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Contents

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Service for the Computer

TELECOMMUNICATION systems, which have now been progressing for over a century, were originally devised to carry, in electrical form, messages intended for either reading or hearing at the receiving end. By about 37 years ago technical progress had enabled them also to carry pictures and documents reproduced in facsimile on the receiving instrument. But during the past few years with the development of the computer—defined as a machine carrying out calculations in several stages automatically—new demands have been made on their services: the transmission of data in such a form that, ultimately, it can be fed directly into the machine without human intervention at the receiving terminal.

The Post Office, as the "common carrier" of telecommunicated material in this country, is deeply involved in these new developments, being called upon to provide the necessary lines of transmission; that the Postmaster General was invited recently to open a new computer centre for Barclays Bank symbolized both the involvement and the fact that the Post Office is bending its energies to meet the new demand.

If data received over communication circuits is to be fed into computers without expensive time-wasting checking, a very high standard of transmission accuracy is required. The Post Office is developing a method of error detection for teleprinter circuits which will reduce undetected errors to less than 1 in 10^6 characters.

The Post Office's latest move, in considering facilities for data transmission, may be even more welcome in that it will enable more speedy transmission to central computers by using the telephone system instead of the teleprinter network.

Subscriber Trunk Dialling for 6,500 Londoners

The Postmaster General inaugurated STD through Metropolitan, London Wall and Moorgate exchanges on July 3, the Lord Mayor making the inaugural call to the Lord Mayor of Bristol. Following is the speech given by the PMG in the Livery Hall of Guildhall.

TODAY we are making another advance towards the complete automation of the telephone service in the City of London by bringing Subscriber Trunk Dialling to three London Exchanges—Metropolitan, London Wall and Moorgate.

The coming of STD to London is possibly the most important development in the history of the telephone service since Her Majesty the Queen opened the first STD installation at Bristol three years ago.

Within the next six months or so 20 more exchanges in London, serving 100,000 subscribers, will enjoy—at least I hope they will enjoy—this new system. From today 6,500 telephone subscribers on these three exchanges will be able to dial well over half their own trunk calls as well as all their local calls and this will lead to a much quicker service. The numbers you will be able to dial outside London will increase progressively as we put in new equipment in other towns.

This is all to the good, because in recent times trunk telephoning has outstripped all our estimates and I confess that the London service has not been what it should be.

The new system should improve the service on all calls, including those still handled by operators, because the provision of new channels will give relief to overloaded switchboards and trunk lines.

After describing how the system works, showing that the robot operator performs all the 14 operations which are necessary under the manual system to complete a call and ensure that it is timed and accurately charged for, the Postmaster General emphasized that the great virtue of this system is its speed. It saves both time and tempers. As you come to dial more and more of your calls, both local and trunk, I fervently hope that the cartoonist's irate telephone subscriber will soon be a person of the past.

The great advantage of this system lies in its flexibility. You pay more or less according to the period of the call. The system rewards brevity and puts a premium on loquaciousness. Disraeli would have hated it. The young MP said to Disraeli "This maiden speech of mine is admirable—it is so clear and it is concise". Said Disraeli "Don't be silly; in politics you must learn to be obscure and prolix". Having studied this talk of Victorian politicians I shudder to think how they would have taken to this.

You pay only for the number of 2d. units of time which you use. A short call to fix a meeting in Glasgow or to arrange to be met by car in Liverpool —those are the short calls I like—may last only 12 or 24 seconds and so cost only 2d. or 4d. And the same is true if you ring up only to find that the person you want is tied up.

Where there is no STD, there is a minimum charge of three minutes for long distance calls. So for short calls under STD there is quite a saving. Even on the three minute basis a long distance STD call would cost 2s. 6d. instead of 3s. 6d., a saving of nearly one-third. That's not bad.

I think at present local calls are pretty good value for money. For subscribers on exchanges within five miles of Oxford Circus the local call area is roughly bounded by Hertford and Welwyn Garden City in the north, Reigate in the south, Greenhithe in the cast and Windsor in the west. Here there are nearly 1½ million subscribers.

For the country as a whole the areas covered by local calls are, on the average, ten times larger than they were before the war or even four years ago. Many calls which cost 6d., 9d. and 1s. are now at local call rates.

Last year I reduced the charge for local calls on home telephones from 3d. to 2½d.—a most unfashionable thing to do. With STD the basic charge for all local calls will however be 2d. I could not however make these further reductions without limiting the time which 2d. would buy. This has been fixed at three minutes in the daytime, and now (from August 1) 12 minutes in the cheap rate period.

Despite what some people have said, we did not go into this business of timing local calls like a bull at a gate. Before we decided on it we timed 200,000 calls. We found that two out of every three lasted three minutes or less. Since the introduction of STD I have made similar tests on a number of exchanges covering about 56,000 local calls. We find that three out of every four local calls last less than three minutes during the day.

The inference is that the result of timing of local calls has been to shorten their duration. In some cases—I agree not all—I think this is a good thing. After all, the telephone is a means of communication, not something on which to practise the art of endless conversation.

Not that I wish to inhibit people from talking at length on the 'phone. I am a servant of the public and I recognize the disadvantage of the new system to the elderly, the housebound, the lonely, the love-lorn and many of us, indeed, who sometimes feel talkative.

Does the public welcome the reduction in the minimum charge for local calls to 2d.—in other words, do they welcome the timing of local calls? Well, 30 per cent. of those we asked think it is a good thing, and 36 per cent. "accept" it—I suppose with typical British resignation—so that two-thirds of our customers arc not seriously bothered about it.

I have to admit, however, that 32 per cent. of our customers, mostly residential, "rather regret it". And this is what I should expect.

Last week (June 28) I announced that as from August 1 the period of the 2d. call during the evening and at weekends would be extended from 6 minutes to 12 minutes. This was right. I hope it will placate some of our customers.

I am very reluctant, however, to make a similar concession during the day time and still keep the 2d. charge, for the great weight of day calling is done by business people, where I think there is everything to be said for encouraging conversations which are concise rather than diffused and gossipy. Besides the cost of such a concession would be very high. But these are early days. We must see how we go on.

I think the only other substantial criticism of this new system is that there will be occasions when you 'phone a large business firm or shop or a railway station, or an airline company and you cannot easily get through to the person to whom you wish to speak.

We have all had this experience—I know I have and I daresay Dr. Beeching has—where you are first connected to the switchboard operator and then told laconically to "hang on"—which one does with rising blood pressure wondering whether people think we are going to live for ever.

This is a very real difficulty and I have been tackling it in three ways. I have discussed it with transport undertakings. The British Transport Commission have already agreed that some of their enquiry traffic should be segregated from their other incoming calls by advertising the telephone number of a group of lines which will be linked directly to the point of enquiry, so cutting out the waiting phase.

Next, in order to help business organizations in general, I have issued a booklet—*The Telephone in Business*—which has been given to all the larger business firms and which gives what I hope is helpful information on how to get the best out of the new system without causing added expense to people who want to get in touch with them by 'phone.

Finally, I hope to provide a better service for the housewife and shopper. The retail trade are discussing this with me. It is largely the responsibility of business organizations to adapt themselves to the new system so that delays are avoided. Certainly it is in their interests to do so and my people throughout the country will give any help they can.

As I say, there have been criticisms of subscriber trunk dialling and I have myself received quite a few letters about it.

What strikes me as curious is that most of the criticisms that I have had are from people who have had no working experience of the merits of the new system simply because STD is not operating in their localities. I have analysed nearly 500 letters which have been addressed to me in recent months complaining, in the main, about the timing of local calls. Thirteen of them—less than 2 per cent.—have come from people who know how it works.

Even so, I don't believe that the gentleman in Whitehall or St. Martin's-le-Grand always knows best. Indeed, I have been at some pains to collate the views of those subscribers who have had actual experience of STD.

I put out 25,000 questionnaires to subscribers on seven representative STD exchanges. The replies show that 86 per cent. of business people and 69 per cent. of residential subscribers prefer the new service to the old. They show that 90 per cent. of business subscribers, and 83 per cent. of residential subscribers think that the dialling of their trunk calls is both quicker and cheaper. They show that something like 90 per cent. of people find it quite easy to operate the codes for dialling. They show that 60 per cent. of all subscribers find their bills, under the new system, pretty well what they expected. Well, I don't think that on the whole that is too bad.

I hope that I have said enough to show I am sensitive to criticisms and that I am always ready to consider modifications or changes in the system if they can be brought into operation without invalidating what I am convinced are the very real gains that the new system brings to the public.

I am convinced this new system represents a big advance in the efficiency of the British telephone service. I am satisfied that as people come to experience it they will find it very much to their liking.

Now, my Lord Mayor, I am highly honoured to invite you to speak as you would wish and then to make the inaugural call.

* * *

As Chairman, Mr. L. G. Semple, Director, London Telecommunications Region, paid tribute to the staff and contractors for their work in enabling STD to start in London, and emphasized the need for educating subscribers in using the telephone, showing what the Post Office is doing to help.

The Assistant Postmaster General inaugurated STD at three more London exchanges—Tate, Victoria and Abbey—on July 10.

New Cables Planned by North Sea Cable Conference

The Conference attended by delegates from seven maritime European Administrations, held in London during early February, to draw up a programme for laying new submarine cables between the United Kingdom and Europe to carry the rapidly growing traffic over the next decade, agreed to a tentative programme providing for seven 120 channel cables in the period up to 1966–67, including direct cables to Germany and Denmark in place of the present transit routings.

Since the Conference there have been meetings with the German Federal Republic and Danish administrations, at both administrative and technical levels, and the aim is to lay the first direct cable to the Federal Republic of Germany in 1963, followed by a second cable to Germany and a direct cable to Denmark in 1964. This means that the new cables will be available in time for the introduction of International Subscriber Dialling some time after 1964.

In addition to deciding a time-table for the provision of new cables the Conference considered proposals to increase the circuit capacity to France, probably by providing another broad band channel on the Tolsford Hill–Lille micro-wave link, and to increase the capacity of one of the Belgian cables by the insertion of repeaters. The total cost of the programme to the United Kingdom is likely to amount to about £3½ million.

Designing an Experimental Exchange

The New Cordless Switchboard at Stafford

R. Thompson

WITH the advent of Subscriber Trunk Dialling the pattern of traffic reaching the operator is changing. The setting up and control of calls, which has hitherto been the dominant feature, is becoming a much smaller part of the work, while enquiry traffic generally—and particularly directory enquiries—is growing rapidly.

This change has made it necessary to review the accepted method of switchboard working which separates "controlling" and "enquiry" traffic on to separate suites of positions, and the Stafford experimental exchange has been designed to provide some of the answers to the questions which arise. The switchboards are of a new all-purpose type, adapted from the standard cordless switchboard and, with a few exceptions discussed later, all calls on which the operator is required, including directory enquiries, are channelled into a single queue.

When in 1957 Stafford Exchange was chosen it was thought that very few new Assistance Centres would be needed. The new exchange at Stafford, then being planned, presented the earliest

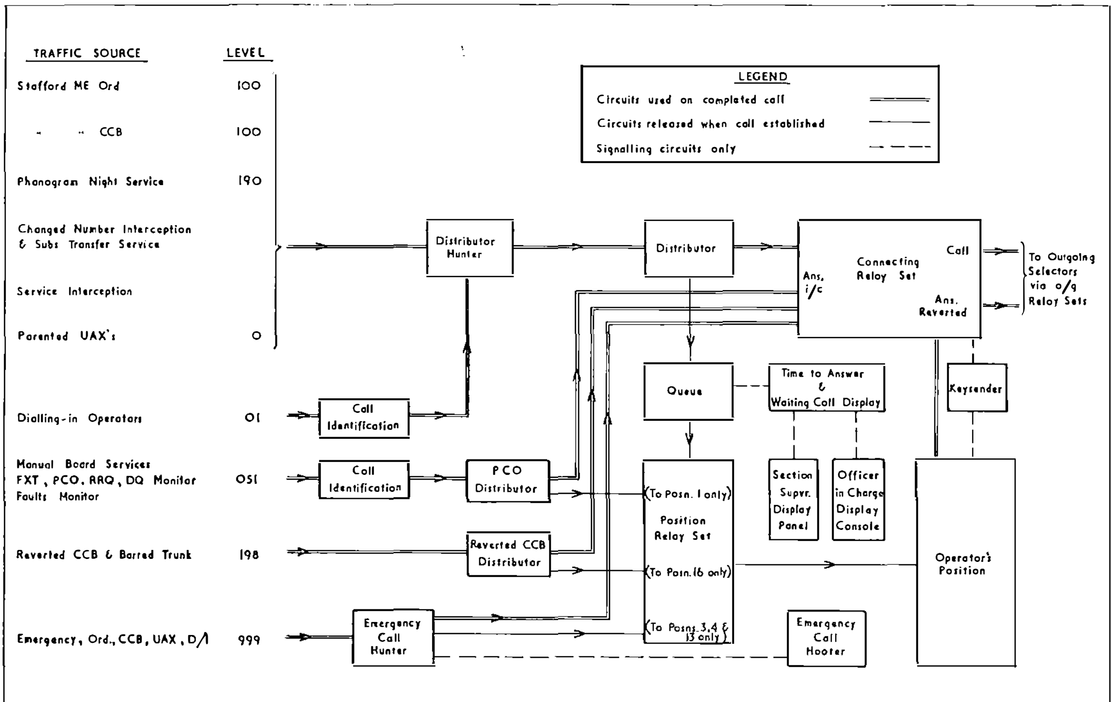


Fig. 1. SIMPLIFIED BLOCK SCHEMATIC DIAGRAM FOR CORDLESS SWITCHBOARD CONNECTING CIRCUITS.

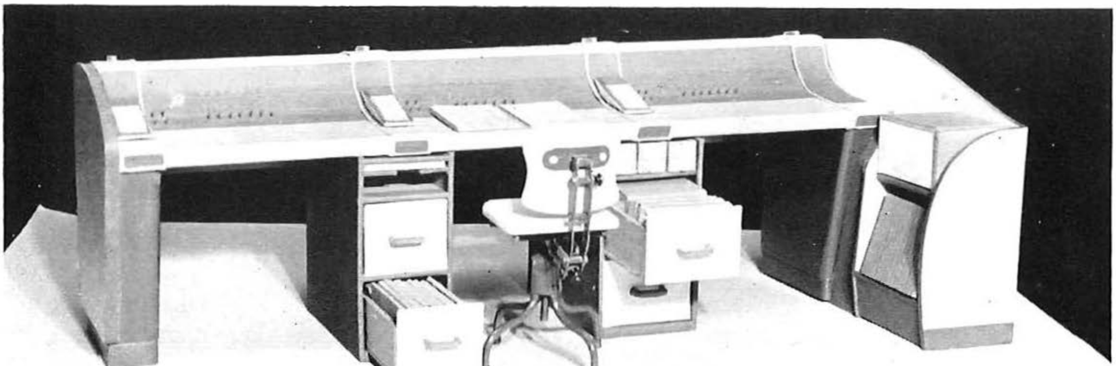


Fig. 2: Model of drawer pedestals and end unit bookcase

opportunity, and was about the right size, for an experiment of this nature. In addition as Subscriber Trunk Dialling was being planned for Middlesbrough it would be possible to release from the Middlesbrough contract a number of cordless positions for the new Stafford Exchange.

Controlling Queue

The general principles of operating the cordless switchboard were described in the February–April 1955 *Journal* ("New Cordless Switchboard at Thanet"). As Stafford will have only 24 positions only one controlling queue is needed. The controlling queue will accept all controlling and enquiry traffic from Stafford subscribers and coin-box users, who will dial 100 for all operator services, and the traffic from parented UAXs, Dialling-in operators, Service and Changed Number Interception and Phonogram Night Service. This traffic will be distributed among all the 24 positions (Fig. 1). To enable the Stafford operator to differentiate between calls from subscribers and those from operators a pip of tone will be applied to calls from operators. Calls from coin-box users will be identified by lamp signal and pay-tone on the line. Barred trunk subscribers will be given access to a selected position for enquiries and directory enquiries by dialling the special code 198 as described below.

Subsidiary Queues

Certain calls require special treatment or reference to specialized records which cannot conveniently be distributed to all operators. To handle these calls three subsidiary queues are provided which will route the calls to selected positions where they can be identified from ordinary calls, and can bypass the controlling queue.

The first of these subsidiary queues caters for emergency calls made by dialling 999. These calls have priority over all other calls and can be answered on three selected positions where they are identified by a red pilot lamp and the sounding of the emergency call hooter.

The second subsidiary queue provides access to a selected position where specialized information which is not distributed to all operators will be available. This position will be reached by keying the code 051 (because of the trunking of the automatic apparatus distant operators will dial 0351). These calls will be identified by a green pilot lamp and a pip of tone as with calls from dialling-in operators. The manual board services provided in this way will be:—

- Fixed Time and Personal Call Monitor;
- Route and Rate Quoting;
- Fault Monitor—initial reports of faults will be accepted by any operator, but subsequent enquiries will have to be extended to the Fault Monitor.
- Directory Enquiries Monitor—for the enquiries for numbers in directory sections not available to the controlling operator.

The third subsidiary queue provides access to another selected position for handling certain types of coin-box calls which need special operating procedure. This arises because the coin slots on a pay-on-answer coin-box can only be opened by an operator when the call has been originated from the box. Therefore, calls incoming to Stafford pay-on-answer coin-boxes on which money has to be collected have to be reversed and controlled at

Stafford. To enable the reversed call to be identified the called party in the Stafford call office will be asked to replace the receiver and then make a call to the exchange by dialling the code 198. This code will route the call to the selected position where it will be recognized by a green pilot lamp and the presence of pay-tone on the line. The call can then be set up in the forward direction and the money collected as on a normally controlled call from a pay-on-answer coin-box.

The code 198 has also been allocated for use by barred trunk subscribers to get the operator services they are entitled to. These calls will be handled on the same position as that used for reversed coin-box calls and will be identified by the green pilot lamp only.

Supervisors' Display Panels and Miscellaneous Circuits

The console for the Officer-in-Charge and the Section Supervisors' display panels will be similar to those at Thanet, but in addition they will show the STD charge rate in force at any time. A red lamp to indicate "Full Rate" and a green one for "Cheap Rate" have been installed, and provision has been made for a third rate should this ever be needed.

A second unit of the same shape as the supervisor's console will be used for the termination of the Part-Time Private Wires, Subscribers' Transfer Circuits and Extended Alarms.

Physical Design Problems

The major problem in the physical design of the Stafford cordless switchboard arose from the need to handle directory enquiry traffic at all positions. The starting point was the standard controlling type cordless position and room had to be found for the directories without building up above the top of the switchboard.

The first approach to the problem of accommodating a complete set of directories within reach of every operator was to place them in two-tier bookcases at right angles to the positions. Two prototypes were made up and tried at Thanet, but they proved generally unsatisfactory; the directories were not all within easy reach of the operator; the bookcases gave the operators the impression of being shut in and they impeded the access of the section supervisor to the positions. The resultant switchboard layout was wasteful of space.

