitude and fixed frequency is sent out. When the radio sender is modulated by speech or other signals, additional frequencies are emitted above and below the carrier and spaced from it by amounts equal to the varying pitch of the signals. A modulating signal having a frequency of 3,000 cycles per second, for example, would cause two frequencies to appear, one 3,000 cycles per second above the carrier frequency and the other the same distance below; thus, when the sender is modulated by speech containing components of up to 3,000 cycles, the signal sent out consists of two bands each 3,000 cycles wide, one above and the other below the carrier frequency, a total width of 6,000 cycles per second.

This latter is the system normally employed for broadcast transmissions, because it requires a simpler kind of receiver. The carrier signal itself conveys no information and can be omitted if reproduced precisely in the receiver. Moreover, since the whole of the information is contained in each sideband, it is possible to dispense with one of these. To do this, however, requires much more complicated equipment at either end. This method of working gives greatly improved transmission for any given expenditure of power and also permits twice the number of services to be worked in any given frequency band.

In the British overseas radio-telephone service, therefore, the single-sideband system is employed whenever the distant country is equipped to use it. On short wave circuits a trace of carrier of about 1 100 the normal power is sent for control purposes.

Radio signals transmitted via the ionosphere—that is the more distant layer of the earth's atmosphere—are subject to both general and selective fading. With selective fading, the different frequency components of the signal fade in and out independently of each other. In double-sideband systems, fading can be adequately compensated in the radio receiver by what is known as automatic gain control, but in single-sideband radio-telephone systems the variations have to be

co-ordinated by means of a device known as a "receive constant volume amplifier", which is normally located at the R.T.T.

Radio-frequency noise of continuously varying level may be associated with the received signal and in multi-channel radio-telephone systems speech from one channel may interfere with the speech of another. The effect of noise and of this cross talk on the intelligibility of speech may be reduced by limited range volume expansion on the receive path and therefore suitable expanders are included in the radio terminal equipment.

At the radio terminals at each end of the circuit, amplification may have to be inserted in the transmit and receive paths, as the levels shown in Figure 2 indicate. It often happens that there is amplification rather than attenuation in the loop circuit formed by the "go" and "return" channels. "Singing", which would otherwise inevitably occur, has to be prevented by the use at the radio terminals of voice-operated "singing suppressors", which block the transmit path, while the receive path is open to the passage of speech signals, and vice versa.

Non-automatic signalling between the international exchanges at the ends of long-distance radio-telephone circuits is provided by sending over the radio channels signals of 500 cycles per second or 1,000 cycles per second, interrupted in each case 20 times per second, according to the arrangements at the distant terminals. The radio terminal bays at Brent incorporate equipment for converting D.C. signals from the exchange to these standards and conversely translating incoming signals to D.C.

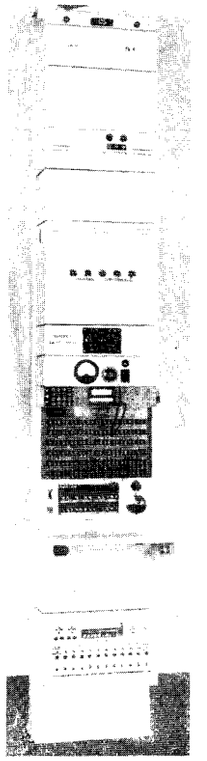
Four pairs of lines are provided between the R.T.T. and the International Exchange for each radio circuit. Two pairs are used for the radio channels, one pair for a monitoring signal fed from the R.T.T. to the exchange and one pair for an order wire between the technical operator and the traffic operator.

The primary requirements so far outlined are met for each radio-telephone circuit by the provision at the R.T.T. of a unit of apparatus known as a "terminal bay". Most circuits, however, require additional apparatus such as privacy equipment and channelling equipment (for multi-channel systems) and this is also installed at the radio terminal to facilitate the engineering operation and supervision of the complete radio-telephone circuit. Privacy equipment is necessary to "scramble" speech in order to render unauthorised reception difficult. Channelling equipment is used to enable more than one speech channel to be impressed on a single radio circuit. Finally, monitoring and testing equipment, together with an extensive network of telephone "speaker" circuits to the radio transmitting and receiving stations and to the International Exchange, are also required.

The New R.T.T.

To make possible the supervision of the radio circuits by a relatively small staff, the controls necessary for the operation of a number of circuits should be grouped together as closely as possible at the Brent R.T.T. This has been achieved by segregating the control and supervisory equipment from the rest of the terminal apparatus. The privacy equipment and channelling equipment have also been segregated to permit as much flexibility as possible in the interconnection of these and to facilitate the specialised maintenance which privacy equipment requires.

FIG. 3. A TERMINAL BAY



The R.T.T. equipment has been installed on the first and ground floors of the building. On the first floor there are (*a*) an apparatus room containing the terminal bays and miscellaneous equipment; (*b*) an operating room containing the positions from which remote control of the terminal bays can be carried out and where the other control and supervisory facilities required by the technical operator are provided. The ground floor accommodates an apparatus room containing the privacy and channelling equipment and also operating positions and apparatus for handling the transmission of broadcast programmes.

Terminal Bays and Associated Apparatus. — The terminal bays, illustrated in Figure 3, are assembled in suites and associated with each pair

of suites are test and miscellaneous apparatus bays, which provide full facilities for testing transmission and routine checking of performance, power switching and distribution, tone and pulse distribution and inter-connection of the terminal bays and operating positions. The equipment installed at present comprises 48 terminal bays, but the apparatus room will accommodate approximately 100 bays, together with the necessary associated equipment.

Channelling and privacy equipments are connected into the circuits of the terminal apparatus on a plug-and-socket basis and a distribution frame to facilitate short or long-term reallocations of the various types of apparatus.

Operating Positions.—Four suites of operating positions are installed and Figure 4 shows two of the suites (with "concentrator" positions at the near ends) and associated suite control positions. Figure 5 is a close-up of an individual operating position. In the centre of each position is a "Position Control Panel", on which general telephone and monitoring facilities are available, and flanking this are four "Circuit Control Panels", from each of which one radio circuit can be controlled via a terminal bay. Test speech from a continuously played tape recording or a test tone at standard level (either continuous or pulsed) can be put on the transmitter path of the terminal equipment or directly to line and a Morse key is provided to permit telegraphic communication between operators under exceptionally difficult radio conditions. The technical operator can ring over the radio circuit and extend the ringing facility to the traffic operator at the International Exchange.

FIG. 4. TWO SUITES OF OPERATING POSITIONS AND ASSOCIATED CONTROL POSITIONS

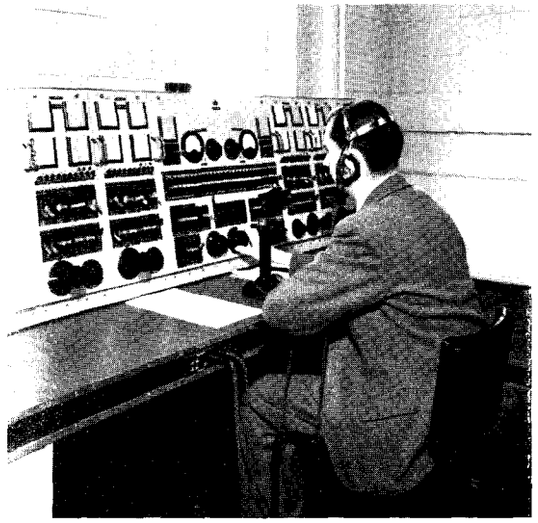
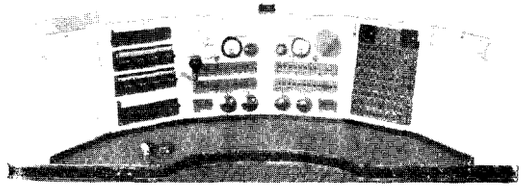


FIG. 5. AN OPERATING POSITION

Four radio circuits are connected to each position control panel, where monitoring and speaking facilities are available. Meters are provided for the measurement of speech volumes and for the tone and noise levels on each circuit. Each control position has two extensions from the Brent P.B.X. and private-wire speaker circuits to the radio transmitting and receiving stations are multipled over all positions. Other direct telephone circuits are provided to the International Exchange.

The facilities which can be extended to the concentrator position at the end of each suite are monitoring, International Exchange speaker circuit and P.B.X. extensions. Circuits which have been transferred to the concentrator position are shown by lamps and at this position an operator is able to check from time to time the condition of any of the radio circuits which he controls and to communicate with the exchange and with the radio stations.

FIG. 6. A PROGRAMME CONTROL POSITION

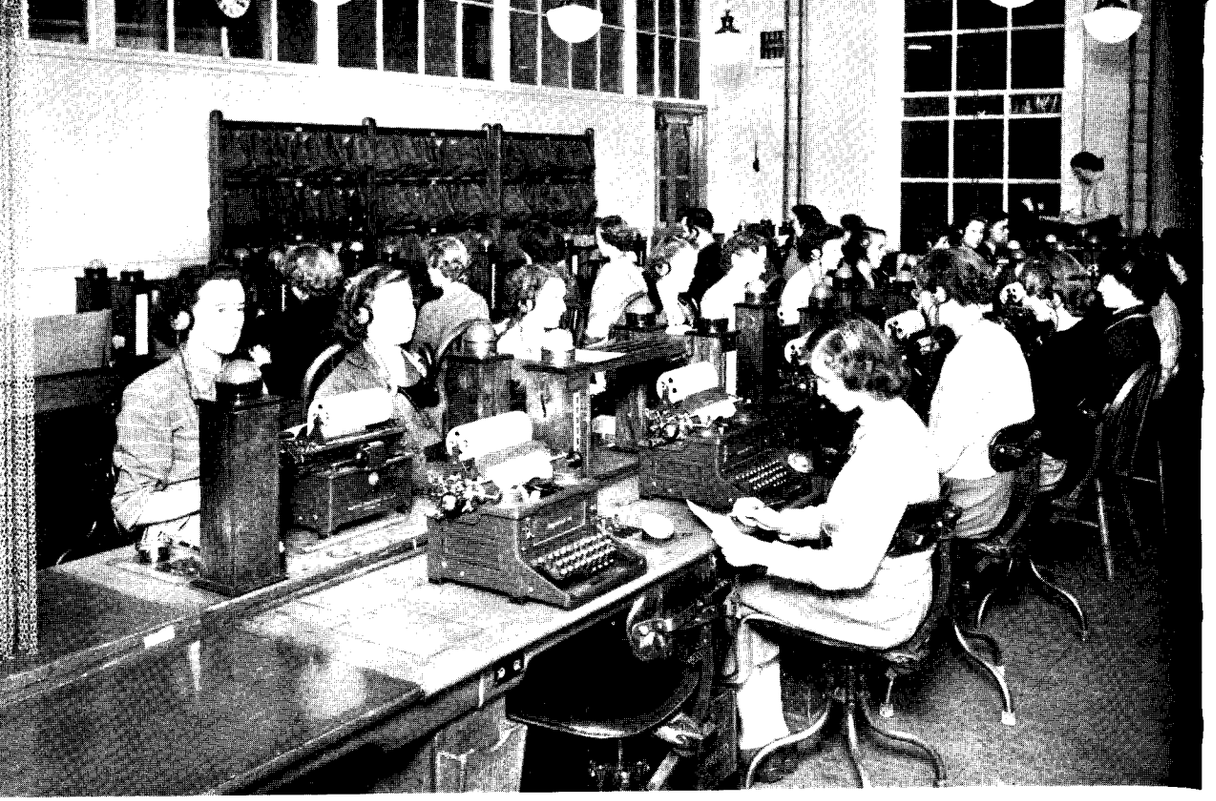


Programme Control Positions.—For broadcast and public-address work, three programme control rooms and a studio are provided. This class of traffic is carried over point-to-point radio-telephone circuits for retransmission by broadcasting organisations or for the use of private concerns and since it demands the highest quality, transmission is handled throughout on "four-wire" circuits, which do not need hybrid transformers, singing suppressors, privacy or any of the special equipment used for telephone traffic. The frequency band width is generally at least 5.5 kc. s. and high-quality microphones are used. Duplicate channels may be provided for reserves and sometimes it is necessary to switch and interconnect a number of radio and land-line channels converging on the Brent R.T.T. One of the programme control positions for controlling and switching networks of land lines and radio circuits used in international relays of broadcast programmes and public addresses is shown in Figure 6. A notable example of the use of these programme facilities is in the Christmas broadcast which culminates in the King's speech, The R.T.T. at Brent being the focal point of radio links with the Commonwealth countries.

Improvement in the performance of long-distance radio-telephone circuits, which has been brought about by the introduction of single-sideband systems and otherwise, has facilitated the automatic control of the circuits at the R.T.T., thus avoiding the need for continuous monitoring and frequent manual adjustment of individual circuits. The introduction of multi-channel working has resulted in a further reduction in the amount of technical supervision necessary for each circuit, since many of the control operations are now common to several circuits. These factors have had a major influence on the design of the new R.T.T. at Brent and whereas at the Faraday R.T.T. one technical operator was required for each circuit, at Brent R.T.T. an operator normally controls up to 4 circuits.

Future development may tend towards the remote control from the R.T.T. of transmitters and receivers for long-distance point-to-point radio-telephone systems.

(This article is based on one of similar title in the *Post Office Electrical Engineers' Journal*, vol. 44 (April, 1951), from which substantial portions have been taken.)



Phonogram operators' positions, Newcastle

Phonogram Queueing Equipment at Newcastle

by D. T. Gibbs, O.B.E., T.D.,
Inland Telecommunications Department

Phonogram and Telephone-Telegram Services

ANY TELEPHONE SUBSCRIBER OR CALL office user can make a call to "Telegrams" and dictate a telegram to a Post Office operator for onward transmission. An incoming telegram is also delivered by telephone to the addressee if it has been given a telephonic address, or if it is more convenient for the Post Office to handle it by this method and the recipient does not object. These telegrams are known in Post Office parlance as "phonograms".

Further, at very many sub-post-offices it is not economical to provide teleprinters for the onward transmission of telegrams handed in at the counter and for the reception of telegrams for local delivery by messengers. Such telegraph traffic, known as telephone-telegrams, is therefore disposed of between sub-offices and selected teleprinter offices by dictation either over the normal

telephone network or over special point-to-point circuits, i.e. telephone-telegram circuits.

The teleprinter offices selected for handling phonograms and telephone-telegrams are called "Appointed Offices" and there are about 300 such offices throughout the country. Special equipment is installed at each Appointed Office, so that incoming calls can be readily distributed to the recording operators; either the operators sit at switchboard positions, select the incoming calls themselves from the answering field and then deal with them while sitting at their positions, or alternatively the operators are located at separate bench tables and calls are connected to their headsets by another operator staffing a manual switchboard, known as a concentrator.

The "Unfortunate" Call

It is an inherent weakness in any system where the answering of subscribers' calling signals depends upon manual selection that there can be no guarantee that signals are answered in the order of their arrival. It occurs, unfortunately a little too frequently, that a calling signal is missed for a period of 1, 2 or perhaps even more minutes, whilst calls originated later are answered within a few seconds.

Various means and devices have been tried in the past, both on the telephone and on the telegraph side, to avoid the "unfortunate" call, but so far no completely satisfactory solution has been found. As a result, a more revolutionary approach to the problem has recently been considered. Automatic switching equipment has been designed which will first receive incoming phonogram and telephone-telegram calls and then discharge them in chronological order to phonogram operators. When no operator is immediately available, the calls are stored and subsequently assigned, again in order of their original arrival, to operators as they become disengaged.

Cyclic Distribution of Incoming Traffic

The question arises whether incoming calls should be distributed to all staffed positions so that the latter are allocated in cyclic order. Furthermore, owing to the unpredictable peaks of incoming traffic, it is desirable that, when all incoming operators are engaged, some assistance should be obtained from the operators handling outgoing phonograms and telephone-telegrams, provided that the total transit time of this traffic is not going to be materially worsened.

Cyclic distribution of incoming traffic to all staffed phonogram positions, however, would cause difficulty in the efficient handling and control of outgoing traffic. On the other hand, with non-cyclic distribution, whilst the disposal of outgoing messages would be facilitated by the use of later-choice positions, there would be serious objection to the uneven loading of the earlier positions with incoming traffic.

The answer appears to be the provision of separate groups of incoming and outgoing positions, with cyclic distribution to the incoming element, and a number of bothway positions to which incoming traffic can be overflowed during periods of pressure.

Automatic Distribution and Call Queueing Scheme, Newcastle

The above principles were incorporated in experimental equipment which was opened at Newcastle in June, 1949. The installation consists of:—

Phonogram and telephone-telegram room:
- Chief Supervisor's desk
- 2 enquiry positions
- 3 section supervisors' positions
- 35 operators' positions
- 1 remote listening position

Apparatus room:
- Main distribution frame
- Intermediate distribution frame
- Four 2,000-type apparatus racks (for automatic distribution equipment)

Circuit provision:
- 20 incoming "90" phonogram circuits
- 17 incoming "951" telephone-telegram circuits
- 6 incoming circuits from Newcastle auto-manual board
- 3 incoming circuits from Jesmond manual board
- 21 direct bothway telephone-telegram circuits
- 12 outgoing exchange line circuits
- 8 operator-enquiry transfer circuits
- 1 bothway exchange line (chief supervisor)
- 1 enquiry-chief supervisor transfer circuit.

The Operator's Position

As access to all outgoing lines is obtained over circuits with key-ended terminations and incoming

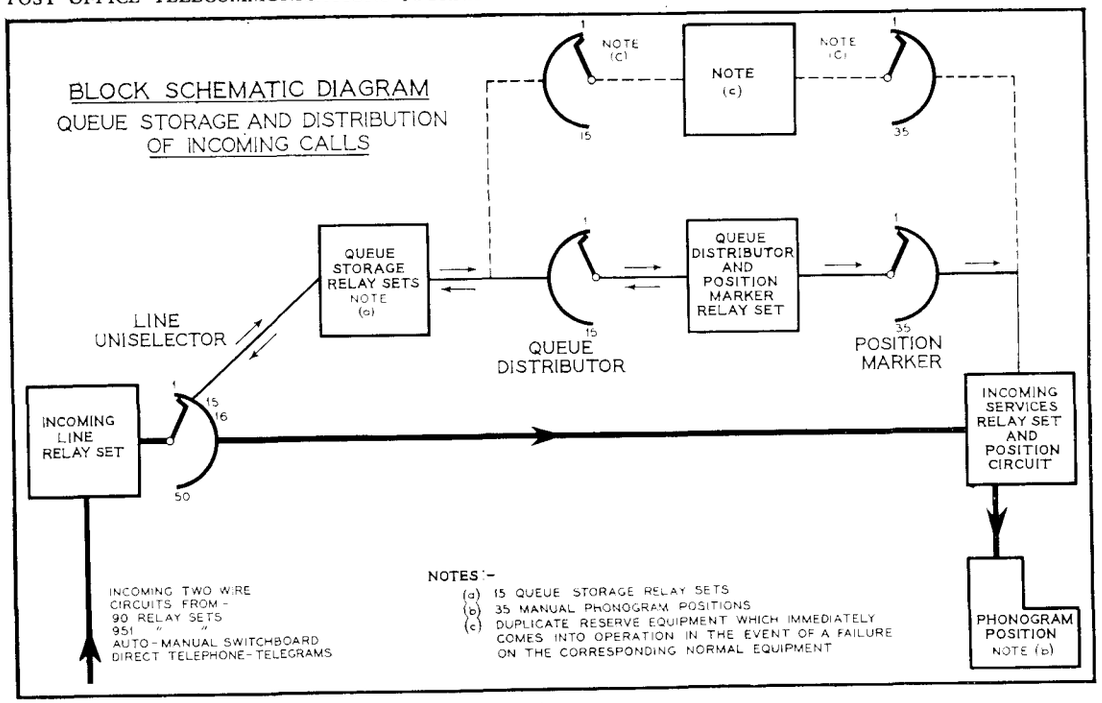


Fig. 1.

calls are distributed automatically to the telephone headsets of operators, there is no requirement for a switchboard jack field, plugs and cords. Each position consists of a flat table with space for a telegraph typewriter centrally located, with three keys and a dial on the right hand side. The keys give the following facilities:—

EX	To set up an exchange call;
TT	To set up a call over a telephone-telegram circuit;
Release	To free the position after the operator has completed the "finishing-off" of an incoming telegram;
EQ XFR	To transfer an incoming call to the enquiry position;
SSR XFR	To transfer an incoming call to a section supervisor's position.

In addition, there is a pillar on each position which indicates, by the glowing of the appropriate light, whether there are 1, 2, 3, 4, 5 or over 5 calls waiting in the incoming queue, or whether the queue is full. On the top of the pillar is a dome-shaped opal cover giving a green or red light, according to whether the position is dealing with an incoming or outgoing call.

All the 35 positions are similarly equipped and, subject to the pre-determined limit of search given to incoming traffic, any position can handle incoming or outgoing calls. Actually the positions, which are accommodated on two double-sided bench tables, are normally worked in three groups, viz., 10 positions for incoming, 10 for outgoing and 15 for incoming and outgoing traffic.