Before further trials a one-sixth scale model of a three-position cordless switchboard was made up and, by also using scale models of the directories,

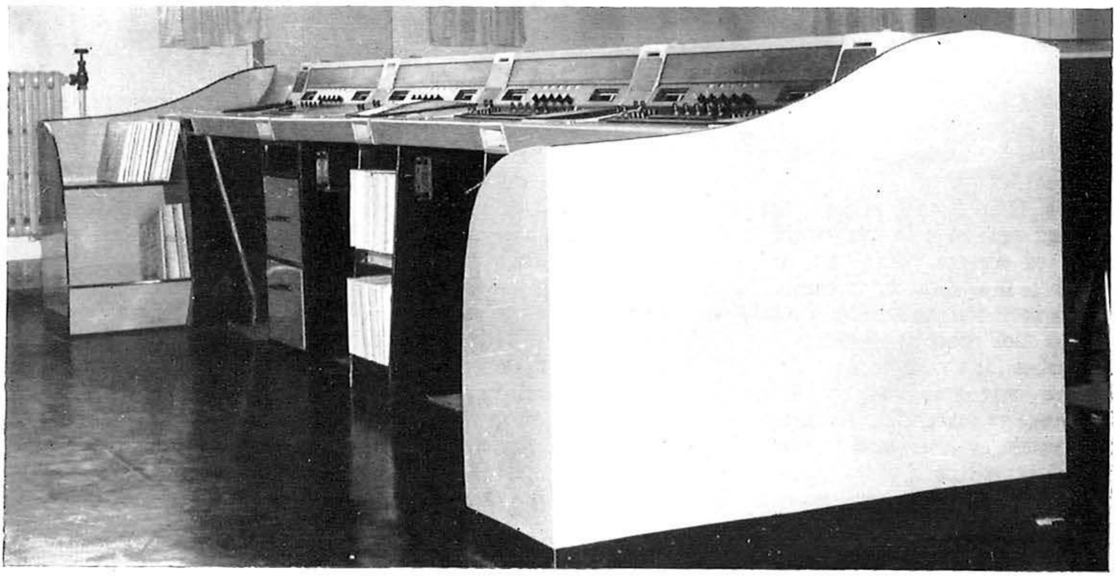


Fig. 3 : Prototype pedestals and end unit bookcases fitted at Thanet Exchange

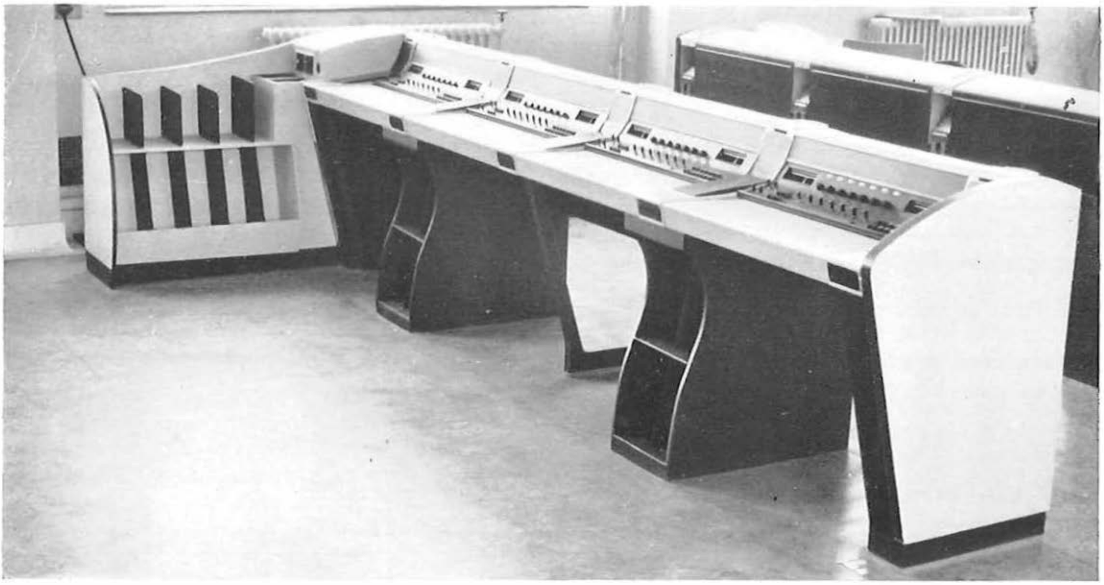


Fig. 4 : Pedestals and end unit bookcase installed at Stafford Exchange

various arrangements were considered for placing the directories within easy reach of the operator. These studies showed that by having a set of directories shared between pairs of operators—that is, with half a set of directories on either side of each operator—the directories could be accommodated in pedestals fitted underneath the keyshelf and in small bookcases at each end of the suite. It was assumed that interleaved directories would be used for the local directory section to avoid the need for supplementary directory records.

Also, from records taken at the existing Stafford manual exchange it was established that 90 per cent. of directory enquiries were in respect of numbers in 15 directory sections. These 15 sections, which included the London Postal Region sections, need a shelf space of 18 inches only compared with 42 inches for a complete set.

The next step was to design pedestals and bookcase to meet these requirements. These were first made in cardboard to the same scale as the model switchboard (Fig. 2). A full scale plywood mock-up of part of a cordless switchboard position was also made on which trials were conducted to find the optimum position of the shelves in the pedestals. From the experience gained in this way four types of under-keyshelf pedestals and an end bookcase were designed and the Post Office Factories Department at Birmingham built prototypes for installation at Thanet (Fig. 3) so that trials could be carried out using artificial traffic.

Prototypes in use

The under-keyshelf pedestals were of two main types. One pair were two-drawer type pedestals each capable of holding half a complete set of directories, one with the directories arranged at right angles to the line of the keyshelf and the other with the directories parallel to the line of the keyshelf. The second pair of pedestals had open shelves capable of holding a part set of directories only; in one pedestal the directories were arranged in an upright position on both shelves and in the other the directories on the top shelf were upright and those on the bottom shelf had the spines uppermost. The end unit bookcases were designed to hold, on two open shelves, the balance of the directories which could not be accommodated in the pedestals.

Evaluation of the trials at Thanet showed that the drawer type of pedestals were not suitable, mainly because of risk of injury to the staff, obstruction of access to the position when drawers were open, and the noise of opening and shutting the drawers. The trials also showed that the second type of open shelf pedestal, gave the better arrangement of the directories. Certain other modifications to the construction of the pedestals and the end unit bookcase were also shown to be necessary to improve the handling of the directories. To prevent the cord from the operator's headset getting in the way of the directories a rubber cord grip will be provided on the side of the pedestal to hold the cord clear of the directories.

Final Design

Because of the large proportion of directory enquiries which can be answered by reference to a few directory sections only, all but one of the end unit bookcases were dispensed with, and only the under-keyshelf pedestals were provided; they were designed to hold part sets of directories between each pair of positions (Fig. 4). Directory enquiries which cannot be answered by reference to these part sets of directories will be extended to a selected position where the operator has access to a full set of directories.

The single end unit bookcase to be used against this selected position has been redesigned to hold a complete set of directories. In addition, space has also been provided for other specialized records; for example, Fault Card, Telephone Routing and Charging File, which will not be made available to all operators. A one-way pneumatic tube to the Test Desk is also provided from this position. The spare carriers will be returned by hand at intervals during the day, thus saving the cost of a return tube which would not carry any live traffic, and making the design of the end unit simpler.

Monitorial Records

During this stage of development it was assumed that the monitorial records could be redesigned to fit into a binder of the same size as a directory, with a width of about two inches across the spine. Subsequent experiments with a multi-post binder have shown that this method of accommodating the monitorial records is entirely satisfactory (see Fig. 5). Other information about lines on service interception, temporary transfers of service, and so on, is filed similarly.

To gain experience with this type of record a set of monitorial records was made up in a multi-post binder for use in the existing Stafford manual exchange. This set of monitorial records has now been in continual use for over six months and the inserts are showing very little sign of wear. In the new exchange a set of monitorial records will be provided for each pair of operators; therefore, with the monitorial traffic distributed over all positions, the use of any single record will be much reduced.

Switchroom Layout

While the design of the switchboard was proceeding the layout of the switchroom was also being considered. The planning of the building, which had been based on a sleeve control switchboard, was so far advanced that the cordless

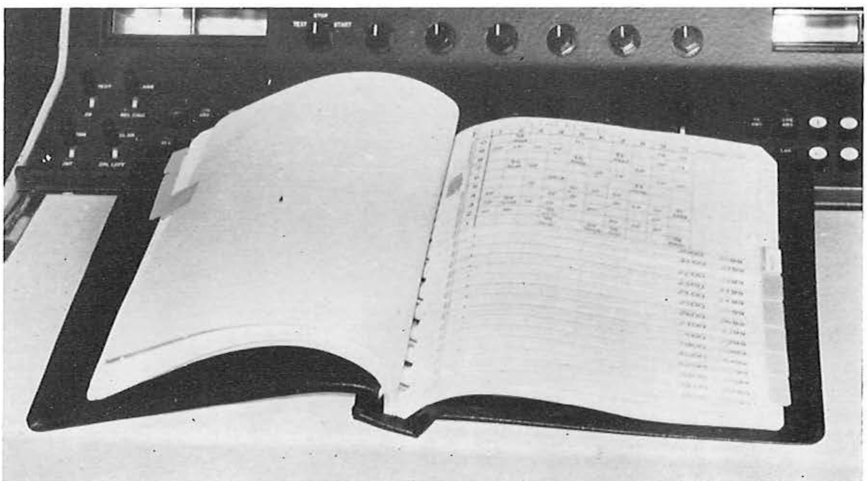


Fig. 5: Monitorial records in multi-post binder

switchboard had to be fitted into the switchroom as planned. The switchroom was only 36 feet wide by four 12-foot bays long, with the staff entrance off centre; the reinforcing grid for the floor has been designed and a ventilating duct run lengthwise under the floor some distance off centre. All these conditions imposed limitations on the layout, some of which could possibly have been avoided if the switchroom had been planned for a cordless switchboard.

Layout of Suites

The design of the switchboard had dictated the need to arrange the positions in suites of four. To find the best layout of these four-position suites within the switchroom and to assist in visualizing the effect of various layouts, a half-inch scale model was made of the switchroom, suites of position and other switchroom furniture. The exchange was designed to open with 24 positions so, with these arranged in suites of four, it was natural to think in terms of two suites—eight positions—as a patrol section supervisor's unit.

Several different ways of arranging the suites were examined; all the positions facing one way, the suites at an angle to the centre line of the switchroom in herring bone fashion, and others. Different groupings of the two suites to make up the section supervisor's unit were also examined: the two suites with the operators facing each other or with them back to back; the two suites, one on either side of the centre gangway.

The layout finally agreed (Fig. 6) after the Staff Side had had an opportunity of studying the model, was selected as giving the best layout for operating conditions, section supervisor control, and exchange management.

The Officer-in-Charge, with her desk across the corner of the switchroom, has an uninterrupted view of the whole switchroom, while provision is made in an adjacent corner for a desk for the exchange clerk and other clerical duties which are best carried out in the switchroom. The section supervisor units, two suites with the operators facing each other, are spaced further apart than at Thanet to allow the patrol supervisor easy access along both sides of the suites.

A small but important item which resulted from the study of the model and the discussions with the Staff Side was the type and location of the

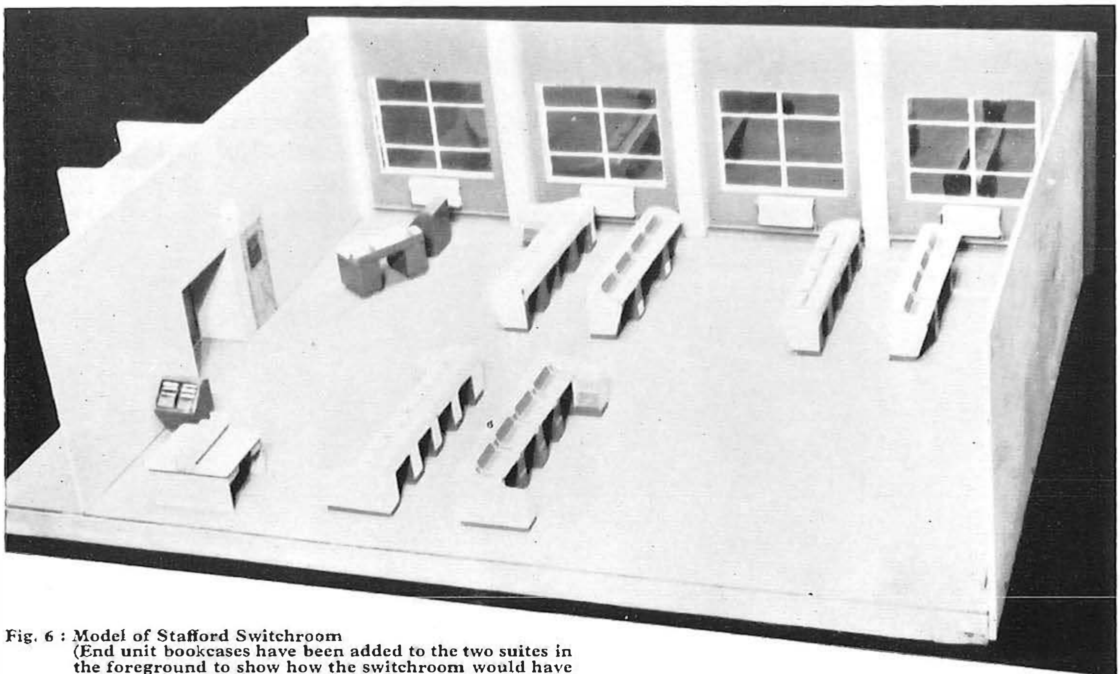


Fig. 6 : Model of Stafford Switchroom (End unit bookcases have been added to the two suites in the foreground to show how the switchroom would have looked if they had been retained on all suites)

exchange clocks. It was thought that the normal type of wall mounting exchange clock fitted on the pillars between the windows would not easily be seen from all positions, and a suggestion from the Staff Side, which has been accepted, was to place two large clocks of the type used in sorting offices one at each end of the switchroom. These clocks have 24-inch diameter faces and can be seen from any position in the switchroom; they are unglazed so there is no reflected light problem.

The local Staff Side have been consulted at all stages during the development and design of the new exchange. They have taken a very lively interest in the progress of the work and have made many useful contributions towards the final job.

It is also appropriate to mention at this point the much wider interest shown in the early stages of the development work and to thank all those who came forward with most useful suggestions and advice.

The new exchange opened on July 29 and a description of its operation under working conditions could perhaps be the subject of a later article in the *Journal*.

New Radiotelephone Equipment for Turkey and Iran

The British ambassadors in Ankara and Tehran presented to the Turkish and Iranian ministers of communications on June 22, £250,000 worth of new radiotelephone equipment provided by the United Kingdom through the Central Treaty Organization (CENTO). Similar equipment will be installed for Pakistan in the near future.

Miss Mervyn Pike, Assistant Postmaster General, and Mr. J. B. Godber, then Joint Parliamentary Under Secretary for Foreign Affairs, listened in London to the ceremonies over a conference circuit between the three countries and exchanged speeches with the Turkish Minister of Communications, Mr. Orhan Mersinli, and the Iranian Minister of Posts, Telegraphs and Telephones, Mr. H. Sami-i.

The equipment presented to Turkey consists, at both Ankara and Istanbul, of two radiotelephone transmitters and receivers, complete with aerials, at separate transmitting and receiving stations outside the cities. At Ankara three radiotelephone terminal equipments have been installed in the PTT Building, Posts Caddesi, and at Istanbul a radiotelegraph channelling equipment with a capacity of six bothway teleprinter channels (each of which could eventually be duplicated if suitable additional equipment were provided), has been installed in the Central Telegraph Office.

Previously, there was only one morse circuit between Istanbul and London and one radiotelephone channel between Ankara and London, the latter being available for only two hours a day. The new equipment has made it possible to provide two bothway teleprinter channels between Istanbul and London, and will make it possible to bring a second telephone channel into service, and extend the daily schedule when the traffic demands it. Additional teleprinter channels will be brought into service later as required. In particular, it is hoped to use some of the available channels for telex as soon as Turkey is ready to open international telex service.

The equipment presented to Iran consists of two all-purpose radio transmitters, two radiotelephone receivers and two radiotelegraph receivers which have been installed, complete with aerials, at separate transmitting and receiving stations outside Tehran; together with three radiotelephone terminal equipments which have been installed in the PTT Headquarters, and two radiotelegraph channelling equipments which have been installed in the Central Telegraph Office, Tehran.

Until recently there was only one radiotelephone channel between Tehran and London, available for 5½ hours a day. The new equipment will make it possible to bring a second channel into service, and extend the daily schedule when the traffic demands it. The telegraph channelling equipment can provide up to three basic teleprinter channels, each of which could be adapted to provide four bothway teleprinter channels between Tehran and London. One channel will be used for sending and receiving public telegrams between Iran and the United Kingdom, two channels will be used for the Iran–United Kingdom telex service (at present routed via Hamburg), and two channels will be leased to commercial customers. Additional channels will be brought into service later, as required.

The Post Office Circuit Laboratory

J. H. Broadhurst, A.M.I.E.E.

A DESCRIPTION of the Post Office Circuit Laboratory was given in the November 1950 *Journal*. The Laboratory was then on the second floor of the Sorting Office Block of the London Chief Office, King Edward Street, where it had grown from a staff of three in 1924 occupying a floor area of 550 square feet, to a staff of 110 with accommodation of 13,500 square feet.

By the very nature of its function, the Circuit Laboratory has been a continuously expanding organization and by 1953 the accommodation in King Edward Street was no longer sufficient. In October of that year, after nearly 30 years in "temporary" accommodation, the Laboratory moved to its present home in Armour House, St. Martins-le-Grand, E.C.1. This removal to new premises with a total floor area of 16,000 square feet provided a unique opportunity for incorporating all the improvements both in layout and facilities which experience had shown to be desirable. Already, however, it has been necessary to expand still further and structural alterations, recently completed, have added a much-needed 1,000 square feet to the working area.

Functions

The main purpose of the Laboratory is to test telephone switching and signalling equipment before it is put into service in such a manner that the final design will function correctly under field conditions with the minimum of maintenance. The organization, procedures and testing techniques employed are those which experience has shown to be best suited to this end. Thus, although the Laboratory works closely with the development engineers, these engineers do not control it. It is a completely separate organization whose function is to test and report, without fear or favour, on a piece of apparatus or a circuit at the request of its designer. It is the designer, however, who will assess the test results and make any decision regarding the subsequent action to be taken. Such a clear-cut limitation of responsibility ensures that each test report is no more and no less than a completely unbiased and factual record of the performance of a piece of equipment under a very stringent testing programme.

During its 35 years the Laboratory has issued some 6,500 reports covering every aspect of the automatic telephone switching and signalling techniques used in this country.

The testing work can be divided into two categories, mechanical and electrical. The mechanical side is concerned with the development and life-testing of switching apparatus—selectors, relays and so on, and the electrical side with the testing of new circuits. Besides the work done inside the Laboratory, much time is spent in the field investigating the teething troubles of new equipment and maintenance difficulties on existing apparatus.

In addition to the investigation work, the special experience and facilities of the workshops are being increasingly used for the construction of demonstration models for lectures and publicity purposes.

Facilities

To test a new item of equipment the Circuit Laboratory must be able to simulate all the conditions under which it will have to function in service, and since the new must interwork with the old, sufficient equipment representing all the standard automatic switching systems used in this country must be available. Thus the permanent plant in the Laboratory includes a UAX No. 12, a UAX No. 13, and complete switching trains for UAX 14, non-director (2,000 and pre-2,000 type) and the director systems.

As the automation of the telephone service proceeds so the equipment in the Laboratory increases and, of course, so does the need for more and more space. Subscriber Trunk Dialling has introduced many new items such as register-translators which, after the completion of testing, will form part of the permanent laboratory plant, as will the complete model of the Continental Semi-Automatic Switching System and, later on, the equipment for the Transit Switching Scheme and International Subscriber Dialling.

View of
main Laboratory

To produce results as quickly as possible the Laboratory must be able to construct its own prototype models, the design and layout of which should resemble as nearly as possible the items which will be used in service. Also, adequate testing equipment, designed to meet the special requirements of the Laboratory, must be readily available.

In both these essentials, the Laboratory is practically self-sufficient, having well-equipped construction workshops and a separate measurements laboratory in which new testing equipment is designed and built.

Photography and optical techniques play an important part in the Laboratory work. Micro- and macro-photography, oscillography and high-speed cinephotography are used extensively, and facilities are available for special measurements involving the use of the profile projector, travelling microscope, hardness tester and so on.

Testing

Many factors can affect the performance of telephone equipment in the field; battery voltages may vary, line conditions will fluctuate considerably, the atmosphere in the exchange may be dusty or corrosive and even the temperature variation in the apparatus room may be of vital importance, particularly with electronic equipment. These adverse conditions must be reproduced in the Laboratory. For example, apparatus that operates from the nominal 50-volt supply from an exchange battery must be tested at 46 volts and at 52 volts as this is the range of voltage which might occur in certain circumstances in a telephone exchange.

The ordinary telephone dial is adjusted to give a pulsing speed of 9 to 11 pps; therefore, all equipment directly or indirectly controlled by a subscriber's telephone dial must be tested at both these pulsing speeds. The ratio of the "break" period to the "make" period of a pulse can also vary within certain limits and as this can be a vital factor in the performance of switching equipment the testing programme must include these variations.

All mechanically operated equipment must be in correct adjustment if it is to function satisfactorily but every adjustment must have some tolerance, therefore the equipment must be tested at the extremes of these tolerances.

As the range of subscriber dialling increases, so the effect of external line conditions on the performance of switching and signalling apparatus assumes greater importance. These external circuits can vary from the simple two wires of a subscriber's circuit to a channel in a carrier system operating over a coaxial cable or micro-wave radio link.

Ideally the insulation resistance of subscribers' lines, junctions and trunk circuits should be infinite but obviously this cannot be achieved in practice. Lower standards of insulation have to be accepted and the terminal equipment must be tested under the worst permissible conditions.

In certain signalling systems the difference between the potentials of the earths at the ends of the circuit may affect performance and an allowance must be made for this "EPD" when testing.

Equipment for the Continental semi-automatic system undergoing tests in the Laboratory

These are some of the factors that must be considered in testing telephone switching equipment. There are, of course, others which are peculiar to certain types of equipment and the rapid introduction of electronic switching and control techniques is adding its own quota of testing conditions. For example, the increasing use of the telephone network for data transmission and the possibility of this traffic interfering with the various A.C. signalling systems has introduced new and important additions to the testing programme.

The possible number of permutations and combinations of these testing limits and conditions if applied in full to every item in even a small switching assembly would involve an enormous number of individual tests and would be quite impracticable besides being unrealistic. It is therefore necessary to select those individual items or circuit elements whose functioning under adverse conditions would affect the overall performance of the equipment.

The tests to be carried out on a new circuit or piece of apparatus are specified by the development engineer who also selects those items to which the full range of adverse testing limits must be applied, as he knows the conditions under which the equipment will be used and how it will have to work in conjunction with other apparatus. The actual method of testing is the responsibility of the Circuit Laboratory.

Life Testing

Before any new item is introduced into the system, it has to be proved capable of giving reasonably fault-free service throughout its working life. To do this in as short a time as possible, accelerated life tests are carried out in the Laboratory; the piece of apparatus is subjected to wear at a much higher rate than it would experience in actual service and from a study of its performance and from measurements of wear of individual components deductions as to its life in the field may be made.

These tests, however, must be realistic and although to save time a rapid testing rate is desirable, several considerations limit the rate in practice. The apparatus must be tested within the specified conditions of adjustment and operation and normal limitations on stepping speeds for pulse-operated equipment must be applied. Similarly the rest period between successive operations cannot be reduced beyond certain limits, otherwise overheating may result.

Thus, although life testing usually goes on continuously, it may not be possible with the above limitations to reduce by a factor of more than two or three the time that the equipment would take to perform the same number of operations under normal service conditions in the field. This is particularly so for items of common equipment such as directors and register-translators which, in a busy exchange, are almost continuously in use.

During a life test the items are periodically checked and the number of single operations or cycles of operations is recorded on counting meters.

Two rooms and four cubicles are provided for mechanical performance tests. The rooms are equipped with racks on which a number of life tests can proceed simultaneously and the four cubicles are used for individual life tests or tests where special atmospheric conditions are required.

In this short article it has been possible to describe only the more important aspects of the work of the Circuit Laboratory but, naturally, with such comprehensive facilities readily available and with a staff having a wide range of skills and experience, the Laboratory is frequently called on to provide a service or solve a problem outside the normal field of telephone switching and most branches of the Engineer-in-Chief's Office and many Headquarters departments can be numbered among the Circuit Laboratory's "customers".

The techniques of automatic telephone switching are continually improving. New materials and devices are being introduced either to improve the performance of existing equipment or to provide the additional facilities required by a progressive telephone service. Testing methods must keep pace with these new developments.

The introduction of electronic devices into telephone switching and signalling has brought the greatest changes, both to the testing requirements and to the testing instruments.

Microseconds and milli-microseconds are replacing milliseconds as significant intervals of time; oscilloscopes, signal generators and frequency

The construction shop

meters are superseding the test lamp and voltmeter as the essential tools of the testing officer.

Subscriber Trunk Dialling and Continental semi-automatic working are recent developments that owe much of their success to the careful and thorough work of the Circuit Laboratory and in the extension of these systems to the ultimate of world-wide subscriber dialling the Laboratory will be able to play an equally vital part whatever the techniques employed.

Don't hang up— hang on!

Educating the public in using the Subscriber Trunk Dialling system presents many problems, one of which is of special interest and peculiar difficulty because it involves the great majority of telephone subscribers, and not only those with STD.

The "pay-on-answer coin-box" which will replace the "fourpenny coin-box" as STD is extended was described in the Autumn 1959 issue. This new coin-box has no "buttons A and B", and the caller dials before putting any money in the box. When the called subscriber answers, a signal to tell the caller to insert his money is given by means of a new tone called "pay-tone". The pay-tone ceases when the caller inserts a coin (a 3d, 6d or 1s 0d piece), but comes on again when the time paid for has expired; another coin must then be inserted to extend the call for a further spell.

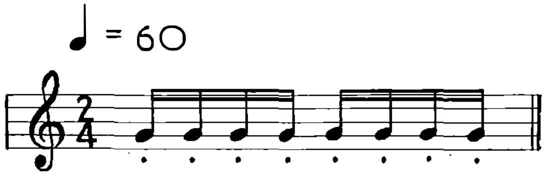
A special problem arises because, when answering his telephone to receive a call from a pay-on-answer coin-box, the *called* subscriber hears the pay-tone, as does the caller. Experience shows that on a proportion of calls the called subscriber replaces his handset on hearing the tone, which he may never have heard before, no doubt thinking that something is wrong. The proportion of calls on which this happens is not more than 1 to 2 per cent., but as any of the four million subscribers now working on automatic exchanges will soon be liable to hear this tone on answering the telephone, and as the caller cannot recover his money if the called party clears (because the new coin-box has no button B), it is important to spread a knowledge of the new pay-tone among subscribers in general as quickly as possible. The problem is particularly awkward in the early stages when there are comparatively few areas equipped with pay-on-answer coin-boxes, and the proportion of subscribers who have received a call from the new coin-box, and have therefore heard the pay-tone, will be quite small for several years to come. The proportion who, having heard the tone, know what it means may be even smaller.

Much is being done to publicize the new tone. The new coin-box and the pay-tone are demonstrated at STD exhibitions, and in the STD film which is shown at these exhibitions, but these reach in the main only the STD subscriber. Press advertisements and leaflets are also to be used as far as possible to acquaint the public with the new tone, but these cannot convey its sound. Broadcasting will be a very effective medium for publicizing the tone, especially when the pay-on-answer box finds a place in sound and television plays, but opportunities are at present few and far between. The pay-tone has been made available from automanual switchboards so that operators can demonstrate it to subscribers who may inquire, and it also may be heard by dialling certain telephone numbers.

Pay-tone can be described in several ways. The official description is "rapid pips". Technically it is a tone of 400 cycles per second interrupted at .250 millisecond intervals for .125 milliseconds. Each "pip" therefore lasts an eighth of a second and there are four pips a second.

Pay-tone has the same pitch as the well-known "engaged" and "number-unobtainable" tones. It repeats its note six times as fast as the engaged tone with which we are familiar, and three times as fast as the new international engaged tone to which the Post Office is gradually changing over (but which is so far provided at a few exchanges only).

Musically the note sounded is G next above middle C on the piano, and it might be represented as follows:—



The pay-tone may be heard by dialling CITy (London) 9401. From an STD telephone, even on the longest distance call to this number, one can have 48 pips for 2d! H.A.L.

Materials Handling in the Supplies Department

H. H. Simmons

Every time material is handled something is added to its cost but nothing to its value.

Money spent on the handling of materials is gone for good and cannot be recovered.

THE General Post Office is not a manufacturer, and the services it renders to the public involve, to a very great extent, moving things about. To provide the 365,000 servants of the Post Office with the means to discharge their duties to the public involves the Supplies Department in the continuous movement of great quantities of materials which vary widely in size, shape and weight. This requires a series of repeated operations of lifting, carrying, pushing, pulling, edging, levering, all of which contribute to the arrangement of stores into the orderly pattern which forms the basis of good store-keeping.

The process is primarily a sequence of shifts from one temporary lodging to another: for example, from the end of the production line to a transport vehicle, then to a storehouse and, via a series of internal handling operations including examination, to a stock position and subsequently to another transport vehicle for the journey to the consumer. This sequence is reversed in the case of stores recovered to depot for repair, refurbishing or for sale as scrap.

Before the end of 1945 a high percentage of these operations was carried out by muscle power with its associated high accident ratio, human fatigue and consequent loss of output after midday, and damage to equipment. The urgent need to conserve manpower at the end of the war, the ageing of existing staff and the difficulty of recruiting younger men, coupled with the inevitable increase in work to set right the neglected and much-damaged communication systems of the country made it necessary to direct special attention to the relief of the burdensome problem of handling which is typical of most supply organizations.

Little was known in this country of what is still correctly termed Modern Materials Handling Techniques until 1942 when it was introduced extensively by the American army in Great Britain. The most significant contribution which, perhaps unfortunately, seems to spring to the mind when the term "Materials Handling" is mentioned, is the versatile fork lift truck used in conjunction with pallets and the unit load system. Because it is possible for a truck-driver, unaided, to pick up a load, move it, set it down again or stack it at will without leaving his seat—a performance which, in addition to releasing manpower, reduces storage area by using formerly inaccessible headroom, reduces handling accidents and injuries, lessens fatigue, speeds and simplifies stock-taking, and speeds the turn-round of vehicles—the fork lift truck has tended to overshadow the many other useful and ingenious aids to materials handling.

The physical working conditions of a storehouse influence, and often determine, the choice of materials handling equipment. Although the Supplies Department has had its share of the limited funds available for building it still has too many warehouses where the limitations on floor-weight, inadequate lifts and generally outmoded accommodation prevent an integrated materials handling plan. Nevertheless, any piece of equipment that eliminates or reduces the burden of manual handling is a mechanical aid, whether it be power or hand operated; and just as the spade is still necessary in spite of the evolution of the tractor-plough, so the humble sack barrow can still play an important role in multi-storied buildings or basements where cramped conditions and lack of room to manoeuvre preclude the employment of more sophisticated equipment.

At the same time, even in a well equipped modern depot such as Bridgwater, a simple innovation like the mobile packing bench to be seen in Fig. 1 is a very useful piece of materials handling equipment,

Fig. 1 : (Left) Mobile packing benches
(Centre) Mobile desk of checker

enabling the packer to take his relatively light packing equipment to the heavier stores he has to pack instead of humping stores all day long to a fixed bench for packing. In a review of this sort it is not possible, nor it is necessary since readers will be familiar with many of them, to detail the types of barrows, fixed platform, hand elevating, elevating platform and pallet trucks, pallets and stillages and similar minor mechanical aids, but it is important that they should not be overlooked or overshadowed by the more spectacular fork lift trucks, cranes and similar eye-catching pieces of equipment.

It must be recognized that what the Supplies Department has done to meet the challenge to reduce handling costs has necessitated studying and solving many separate problems, because generally speaking every materials handling problem is an individual one. Within the compass of this article it is possible to do no more than to deal very broadly with the general application of handling techniques in the Department.

The initiative taken by the management of the Supplies Department to improve handling methods, and the reason for it, have been touched upon earlier and need not be repeated. The Department was fortunate in having one or two officers with the flair, and the knowledge, to carry out the necessary work studies, to plan lay-outs and to advise on design of buildings. They acquired most of this knowledge during service with the Armed Forces which imaginative management enabled them to exploit on their return to their civilian occupation.

Perhaps one of the most difficult hurdles the management of the Supplies Department had to take was to convince those responsible for providing space for the increasing volume of stores that multi-storied warehouses discarded by other organizations because of their unsuitability were equally unsuitable for Post Office stores.

From the outset the staff, chiefly the industrial staff, were kept fully advised of the proposed changes through the normal Whitley channels, and it is important to record that whatever may have been the experience elsewhere, the staff of the Supplies Department co-operated, and indeed continue to co-operate, most whole-heartedly and enthusiastically and have contributed valuable suggestions and ideas.

In addition to staff consultation the staff had to be trained in the new techniques. A Training Division was established and courses of instruction were carefully compiled and have been amended and adjusted to keep them abreast of developments. Carefully selected instructors have been provided with the necessary knowledge, accommodation and apparatus to train the various grades of the staff in the work they have to do. There was, and still is, full consultation with the Staff Side on training methods.

Training has had to cover a very wide field. Whatever provision of mechanical aids is made, and no matter how much a materials handling manager may strive towards the goal that materials "shall not be touched by human hand", there will always be *some* need to lift or move loads by muscle-power. Manual lifting and handling if not properly performed can cause strains and more serious injuries to operators with consequent sick leave and loss of productive time, and at best will cause undue fatigue early in the day and less efficient performance thereafter. Instruction in the correct methods of manual lifting and handling is therefore given in the primary training of warehouse grades, including first-line supervisors, based on the teachings of the Institute of Human Kinetics. Practical demonstrations by instructors, supplemented by films and film strips, followed by practice by each pupil under careful guidance from the instructors, provide men with the knowledge necessary to carry out their tasks without damage or strain to themselves. It is gratifying to recall that a demonstration of these methods to Midland Region representatives at the Supplies Department's Birmingham Depot initiated the instruction now given in correct lifting and handling methods to the engineering labour force.

Clearly that part of modern materials handling which envisages the replacement of numbers of men by a relatively few machines demands the careful selection of vehicle operators, sound training, and good supervision. A careless or unskilled operator can lose valuable time in each movement, or possibly damage the vehicle or stores; an inefficient operator requires more space in which to manoeuvre with consequent restriction of storage space. Training in the handling of all

Fig. 2: Vehicle fitted all round with roller shutters to facilitate palletized loading

Fig. 3 : Moving-floor van. Loading and unloading area always presented to tail-board

powered vehicles is therefore given, quite often on site, as for example with cranes.

A prime factor in the efficient use of fork lift trucks is the skill of the driver in dealing quickly and efficiently with the various situations encountered in handling a wide variety of stores. A Training School at Wembley Depot, staffed by Supplies Department instructors, deals with the specialized problem of training fork lift truck drivers in their very important job. The course is very thorough and includes negotiating manufactured hazards, loading a van and stacking all types of pallets and loads in simulated difficult conditions. At the end of the course the driver is given a *viva voce* examination in the theory of his work, and safety measures, in addition to practical tests by the chief instructor; if satisfactory he is given a certificate that he is properly trained, suitable, and capable of handling the important and expensive equipment of which he will have charge.

Training is also given at the Wembley School, by Supplies Department instructors, to fork lift truck drivers who are to operate these machines in Telephone Area stores. Instruction has also been given to postmen nominated to drive fork lift trucks in some of the larger sorting offices.

Because of the need during the war to disperse vital stores against heavy aerial attack in almost any accommodation, provided it was away from the main target area, the Supplies Department possessed a very mixed collection of buildings at the end of hostilities. Reconcentration, studied in the light of new building concepts to facilitate good space and movement planning and warehouse lay-outs made it clear that multi-storied buildings were outmoded and placed a very real restriction on the types and capacity of aids which could be used. The advantages of single-storey ground floor accommodation in the storekeeping operations of receipt, examination, binning, selection for issue, packing and despatch and the facility such accommodation afforded to inject flow-line techniques into these operations were proved. No multi-storied buildings have been built or acquired for the Supplies Department since the war and it is most unlikely that any will be.

It is generally accepted that the study of a materials handling problem can never be regarded as entirely completed; indeed, "continue to examine the system for possible improvement" is one of the chief principles of materials handling. It is a far cry from the introduction of the first fork lift truck in the Supplies Department at the end of 1945—acquired from Army surpluses and driven by a German prisoner because no one else of suitable rank knew how—to the 97 trucks now in use, with fully trained drivers and an equal number of reserve drivers. While the Supplies Department is modestly satisfied with progress it acknowledges that a great deal remains to be done yet.

Nothing has been said in this article about powered conveyors because few are used in the Supplies Department since, generally speaking, fixed conveyors on warehouse floors have many disadvantages. Yet in most large warehouses the need for some such form of constant traction is felt. The advent of automatic line-following devices such as the EMI Robotug, the Conveyancer Automatic Line Follower, and the American Guide-o-Matic, which can tow a three-ton train of trucks and either optically or electrically follow a predetermined route with programmed stops, presents an opportunity, which is being closely watched in the Supplies Department, to overcome the difficult problem of selecting an item from store and delivering it to the despatch area, or from the receipt area to a selected storage space, without the need to employ operatives to drive trucks or

Fig. 4 : Fork lift truck with rotary tilting head

push barrows. The automatic line-following device opens up most interesting possibilities of flexible automatic horizontal traction, economical of space, manpower and maintenance costs.

The thought given to the importance of providing the correct type of stores-carrying motor vehicle can to some extent be gathered from Figs. 2 and 3. Fig. 2 shows a vehicle designed with roller shutters all round to enable palletized loading; the vehicle in Fig. 3 is fitted with a moving floor so that the area to be loaded or unloaded is always presented at the tailboard by the driver cranking it forwards or backwards as necessary. This vehicle, used in conjunction with a fork lift truck and the unit-load system, presents as good an example as any of the economies to be reaped from good materials handling transport. The van illustrated will contain 3,000 cartoned telephones. To load or unload such a consignment used to take three men about four hours. The same quantity can now be handled by the fork lift truck driver and the vehicle driver in 30 minutes. There is still great scope for improvement in this particular field, but positive progress demands a much greater measure of standardization of equipment and co-ordination outside the control of the Supplies Department. Co-ordination is touched upon again later.

No comment has been made in this article on the profitability of the materials handling venture in the Supplies Department. To give clarity and force to statistics which would indicate savings in labour, space, vehicle turn-round time and so on would require much space; it will suffice to say that if the increased volume of stores being handled now compared with 10 years ago was still handled by old-fashioned manual methods, 350 more men would be required on the basic labour force of the Department than are in post at present—plus, of course, appropriate supervision.

To obtain the maximum benefit from the unit-load or palletized system the co-operation of the Department's suppliers and customers is necessary. Some small progress has been made in both directions. It is perhaps not to be expected that contractors would be prepared to go very much out of their way to incur expense to reduce Post Office handling costs, but action within the Post Office has been somewhat disappointing. It seems to be accepted that responsibility for improved handling rests with each department, and to a degree this must be so. If slavishly followed, however, this principle prevents the building up of a common pool of knowledge, and there is some evidence that departments wishing to improve their handling methods have had to begin from the ground floor, although there was knowledge and experience within the Post Office (the garnering of which had been paid for), which would have helped them considerably on their way. Opportunity to achieve some measure of standardization is denied which would make possible interchange of equipment, and advantage cannot be taken of reduced prices for spares given by manufacturers under the "large fleet operators" concession.

To some degree the full development of improved handling methods in the Supplies Department has been inhibited by the inability to achieve collaboration and co-ordination with many of those with whom it has to deal. Most of our large and progressive manufacturing organizations have devoted a great deal of money, time and effort to the improvement of their materials handling methods. They have found it essential to establish a materials handling division, the sole purpose of which is to improve and co-ordinate handling and transport methods. The rewards they have reaped have been rich—and well publicized. Since it is worthwhile to these organizations to co-ordinate effort towards improved handling techniques, does it not prompt the thought why the Post Office, which is almost entirely concerned with the movement of great quantities of material, adheres to a policy of unilateral effort by branches and departments? Is there no place for a measure of co-ordination?

NOTICE TO READERS

The index to the present volume will be published with the next issue, Winter (November) 1961.

The first number of the *Journal* was published in November 1948 and the annual volumes have since run from the November (now Winter) issue to the following August (now Autumn) issue, a single volume thus including numbers published in two successive calendar years.

As this causes some confusion future volumes will include issues published in one calendar year only.

Making the change involves including five issues, Winter 1960-Winter 1961, in the current Volume 13, and opening Volume 14 with the Spring (February) 1962 issue.

The Index to Volume 13 is therefore being deferred to enable it to cover the complete five issue volume.