Use of Positions for Incoming Traffic

An incoming position becomes available for incoming calls as soon as the operator's headset is plugged into the instrument jack. Calls are distributed automatically to all staffed positions in the incoming group in cyclic order, but in the event of all such positions being engaged, calls are overflowed to the staffed disengaged bothway positions. Only when no staffed incoming and bothway positions are immediately available, are the incoming calls queued and this fact is indicated

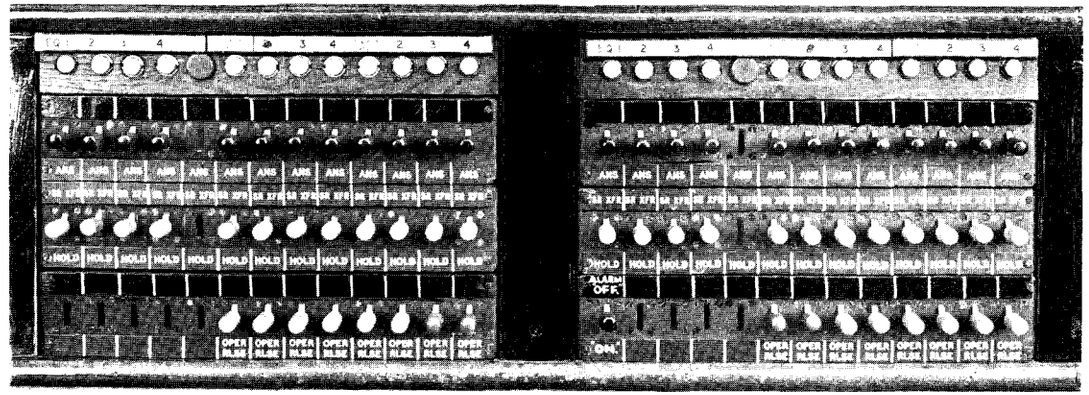


Fig. 2. Panels on enquiry positions

to operators by the glowing of the appropriate lamp on the position pillar display. As positions become free (including bothway positions previously handling outgoing traffic) the calls are discharged to them in the original order of their arrival, but reversion to cyclic distribution to only incoming positions takes place as soon as the queue has been cleared.

Should there be a sustained period of pressure, a master key, fitted on the Chief Supervisor's desk, can be operated and this causes all the staffed bothway positions to be included in the cyclic search. In addition, individual keys in respect of all positions in the outgoing group are provided, so that any number of these positions can also be brought into the cyclic search; except when these keys are thrown, no incoming traffic is ever received on outgoing positions.

The block schematic diagram given in Figure 1 shows how an incoming call is set up to the phonogram operator's position. An incoming call causes a line uniselector to hunt over its earlier contacts for the first free outlet of the queue storage relay sets, which can provide for a maximum storage of 15 calls. The queue distributor uniselector starts to discharge each call in turn in the order of its arrival as soon as the next operator's position to become free has been preselected by the position-marker uniselector. The incoming line uniselector, used initially, now searches over its later contacts for the position allotted by this position marker and the connection is set up direct from the incoming line uniselector to the incoming position circuit. The whole of the common equipment, i.e. queue distributor, position-marker relay set and position marker, is now released. Calls arriving when no calls are held in the queue storage follow the same process as already described and the free staffed incoming positions are immediately allotted in cyclic order by the position-marker uniselector.

Handling of Incoming Calls by Operator

An incoming call is connected directly to the telephone headset of the operator and at the same time the green lamp on the display pillar glows. The operator is thus relieved of the strain of watching for calling signals and of performing any manual function to answer a call. The operator accepts the telegram by typing the message dictated by the caller, and on completion the caller will clear. The incoming position, however, is guarded against the arrival of further incoming calls, so that the operator may complete the further items required before the telegram is ready for onward transmission. During this period, the green position light remains glowing for 15 seconds, after which it changes to a flashing signal. The operator clears her position by operating the release key and the position is then available for a further incoming call.

An operator can transfer a call to her section supervisor's position or to an enquiry operator by throwing her SSR XFR key or EQ XFR key, respectively. In either case, the phonogram operator is held in circuit until a release key at the distant position is thrown.

Originating Outgoing Calls

An operator throws the EX key and this causes a uniselector associated with the position to hunt for a free exchange line to the Newcastle automatic exchange, returning engaged tone should all outlets be in use. The operator establishes a call by dialling the required number and the subsequent restoration of the key to its normal position releases the connection. The red position light glows while the operator is engaged with the outgoing call.

The busier sub-post-offices are given bothway telephone-telegram circuits, which are terminated directly on uniselectors associated with the phonogram automatic equipment. Access to these circuits is obtained by the operator's throwing the TT key and she then dials the pre-arranged code (normally 1 or 2 digits) of the office required. Otherwise the conditions are similar to calls set up over the normal telephone exchange equipment.

Enquiry Position

A two-position enquiry switchboard is installed. In addition to the keys and dial provided on the surface of the table to give the normal outgoing facilities, a vertical panel (see Figure 2) is provided and, as all circuits are key-ended or are accessible by means of keys, the use of cord circuits is avoided.

Incoming calls from the phonogram operators are indicated by calling lights on the panel and the enquiry operator selects the call she wishes to answer by depressing the appropriate ANS key downwards. She can release the phonogram operator from the connection by the depression of her OPER RLSE key. The enquiry operator may herself transfer a call to the Chief Supervisor by moving the SR XFR HOLD key upwards.

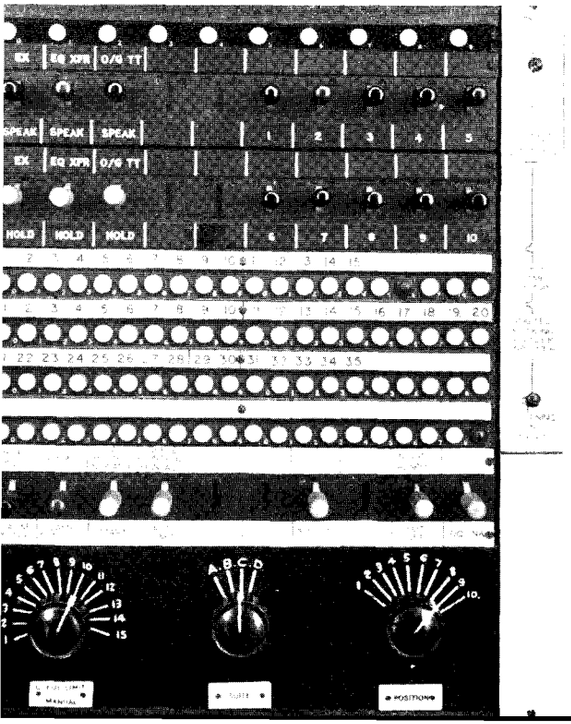
The four terminations shown in the left-hand side of each panel, labelled EQ 1-4, were intended to accommodate direct enquiry circuits from the Newcastle auto-manual telephone switchboard. These are not at present in use.

Section Supervisor's Position

Three section supervisors' positions are installed at the end of the phonogram bench tables. Each position consists of a small vertical turret which has a prominent dome-shaped supervisory lamp, associated with an audible alarm, to indicate that a call requires answering. Two keys are fitted, one for operator's release and the other for forced release. The former is used when the section supervisor decides to take over control of the call.

No facilities are given to a phonogram operator whereby she herself can free her position of an incoming call; hence, if her position is being permanently held through some faulty condition etc., she must request her section supervisor to apply forced-release conditions. This is done by the operation of the second key referred to.

Fig. 3. Panel at Chief Supervisor's desk



Chief Supervisor's Desk

Figure 3 is a photograph of the vertical panel of the Chief Supervisor's desk. The facilities provided are, reading from the top of the photograph:

(*a*)	EX SPEAK (lamp and 2 keys)	To make and receive calls over the normal exchange network.
(*b*)	EQ XFR (lamp and 2 keys)	To receive a call from enquiry position.
(*c*)	O G TT (2 keys)	To originate calls over telephone-telegram circuits.
(*d*)	O G posn's control (10 keys)	In conjunction with B W position master key (item *k*), to extend the cyclic search of incoming calls to any of the 1 to 10 outgoing positions.
(*e*)	Queue lamp display (16 lamps)	To indicate number of calls waiting in queue, plus queue-full conditions.
(*f*)	Staffed incoming positions indicator (35 lamps)	To indicate the number of staffed incoming positions (and also bothway and outgoing positions when they are included in the cyclic search).
(*g*)	Queue-full alarm cut-off (1 key)	To disconnect audible alarm which operates when queue-full conditions exist.
(*h*)	Queue lamp cut-off (1 key)	To extinguish the lamp indicating queue condition (see item *e*).
(*i*)	I C posn's indicator (1 key)	To extinguish the lamp indicating number of staffed positions (see item *f*).
(*j*)	Queue control Manual Auto (1 key)	To change over from manual to automatic control of queue length (see item *n*).
(*k*)	B W posn master (1 key)	To extend cyclic search for incoming calls to staffed bothway positions.
(*l*)	Night Alarm (1 key)	To connect remote extension alarm so as to give audible warning of an incoming call when no phonogram positions are staffed.
(*m*)	DQ NA (1 key)	To disconnect audible alarm which is associated with incoming calls to supervisor's desk (see items *a* and *b*)
(*n*)	Queue limit manual (multi-switch)	To pre-determine manually the maximum number of incoming calls that can be stored in the queue (in conjunction with Manual Auto key—see item *j*).
(*o*)	Listening-in supervisories (2 multi-switches and 2 lamps)	By use of "suite" and "position" switches, to select a phonogram position on which listening-in is required.

The Queue

The conditions under which a queue is formed and how the calls are eventually discharged have already been described. While the call is waiting in the queue, ringing tone is returned to the calling subscriber and this ceases immediately the call is discharged to an operator. Should there be no queue storage relays available when the incoming call arrives, then engaged tone is returned to the caller, who will need to clear and make another call later.

The maximum number of calls that can be held in storage on the Newcastle equipment is 15, but if there are only a few staffed positions and a number of calls are waiting, then a call may take an unduly long time to pass through the queue. Hence, when there is a limited number of operators available to handle incoming traffic, it is preferable to reduce the length of the queue and to return engaged tone to incoming callers at an earlier stage. On the other hand, it is very desirable to avoid

giving engaged tone, as it is tantamount to saying to a subscriber "The Post Office is too busy to deal with you". The determination of the length of a queue is therefore affected by two conflicting factors.

It was decided to incorporate in the automatic phonogram equipment at Newcastle a circuit whereby the size of the queue would be lengthened or shortened automatically to correspond with an increase or decrease in the number of staffed incoming positions. The actual relationship between the number of incoming positions and length of queue at any one time was pre-determined on the basis that the proportion of calls given engaged tone should not be worse than 1 in 50 and that only in the most exceptional circumstances would a subscriber be kept waiting as long as 2 minutes.

If desired, however, this automatic control of queue length can be substituted by one of manual selection, by use of the rotary switch situated on the Chief Supervisor's desk. As it is difficult to ensure that this switch is always adjusted when movements of staff occur, automatic control is usually preferred.

Meters

A cabinet containing over 150 pairs of meters is installed in the phonogram room. These meters, which are associated with individual operating positions and with incoming lines, were provided with the object of recording service and staff statistics, but the volume of work involved in reading them and evaluating the results has rather detracted from their usefulness. An alternative scheme, based upon the application of automatic traffic recorder technique, is now being developed and, whilst using considerably fewer meters, it should give all the information required to enable a detailed study of the standard and efficiency of the service to be undertaken.

Choice of Positions to be Staffed

The conclusion reached so far on the best allocation of staff to the three groups of positions is that the incoming positions should be staffed on the basis of the number of positions likely to be justified by the traffic. Of the balance of staff, one half should be employed on outgoing positions and the other half on bothway positions. Operators on the incoming and outgoing positions would normally deal only with incoming and outgoing traffic, respectively, and the operators on the bothway positions would handle outgoing traffic

primarily, but should always give priority to incoming calls immediately a queue starts to form. This latter condition is automatically achieved, since, with the restoration of the EX TT key on a bothway position on completion of an outgoing call, a waiting call would be assigned to that position straight away.

Results of the Field Trial

The equipment is working very satisfactorily. There has been most favourable public comment on the phonogram service at Newcastle since the new equipment was introduced. As no change has been made in the staffing basis, this reaction must be largely influenced by the elimination of "unfortunate" calls.

Observations show that incoming calls that do not meet queue conditions are answered within one second. It is unusual for calls that do enter the queue to have to wait much longer than 10-15 seconds before an operator becomes available. When exceptional peaks of traffic do occur, or when there are shortages of staff, there have been no complaints from callers that they receive engaged tone. There is evidence, however, that the queue length relative to staffed positions can be increased with advantage, and this would still ensure that a caller would not be kept waiting in the queue for an unduly long period. Facilities are incorporated in the automatic equipment whereby alterations in the ratios of queue lengths to staffed positions can be readily effected.

The operating conditions and facilities have also been very well received by the phonogram supervising and manipulative force alike. One interesting point is that the automatic presentation of incoming calls to operators, whereby an operator has to perform no positive action to obtain connection to a caller, has worked very efficiently and saves between one and two seconds on the average time to answer.

Future Installations

From the experience of the Newcastle trial, it is clear that phonogram automatic distribution and call queueing equipment is the best type of installation to meet requirements where over 20 phonogram positions are justified. Contracts have been placed for this automatic equipment to be installed in Liverpool and in the London North Ring Office. Each of these offices will need 50 positions and a queue of 25 waiting calls. This means a slight variation of the Newcastle design, in which a single 50-point uniselector accommodates both the queue and position circuits: 50-point uniselectors will be used for the latter purpose and 25-point uniselectors for the queue control. Another minor modification will be the replacement of individual queue length display pillars on each operating position by large lamp-display indicators, centrally situated on the walls.

The extent to which this equipment can be justified for phonogram rooms with less than twenty positions has yet to be settled. In any case, it is probable that a simplified form, using many of the main principles incorporated in the Newcastle installation, could be introduced for phonogram rooms requiring more than ten positions.

NOTE.—Readers interested in the details of the equipment, particularly the circuit design, are referred to two articles written by H. E. Wilcockson, A.M.I.E.E., and H. Walker, published in the *Post Office Electrical Engineers' Journal* of October, 1949, and January, 1950.

CABLE AND WIRELESS SERVES THE WOOL TRADE
(continued from p. 56)

messages are telephoned to customers in the usual way. Confirmatory copies of all telephoned messages are sent to the recipients, by hand within the hand delivery area, by post elsewhere.

Much of our overseas telegraph business is competitive and it is essential for the Cable and Wireless manager to know his customers well and to study their individual requirements closely. Any slackening of vigilance on his part will soon result in a shifting of traffic to rival companies. Of course, it is not sufficient to give a good service only on routes which are competitive: bad service on a non-competitive route may well cause customers to refuse us traffic on competitive routes. The Bradford wool merchants are naturally exacting clients, as minutes mean money when large sums depend upon small price movements. Any undue delay needs a lot of explaining to people who, because of their years of cabling experience, are as familiar with the preamble of a telegram and transmission times as staff who have spent their lives in the telegraph service. Tension in wool circles is such that errors, happily few, are not lightly accepted. However, ordinary-rate telegrams are normally delivered to the recipient within a little over 2 hours of being filed in Australia, whilst urgent messages reach their destination within three-quarters of an hour—which, according to Shakespeare, was about Puck's time for the job.

Post-War Development in Telecommunications Buildings

by W. T. Fraser,
Asst. Chief Architect, Ministry of Works

PRIOR TO THE OUTBREAK OF WAR, VERY ACTIVE consideration was being given to the planning and architectural development of telecommunications buildings, but the intervention of the war not only interrupted the trend of thought but made impossible of achievement much of the development then planned.

In 1945, however, the tension was lifted and hope for a peaceful future took root once more and with renewed vigour the problem of planning telecommunications buildings was tackled afresh.

In the process it was soon realised that the thought given to the subject in the pre-war days formed a substantial and desirable basis for renewed study. Even the disasters of war supplied a measure of wisdom which was invaluable to the new approach, though at first no-one was prepared to consider the possibility of such a conflict occurring again for many generations to come.

Architects, in fact, took a very optimistic view and sought to express it architecturally by introducing more freedom, space, air, light and colour into their designs for post-war building schemes. Now the time had arrived for the expression of imaginative thought and the achievement of great things, and who knows what measure of real progress might have resulted from this optimism and enthusiasm engendered by the release from war anxieties, had not the same old war clouds appeared again so soon on the horizon?

In these post-war days, however, there is much evidence to show that the prevailing conditions have been squarely met, and chequered though the course of development has been, some undoubtedly beneficial progress can be claimed.

Almost the earliest post-war development in telecommunications buildings was a new formula re-enacting the basic principles agreed in 1939 for the selection of sites in respect of size, which would provide for possible future extension of the building by 100 per cent. to 150 per cent. of the initial twenty-year essential requirements. Then,

THE STEEL-FRAMED BUILDING

Fig. 1. In course of erection *(By courtesy, Messrs. Boulton & Paul, Ltd.)*

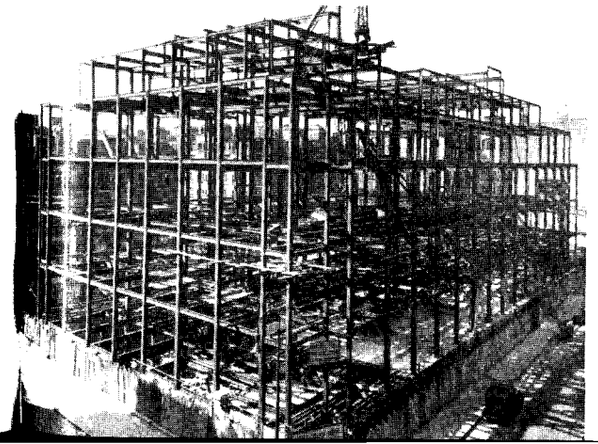


Fig. 2. Completed *(By courtesy of Senlac, Ltd.)*

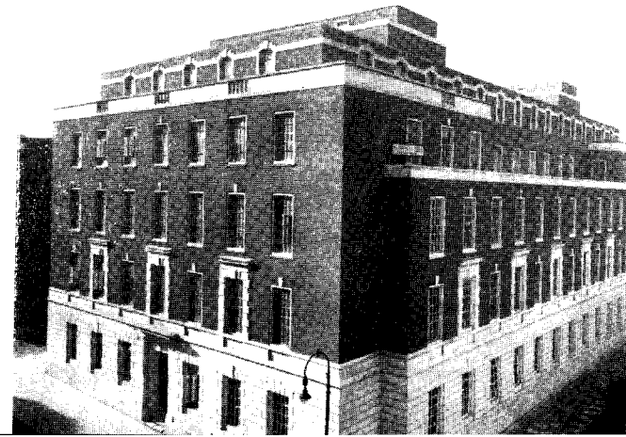


Fig. 3. Pre-war

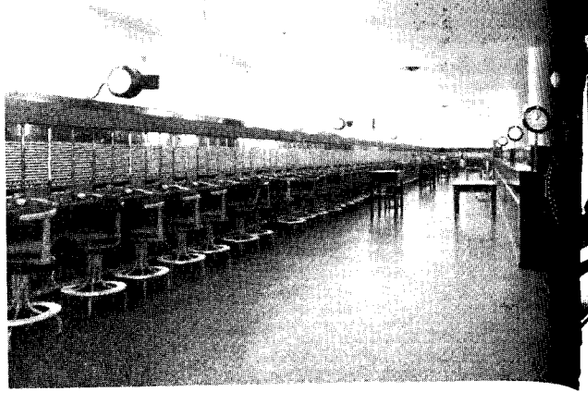


Fig. 4. Post-war *(Crown copyright)*

SWITCHROOM DESIGN

drawing on war-time experience and the evidence of the value of framed buildings over load-bearing wall construction, it was decided that new buildings of two or more stories in height should be constructed with a steel or reinforced concrete frame, capable of bearing all the floor and apparatus loads and transmitting them direct to the foundations without the assistance of the enclosing walls. A building of this nature is far more resistant to collapse from shock or fire than one depending entirely upon the strength of the wall construction. Figure No. 1 shows a typical example of a steel frame in course of erection and Figure No. 2 shows the completed building of which it is the structural part.

Concurrently with the introduction of frame construction, it was decided to plan the welfare accommodation on the top floor of exchange buildings and the switchroom on the floor immediately below and to make both these floors strong enough and the rooms high enough to take switching equipment, as an economic provision for the possible future extension of apparatus.

In view of the anticipated introduction in the near future of cordless-type switchboards, consideration is at present being given to the most economical widths to make new apparatus rooms and switchrooms, bearing in mind such matters as the normal development of building sites and the most suitable arrangements for apparatus, equipment, lighting and working space. A width of 45 ft. would appear to be the desired standard for both rooms, but all the difficulties connected with the problem have not yet been overcome.

Apart from these material and specific developments, a subtle but decided change in the planning of requirements has taken place. Formerly it was considered essential to plan in a way that would produce a design with a formal and balanced arrangement of doors and windows in keeping with the traditional manner of the pre-war period, but now planning has been freed to a large extent from the restrictions such formal arrangements imposed and expresses more directly the actual functions and purposes of the building. Symmetry in planning is no longer considered essential, nor in many cases is it desirable, and so what is known as functional planning, which affords greater facilities for providing and arranging the somewhat complex building requirements of today, is being developed and has become a definite trend in the planning of our post-war buildings.

When it is realised, however, that the planning, design and contract stages of a medium-sized telephone exchange occupy a period of some 18 months and the actual erection of the building another 18 months or more, it is not difficult to appreciate that if building progress is not to be interrupted, general improvements in planning can be introduced only very slowly into the new building schemes.