Sixty Years of Loading Coils

J. Smith

1961 is the Diamond Jubilee of the loading coil in the United Kingdom and it seems appropriate that a short survey covering the development and present application of this useful device should be published to mark the event. In spite of the large number of long distance circuits provided by modern carrier and coaxial cable systems, which make no use of loading coils, it is estimated that no fewer than eight million coils are installed in the audio cable system of the United Kingdom. The great majority of these are in steel cases placed in manholes (see Fig. 1), while some cases are clamped to poles and jointed into aerial cable systems. Following recent developments, cases are now installed in surface joint boxes (see Fig. 2) and individual coils (Unicoils) are in cable joints (see Figs. 3 and 4).

It was in 1887 that the great English physicist Oliver Heaviside suggested the addition of inductance to lines. By what is now agreed to be simple mathematical deduction he proved that the addition of inductance led to reduced distortion and attenuation. His troubles came when he tried to convince his engineer contemporaries that there were practicable ways of doing this. The more obvious method was by fine iron wire or tape wrapped around the line wires. This was a time-consuming operation, was very costly and added only a very small amount of inductance. Nevertheless, the idea was used for some submarine cables.

Heaviside's next thought was to surround the wire with a paste in which iron filings were mixed, but here again the amount of inductance which could be added did not justify the operation. He was irritated by the lack of success in the development of his idea and even his suggestion in 1893 that larger amounts of inductance could be added by coils in the main circuit found no ready response.

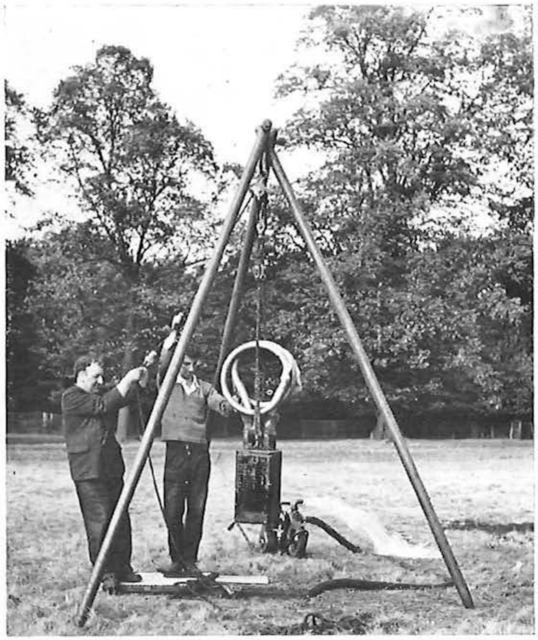


Fig. 1 : Lowering an underground type of loading case into a manhole

It was unfortunate for Heaviside that no man at that time could find a practicable means of lump loading and the world had to wait until 1899 before an Austrian-born United States citizen, Pupin, took out the famous patent which introduced the "loading of telephone cables by means of inductance placed at intervals".

The earliest forms of loading coil were air cored. Although this led to bulky coils for reasonable values of inductance it was a prudent design, since the electrical characteristics of the coils would not have remained stable for very long if provided with the simple iron cores then available. In the United Kingdom the Birmingham–London No. 1 cable was loaded with such coils experimentally in 1901. The results must have been promising, for in 1903 the Liverpool–Warrington cable was loaded with 45 millihenry coils at a spacing of one mile and it was claimed that with this loading an improvement factor of 2.75 over an unloaded cable was obtained.

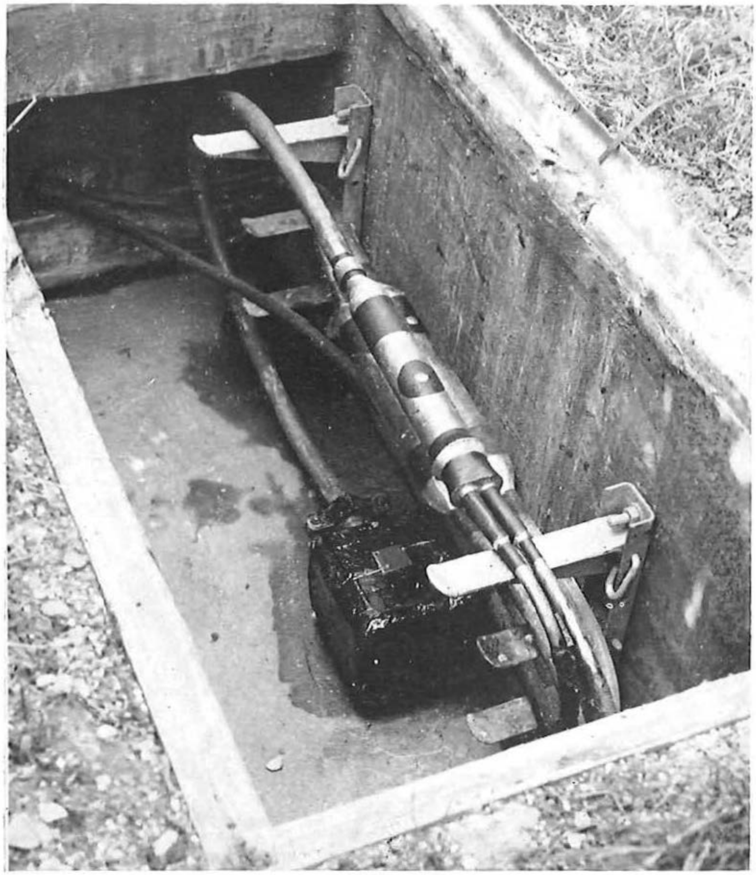


Fig. 2 : Chamber type loading case installed in surface joint box

Coils with iron cores of toroidal form giving much greater inductance were introduced in the United States in 1903 but in the United Kingdom such coils were not used until 1908, when the Liverpool–Manchester cable was loaded. The cores of these coils were made up of iron wire four mils in diameter, no fewer than 25 miles of wire being required for each core. Not only was this method of manufacture costly; the coils themselves were unstable and over a period lost their inductance.

During World War I cores made of electrolytic iron powder compressed at high pressure were introduced in the United States, to be followed later by the first of the alloy powder cores, a combination of nickel and iron being used to give a much better performance in smaller sizes than hitherto. A still further reduction in size occurred in the early 1950s with the introduction of a copper-nickel-iron alloy powder core and this is the type in use today for toroidal coils.

The great virtue of the toroidal coil in its modern form is its stability under various conditions of use. In the loading coil these conditions can vary from those experienced in a manhole or joint box beneath a busy street to the top of a pole when used to load an aerial cable. This stability is brought about by the absence of an air gap in the core, by the material of the core, and by careful manufacture at all stages.

In recent years the introduction of new magnetic materials, notably the ferrites, has led to remarkable achievements in the field of magnetism. The application of these new materials to the loading coil problem was not long delayed and coils employing these materials are now in use experimentally in the United Kingdom. The design of coils using ferrites is entirely different from that

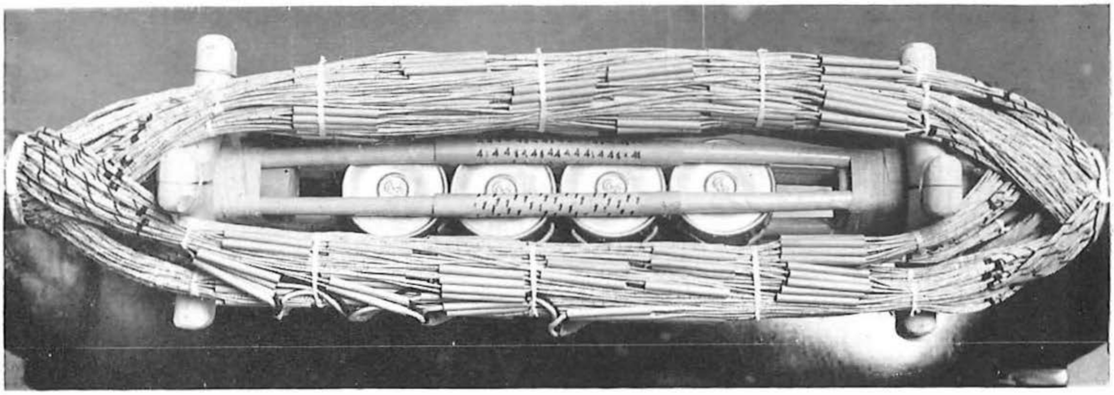


Fig. 3 : Unicoils supported between four coaxial tubes in cable joint. The end formers are removed before the joint is closed

employed when magnetic alloys are used. In the latter, the coil windings entirely surround the toroidal core. When ferrites are used the ferrite material entirely surrounds the coil winding and an air gap is introduced to avoid magnetic saturation (see Fig. 5). Long term stability under working conditions has yet to be established for this new type of loading coil and the results of early installations will be watched with interest. One of the advantages of the ferrite loading coil is that comparable electrical performance to that obtained with toroidal cores can be obtained in a smaller volume. This is particularly attractive when loading coils are installed in joints and it is in this application that the first ferrite coils have been used by the British Post Office.

The earliest loading coils were in cast iron cases of cylindrical cross section. In 1931 welded sheet steel cases of square cross section were introduced and these are the type in use today. To guard against corrosion and mechanical damage the steel cases are sprayed with zinc, fitted with a hessian bag and dipped in hot bitumen. Many attempts have been made to improve on this finish but, surprisingly, none has yet been found to approach it in economy and effectiveness.

For ten years it has been the practice to insert up to four loading coils in a joint, this, in the first place, being the general requirement when screened pairs were loaded at a spacing of 1,000 yards for broadcast programme purposes (see Fig. 3). The reduction in size of coils made possible by using

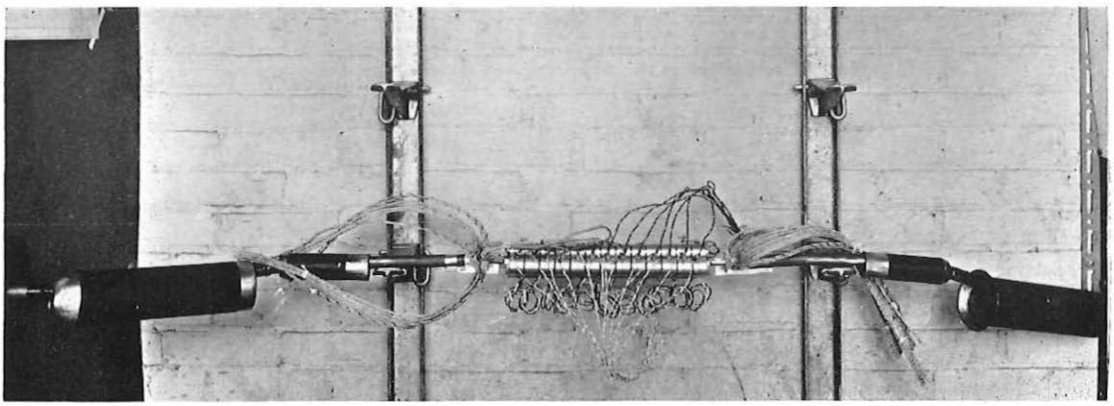


Fig. 4 : Partially completed joint for 38 ferrite type unicoils to be housed in 3″ diameter sleeve

the new core material led to the development of methods by which many coils could be installed in cable joints. Designs were completed for housing up to 104 coils in a normal jointing sleeve but for the present it has been decided to limit the design to 38 coils. This number can be accommodated in a jointing sleeve 24 inches long by 3 inches internal diameter. It is in this application that the ferrite coils with their smaller size are proving attractive (see Fig. 4).

Since the birth of the loading coil many values of inductance and spacing have been employed. The first schemes used 35–70 millihenry air cored coils at one mile spacing. Then followed a period when large inductances at wide spacing (for example, 136 millihenries at 2.6 miles) were fashionable but in the late 1920s it became clear that the restricted bandwidth of frequencies which this form of loading could transmit effectively was the cause of many transmission complaints. As a result a loading of 120 millihenries at a spacing of 2,000 yards was standardized, to be followed about 1935 with the present standard of 88 millihenries at 2,000 yards. This gives a nominal cut off frequency of 3,920 cycles a second and is found quite suitable for audio circuits. Main programme or music circuits when carried in audio cables are provided on screened pairs having conductor weights of 25 lb or 40 lb per mile. The standard loading for these circuits is 16 millihenries at 1,000 yards spacing giving a nominal cut off frequency of 12,770 cycles a second.

With the continual spread of broadcasting the demand for programme circuits linking outside broadcast points with the main broadcasting centres became quite large. These circuits are

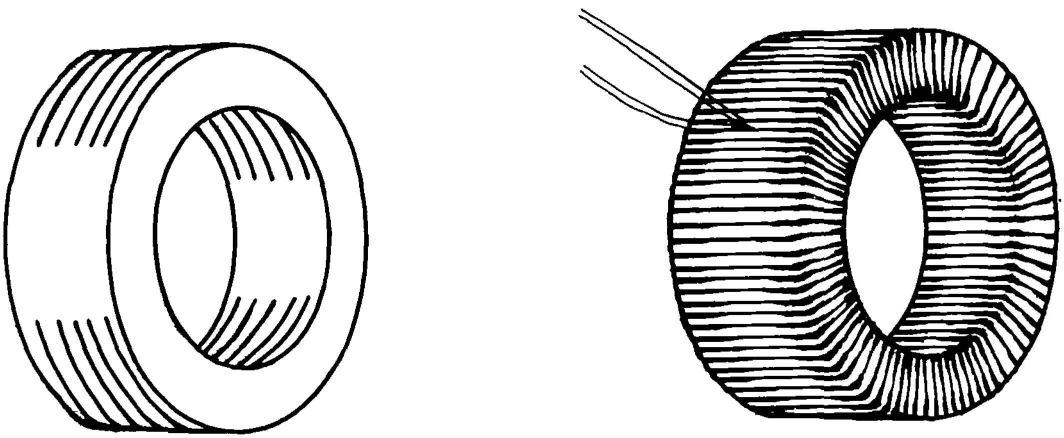
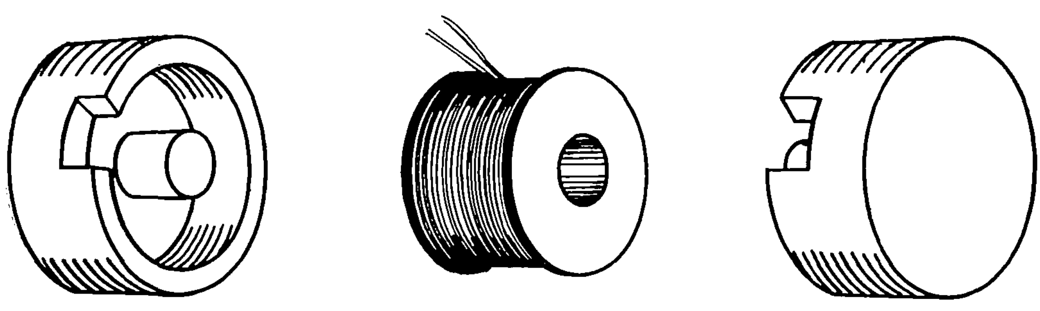


Fig. 5 : Exploded sketches to illustrate :
(above) toroidal coil wound on a core of magnetic material
(below) ferrite type coil in which the magnetic material surrounds the winding
The drawings are not to scale. The ferrite type coil is half the size of the toroidal coil)



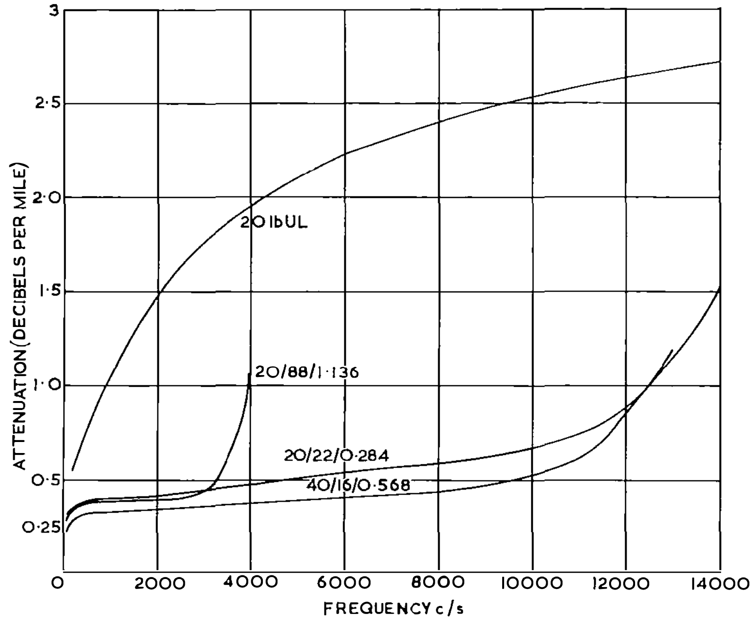


Fig. 6 : Attenuation-frequency characteristics of current standard loadings compared with unloaded cable

required only occasionally and the extra cost of screened pairs cannot be justified. An acceptable solution to this problem has been found by loading unscreened pairs with 22 millihenries at a nominal 500 yards spacing. The pairs thus loaded have similar attenuation to the normal audio pairs loaded with 88 millihenries at 2,000 yards spacing but have a cut off frequency which is acceptable for programme purposes. At normal times they are in use for traffic purposes.

The object of this loading is to provide circuits of programme or near programme quality at small cost and this object would be defeated if loading points had to be built on existing duct tracks at precisely 500-yard intervals, or even with the tolerance of 1 per cent. normally used for loading spacing. To avoid this a tolerance of 60 yards is allowed and the loading sections are built out with capacitors to 560 yards where necessary. This spacing gives a cut off frequency of at least 13,000 cycles per second, and is quite adequate for the purpose. New duct routes are provided with loading points at 500 yards and a section tolerance of 2 per cent.

Much of the earlier loading remains in the network but all routes having a lower cut off frequency than 3,340 (120 millihenries at 2,000 yards spacing) are being programmed for conversion to modern standards.

The attenuation-frequency characteristics of the standard forms of loading at present in use are shown in Fig. 6.

For the past 25 years it has been confidently forecast that the advent of amplifiers and carrier systems will cause the loading coil to be a redundant device in telephone cable networks. Taking a long view this is obviously true but the early forecasters have already been proved wrong in their time scale and it may well be that the loading coil will still be a feature in telephone networks in the year 2001.

The BBC and ITA used 46 cameras altogether at York Minster and Hovingham Hall for the Duke of Kent's Wedding on June 8. Post Office engineers provided a total of 17 video links, and an injection facility at Timshill Repeater Station on the Kirk o'Shotts-Manchester television radio link. Seventeen video send units and 20 video repeaters were used. Post Office Outside Broadcast teams were drawn from London, Manchester, Birmingham and Scotland. The BBC programme was also transmitted on Eurovision.

Both broadcasting organizations have expressed their thanks for Post Office assistance.

Recent Changes in Inland Phonogram Switching Arrangements

A. B. Wherry, B.Sc.(Eng.), A.M.I.E.E.

WITH the introduction of Subscriber Trunk Dialling and the installation of the new pay-on-answer coin-boxes, facilities are being provided so that a coin-box user can dial his own call direct to "phonograms" to dictate a telegram instead of having to make the call via the telephone exchange operator. This has necessitated some engineering development work and the opportunity has been taken to introduce other changes into the existing scheme.

Arrangements Before STD

In non-director areas ordinary subscribers normally dial "90" for direct access to the phonogram operator, while ordinary subscribers on dependent UAXs precede this code by appropriate routing digits. The trunking at the automatic exchange is designed to routc the phonogram traffic from all ordinary subscribers via a single group of circuits to the phonogram operator.

In director areas the code TEL is used for access to the phonogram service. The routing of the calls from the originating director exchange to the phonogram board varies for particular exchanges and may be from code levels, PBX final selectors or via levels at a tandem exchange.

Prepayment coin-box subscribers in both director and non-director areas do not have direct access to the phonogram service because it would be necessary to give an indication to the phonogram operator that the call is from a coin-box and that the charge for the telegram must be collected. To give such an indication with the prepayment type of box it would be necessary in some instances to provide a separate switching path and separate junctions for calls from ordinary and coin-box lines, and this would be too costly. Coin-box users wishing to dictate telegrams therefore dial "O" to call the automanual exchange operator who connects them to phonograms and tells the phonogram operator that the call is from a coin-box line.