In this 18 months or so of the period prior to the start of building operations, a site suitable for economic building development and of sufficient size to accommodate the initial requirements and provide for ample possible future extension must be found near to the telephone centre of the area which is to be served by the new exchange. When the location and suitability of the site have been agreed by the Post Office and the Ministry of Works, respectively, and certain town-planning and other clearances have been obtained to the use of the site for telecommunications purposes, preliminary sketch plans for the proposed new building scheme are prepared, followed, on agreement, by the preparation of final sketch plans and estimates of cost. These must be approved by the Post Office before working drawings, specification of works and bills of quantities can be put in hand. The Architect, during the sketch-plan stages,

Fig. 7. Pre-war *(Crown copyright)*

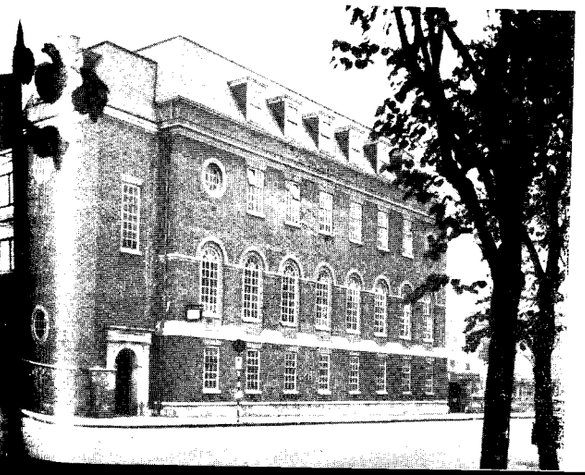
Fig. 8. Post-war *(Crown copyright)*

LOUNGES

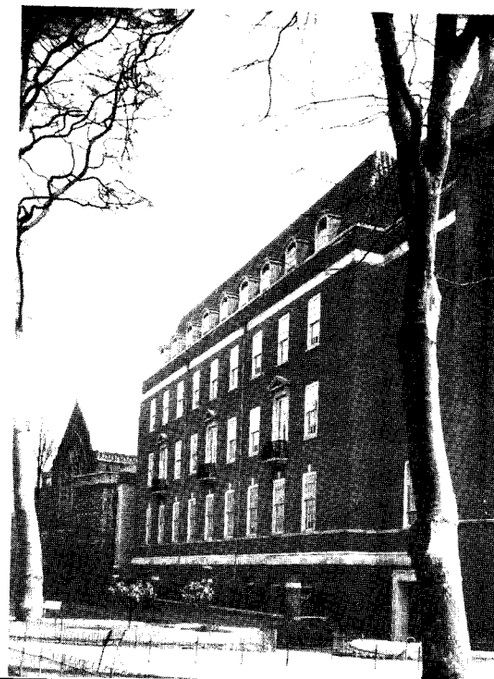
DINING ROOMS

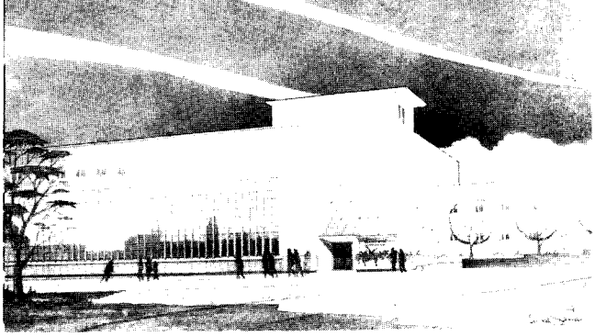
Fig. 5. Pre-war *(Crown copyright)*

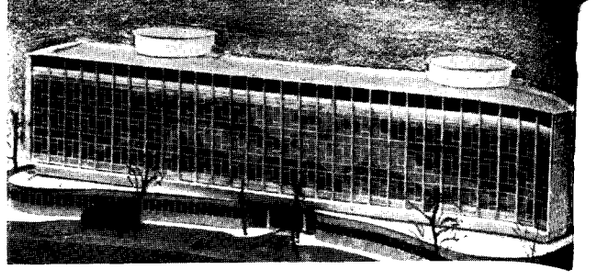
Fig. 6. Post-war *(Crown copyright)*



Figs. 9 and 10. Pre-war telephone exchanges *(Crown copyright)*







Figs. 11 and 12. Examples of post-war architecture (*Crown copyright*)

works on and develops the design of the building and the Estate Surveyor pursues the negotiations for the acquisition of the site. When working drawings, specification, bills of quantities and contract documents are ready, invitations to tender are issued to contractors; then follow the examination of the tenders received and the preparation of a further estimate of cost based on the tender figures and, if all is in order, a recommendation is made to accept a tender. Only after all these preliminaries are satisfactorily completed can the actual building operations be started. The site, of course, by this time should have been acquired, so that possession of it can be given to the building contractor.

The period of time allowed for the building operations naturally depends upon the size and nature of the building project, the supply of building materials and the labour conditions prevailing at the time. Throughout the building operations, constant supervision at the site is required and the Architect has a Clerk of Works allotted to him to aid him in this usually onerous task and in progressing the works from start to finish.

Apart from the post-war general improvements in working conditions, an important development, and one which affects the staff perhaps more than any other, is the proposal now under consideration to provide joint welfare accommodation in place of the pre-war system of separate retiring rooms and cooking rooms for men and women. At North Trunk Control Centre, London, where combined welfare has been introduced experimentally, the advantages of having a well-planned canteen dining room, lounge and games room *en suite*, together with first-aid rooms, cannot fail to be recognised and appreciated.

Many other features of post-war development have also been introduced into this important exchange; for instance, the structural members in the walls and ceilings of the switchrooms and dining rooms have been concealed behind unbroken surfaces, which streamline the rooms and impart to them a sense of restfulness not to be obtained in rooms where there is a repetition of deep beams on the ceilings and the wall surfaces are broken by projecting stanchions. This is a decided contribution towards the creation of conditions which will improve efficiency in the working rooms and provide comfort and induce relaxation in the various welfare rooms.

Large glazed screens also have been used with pleasing effect to separate dining room, lounge and games room and the main staircases have been enclosed externally by large semi-circular windows, which, running continuously through all floors from ground to roof level, flood stairs and landings with light and create a feeling of freshness and ease of going.

However, perhaps the most welcome and effective change from pre-war standards is provided by the use throughout the building of carefully selected colour schemes, and it is evident that the staff, who are consulted in every case, are becoming more and more colour-conscious and appreciative of the careful consideration that is being given to this aspect of post-war development in interior design.

Colours of high light-reflection values, balanced and accentuated by small amounts of rich deep colour, have mostly been used at North Trunk Control Centre. In the first-floor switchroom, the ceiling and window reveals are broken white, the window and side walls and the doors sulphur, the end walls and free standing columns light grey, and the floor is covered with deep blue linoleum. In the second-floor switchroom, the ceiling is parchment, walls and doors are light grey, free standing columns deep blue and the floor linoleum is red. Gayer colours have been chosen for the dining room, servery and kitchen. The dining

room has a pale blue ceiling, peach walls and doors and the free standing columns are blue. The front of the servery counter is bright cerise and the interior walls and ceilings of both servery and kitchen are primrose, while the doors, by way of contrast, are coloured light blue.

Variations of these colours have been used in the decoration schemes of the adjoining lounge and games room and in all other parts of the building, due regard being had to the aspects of the various rooms, their functions and the nature of the work to be done in them. Furnishings and fittings have also received very careful attention and selection.

Figures Nos. 3 and 4, although not in colour, convey some idea of post-war improvements in switchroom design, Nos. 5 and 6 contrast pre-war and post-war dining rooms and Nos. 7 and 8 pre-war and post-war sitting rooms (or lounges).

So much, then, for planning development and the improvements of interior design; and now what of the all-important matter of architectural design as applied to the exterior of our post-war buildings?

Despite the setback the process of imaginative thought suffered when it was so soon realised that a lasting peace was not to be relied upon, nor to be fully expressed in the architectural design of the new buildings, the architects, nevertheless, with commendable spirit, have met the situation and overcome many of the restrictions imposed by post-war conditions, the changing construction requirements and the scarcity of building materials, and are succeeding in no small measure in producing designs which express dignity, suitability for purpose and a distinct freshness of treatment and form comparable with the best conceptions of present-day architecture.

A new external appearance is evident. Gone are the cornices, moulded window architraves and applied forms of enrichment, typical of pre-war days: gone to a great extent also are the high-pitched roofs and dormer windows. The necessity to economise in the use of scarce and expensive materials and in the use of labour has contributed to the elimination of these pre-war features, but the new appearance is largely a direct consequence of freer planning and the interesting sense of form which it engenders. The aim is to build up, by the use of simple, well-proportioned architectural forms, a building of character, which, while satisfactorily providing all the accommodation requirements and operational facilities, will also express some measure of the functional purposes, succeed in becoming a good neighbour and be worthy of the labour and thought expended on its creation. A successful design emerges only from a complete and careful study, not only of the planning requirements but also of the position, size and aspect of the site and the nature and character of the immediate surroundings. Some appreciation of this new architectural trend can perhaps be obtained from a comparison of figures Nos. 9 and 10 and Nos. 11 and 12, but, of course, it must not be assumed that the changes in motif, form and character are so marked in every case.

The Chief Architect's Division of the Ministry of Works is responsible for the design and erection of an ever-increasing large number of buildings and the architects engaged on the work keep well abreast of modern requirements and conditions and the best architectural trend in planning and design. On occasions, however, when by reason of size or unusual public interest building projects which are to occupy very important sites assume an abnormal degree of importance, it is customary for the Ministry of Works to ask for the opinion of the Royal Fine Art Commission. The proposed New North Block of Faraday Building, the new Oxford Exchange and, more recently, Heath Row Exchange are instances in which the Royal Fine Art Commission's opinion has been obtained.

Perfection in architectural design, of course, is as unattainable as is perfection in the other arts, but the pursuit continues with much earnest endeavour and at times is rewarded by some measure of success.

Crown-Copyright photographs reproduced by permission of Ministry of Works. Buildings illustrated: 1, 2, 4, 6 and 8—Trunk Control North, London; 3—Whitehall Exchange, London; 5 and 7—Faraday Building, London; 9—Beckenham Exchange, Kent; 10—Mayfair Exchange, London.

The Telephone Act

by R. J. P. Harvey, C.B.,

Director of Inland Telecommunications

THE TELEPHONE ACT, WHICH BECAME law in August, 1951, is the first Act to be passed by the United Kingdom Parliament for the specific purpose of empowering the Postmaster-General to regulate the use of the telephone system. For that and other reasons, its passing represented an important stage in telephone service history, and readers of this Journal will be interested to have a description of the reasons why the Act was passed and of the developments in mind now that the Act is on the Statute Book. It will seem strange that 1951, seventy-five years after the invention of the telephone, should be the year when the first Telephone Act was passed. The reason is simply that the conduct of the telephone service by the Postmaster-General has been undertaken under the powers conferred on him by a number of Telegraph Acts, because, by a legal decision of 1880, a telephone was held to be a "species of telegraph" under the Telegraph Acts then in force. The legal and parliamentary authorities of the 1880's could have had no idea of the way in which the telephone service would develop in the ensuing seventy-five years. Yet we may diverge for a moment to notice how brilliant in anticipation their or their predecessors' work proved itself to be, for in the legal case of 1880 the judge pointed out that the Telegraph Act of 1869 had succeeded in covering not only the telephone before it was invented, but also what we have since come to know as wireless telegraphy and telephony, if such methods of communication should ever be invented!

What the Act does

The Act of 1951 is concerned with machinery only and gives the Postmaster-General power to make Statutory Regulations governing the provision of, and the charges for, telephone service, and the conditions under which that service is provided. To quote the words of the Explanatory Memorandum presented to Parliament with the Telephone Bill, "the basic change . . . is the provision of equipment and apparatus under a system of Statutory Regulations instead of under a system of contracts in order to simplify and cheapen the procedure whenever a change in rentals or other charges now fixed contractually becomes necessary". In order to appreciate what that paragraph of the Explanatory Memorandum involves, it is necessary to have a picture of the present arrangements governing the provision of telephone service.

Present Arrangements and Changes made by the Act

Under present arrangements, telephone service is provided partly on the basis of contracts between the Postmaster-General and individual telephone subscribers, specifying the rental charges payable, the minimum period of service, the length of notice required to determine service and certain other conditions, and partly under Statutory Regulations covering local and trunk call charges and conditions of a general character regarding the use of the telephone service. Under the new machinery, the Postmaster-General is enabled to provide in or under new Regulations both for the particulars specified in the present ones and for those specified in subscribers' individual contracts.

The Reason for the Change

The Telephone Act has a very practical purpose, namely to provide machinery to enable procedure to be simplified and to save labour and money. There are now five million individual contracts and it is obvious that any alteration of conditions that cannot be brought into operation by Regulations is

costly to introduce, since such a change cannot be made until the existing contracts, which include the conditions it is desired to alter, have been terminated by due notice and fresh contracts concluded. The five million agreements are held by some three million subscribers and the business of terminating these contracts and entering into fresh ones would clearly be a most formidable undertaking, calling for the use of a considerable number of staff. Moreover, the telephone service continues to grow and the problem presented by the specification in individual agreements of certain conditions of service, which can be altered only by substituting fresh agreements, becomes progressively greater. It should not be overlooked that even as regards charges for telephone service the present arrangements do not follow a uniform pattern; call charges (both trunk and local) can be altered by the relatively simple Regulation process, whereas rental changes can be made only by the laborious and costly process of concluding fresh agreements. It is obviously right that there should be one basis on which such revisions can be made.

The Provisions of the Act

The Act, although short, is comprehensive and the fact that it is so compact is a tribute to the skill of Parliamentary Counsel in drafting a measure designed to give the Postmaster-General power to provide by Regulation for all aspects of a business as complex as the telephone service. The Act has four Sections, and the first gives the Postmaster-General power to make "Regulations for determining the terms and conditions on which the use of means of telephonic communication provided by him (whether through the medium of the public telephone system under his control or otherwise) will be permitted and for the general conduct of telephonic business carried on under his control . . . ." This Section goes on to confer the power to make Regulations covering particular aspects, namely the terms and conditions on which calls are made, the fixing of charges, the arrangements for payment of charges, and so on. The second Section preserves the power of the Postmaster-General to make agreements for the provision of telephone service in individual cases and enables him to make Regulations providing for the continued provision of telephone service for existing subscribers when their agreements are brought to an end. The third and fourth Sections provide for the repeal of obsolete provisions of the Telegraph Act of 1868 and for the short title, interpretation and extent of the new Act.

Action after the Passing of the Act

The Act having reached the Statute Book, two steps of a major character have to be taken before the new Statutory Regulation system can be brought into full operation. The first is the framing of new comprehensive Regulations, incorporating the present rental charges and conditions of service in place of those at present specified in individual agreements, and the second is the business of terminating the five million existing agreements. Both these measures have involved a great deal of work and when this article appears in print the second will still be running its course. It is planned, however, that the new Regulation system should come into full operation on the 1st April, 1952.

The New Regulations

"The Telephone Regulations 1951" were laid before Parliament on the 30th November, 1951. Under the provisions of the Telephone Act, these Regulations are subject to what is known as the "negative resolution procedure", under which a prayer to annul them may be made at any time during the 40 sitting days following their laying. This means that the Regulations are, so to speak, at risk during the period of 40 days after the date of laying. This does not mean, however, that it is impossible to take action under them until the 40-day period has expired, since, should there be a successful prayer against the Regulations, this does not invalidate action which may have been taken under them beforehand. The new Regulations replace all current Regulations made under the previous statutory authority, namely the Telegraph Act 1885, and, concurrently with laying them, there were laid before Parliament "The Telephone (Revocation) Regulations 1951", which revoked all the existing Telephone Regulations. The new Regulations deal comprehensively with the provision of telephone service for subscribers (including renters of private telephone circuits) and for call office users. They incorporate the rental charges, which have hitherto been specified in agreements, and bring up to date the existing Regulations on other aspects of the telephone service. They also provide for the transition from the system of contracts to the Regulations system and for continuity of service for existing sub-

scribers, subject, of course, to their right to give notice. They make no change in the present rentals and if a change in rentals becomes necessary further Regulations will be laid before Parliament. An interesting feature is that, wherever possible, the charges payable have been specified. While this sounds a simple and obvious matter, the complications of the charges and the wide variety of apparatus and facilities provided in the telephone service mean that the schedules to the Regulations contain a very considerable amount of detail in the matter of charges. The Act gives the Postmaster-General power to fix charges which are not specified in the Regulations, and the Regulations provide for the fixing of certain charges in this way, but where the charges are non-standard, it will be usual for these to be specified in individual agreements similar to those that are in use to-day.

Termination of Agreements

The system of agreements is as old as the telephone service itself, and people employed in the telephone service have, so to speak, grown up with them. Their virtual disappearance represents the end of a chapter and in the minds of some there may be regret at seeing them go. On the other hand, as will be clear from the earlier part of this article, the system of agreements as it has developed is now outmoded, and some simpler system is essential. Throughout the consideration of the general problem, great weight has been given to the sanctity of contracts, and the arrangements for terminating the existing contracts have been so framed as to ensure that the provisions of the agreements are respected. Some agreements—in general, those concluded before 1934—provide for giving three months' notice of termination; the great majority, however, provide for one month's notice, and the organisation of the work of terminating agreements has followed the pattern dictated by the existence of these two groups.

This part of the work itself falls under several headings; first, the notice terminating existing agreements and the accompanying explanatory letter to subscribers; second, the segregation of the different groups of agreements in Telephone Managers' Offices and other preparatory work; and, third, despatch of the notices and the handling of questions following the receipt of these letters and notices. The first of these might well, to those who were concerned with it, form the subject of an article in itself! What we needed was a notice which met all the legal requirements and was of general application. From many points of view, the appropriate arrangements would have been to send notices framed to suit the circumstances of individual agreements or types of agreements. Clearly, however, there were advantages, in an operation of this magnitude, in having a single form of notice, and while that did not ease the legal problem, it certainly did ease the administrative problem. In the letter accompanying the notice, our object was to give an explanation which would be abundantly clear to the recipient, would tell him what action he needed to take, and would result in the least possible number of enquiries. These points were of the greatest importance and were to some extent interlinked. The subscriber would obviously want to know whether the unusual happening of the receipt of a registered letter from the Telephone Manager meant that he had, or had not, to take any action. The letter made it clear that, save in those cases where the Regulation system would not apply and where, because of non-standard conditions or charges, a fresh agreement was to be entered into, no action by the subscriber was necessary. From the point of view of the Telephone Manager and his staff, the last point was of great importance; the preparation and despatch of notices to each telephone subscriber meant a considerable effort and if, on top of that, there were added a large number of enquiries, they would be difficult to handle promptly and satisfactorily.

Segregation of the records of different types of agreements was also a big job and called for ingenuity in working out the best arrangement. To solve this problem, a card, which might well be called the "master card", was prepared for every subscriber, and these cards formed the basis of all the subsequent operations. It was fortunately possible to use addressing machines for entering certain particulars on the cards and, indeed, to use them throughout the whole business of preparing letters and notices, thus ensuring that the despatch of the letters and notices fitted into the overall time-table and general plan.

At the time this article was written, the work of despatching letters and notices to those subscribers whose agreements provided for three months' notice of termination had just been completed. In the country as a whole, agreements of this type number about 400,000 and while that may seem a small figure in relation to the totals of traffic handled by the Postal services, it is not an insignificant figure, especially as all the letters had to be sent by registered post. It was obviously necessary to avoid the period of heavy postings for Christmas, and it was arranged that these notices should all be issued in the first ten days of December. The detailed arrangements for keeping records of despatch and for custody of receipts for the registered letters on delivery called for considerable initiative and close co-operation between the Telephone Managers and Head Postmasters. For this operation, as indeed throughout, the objective was to streamline the processes as much as possible and thereby to limit the amount of work.

In framing the arrangements as a whole and in their actual execution, there has been the closest contact also with the Staff Associations concerned, and the circulars issued by Headquarters were framed in the light of consultation with the Staff Associations. It is possible to look back with satisfaction on what has been accomplished, and it is also possible to look forward with confidence to the completion of this task. It is true that the major effort has, in a sense, still to come, since the bulk of the letters and notices will not be issued until January and February, and the despatch of ½ million letters will not pass unnoticed and cannot be accomplished without a considerable effort on the part of Post Office staff of many grades. The experience gained, however, from the issue of the 400,000 notices terminating agreements subject to three months' notice will be of considerable value and will fortify us in tackling the major part of the job that lies ahead. It will be of particular value in illustrating the kind of questions which the receipt of the notices inspires. Much thought was given to the questions that might be asked and even more thought to the answers that should be given! It would need "second sight", however, to anticipate all the questions that may be asked, and all that could be done was to concentrate on those that seemed most likely and to frame draft answers to assist the staff of the Telephone Managers who would be handling the enquiries.

Conclusion

Enough will have been said in this article to illustrate the importance of the Telephone Act and the magnitude of the work required to bring about the changeover from a system based on individual agreements to one based on Statutory Regulations. The size of the task is such as to call for special efforts on the part of numerous staff of many grades in the Post Office, and the task has been cheerfully and willingly accepted. The change in system is of real importance and advantage from the point of view of administration of the telephone service, and the object is to carry it through without in any way affecting the service to existing subscribers. The Act and the measures taken since its passing will greatly simplify the running of a great public service, and the measures putting the new machinery into operation have been designed to do so in the most efficient way possible and in a way which fully safeguards the interests and rights of the telephone-using public.

Following on the article in our last issue on "The Post Office Ship-Shore Services", in which the author described the handling of distress calls by Land's End Radio, Mr. Williamson has agreed to write a further brief contribution. This will deal with the role played by the Post Office in connection with the courageous efforts of Captain Carlsen to save his ship, "Flying Enterprise," the loss of which off Falmouth was reported while these pages were being printed. The article will appear in the next issue of this Journal.

Radio and Echo-Sounding Help the Fishing Industry

by F. E. Ferneyhough

MORE AND MORE DOES THE SCIENCE OF electrical transmission in one form or another play its part in modern society. The last quarter of a century has seen the most modern development, radio, gather impetus and with astonishing speed occupy a premier place in our present civilisation. The ubiquitous radio has already played an invaluable part in industry, commerce and war and has become so interwoven in the fabric of our modern world that it is difficult to imagine life without it. Amongst its multitudinous uses, it is hardly surprising, therefore, that this very modern facility should now be closely associated with that most ancient of crafts—fishing.

Not only do communications by radio play an important part in the fishing industry, but enquiry into the details of the business reveals an even closer link with modern scientific developments, for now the use of sound waves and their reflection from the sea bed and other objects plays a vital part in the gathering of food from the sea. These two scientific developments have combined not only to make the strenuous lives of our fishermen less physically hazardous, but their actual livelihood more certain.