To maintain the service when the phonogram office is closed at night or at the week-end, arrangements are made in non-director areas to divert some of the normal day phonogram circuits to a telephone switchboard. Keys are used to control the switching and the last one or two circuits in the group are diverted; the operation of the switching key also busies the circuits which are not diverted. These diversion keys may be under the control of either the exchange operator or of the phonogram position operator.

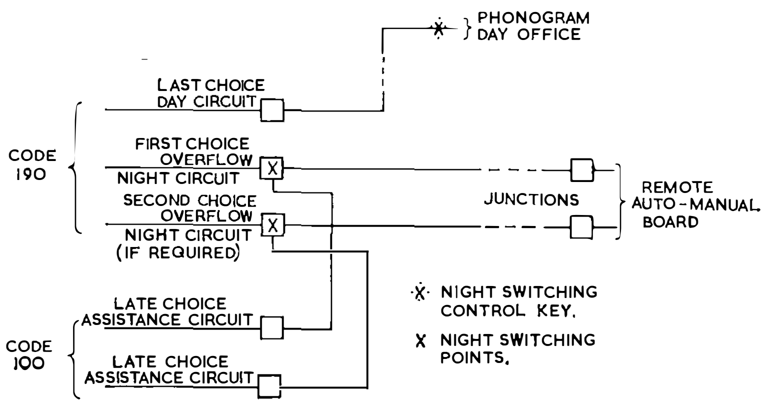


Fig. 1: Overflow method—night phonogram traffic to remote automanual board

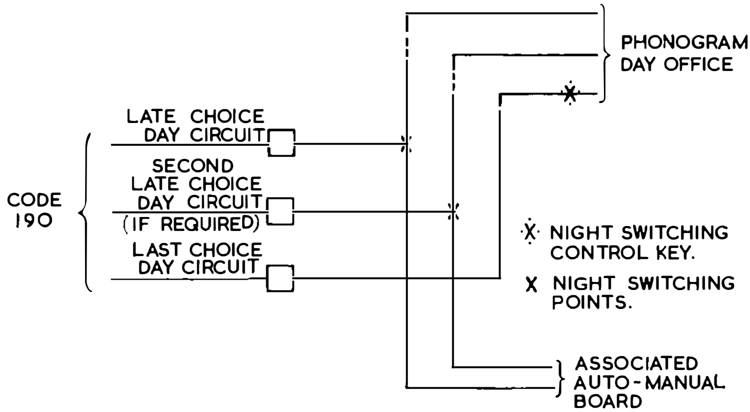


Fig. 2 :
Late choice switching method—night phonogram traffic to associated automanual board

Procedure and Arrangements under STD

With the introduction of STD the code 190 will be used by ordinary subscribers in non-director areas for access to the phonogram operator, and in director areas the code TEL will continue to be used. Pay-on-answer coin-boxes in both director and non-director areas will use the same code as ordinary subscribers for direct dialling access to phonograms and there will be a tone to indicate to the phonogram operator those calls which are from coin-boxes. On these directly dialled calls the phonogram operator will be able to control the opening of the coin-box slots when she asks the caller to insert the fee and she will be able to operate the "audit" facility if she is in any doubt about the amount collected.

The existing phonogram night switching equipment does not cater satisfactorily for access from pay-on-answer coin-boxes under all conditions of working and to overcome this difficulty new night diversion circuits are being designed. Advantage is also being taken of this change to alter the present practice so that the control of the change-over from day to night working is given always to the phonogram staff.

Two methods of diverting at night subscriber dialled traffic to "phonograms" will be used in future:

(a) *The "overflow" method.* The operation of the switching key at the phonogram office busies the phonogram circuits and opens for service one or two junctions to either a phonogram night office which has phonogram automatic distribution equipment or to a remote sleeve control automanual board using appropriated "late choice" "100" assistance circuits (Fig. 1).

(b) *The "late choice switching" method.* All but one or two late choice phonogram circuits are busied by the operation of the switching key, circuits not busied being switched to either a phonogram night office or to an associated sleeve control automanual board over circuits provided exclusively for the switched phonogram traffic (Fig. 2).

In director areas further complications arise with the introduction of STD because of the various methods which have been used (already mentioned) for routing the phonogram traffic. To overcome these difficulties two methods of routing will be the future standard:

(i) all the calls will be routed via the main tandem exchange, or

(ii) exceptionally, a level at a director exchange in the vicinity of the phonogram office will be used to give access to phonograms.

The night switching arrangements already described will be practicable with either of these alternatives.

When night switching has taken place the automanual operator may be required to extend phonogram calls to the appropriate night office. The telephone operator will extend the calls from ordinary subscribers as for other traffic but because coin-box discrimination facilities cannot be extended through the automanual switchboard to the phonogram operator, the telephone operator will tell the phonogram operator that the call is from a pay-on-answer coin-box and will effect the opening of the coin slot so that the phonogram operator may collect the appropriate fee. Should a check be required then the phonogram operator will recall the telephone operator who will operate the "audit" facility for her.

The Public Relations Department

WE hope to publish in our next issue an article by the Public Relations Officer on "Public Relations and the Telecommunication Services." The PRD appears in this issue as the subject of our departmental feature as a preliminary to that article.

Oddly enough the PRD, representing one of the newest developments in the life of the Post Office, is the oldest *department* in Headquarters. When it was founded in 1934 the Headquarters directorship, under the two Ministers, consisted of a Secretary to the Post Office as permanent head, with only two Directors, for Postal Services, and Telegraphs and Telephones respectively. The Bridgeman Committee on the organization of the Post Office had reported in 1932 and it was not until 1934 that, following its recommendations, the permanent head became a Director General. Regionalization, also recommended, started in 1937, and gradually, through years of growth, the two administrative departments have been expanded and sub-divided until there are now nine.

The PRD, charged with publicizing the Post Office's many services, stimulating customers' co-operation in using them to their best advantage, and reflecting public opinion on the services to the administration, has to work in close co-operation with these nine Headquarters departments—and with the Post Office Savings Bank, the Engineering and the Accountant General's departments. It is equally concerned to co-operate with the 10 Directors in the regions and with all supervisory officers down to Head Postmasters and Telephone Managers. It is a small department, with a staff of only 40 at Headquarters but working closely with the 10 Regional Public Relations Officers in the field.

The head of the Department, the Public Relations Officer, is an expert in his subject, drawn from outside the Post Office. Ranking as an Assistant Secretary, he is the direct adviser of the

Left to right: Mr. J. EVANS, Deputy Public Relations Officer; Mr. K. J. LEY, Chief Press and Broadcast Officer; Mr. T. A. O'BRIEN, CBE, Public Relations Officer; Mr. F. B. SAVAGE, Controller of Publicity; Mr. John L. YOUNG, Controller of Publications.

Ministers on public relations and attends all meetings of the Post Office Board, the Minister's Committees, and all conferences of Regional Directors, Telecommunications Controllers and Postal Controllers.

He has an administrative Principal as Deputy Public Relations Officer, and three Controllers as heads of the Press, Publicity and Publications divisions respectively.

The Controller of the Press and Broadcast Division—the Chief Press and Broadcast Officer—is a journalist who heads the Press Room and organizes the flow of written and oral information to the Press and broadcasting authorities, as well as Press conferences, the attendance of the Press at all public events, and special facility visits by groups of newspapermen. In the other direction he keeps the administration informed about Press reaction to Post Office policies. Under him a special officer maintains liaison with the broadcasting authorities.

The Controller of the Publicity Division plans and produces commercial advertizing, posters, exhibitions, booklets, leaflets, notices, films and school projects, maintains the Photographic Library and organizes Market Research.

The Controller of Publications supervises the production of the *Post Office Guide* and associated publications, and the *Post Office Magazine*, edits the *Post Office Telecommunications Journal* and personally prepares briefs for ministerial and other speeches, and special articles.

Many activities of the PRD are hardly classifiable among these main categories; these include particularly the Social Surveys by which the Department ascertains the opinions of customers about Post Office services, hospitality, ceremonies, care of foreign visitors, local Advisory Committees and so on. As the Public Relations Officer is Joint Chairman of the Internal Relations Panel (non-engineering) the Secretary of this IRP is a member of the PRD.

The 10 Regional PROs are strictly employed under their respective Directors but, working in close association with the PRD, they attend a twice yearly conference about current public relations problems under the chairmanship of the PRO.

The Public Relations Department is, in fact, the creator, in close co-operation with the administrative departments, of the wide variety of publicity and advertizing which seeks to support the primary officers of public relations of the Post Office—the men and women throughout the country who are in daily contact with our 50 million customers.

Telephone Charges Increased

The Postmaster General, announcing on July 24 increases in charges for some Post Office services, said that since the last tariff increases in 1957 wages and price increases had added £55 million to the Post Office bill and that no less than £25 million would fall in the current year. He expected to absorb two-fifths of this £25 million but even so must raise a further £25 million in a full year to maintain financial soundness and to prevent a sharp increase in dependence on the Exchequer for capital. He had decided to raise £16½ million from the telecommunication services and £8½ million from the postal services.

The principal changes in telephone charges are:

Annual telephone rentals by £2, the rental for exclusive business lines rising to £16 and for exclusive residential lines to £14.

Telephone connexion charges doubled, from between 15s. and £5 to between 30s. and £10.

Connexion charges for long lines—where the subscriber is more than three miles from an exchange—were increased, but the excess rental charge was abolished.

The connexion charge increases came into force on July 26 and the increased rentals will date from the first accounting period in or after November 1.

Miscellaneous and private wire charges are being rationalized and many of them increased.

The increases in telephone charges are estimated to bring in £16½ million during a full year.

The principles in deciding which charges were to be raised were that the increases should apply to services run at a loss (inland printed papers, samples, newspapers and parcels, the postage on which will be increased from October 1) and services which, like telephones, demand a high rate of investment but which are not providing adequate return on capital.

Electrical Protection of Telecommunications Plant

S. J. Little, M.I.E.E.

THE protection of telecommunications plant against the effects of lightning discharges and contacts with power lines has been the concern of telecommunication engineers for many years. In the early days, the primary risk was lightning and, before about 1895, it was the practice to provide only lightning protectors at the exchange and subscribers' premises. During the 1890s, however, rapid developments took place in the electric power industry, in particular in electric tramway systems, and after a number of fires had occurred in telephone exchanges in various cities abroad because of contact between tramway trolley wires and overhead telephone wires, telecommunications engineers directed their attention to reducing the risk from this source.

In the United Kingdom the solution was to fit fuses, lightning protectors and heat coils to the lines; Fig. 1 shows the arrangement of these components. To mount these units and to terminate cables, an iron structure was evolved. This became known as the Main Distribution Frame (MDF) and the early physical design of this frame was continued with only minor changes for more than 60 years. Street cables were terminated in cable pair numerical order, on fuse mountings on the line side of the frame. On the opposite or exchange side were units carrying lightning

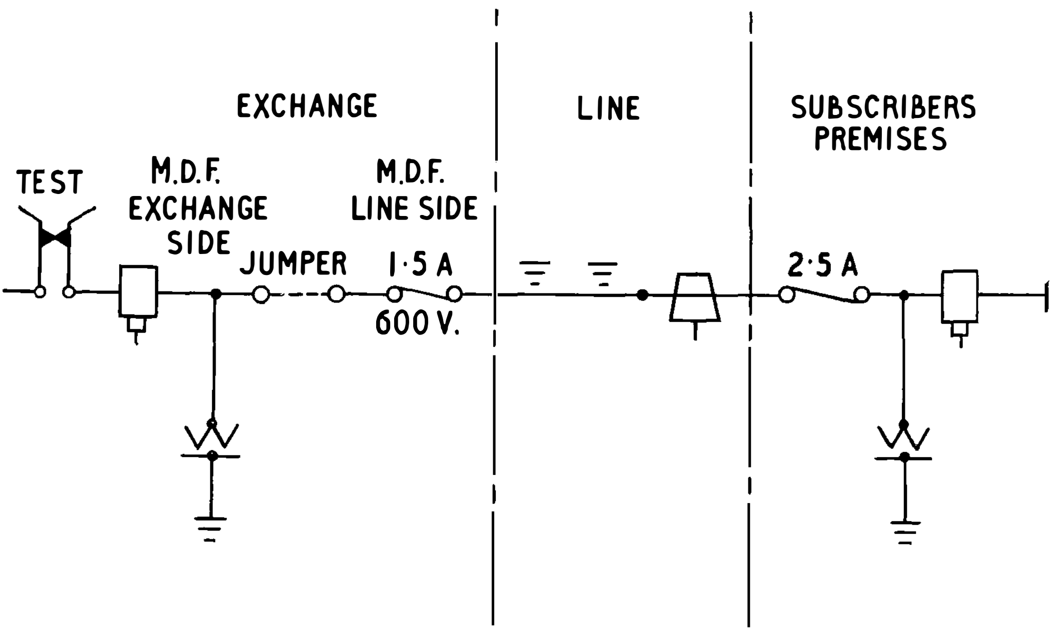


Fig. 1 : Early protection arrangements

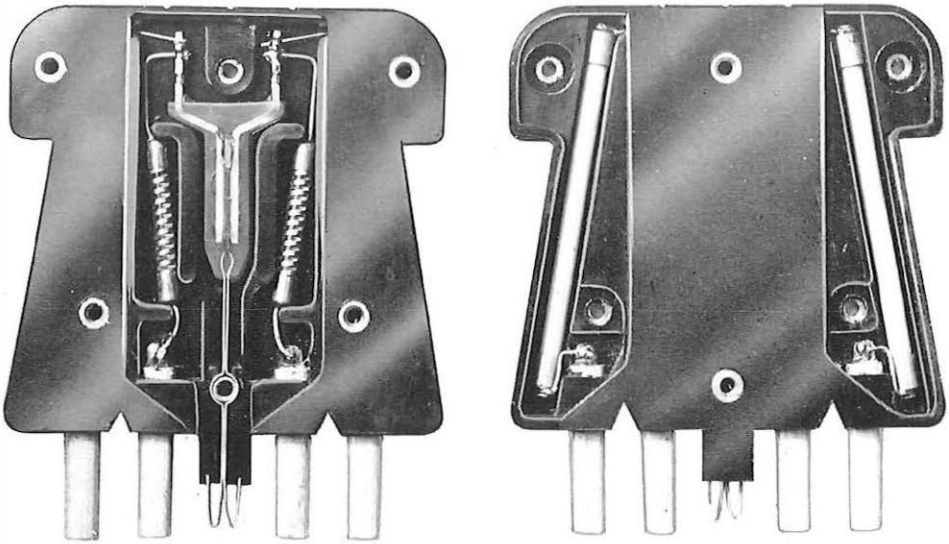


Fig. 2 : Worksop fuse and protector plug

protectors and heat coils, the exchange equipment being connected to these units. The units on both line and exchange side of the frame were mounted in vertical columns, the former having on each column a capacity for 220 street cable pairs, and the latter for 200 internal equipment pairs. Interconnexion between line and exchange side units was by twin wires, known colloquially as jumpers.

Developments in Protection

The protection arrangements introduced in the early 1900s remained in service with only minor modification until the 1930s. It was then decided that a new protection technique should be developed which would eliminate fuses and provide heat coils or the equivalent for each circuit, with lightning protectors for overhead circuits only. Protective items were to be fitted on the line side and testing facilities on the exchange side of the frame.

These recommendations were not fully accepted, principally because of the difficulty of segregating on the MDF wholly underground lines from those containing an overhead component, and in 1938 it was decided to proceed with a trial installation at Worksop Exchange, in which heat coils were replaced by delay action fuses, the line fuses were retained and a modified type of lightning protector fitted. These components were contained in withdrawable units (Fig. 2), 300 of which were mounted on each vertical of a new type MDF. Although it was subsequently found that the delay action fuses tended to blow during lightning storms, the Worksop trial was generally satisfactory and there is little doubt that further development would have taken place if war had not broken out.

As a corollary to the Worksop experiment and stemming directly from the lightning protector developed for that trial, a new lightning protector was evolved to replace the carbon unit which had been in use with only slight modifications since the 1900s. The result was the present unit (Fig. 3) which consists of two brass electrodes separated by a cellulose acetate spacer enclosed in a plastic moulding. When the new protector was introduced, the general question of protection at subscribers' premises was considered, and it was decided that the heat coil, then fitted as standard at that point, could be eliminated.

In 1952 it was concluded that the exchange heat coil, which was a source of maintenance troubles, should be replaced by a fuse. The search for, and development of such a fuse took time, but ultimately the arrangement shown in Fig. 4 was evolved.

The new fusc which combines the characteristics of a line fuse and heat coil, consists of three portions: a helical spring, a low melting point solder bead and a fuse wire. Most of the electrical resistance of the element is in the fuse wire which, when sufficient current flows through it, develops enough heat to melt the solder bead. The spring then retracts and the fuse is open circuited. Originally the fuse was designed as a 600 volt unit,

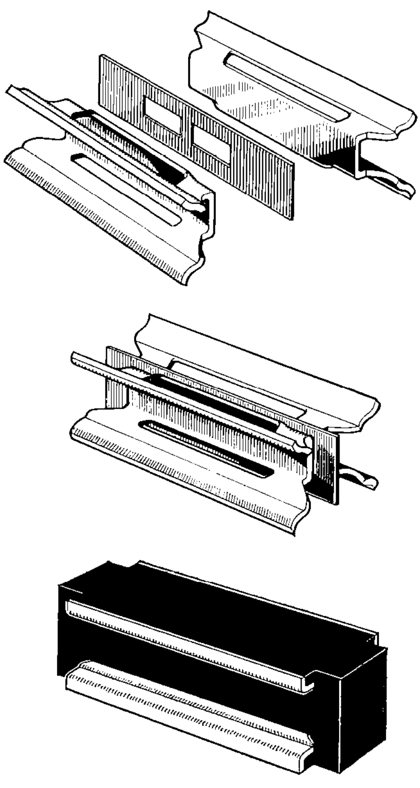


Fig. 3 : Lightning protector—Protector Electrodes No. 1b

but as explained later, it has been found possible to reduce its rating to 250 volts.

For field trial pairs of fuses were mounted in a carrier designed to plug into a unit fitted on a standard MDF, there being 300 carriers, in groups of 30, on each vertical. The new arrangement was brought into service at Spring Park Exchange, London Telecommunications Region, in 1959. While for various reasons the arrangements adopted at Spring Park have not been standardized, the experiment demonstrated that the increased concentration of jumper wires which would occur on a new, more compact MDF, could be accommodated and the experience gained materially assisted subsequent development.

In 1957 attention was directed to the possibility of further modifying protection arrangements at subscribers' premises, primarily with the object of reducing capital and maintenance costs. Investigation showed there was a case for omitting all protection at subscribers' premises fed by wholly underground or short overhead lines, while for longer overhead lines, a lightning protector only was required. The new policy at subscribers' premises thus became: entirely underground circuits—no protection; circuits with four or fewer overhead spans—no protection; circuits with more than four overhead spans—lightning protection only.

Review of Protection Arrangements

Although attempts have been made in the past to modify exchange protection arrangements it was not until recently that a concentrated attack was made on the problem. This arose from the realization that if protection could be so modified that the physical dimensions of the MDF could be reduced, then considerable economies would be achieved, particularly in building costs. A critical review of the protection components was, therefore, undertaken.

The first item to be considered was the heat coil. It was found that a large number of these failed every year and in an effort to determine the causes of failure, all the heat coils in four exchanges, some 14,000 in all, were replaced by new items and their performance watched for two years. During this period 48 failed, 40 from mechanical causes. Of the remaining eight, three showed signs of electrical operation which could be related to known power contacts. Five also showed signs of electrical operation but no power contacts could be traced. On this evidence the heat coil could hardly be said to be a good investment.

Complementary to this investigation, information was collected about damage to exchange and subscribers' equipment consequent upon power contacts. This showed that over a period of two years there were 115 occurrences of damage to exchange equipment and 34 to subscribers' apparatus. In some instances the protection equipment operated but in quite a number of others it failed to safeguard Post Office plant.