Every year the fishing fleets from the east coast of Scotland and England set out during the months of June to December to gather the silver harvest of the North Sea. Herring is the king of fish and the variety of its processed forms after being lifted from the sea makes for its undying popularity throughout the western world and for the harvest itself to form a continuous and recurring hope of wealth for those whose lives depend on the success of the annual venture.

Fishing vessels at Lowestoft

Between September and early December, the mature fish, in their best condition following their migration down the east coast of the British Isles somewhat earlier in the year, reach that part of the North Sea lying between East Anglia and the coast of Holland. Here in their millions, having moved slowly in shoals from Scottish waters past the shallow Dogger Bank area, they reach the autumn feeding grounds centred north-east of Smith's Knoll and roughly 70 miles from the famous fishing ports of Lowestoft and Yarmouth. (See Figure 1.)

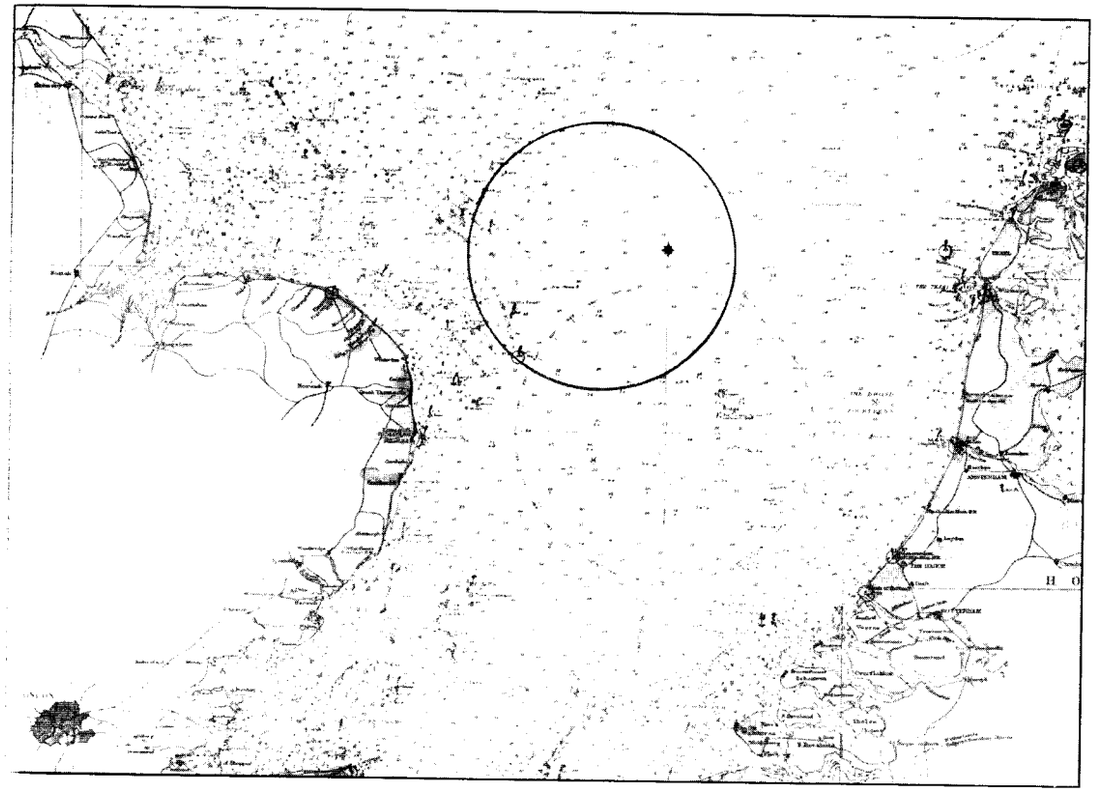
It is from these ports that the home fishing drifters, those high-stemmed craft, go out to fight the North Sea for the sake of the world's breakfast table. The severity of the east coast gales is, of course, a by-word. Their persistence is slowly eating into the Suffolk coast and their driving power has twice within living memory shattered the man-made concrete and interlocked steel bastions of that eroding coastline near Lowestoft and left in their wake the broken and twisted remnants. It is not surprising, therefore, that the men who must fight these conditions in their relatively small ships should look to any means that will ease their lot.

Such is the reason for ship owners and skippers realising all the advantages of the small-craft radio-telephone equipment and installing it with direction-finding facilities on almost every fishing drifter and trawler operating from British ports.

These sets are licensed by the Postmaster-General and have a daylight range of 150 miles. The ships call on a 1,650 kc. s. frequency but operate to each other and to the G.P.O. coast radio stations on frequencies around 2,000 kc. s., each ship having its own 4-letter call-sign. From the G.P.O. shore stations—the N. Foreland and Humber establishments being those most used by the home fishing fleet—the telephone network of the country is open to them.

The radio installations on these vessels allow two-way communication by radio-telephony and wireless telegraphy between one ship and another

Fig. 1. The centre of the home fishing activities lies within the black circle on this chart



and with the coast stations on the mainland for social, commercial and emergency purposes. In the chancy game of fishing, these facilities allow the owners to be in immediate touch with the ships, so that market conditions can be discussed and so that the destination of ships may be switched at a moment's notice, when a glut or poor catches may make such rapid alterations desirable. A falling market on the east coast may be offset by an allotted ship making for Ymuiden or the Hook of Holland and there selling the catch for eventual transit to Germany or other parts of Europe. The disposal of fish over and above the day-to-day requirements of the home market is a difficult operation, an operation in which the radio, the G.P.O. coast stations and the inland telephone network play a part which has helped to solve many of the old and most difficult marketing problems.

There is a certain camaraderie among the skippers, and news of an exceptional catch is often transmitted for the benefit of others. Good news spreads quickly: many ears are listening and the rotating loop aerials of the direction-finding equipment obtain bearings for other ships whose quest amongst the searching winds and high seas on that wide stretch of relatively shallow water is thereby shortened.

Several British firms have done much to develop the radio equipment of these ships, thus lightening the still exceptionally hard life of the fishermen.

Within recent years another considerable contribution has been made to the certainty with which the ships, whether in daylight or darkness, are able to detect the elusive shoals.

It needs little imagination to picture the work and hardship involved in preparing for and shooting a mile of buoyed nets in darkness from the deck of a fishing vessel, continuously drenched with spray in a November nor'-easter, and in hauling in after several hours, with bare hands, or to realise the avidity with which any device is welcomed which will make the good results of that effort more certain. Such a device is the latest echo-sounding equipment, with which, almost without exception, these vessels are being equipped.

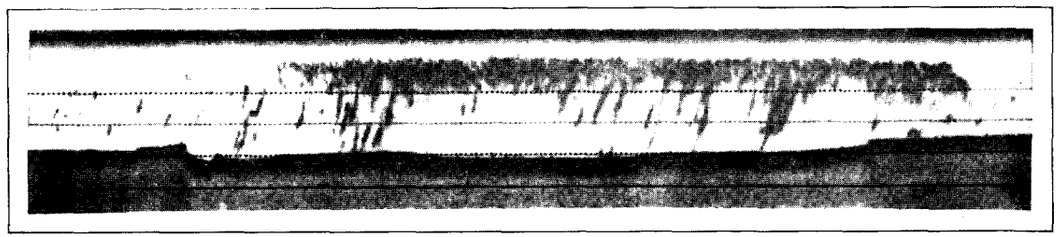
Depth sounding equipment is manufactured by several firms. One type most commonly used, for instance, consists of a projector having a flat circular magneto strictive element with a toroidal winding, which may be installed either in direct contact with the sea or inside the hull of the ship, so that reception and transmission take place through a diaphragm or even the shell plating of the ship's bottom. Sound vibrations from the electrical element, at frequencies higher than can be detected by the human ear, are projected vertically to the sea bed, from which they are reflected. They are received back by the projector, which can act as both a sound transmitter and receiver. The sound transmission pulses are controlled electronically by a mercury-vapour discharge tube and the time taken from projection to reception is, of course, proportional to the depth of water below the keel, for the impulses travel at a constant speed in sea water. The number of soundings per minute is also regulated and related to the sea depth.

It is some time ago now since it was realised that depth sounding equipment suitably designed and modified could pick up and record the echoes of objects between the ship and the ocean bed. The importance of this development was immediately exploited in its application to the detection of fishing shoals. Instruments have been specially designed to provide a direct reading of the depth of water below the ship by means of a stylus carried across specially scaled and continuously moving paper (Figure 2). By this means a continuous graphical record produces an exact contour of the ocean bed and indicates the depth to within the limits of a few inches. Apart from the distinct advantage to any sea captain for navigational purposes, this recorder shows up quite clearly on the graph paper the presence of shoal fish. (See Figure 3.) If the evidence is sufficiently promising, it is at this point that the nets are shot. The harvest resulting from all the labour of shooting and hauling nets has usually been a matter of chance, but the advantages now available mean that labour may be conserved, to be expended at a time when the shoals are actually in evidence.

The wresting of sustenance from the sea depends more than ever on the help derived from modern technical assistance, and the skippers of the fishing vessels are now so habituated to the help of the echo-sounding instruments that they would be at a great loss without them. Each skipper annually aims for and hopes to receive the Prunier Trophy, awarded to the ship securing the largest catch of herring during one night's fishing. The highest catch ever recorded was over 300 cran—about 50 tons—a third of a million fish. This is, of course, an exception, but any aid that can be given towards better catches by more modern equipment is only a small reward for the never-ceasing fight and indeed the tragedies that are the lot of those who go down to the sea in ships.