The next item to be examined was the exchange line fuse. This was rated at 600 volts, a parameter fixed in the early 1900s when the major risk was that of contact with traction circuits operated at 600 volts DC. Assessment of damage has shown, however, that the risk is now from 240 volts 50 c/s supplies. It follows that the voltage rating of the fuse can safely be reduced to say 250. This has the immediate effect of reducing its physical length, with consequent space savings.

Finally, the lightning protector became a subject for investigation. Here an analysis of some 6,000 occurrences of lightning damage showed that the plant most vulnerable to such damage was underground cable continuations of overhead lines, the most vulnerable point being the cable in the immediate vicinity of junctions between overhead and underground parts of the external network. Lightning protectors at the exchange gave no protection at these points and it was evident that if lightning damage is to be reduced, lightning protectors are required not at the MDF but where underground lines from an exchange change to overhead.

New Standards of Protection

These considerations, coupled with field experience, led to the conclusion that, to meet present-day conditions, protection of subscribers' lines should take the form of sensitive fuses at the exchange with lightning protectors at the subscribers' premises and at the junction of the overhead and underground parts of a line. Lightning protectors could, however, be dispensed with if only a short length of overhead line was involved and a length of four spans has been chosen as the limit.

The new protection standards are, therefore, as shown in Fig. 5. The availability of the new fuse described earlier facilitated introduction of the new standards but as it is rated at only 200 mA it cannot be used on power feeding conductors to PBXs or ringing supply leads. Such circuits will therefore

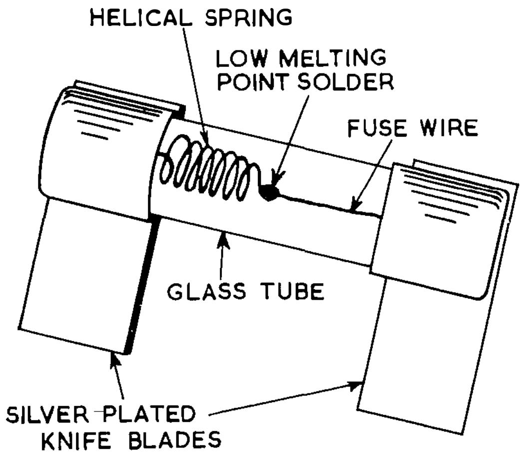


Fig. 4 : The new fuse

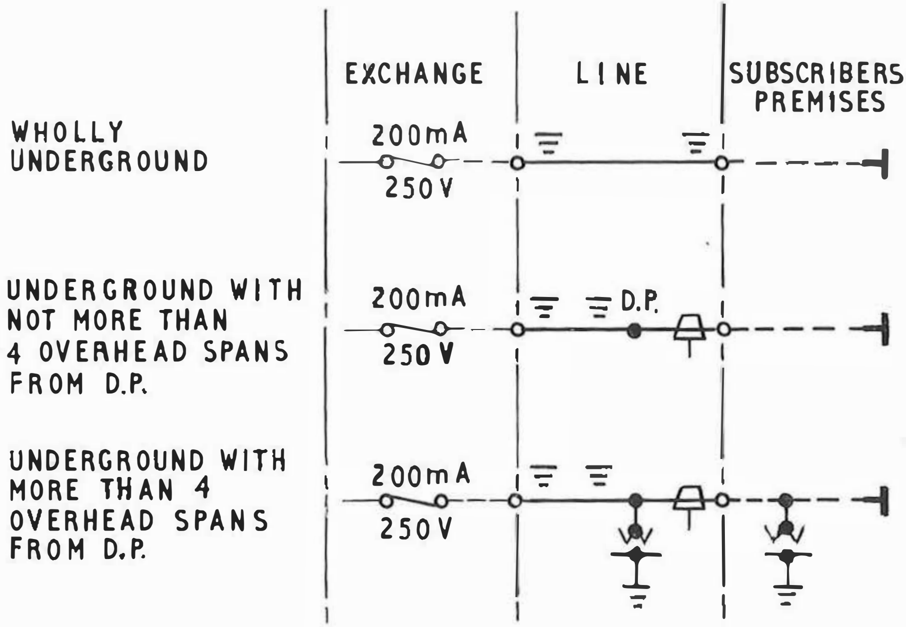
be fitted with dummy fuses. These are metal links with an insulated body having the same size and shape as the new fuses. Lightning protectors for the new standard will be those illustrated in Fig. 3.

New Main Distribution Frame

As stated earlier, the physical form of the MDF had changed little since its introduction. The changes in protection standards did, however, enable the frame to be redesigned to simplify manufacture and installation and reduce the floor space occupied. Thus, whereas the old frame was built of individual iron work assemblies which required to be concreted into the floor, the new frame is made up of separate assemblies which are sufficiently stable to stand on an existing floor without any special preparation. Separate units are provided for the termination of street and internal equipment cable pairs and each unit has a capacity equivalent to eight of the old verticals and yet occupies only the floor space formerly taken by four verticals.

The fuse mounting of the new MDF has been designed to accommodate the new 250 volt, 200 mA fuses. The basic unit is a two circuit assembly, that is, it holds four fuses. Twenty assemblies are built into a fuse unit (Fig. 6) which thus provides protection for 40 circuits. Ten fuse units are fitted on each vertical with fuses mounted on the left hand side as seen from the front, and jumper tags on the right.

Simple interception jacks only are fitted on the



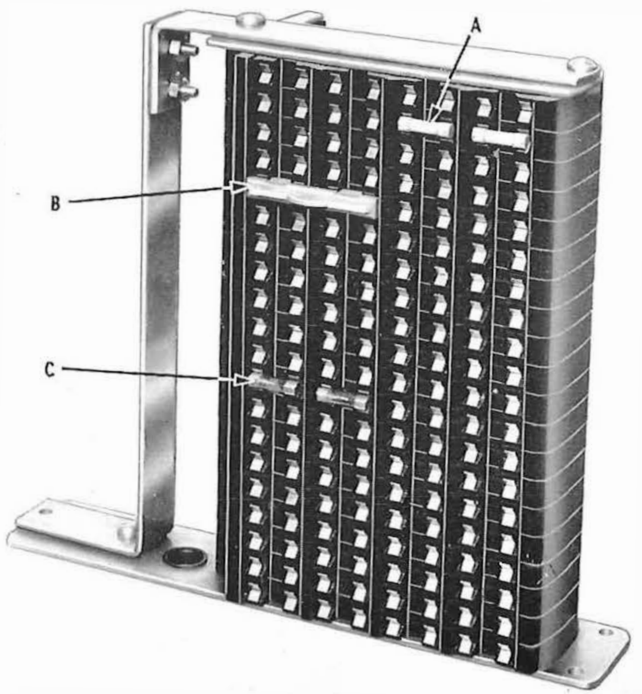


Fig. 5 (above) : **The new protection standard**

Fig. 6 : New fuse unit
A are dummy fuses
B are fuse covers
C are fuses

exchange side of the new MDF to give access for test purposes to external lines and internal equipment.

Although the MDF is the point at which protection units are fitted and testing can be carried out, it also provides interconnexion between street cables and internal equipment. Such interconnexion must be a simple matter and not, so far as is practicable, subject to congestion. On the old MDF such congestion tended to arise largely because it was difficult to recover jumper wires no longer required and to the obstruction caused by short jumpers crossing at right angles to the normal flow. The new MDF has been designed to avoid these disadvantages.

While the old MDF, with its protection components has served the Post Office well for many years, the new design not only meets changes in conditions in the telephone system and the risks to which that system is exposed but also gives greater circuit terminating capacity with consequent savings in exchange building costs.

CANTAT nears completion

This year CANTAT is being laid—the first British-designed transatlantic telephone cable, and the first link in the Commonwealth round-the-world submarine cable network. H.M.T.S. *Monarch* is laying 1,900 nautical miles of cable, including 1,500 miles of the new armourless lightweight cable, and 85 two-way rigid repeaters between Oban in Scotland and Hampden, Newfoundland. The cable is extended to the terminal station at Corner Brook on the west coast of Newfoundland over a 72 mile land section.

Ten thousand volts at 430 mA will be required to power the submerged repeaters, and special constant current units at the terminal stations each provide half the total system voltage.

At Oban a new terminal building houses this equipment, with the associated transmission equipment which translates the 60 standard telephone channels to and from the cable frequency bands.

All submarine terminal equipment is rigorously checked at all stages of manufacture and is extensively tested before being installed. On completion of the installation a further exhaustive series of tests ensures fault free operation of these important transmission paths. Comprehensive monitoring facilities are built into the submarine terminal equipment with pen recording instruments giving long term data on the satisfactory operation of the system. A control console is being constructed which will give meter and lamp displays of vital information from the CANTAT system so that in the event of a fault in the terminal equipment immediate changeover to a standby transmission path can be made by push button control. Automatic changeover to a reserve power unit is a feature of the cable power feeding equipment.

Installation and testing of all equipment is in an advanced stage of completion and the main transmission paths required for cable laying operations are now ready.

Early in April, *Monarch* laid the first cable section, comprising 700 nautical miles of cable, 30 submerged repeaters and two submerged equalizers. This section, in part, is conventionally armoured to afford additional protection against possible trawler damage on the Rockall Bank fishing grounds.

The second cable section, laid in June, comprises 780 nautical miles of lightweight cable, 30 repeaters and 3 equalizers. The final laying operation in early autumn will complete the transatlantic link.

The St. Lawrence submarine cable system carrying transatlantic circuits to the Canadian mainland will also be laid during the summer by the new cable ship *Alert* and an intensive programme of overall testing and lining up will then be carried out to ensure that all circuits are of the highest possible quality and ready for public service.

The provision of an additional transatlantic cable has caused problems at the Metropolitan terminals and the London International Exchange will be moved to larger accommodation in Faraday Building. On both sides of the Atlantic telecommunications staff are actively engaged in ensuring that all is in readiness for the opening in November of this new transatlantic telephone link.

R. H. Franklin

Telecommunication Statistics

In this issue we present some figures for the complete financial year to March 31, 1961, compared with those for the two previous years.

	March 31st 1959	*March 31st* 1960	*March 31st* 1961
The Telephone Service at the end of the year			
Total telephones in service ...	7,532,500	7,855,700	8,280,400
Exclusive exchange connexions ...	3,464,500	3,652,300	3,894,400
Shared service connexions ...	1,141,600	1,131,700	1,142,400
Total exchange connexions ...	4,606,100	4,784,000	5,036,800
Call offices ...	73,300	73,700	73,900
Automatic exchanges ...	4,982	5,088	5,190
Manual exchanges ...	1,027	921	811
Orders on hand for exchange connexions ...	145,000	143,700	169,800
Work completed during the year			
Net increase in telephones ...	206,400	330,100	422,300
Net exchange connexions provided ...	368,900	429,900	489,600
Net increase in exchange connexions ...	106,500	177,900	252,800
Traffic			
Inland telephone trunk calls ...	340,000,000	383,000,000	422,000,000
Cheap rate telephone trunk calls ...	79,000,000	85,000,000	98,000,000
Oversea telephone calls:			
Outward ...	2,678,000	3,096,000	3,356,000
Inward ...	2,596,000	3,035,000	3,400,000
Transit ...	290,000	80,000	83,000
Inland telegrams (excluding Press and Railway) ...	13,000,000	13,000,000	12,000,000
Greetings telegrams ...	3,000,000	3,000,000	3,000,000
Oversea telegrams:			
Originating U.K. messages ...	6,251,162	6,421,000	6,369,000
Terminating U.K. messages ...	6,292,001	6,448,000	6,454,000
Transit messages ...	5,607,945	5,635,000	5,496,000
Inland telex calls ...	3m. calls from manual and auto. exchanges. 2m. metered units from auto. exchanges	4m. calls from manual and auto. exchanges. 8m. metered units from auto. exchanges	2m. calls from manual and auto. exchanges. 37m. metered units from auto exchanges
Oversea telex calls:			
Originating (U.K. and Irish Republic) ...	1,944,335	2,429,000	2,948,000
Terminating (U.K. and Irish Republic) ...	1,886,869	2,311,000	2,773,000
Transit ...	41,398	31,000	105,000

NOTES

During the year the telephone order list increased from 143,700 *to* 169,800. *At the end of the year* 115,000 *applications for service were in process of being met and* 54,800 *were waiting cables or exchange equipment.*

The oversea telephone services were extended by opening service with Burma and Sarawak. The total number of calls over the first Transatlantic Telephone Cable was 498,358 *(excluding those on circuits leased to Continental countries for public traffic. Since May,* 1960, *these leased circuits have been charged for on an annual rental basis). There was an increase of traffic of* 11 *per cent. with Canada and* 14 *per cent. with the United States during the year, based on corresponding traffic figures for* 1959-60.

Conversion of the inland telex system to automatic working was completed in December, 1960. *During the year the number of subscribers lines increased from* 5,923 *to* 7,089.

By March 31, 1961, *there were oversea telex services between the United Kingdom and* 54 *countries.*

(Comet 4 Jetliner, by courtesy of BOAC)

Circuits for International Civil Aviation

P. T. F. Kelly, B.Sc.(Eng.), A.M.I.E.E.

WITH the introduction of high-speed jet-propelled aircraft on the North Atlantic air routes the International Civil Aviation Organization (ICAO) requires a very reliable communications network linking the various oceanic air traffic control centres and other centres concerned with the operation of air traffic over the North Atlantic.

The concerned member states of ICAO met in Paris in January 1959 and recommended that the facilities required in the North Atlantic area should be provided by leasing circuits in the proposed SCOTICE and ICECAN submarine cable systems which were at that time being discussed as a means of linking Scotland with the Faroes, Iceland, Greenland and Canada (Newfoundland).

One of the facilities required by ICAO was an omnibus speech circuit linking the Oceanic Air Traffic Controllers at Shannon (Ireland) and Redbrae (near Prestwick, Scotland) with those at Reykjavik (Iceland) and Gander (Newfoundland), and with an air/ground radio operator at Prins Christian Sund (Greenland) through whom contact could be made with individual aircraft in that area. Occasional access via Gander was also required with the Air Traffic Controller at Goose Bay (Labrador).

Selective calling facilities were required on the circuit so that individual controllers could be called but, in addition, a master facility was required so that in an emergency all controllers could be called simultaneously by any one station.

To set up such a circuit some 4,000 miles long close co-operation between the various telecommunications and civil aviation administrations concerned in the various countries is necessary. To determine the technical requirements of the facilities ICAO needed a joint meeting was held in London in July 1960, which representatives of the civil aviation and telecommunications administrations from the United Kingdom, Irish Republic, Denmark, Iceland and Canada attended. Detailed requirements were discussed and the administrations agreed to go ahead on the basis of a common technical design and performance.

The plan evolved was that an omnibus four-wire speech circuit should link London with Vestmannaeyjar in Iceland, via Gairloch (Scotland) and Torshavn (Faroes) and with Frederiksdal (Greenland) and Corner Brook in Newfoundland. Spur four-wire circuits would be provided from this main link to connect London with Prestwick and Shannon, Vestmannaeyjar with Reykjavik, Frederiksdal with Prins Christian Sund and Corner Brook with Gander. All the ICAO stations and the telephone repeater stations at Corner Brook and London would have access to the circuit and all the stations, including those at Corner Brook and London, would have the necessary selective calling and speaker facilities.

Corner Brook and London were added to the circuit to enable speedy restoration of service should the cable break down. ICAO required that the circuit should be restored within five minutes of the breakdown being reported. To meet such a requirement would require staffing all the main repeater stations throughout the 24 hours, which would have been uneconomic. Consequently, the administrations agreed to provide certain re-route facilities on a more or less permanent basis. To guard against submarine cable failure of either the SCOTICE or ICECAN system an alternate routing is to be made available in CANTAT via a circuit linking London with Corner Brook. Since these two stations are staffed throughout the 24 hours, a re-route can be achieved quickly when required. Fig. 1 shows the relationship of the various ICAO stations to the submarine cable systems.

Each administration agreed to arrange to cover the re-route requirements within its own inland network by standby facilities. In the United Kingdom this will be achieved by providing duplicate routes between London and the submarine cable terminal station at Gairloch and probably between London and Prestwick. ICAO have stipulated that the bandwidth of the main circuit should be not less than 300–3,050 c/s and as the bandwidth of circuits within the United Kingdom generally extends beyond 3,050 c/s excess bandwidth will be used to introduce a pilot tone of 3,200 c/s which can then readily be used to provide an automatic monitor and changeover facility on these links. Failure of the 3,200 c/s pilot frequency on the working route will thus cause the standby route to be brought into use.

At the Oceanic Air Traffic Control station at Redbrae near Prestwick the 13 operators' positions are being modified to provide the calling and speaking facilities needed. A photograph of a typical Air Traffic Control centre is shown in Fig. 2. Normally, in an Oceanic Control Centre,

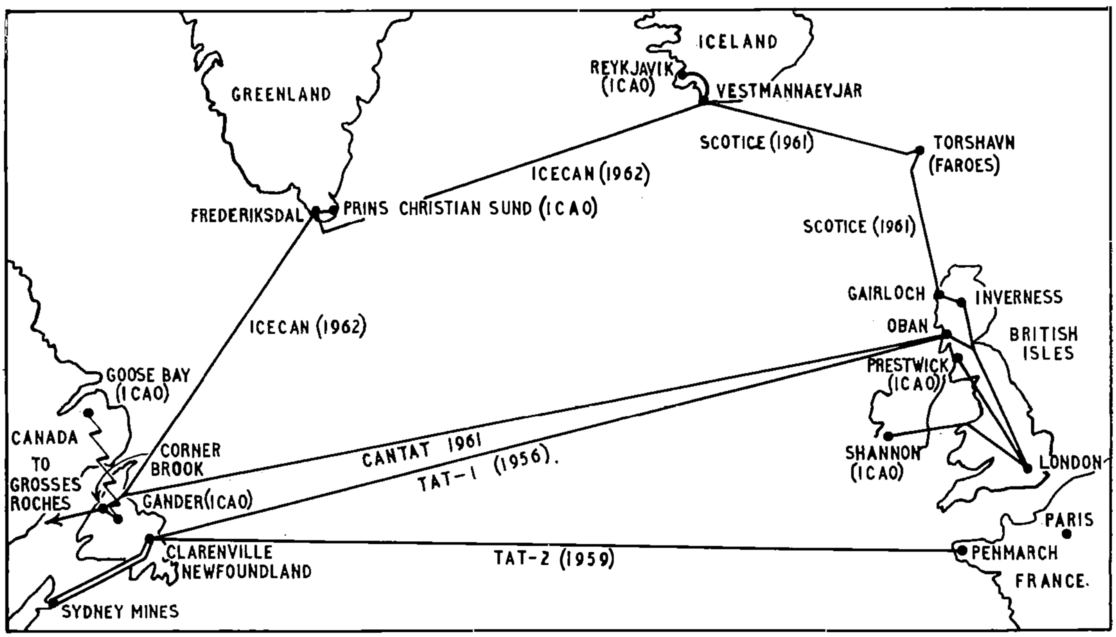


Fig. 1 : Civil aviation requirements and their relationship to the transatlantic cable system

Fig. 2 : A typical Air Traffic Control centre *(Courtesy, Ministry of Aviation)*

certain controllers deal with eastbound traffic and others with westbound traffic and these functions may be further subdivided according to the height at which an aircraft is flying. Other controllers may deal with other aspects of control than that of en-route flight.

The arrangements being introduced at each station are such that any controller may obtain any other station by dialling a four-digit code appropriate to the station to be called. Where the organization of the centre requires, several codes will be allocated, one to each of the group of controllers dealing with a particular sector. The initiation of the dialling impulses is being arranged to cause the transmission of the appropriate four-digit signalling code using alternate pulses of 600 and 1,500 c/s tones.