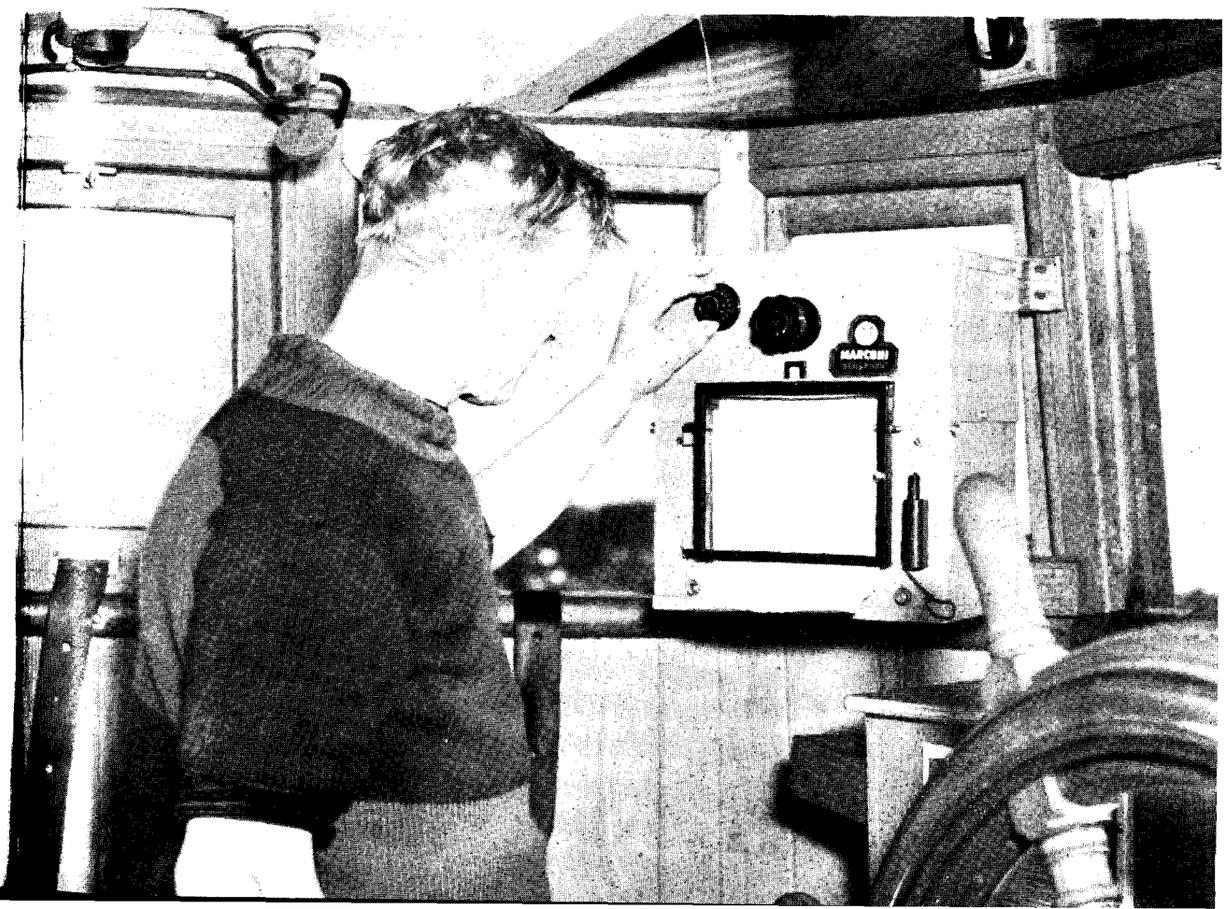
The author wishes to record his appreciation of the assistance given to him, particularly by Mr. F. H. Hunt, of the Marconi Marine Depot at Lowestoft, by Mr. J. E. Davies, of the Marconi International Marine Communication Company, Ltd., and by Skipper H. G. Meen, of the Lowestoft Drifter, *George Spashet*.

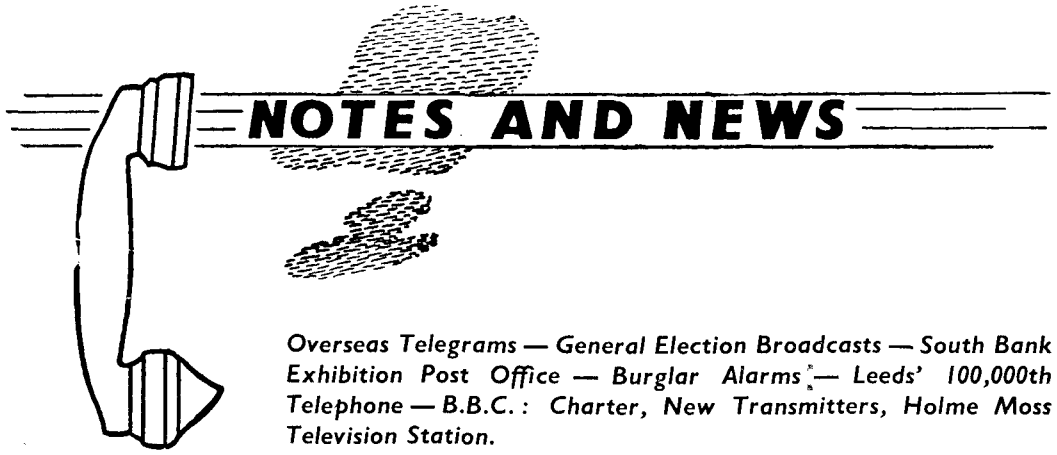
Fig. 2. How the presence of dense herring shoals between surface and sea-bed is shown by the echo-sounder



(By courtesy, Marconi I. M. C. Co., Ltd.)

Fig. 3. Operating the echo-sounding device in the wheelhouse of a herring drifter





NOTES AND NEWS

Overseas Telegrams — General Election Broadcasts — South Bank Exhibition Post Office — Burglar Alarms — Leeds' 100,000th Telephone — B.B.C.: Charter, New Transmitters, Holme Moss Television Station.

Inland Handling of Overseas Telegrams.—The use of the teleprinter manual switching network for the circulation of overseas telegrams between the Central Telegraph Station in Electra House, London, and certain provincial post offices has led to an improvement in the quality of service on overseas telegraph traffic. It is proposed to extend this arrangement to the rest of the country in due course.

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The General Election.—World interest in the General Election, which took place on the 25th October last, was reflected in the heavy demand by overseas countries for broadcast commentaries. During the week ending 29th October, international telephone circuits, both line and radio, were used by the Post Office for the purpose of relaying over 130 commentaries on the election to 13 different countries. Some 60 commentaries were relayed to the U.S.A. alone; in fact, during the early hours of the 26th October, when results were being declared, the trans-Atlantic radio-telephone circuits were in use almost continuously by the four major American broadcasting networks. A period of disturbed radio conditions, which preceded the election, finally cleared on the 24th October, with the result that all relays were successfully completed, excellent conditions being experienced throughout.

South Bank Exhibition Post Office.—During the Festival of Britain, the Post Office at the South Bank Exhibition accepted 5,204 inland telegrams and 1,023 for overseas destinations, and it delivered 785—mostly to the Festival Hall.

The telegrams for overseas were sent to 76 countries, including such remote islands as Hawaii, Falklands, Fiji and Iceland, and to ships at sea. The largest number (119) were sent to France, with U.S.A. (91) in second place, followed by the Irish Republic and Australia (both 66).

Almost every Commonwealth country and most European countries received telegrams handed in at this Post Office by visitors to the Exhibition.

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Burglar Alarms.—For many years certain types of approved alarms have been used on subscribers' telephone lines. When actuated, these devices call the local telephone exchange or, in some cases, dial the police station direct. The warning is conveyed by means of a recorded message which is repeated several times.

Arrangements have now been made with the manufacturers to standardise the warning messages, but variations will be permissible in exceptional cases, to suit local police requirements. Manufacturers will submit the text of the message to the Telephone Manager before it is recorded.

Leeds Telephone Area installs its 100,000th Telephone.—An important milestone in the history of the Leeds Telephone Area was reached by the installation of the 100,000th telephone station. To mark the occasion a special inscribed telephone was fitted in the room of the Lord Mayor of Leeds and was formally handed over to the Lord Mayor by Mr. L. G. Semple, C.B.E., Regional Director, North Eastern Region, towards

he end of last year, in the presence of a representative gathering which included civic officials, epresentatives of the Post Office (officials and taff), the Leeds and District Postal, Telegraph nd Telephone Advisory Committee and the Press.

The Leeds Telephone Area was formed in 1936 rom part of the West Yorkshire Telephone District and at the time of its formation the Area ntained some 44,000 telephones. By the outreak of war in September, 1939, the figure had eached 57,000, and by 1945 70,000. Since the nd of the war the average net increase per annum s been nearly 5,000, compared with about 3,700 re-war; in fact, during the last year the figure was er 6,000.

★ ★ ★

ites for small U.A.X.'s.—The present standard te dimensions for U.A.X.'s 12 are 12 ft. × 18 ft. r growth up to 45 lines at the 15-year period and ft. × 60 ft. for growth above 45 lines. It has been und by experience that the smaller site is sufficient and it is therefore proposed that in ture the smaller site of 12 ft. × 18 ft. should be creased to 18 ft. × 32 ft.

B.B.C. Charter and Licence.—The Charter and Licence granted to the B.B.C. for five years from the 1st January, 1947, expired on the 31st December, 1951. On the 28th November, the Postmaster-General announced the Government's decision to grant a short-term Charter and Licence to the B.B.C., for six months from the 1st January, 1952. The terms and conditions of the temporary Charter and Licence are, in general, the same as in the previous documents.

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Measures to Improve Reception of the B.B.C. Home Services.—In order to improve the reception of the Home Service in certain parts of the country, the B.B.C. is providing twelve medium-wave, low-powered transmitters. Six of the new stations are working, but are not yet using full power. They are Barrow-in-Furness, Brighton, Hastings, Ramsgate, Scarborough and Whitehaven.

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New Television Station.—The B.B.C. television station at Holme Moss was opened for full service on the 12th October, 1951. The power of the vision transmitter is 45 kW.—one of the most powerful in the world.

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Corrections.—In *Notes and News* (Nov. 1951 issue), under the heading "Telephone Supply and Demand", the figure for circuits over 25 miles in length installed during the year ending 31st March, 1951, should read 680, not 84.

The authors of *Coin Collecting Boxes—How They Work* (Nov. 1951 issue) wish to correct an error that appeared on p. 15. The second paragraph should read: *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 coin microphone, and at 1C short-circuits the transmitter of the telephone handset to prevent premature conversation.* In Figure 7, contact 3B should be shown as closed and a connection should be shown between the long springs of D3 and 2A.

Book Review

TRANSIENTS IN ELECTRIC CIRCUITS, USING THE HEAVISIDE OPERATIONAL CALCULUS (2nd edition), by W. B. Coulthard, B.Sc.(Eng.) London, A.M.I.E.E., M.A.I.E.E.; Sir Isaac Pitman & Sons, Ltd.; 260 pp.- 32s. 6d.

This book is distinguished, among several with similar titles, by its emphasis on practical matters. After an introductory exposition of operational methods, the rest of the book is mainly devoted to analyses of practical circuits such as arise with transformers, arcs, circuit-breakers, spot-welders, control systems, D.C. and A.C. motors, cables, artificial lines, filters etc.; mechanical and electromechanical systems are also dealt with. Each circuit is discussed from the practical point of view and the discussion is not confined strictly to transient response; many references to books and papers are given. Further points on operational technique are introduced as required, including a treatment of Fourier Series and Integrals, Laplace transforms, and the non-linear circuits arising with variable parameters.

With such an enormously wide field covered, it is not surprising that the treatment of the various topics is brief. In spite of the practical outlook of the book, the treatment of operational calculus, perhaps from the desire to cover everything, places undue emphasis on techniques suitable for the skilled mathematician rather than the practical engineer. The method of dealing with boundary conditions is poor. Instead of showing the simple method of obtaining an operational equation which can be interpreted by the same process as for systems initially at rest, the author switches over to the non-p-multiplied Laplace transform, switching back again—without any proper explanation—in an example. For products of operational expressions, the Duhamel integral is used rather than partial fraction expansion, the latter being hardly discussed at all.

This review is of the second edition of a once reprinted book first published in 1941, so that a fair number of people must have found it worth buying. It should be very useful as a reference book to those with a knowledge of the principles involved, but it is not recommended for beginners.

Publication and Price. This Journal is published in November, February, May and August. Price 1/-. The annual postal subscription rate is 4/6 post free to any address at home or overseas.

Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunication 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.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Headquarters G.P.O., London, E.C.1. Telephone: HEAdquarters 4330. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."