The use of such a two-frequency calling code has the advantage that all equipment on the route is identical and provides a signalling system which is highly immune to false operation from speech. Special codes will be allocated to enable a "Master" call to be originated, calling all stations simultaneously, and to enable the "fault reporting and switching stations" at London and Corner Brook to be obtained when required. A circuit of such length and having so many stations connected to it needs special four-wire telephones in which the transmit direction is completely separated from the return direction of transmission. Also, the switchboards are to be modified to ensure that such conditions are met. The use of four-wire telephones normally eliminates side-tone effects but it has been shown that the complete elimination of side-tone, without the presence of transmitted signals in the receiver, gives unsatisfactory conditions for a conversation; consequently, special circuitry is included in the main transmission path to provide a degree of side-tone without affecting the basic requirements of complete separation of transmit and receive paths. It is now common practice in certain administrations to record all conversations between air traffic controllers dealing with the passage of civil aircraft and a special output is provided on the equipment at each station on the circuit to enable recording of speech on the circuit.

Eventually, it is expected that the dialling facility will be replaced by a simple press-button calling device which will automatically transmit the required four-digit code appropriate to the called station or to a particular controller at a given station.

The SCOTICE submarine cable system which is being provided as a joint undertaking of the United Kingdom Post Office, the Great Northern Telegraph Company of Denmark, and the Danish and Iceland PTTs, should be completed shortly after CANTAT this year. Until the ICECAN cable (a joint Canadian Overseas Telecommunication Corporation–Great Northern Telegraph Company project) is available in 1962, an interim arrangement will be introduced to link Gander with Shannon, Prestwick and Reykjavik using the CANTAT and SCOTICE cables.

In addition to the speech circuit ICAO require four telegraph circuits between stations in the

United Kingdom, Iceland, Greenland and Canada. The circuits will be routed in Frequency Modulated Voice Frequency Telegraph systems (FMVFT), which are to be provided as part of the overall submarine cable systems. The precise usage of these circuits has not as yet been decided, but two of the circuits will probably form part of the existing Aeronautical Fixed Telecommunications Network (AFTN) and will terminate in the United Kingdom at the Ministry of Aviation's Civil Aviation Communications Centre at Croydon, where traffic can be relayed over existing AFTN circuits to the desired European terminals. Of the other two circuits one will probably be used as a liaison circuit linking the various air/ground radio operators at Gander, Prins Christian Sund, Reykjavik, Shannon and in the United Kingdom. The remaining circuits will probably be used for interchange of meteorological information.

Certain of these telegraph circuits will have to be operated on an omnibus basis in that messages originating from one station will have to be transmitted to the remaining stations on the circuit. Special conference units will be provided at selected points on the cable network for this purpose.

The telegraph circuits will initially be operated at a speed of 50 bauds (66 words a minute) but ultimately 75 baud operation (100 words a minute) will be adopted. So that the distortion limits specified by ICAO are not exceeded, regenerators will be provided at selected submarine cable stations.

ICAO have requested that restoration of telegraph circuits should be effected within 15 minutes of a cable failure. To achieve this re-route facilities will be made available via the CANTAT system in a similar manner to that planned for the speech circuit but to speed up the restoration the individual FMVFT systems themselves will be re-routed. In the event of failure, for instance, of the SCOTICE system, the London-Vestmannaeyjar FMVFT system will be re-established via a London–Oban–Corner Brook–Frederiksdal–Vestmannaeyjar link by switching to the new routing at the VFT terminals at London and Vestmannaeyjar. To safeguard the inland routing between London and the SCOTICE cable terminal at Gairloch, automatic changeover to a standby routing will take place, using an out of band pilot tone of 3,200 c/s in a similar manner to that being provided on the speech circuit.

With the completion of the CANTAT, SCOTICE, and ICECAN Submarine cable systems a reliable 24-hour communication network, which will meet all the requirements of ICAO, will be possible. Such a network will no doubt greatly assist in achieving greater safety and regularity in the movement of aircraft operating over the North Atlantic. In view of the rapid growth of such traffic, and with the possibilities in the next 10 years of aircraft on this route having speeds in excess of the speed of sound, the easy and reliable transfer of control of each aircraft to the next control station becomes even more necessary. A breakdown in communications for 30 minutes could well mean that several aircraft would have moved unannounced from one control area to the next, so full re-route facilities would be more than justified to guarantee the safety of the air lanes.

The introduction of the facilities described would not have been possible without the full international co-operation of the various civil aviation and telecommunications administrations responsible and it is to their credit that a compatible system, both operational and technical, has been evolved which will surely be adopted in other parts of the world when suitable and reliable communication facilities are available.

Post Office Honours

Mr. A. Wolstencroft, Director of Radio Services, was made a Companion of the Order of the Bath in the Queen's Birthday List.

Mr. C. W. C. Richards, Senior Executive Engineer, was honoured with the O.B.E. for services in Pakistan.

Mr. F. N. Charles, Area Engineer, Brighton Telephone Area; Mr. E. A. Emery, Executive Engineer, West Area, London Telecommunications Region; Mr. H. S. Gibbs, Chief Telecommunications Superintendent, External Telecommunications Executive, and Mr. A. J. Smith, Senior Sales Superintendent, Coventry Telephone Area received the M.B.E.

Among recipients of the B.E.M. were Mr. J. H. Knight, Technician, Class I, North West Area, L.T.R.; Mr. J. A. Moody, Technical Officer, Tunbridge Wells Telephone Area; Mr. A. P. Robertson, Technical Officer, Edinburgh Telephone Area; Mr. J. H. Stammers, Supervisor (Telegraph), Leeds, and Miss I. K. Jones, Senior Chief Supervisor, Continental Telephone Exchange.

Her Majesty's Telegraph Ship "Alert"

We reported in our Winter 1960 *issue that HMTS "Alert", latest addition to the Post Office fleet of cable ships, had been launched by Mrs. Reginald Bevins, wife of the Postmaster General, on November* 7. *The vessel was completed during April this year and, following extensive sea trials, was formally accepted by the Post Office on April* 21.

HER Majesty's Telegraph Ship *Alert* is the fourth Post Office ship of that name. Although intended primarily as a cable repair ship, to maintain the expanding network of submarine cables in the North Atlantic, she is fully equipped to lay either uninterrupted or repeatered cables and, in fact, is helping HMTS *Monarch* this summer to lay the new Anglo-Canadian telephone cable, CANTAT. She left Greenwich on June 25 on her first operational voyage after loading a total of 380 miles of cable and 20 repeaters. The cable, CANTAT B, is to run from Grosses Roches, in Quebec Province, to Corner Brook, Newfoundland, and will provide 120 circuits. From Corner Brook the cable will be linked overland to White Bay, from which point it will ultimately be connected with the CANTAT A cable terminating at Oban, Scotland.

Since leaving Greenwich, *Alert* has surveyed the route and started the lay during July 10.

Three cable tanks are built into the ship, having a total cable stowage capacity of 57,220 cubic feet, by volume and 3,040 tons by weight. With light weight cable stowing at 81 cubic feet per mile (2.3 tons per mile) about 700 miles of this type of cable can be carried, with repeaters.

The introduction of solid repeaters into cable has transformed the loading and laying of cable from a simple to a complex operation. With lightweight cable repeater spacing is usually about 26 miles, which means that 26 miles have to be loaded into the tank, then the connected repeater stored at deck level, then a further 26 miles in the tank and a second repeater on deck, and so on.

To stow the bights of cable that run from tank to repeaters, and to allow a continuous lay to take place, full depth vertical recesses are formed in the forward walls of *Alert's* Nos. 2 and 3 cable tanks for cable bight stowage. These recesses are extended beyond the cable tank top (main deck) level to the upper deck level where repeaters are stacked. Both main and upper decks are slotted from the 8-foot wide recesses to points beyond the tank centres. Tubular steel gridding between the two decks gives a converging-diverging cable exit from each tank and the facility for passing cable from the bight recesses, through a hinged gate, to the exit throat directly above the tank centre.

On the upper deck a trough extends from the forward cable tank and runs past the exits cable tanks 2 and 3 to the aft cable laying machine. Cable and repeaters run along this trough during laying operations.

Laying the Repeaters

The after cable machine is the second of its type to be made, the prototype having been in use on *Monarch* for a considerable period and having been proved a complete success. This gear is designed to allow solid repeaters to by-pass the machine and be launched overboard without the need to stop the ship. It consists of a splaying stool at which the cable is diverted and replaced by a by-pass rope, five 6-foot diameter sheaves, four of the sheaves being "Vee" sheaves while the fifth and most forward sheave has a flat tread.

All sheaves are in the fore and aft line, the aftermost three being coupled together by chain and sprockets, the remaining two being idlers in the paying out condition and having brakes fitted to produce necessary back tension.

A 250 constant current electric motor is coupled through gearing to the aftermost of the threechain coupled sheaves. In the paying out condition this motor is used regeneratively as a brake, with a water cooled mechanical friction brake. When picking up the two idler sheaves are clutch driven from the motor and provide adjustable tension to hold the cable on the three motor driven sheaves which provide the main lifting power. The gear can pick up 10 tons at 1 knot and pay out 6 tons at 8 knots.

Two picking-up and paying out gears are installed port and starboard on the main deck forward, hatches above the two hauling drums opening out to the working foredeck. Each gear has a cable drum 7 feet in diameter and is capable of lifting 30 tons at 1 knot, with proportionate increase of picking up speed for lower loads. They are designed to pay out cable over the bows at a tension of 0 to 9 tons at any speed from 0 to 8 knots. Three forms of braking are used, mechanical, hydraulic and electrical, to share the braking load or to sustain cable tension. Each cable gear is fitted with a hydraulically operated 4 speed gearbox, three for picking-up and one for paying out, and is driven by a 250 h.p. constant current motor.

Two dynamometer sheaves, together with two holding back sheaves, are installed for use with the two cable machines. Control of the two forward cable gears is centralized remotely in a small Deckhouse overlooking the foredeck.

Bow gear consists of three cast steel "Vee" sheaves, 7 foot diameter on the tread. A gantry and electrically operated hoist and traversing winch are fitted at the bows to enable repeaters to be hoisted inboard, or placed outboard, during forward cable laying or repairs.

A taut wire machine is fitted aft, the purpose of which is to enable the distance travelled and ship's speed to be measured with accuracy. In operation a high tensile steel "piano" wire is weighted and placed overboard. When the vessel moves away at the start of a lay this thin wire remains anchored and the distance between ship and anchor is bridged by wire which is pulled from a reel containing usually about 120 miles of the wire. On its way overboard the wire almost completely laps and drives a carefully dimensioned pulley which is free to rotate. Rotation of this pulley is transmitted via Selsyns to a "Slackometer" unit in the control room where it is there translated into ship's speed and distance travelled.

Slackometer Unit

Selsyns (electrical means of transmitting movement from one point to another) connected to the dynamometer sheaves also feed into the Slackometer unit where the sheave revolutions are similarly dealt with and can be read off as cable speed and cable length. The Slackometer unit also compares cable length with distance travelled, from the start of the lay, and gives a continuous and visual indication of thc percentage of cable slack being payed out. Working from this instrument, cable tension is adjusted to give the predetermined percentage of slack cable required.

The testing room, 37 feet long by 13 feet wide, has a wide selection of testing instruments to enable a large variety of tests to be made, both for fault location and to check the characteristics of cable as it is being laid. Adequate space is provided for installing temporary specialized equipment, or to accommodate any further permanent additional equipment which may be required.

A full range of navigational instruments has been provided to facilitate the precise navigation essential to cable work. The master gyroscopic compass feeds repeaters at various positions in the ship in addition to the usual magnetic compasses. Steering can either be by hand or automatically gyro-controlled, the Voith-Schneider propeller being particularly useful at lower speeds. Radar, Decca Navigator and Loran units are installed to give the means of locating the ship's position either inshore or in the open ocean. The normal distance log, and a combined speed and distance recorder, are augmented by a taut wire distance recorder which operates during cable laying and provides an accurate means of assessing distance travelled.

Propelling Machinery

Four 8-cylinder diesel engines, each rated 1,860 b.h.p., run at a constant speed of 428, each driving one main generator. The four main generators each have an output of 895 at 428. *Alert* is twin screw, and each propeller shaft is driven by a main propulsion motor rates 2,200. Two distinct controlled constant current loops are formed, each embracing one propulsion motor and either one or two of the four main generators. To avoid complex switching arrangements there is no connexion between the motor of one and the generators of the other loop. An amplidyne exciter maintains the field strength of each motor at constant maximum value, the propeller torque being controlled by variation of the main circuit (armature) current which is maintained constant at any selected value by means of an amplidyne exciting the main generators.

Any main generator can be taken out of or put into circuit by interlocked switches which prevent any incorrect sequence of operation. Reversal of rotation is achieved through reversing contacts for the propeller motor amplidyne fields and by small potentiometers for the generator amplidyne fields, which are directly coupled to controllers forming part of the engine-control telegraph system.

The telegraph system permits direct telegraph control from either bow or stern locations from which control is necessary on cable work. On the Navigation Bridge transmission of the desired movement to the Engine Room requires acknowledgement before it is automatically effected. Any movement of the bridge telegraph immediately removes control from bow or stern.

Auxiliary Equipment

For the supply of electricity for lighting and power purposes six auxiliary generators are installed. Four of the six are coupled in tandem with the four main generators, the remaining two are independently driven by auxiliary diesel engines. Each of the auxiliary generators has an output of 300 and all run at 428. An auxiliary 1,000 amp constant current loop supplies the higher auxiliary power requirements; this loop includes the two forward cable engine motors, the aft cable engine motor and the driving motor for the transverse thrust Voith-Schneider propeller. This 1,000 amp loop is true constant current, torque and control in this case being obtained by varying motor field strength and reversing field current direction as required. An amplidyne controls the field of the auxiliary generators to ensure the maintenance of the constant current value. Any one of the six auxiliary generators can be used to supply either constant current or constant voltage.

To assist in handling the ship at low speeds, or when stopped on cable work, a Voith-Schneider propeller is fitted in a transverse tunnel located well forward in the vessel. This propeller gives a side thrust of 2½ tons to either port or starboard and is hydraulically controlled from either Bridge, Bow or Stern positions.

Windlasses, capstans, and a 4½ ton lift deck crane, are all electrically driven from the auxiliary generator constant voltage supply.

Accommodation

The new *Alert* can carry a total complement of 102, and there are 12 spare berths for the occasional use of Cable Representatives. Captain, Chief Engineer and Chief Officer are provided with suites, all other Officers and Petty Officers with single berth cabins, and the remaining personnel with double berth cabins. Officers, Petty Officers, and crew each have their own messrooms and recreation rooms, all of which are air-conditioned in addition to being mechanically ventilated. A well-equipped workshop is provided for the use of the crew in which they can indulge their various hobbies. The extensive use of "Formica" in alleyways and rooms throughout the ship gives a true impression of cleanliness and hygiene.

Mr. W. Stubbs, CBE, MC, has succeeded Mr. W. W. Shaw-Zambra, CVO, CBE, as Secretary General of the Commonwealth Telecommunications Board. Mr. Stubbs was formerly Director General of Telecommunications in the Malay Federation and Singapore. Mr. Shaw-Zambra had been Secretary General since the CTB was formed in 1949, and was formerly Secretary of its predecessor, the Commonwealth Communications Council.

Developments in Data Transmission

It is in the long-term interests of data users to adopt their working methods to suit established telephone and telegraph networks, said Mr. M. B. Williams, Post Office Engineering Department, at a conference attended by 300 representatives from industry and commerce interested in data processing systems and methods.

Where telegraph speeds (50 bits per second) are adequate either private circuits or the telex system can be used. A telex call can now be set up in the usual way in the United Kingdom, switched to data transmission, and use any code or message structure up to the 50 band modulation rate, provided only that combinations simulating clearing conditions are avoided. Facilities are being developed for automatic error control using the duplex facility which can be provided in the United Kingdom telex network. Greater scope for data transmission is given by the telephone network. Up to 2,000 bits per second serial transmission is possible on private circuits and up to about 1,000 bits per second on calls set up on the public telephone network.

Post Office Preparation

Scope seems to exist for a simple parallel-type of data transmission system. The Post Office is preparing for the supply on rental terms of terminal modulator/demodulator equipment which will handle data up to 1,000 bits per second on the public telephone network. The user will provide input, output and error control equipment.

The need was stressed for standardization of the input and output connexions of data handling equipment so that such terminal equipment could be matched without difficulty to customers' apparatus. The existence of an American standard for the "Interface" was pointed out.

Data is usually transmitted in blocks of characters and errors come in unpredictable bursts; consequently, in practice, users wanted to know how much good time they could expect on a circuit and what percentage of blocks could be successfully transmitted. Figures on error rates are generally given on this basis for all types of circuits, and percentage rates of the order of 98 or 99 per cent. are generally being achieved. Concluding with a review of wideband circuits which could be made available from main line telephone plant, Mr. Williams pointed out that a 48 kc/s (12 channel) bandwidth seemed a very convenient and useful link which, in future, could probably be provided fairly generally both nationally and internationally.

Mr. P. A. Long, Inland Telecommunications Department, reported the results of an approach to some 300 electronic computer users and potential users to ascertain whether they were likely to need telecommunication channels for transmitting data between their various branches and a computer centre. Results indicated that there would be a demand for appropriate facilities and that present type of circuits—private telegraph and speech type circuits, telex and the public telephone network—would probably meet the most needs for some time.

Character Recognition

On character recognition it was suggested that ideally all members of a staff and all members of an automatic data processing (ADP) system, both human and machine, should be able to read the same language. There were many ingenious devices and schemes for achieving this; some involved magnetic ink and specially formed characters, while others scanned printed matter (even handwriting). A common factor was that it was essential to place the document in such a way that recognition or reading could proceed and it might well be that even if a general character reader were developed its cost might be outweighed by the cost of changing all the relevant documents to a standard specialized form.

A speaker on Document Handling pointed out that it was not sufficient merely to install a computer to mechanize existing work; it was essential to overhaul the firm's method of working if any worthwhile improvement was to be obtained from a computer. Another speaker described DORIS (direct ordering, recording and invoicing system) devised by Shell Mex and BP to deal with customer's orders, a system which dispenses entirely with documentation. Telephone orders are recorded as punched paper tape by depressing keys in sequence. Each key controls equipment which contains pre-recorded information of customer's name, delivery address, quantity, and so on. Orders can be taken rapidly and accurately and the whole system is admirably suited to the needs of the Company.—*J. R. Bonner*.

RAF Data Processing

The Air Ministry has ordered a £600,000 A.E.I. electronic computer for the Royal Air Force Station at Hendon. The computer should be in service by Spring, 1962, and will provide the RAF with a unique means of controlling the ordering, distribution, and stock control of some 700,000 stores items for their aircraft and guided weapons. Communication links will be provided between the computer centre and every major RAF station at home and overseas.

The Post Office is providing the communications network and terminal equipment to deal with the daily programme. Up to 4,000 transactions an hour will be received during the day. They will be processed by the computer during the night and action messages will be produced and sent to stores depots and to the originators of the transactions before 8 a.m. Some transactions having special priority will be processed within an hour of receipt. Most RAF stations at home will send and receive data over the teleprinter automatic switching network now used by the Air Ministry for administrative traffic, but some very busy stations will have direct circuits to Hendon.

The Post Office's newly designed error-detection equipment will be provided on all circuits. Oversea data will be sent and received over error corrected duplex radio links terminating at Hendon.

Telephone Story at Radio Show

The Post Office display at the 1961 Radio Show presented dramatically the story of the telephone from the day when Sir William Preece, then Engineer-in-Chief, introduced it into this country, to a forecast of the future, when telephone calls may be transmitted via space satellites.

The setting was a high ceilinged circular room, the lights dimmed and music in the background. The music faded and a voice spoke; the story was unfolded orally and visually, passing through 80 years of progress and growth to Subscriber Trunk Dialling and the new pay tone.

A skyline of London dominated by the new Museum Tower was presented, the commentator explaining how it will be used as a centre for microwave radiotelephone trunk circuits. Developments in world-wide cable, dialling between countries and continents, were shown.

Finally, a model space satellite floated above the earth's surface with lines of light showing how radio signals sent into space can be bounced back.

OUR CONTRIBUTORS

J. H. BROADHURST ("The Post Office Circuit Laboratory") is a Senior Executive Engineer in charge of the Circuit Laboratory. Entering the Post Office as a Youth-in-Training in the Canterbury Area, he spent eleven years on general maintenance duties, and in 1934 went to the Engineer-in-Chief's Training School at Dollis Hill as an instructor. Promoted Inspector in 1935, he was transferred, after two and a half years in the Correspondence School, to Telephone Branch of the E-in-C's Office. He spent the years from 1941 to 1944 as a Chief Inspector in Aberdeen Telephone Area, and returned to Telephone Branch as an Executive Engineer in 1944, where he worked on trunk mechanization and cordless switchboards until 1953 when he was promoted to Senior Executive Engineer, taking up his present post in 1955.

P. T. F. KELLY ("Circuits for International Civil Aviation") joined the Post Office London Telecommunications Region, South West Area, as a Youth-in-Training in 1944. After a short period at the Central Engineering Training School at Stone he was appointed Assistant Engineer in 1948 in the Engineering Training Branch, transferring to the Transmission and Main Lines Branch on promotion to Executive Engineer in 1950. In 1953 he joined the project team planning the first transatlantic telephone cable system and on promotion to Senior Executive Engineer in 1957 was engaged on planning and developing European submarine cable schemes, including the recent systems to Sweden and the SCOTICE project. At present, he is working on planning the TAT 3 project. In the course of his duties he has travelled several times to the United States, Canada and the Continent of Europe.

S. J. LITTLE ("Electrical Protection of Telecommunications Plant") is a Senior Executive Engineer in the External Plant and Protection Branch of the Engineering Department. He entered the Post Office as a Youth-in-Training in the North Power Section of the London Engineering District. In 1936 he became a Probationary Inspector and spent the next 17 years as Inspector, Chief Inspector and Executive Engineer on Power work in the London Telecommunications Region. In 1953 he transferred, on promotion, to his present branch where he has been concerned with problems relating to the protection of Post Office plant from contact with, and induction from, power systems.

H. H. SIMMONS ("Materials Handling in the Supplies Department") began his Supplies Department career as a Clerical Officer in 1924. He was promoted to Executive Officer in 1939 and during the war served with the Army in the Western Desert, Egypt, Palestine and Transjordan, reaching the rank of Major. Returning to the Post Office he was promoted to Higher Executive Officer in 1945 and to Senior Executive Officer in 1949 when he took charge of the Uniform Clothing Depot at Hook. In 1950, he became Deputy Depot Manager, London Engineering Group, being promoted to Depot Manager (Senior Executive Officer) in 1952. He took up his present post of Assistant Controller of Supplies (Senior Chief Executive Officer) in 1954.

(Continued overleaf)

Principles and Practices for Students

Telecommunications Principles and Practice by W. T. Perkins (George Newnes Ltd., London, 1961. 3,844 pp. 21s.) is a completely revised edition of a well proved book for students studying for the intermediate grade of the Telecommunications Technician Certificate of the City and Guilds of London Institute. It covers the syllabuses of two subjects: Elementary Telecommunications Practice, and Telecommunications Principles A. The revisions include the use of the rationalized MKS system of units and the introduction of a completely new chapter on valves, semi-conductors and transistors.

At first sight the text gives the impression of brevity, but on closer examination this does not seem to be disadvantageous. The author does not waste any words, yet his text is most readable, flows smoothly and his treatment is adequate for the standard aimed at. This is achieved in the first part by concentrating on a thorough and sound treatment of basic principles. Having studied the principles in the text the student is advised to carry out the recommended experiments and to consolidate his knowledge by working out a variety of problems for himself. For this purpose he is referred to the author's other book *Elementary Telecommunications Examination Guide*, which gives more than 300 questions on the subjects concerned, with model answers. The two books are intended to supplement one another and to be used together.

In dealing with Telecommunications Practice Mr. Perkins evidently aims at supplementing the student's own observations in encountering apparatus and equipment in his day-to-day work as a telecommunications technician or in his practical experience as a trainee. This enables the author to give, in a concise form, just the information which such a student needs to understand the functions of telecommunications apparatus and equipment and its place in the system as a whole, without attempting to fill in all the practical details, which are best learned at first hand by doing practical work in the field under expert guidance, and again by writing answers to typical examination questions—in this subject mainly descriptive. The emphasis throughout is on the student doing things for himself.

If the student is prepared to take his studies seriously and carry out the author's recommendations, he can use this book with confidence; it will undoubtedly stimulate his interest and provide all the text-book information he needs for his examinations. The book is amply illustrated by clear diagrams and has a good and carefully prepared index to facilitate reference.

In the opinion of the reviewer there is too much prejudice in the teaching profession against learning a subject by attempting to answer copious questions from past examination papers. Too often this is classed as "cramming" and is said to aim at passing the examination rather than studying the subject. This is often quite untrue, and if past examinations have been really searching and soundly designed—as those in the subjects covered by this book are considered to have been—no better way seems available, of testing one's knowledge, adding to it over a wide field and increasing one's confidence in the ability to use such knowledge when writing answers to past examination questions.

F. C. Mead

Our Contributors (concluded)

J. SMITH ("Sixty Years of Loading Coils") is an Assistant Staff Engineer in the Main Lines Planning and Provision Branch of the Engineer-in-Chief's Office. He entered the Engineering Department by way of the Birmingham Test Section in 1923, and was appointed to the Lines Section of the Engineer-in-Chief's Office in 1930, where he was engaged on line plant economics until 1935. He was transferred to Main Line duties in that year, and with the exception of two years in the North East Regional Headquarters and four years in the War Office as Post Office Liaison officer, he has been wholly engaged since that time on these duties.

R. THOMPSON ("The New Cordless Switchboard at Stafford") is Assistant Telecommunications Controller Class I at Midland Region Headquarters. He entered the Post Office as an Assistant Traffic Superintendent in 1937. During the war he served in RAF Signals, and in 1947 went to HQ Scotland on promotion to ATC II. He transferred to Midland Region on promotion to ATC I, where he is responsible for exchange planning in the region.

A. B. WHERRY ("Recent Changes in Inland Phonogram Switching Arrangements") is an Executive Engineer in Equipment Branch of the Engineer-in-Chief's Office where he is particularly concerned with exchange systems planning and design. He joined the Post Office in 1942 as Youth-in-Training in the Plymouth Telephone Area and served in that Area until he was promoted to Assistant Engineer in the Engineer-in-Chief's Office in 1949.

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The Plan-Etelphone, fulfilling all requirements for plan number working, is the ingenious adaptation of a form already approved by the Council of Industrial Design, accepted by the B.P.O. and now in world-wide service. The extra equipment needed to cater for extension systems has been skilfully embodied in the Etelphone without detracting from its aesthetic qualities. Several types are available all capable of conversion to wall mounting.

The instrument has provision for 4 press buttons which can be arranged for any condition of interlocking or releasing. Simple switching requirements are met by fitting special "two in one" buttons, thus providing a maximum of 8 in this way. Additional buttons or lamps can be fitted on either side above the dial with an alternative lamp signal available adjacent to each of the 4 central buttons.

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New Telephone Apparatus for Customers

The Summer 1960 *Journal* contained a pre-view of some of the new items of telephone apparatus being developed. During the course of the past year the following new items have been introduced and are now available to customers:

Hearing Aid telephone: a 700-type telephone with a miniature transistor amplifier inside the handset.

Telephone 710: the four-button version of the 700-type telephone for use on extensions stations requiring more than one button.

Six-key switching unit (Plan Set N625): a plinth, on which the 700-type telephone will stand, containing the control keys and signalling lamps for the main stations of extension plans 105, 105A, 107 and 107A (the new plans corresponding to plans 5, 5A, 7 and 7A, but with improved facilities).

Table pattern switchboard (2 + 6): a lamp-signalling switchboard in a grey plastic case, with a capacity for two exchange lines and up to six extensions. The modern counterpart of the 2 + 4 switchboard.

Telephone 710 and the Plan Set N625 complete the range of apparatus needed to provide the full range of extension plan facilities with the new 700-type telephone.

Telephone Colours

The following table giving the percentage breakdown of demand for coloured telephones shows that there has been some shift of popularity from light ivory to other colours. The distribution has remained remarkably constant for the past twelve months.

	Light Ivory	Two-tone Grey	Lacquer Red	Two-tone Green	Topaz Yellow	Concord Blue
Orders up to December 31, 1959 ...	62.8	12.0	9.4	5.1	2.9	2.0
Orders Jan. 1—May 30, 1961 ...	51.0	17.1	12.4	10.8	5.0	4.5

The colour was not specified in 5.8 per cent. of orders during the earlier period but in only 0.5 per cent. received in the later period.

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

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

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 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

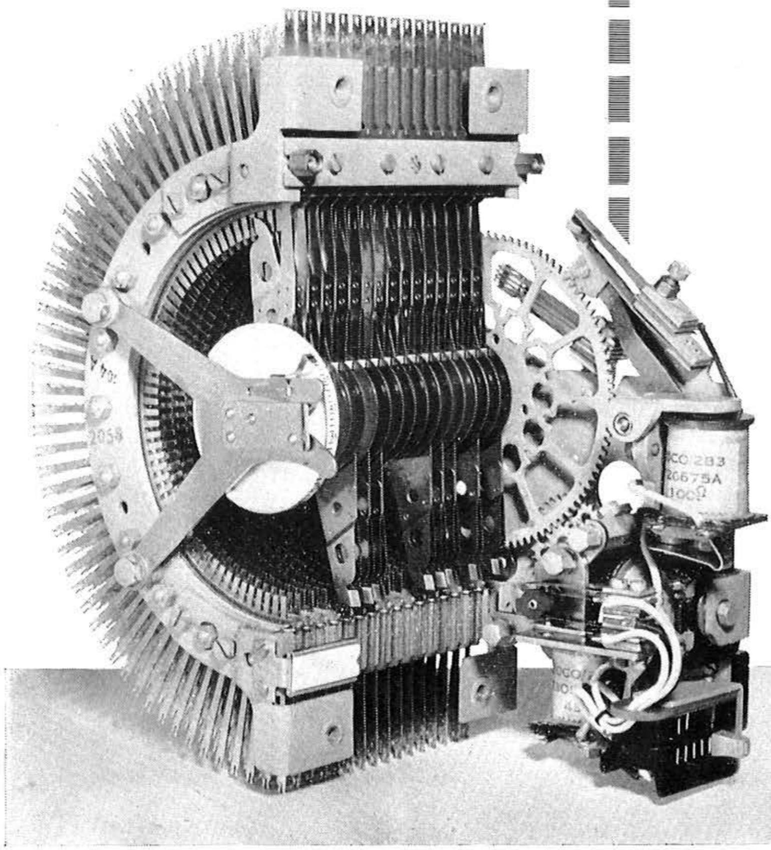
GPO

for subscriber trunk dialling...

The success of Subscriber Trunk Dialling depends to a large extent on the provision of a grade of service on long distance routes similar to that enjoyed in local exchange switching. To achieve such service economically it is essential that a high outlet availability is provided at trunk switching centres, coupled with the facility for flexible allocation of outlets.

AEI

high speed motor uniselector



The AEI Motor Uniselector was expressly designed to meet these needs and its outstanding success in operator controlled trunk switching in the United Kingdom and many other parts of the world is a guarantee of its equal success under subscriber trunk dialling conditions. High search speed, twin wiper contact, low vibration and lack of microphonic noise are some of the further features which combine with the unique reliability of the mechanism to make it the obvious choice for modern trunk switching.

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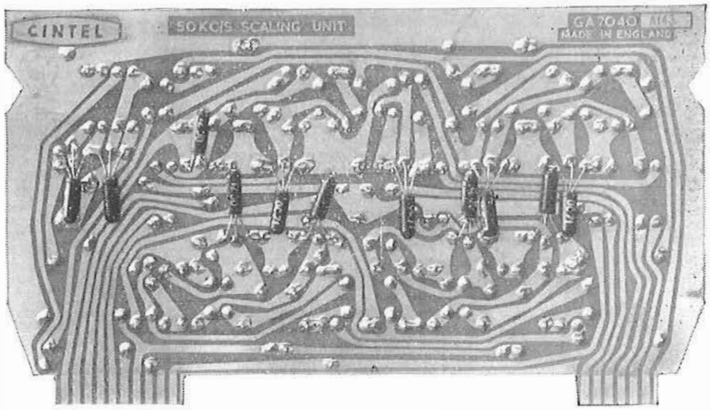

A complete range of transistorized counter panels of common size, fixing method and electrical connexion, designed to provide a flexible unit system whereby any special requirements in the counting or data processing fields can be quickly built up.

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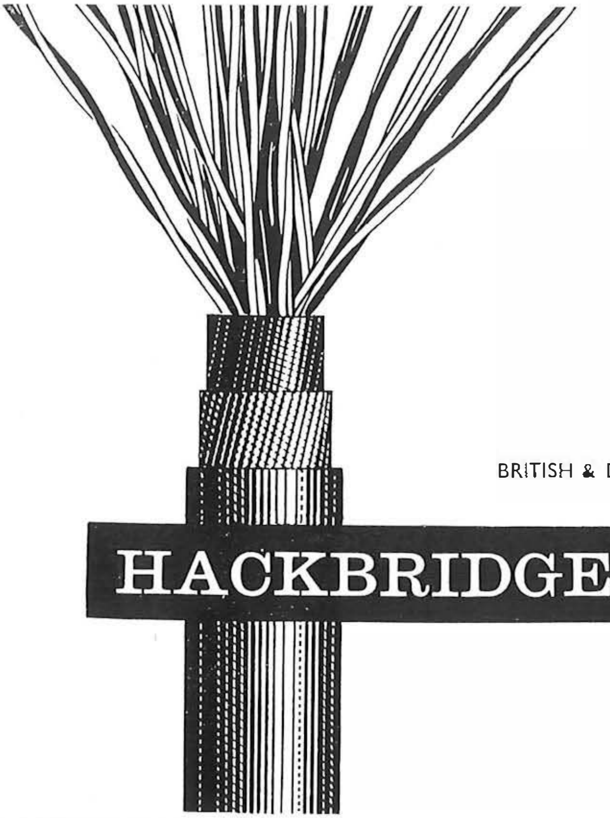

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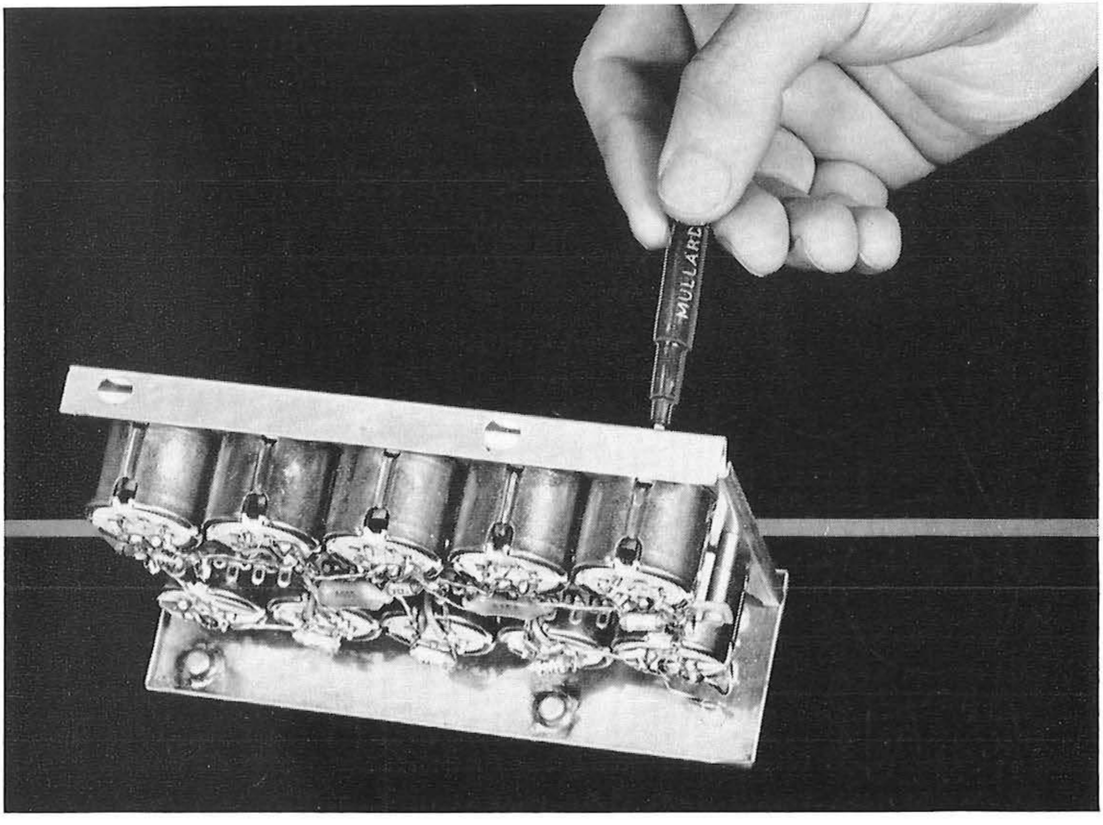

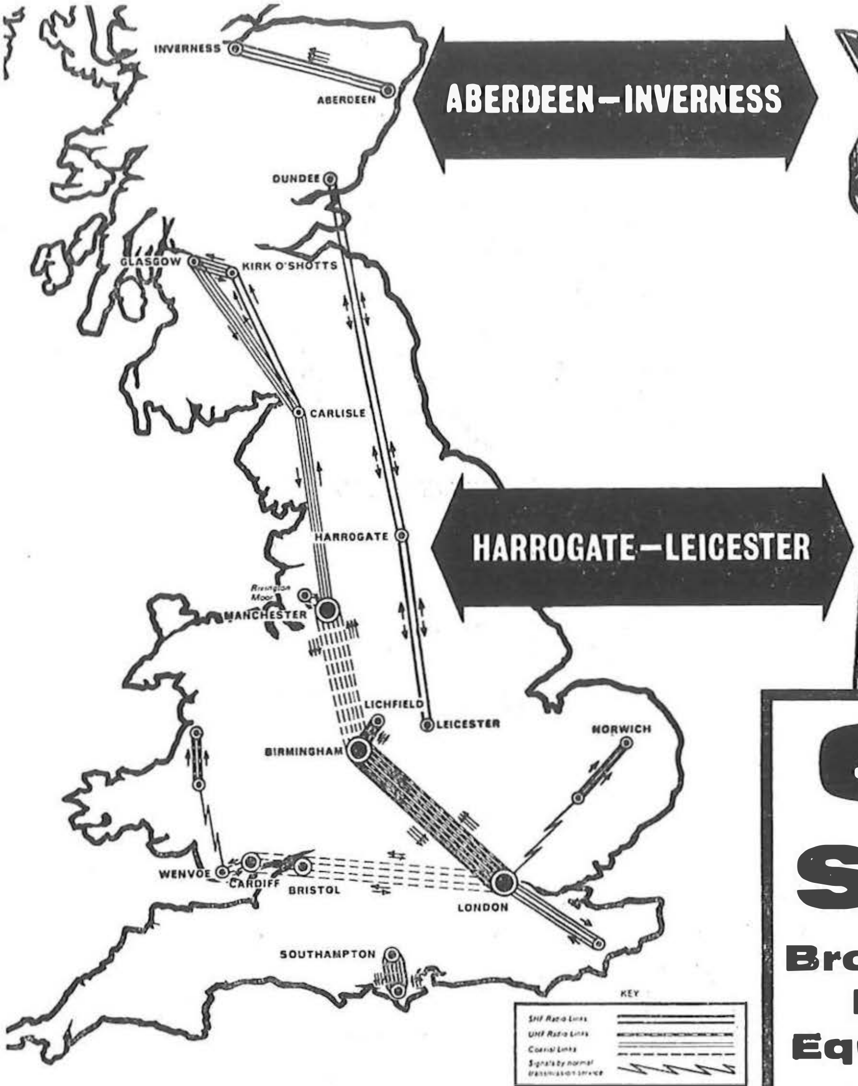

G.E.C. has been awarded contracts to supply and install three radio channels between Aberdeen and Inverness and two bothway radio channels between Harrogate and Leicester. The Harrogate-Leicester link is an extension of the link already announced between Dundee and Harrogate, and is the second stage of a new national broadband microwave network for telephony.

The North of Scotland link will carry television signals from Aberdeen to a new transmitter near Inverness.

Both systems operate in the 6000 Mc/s frequency band and can be extended by the addition of further RF channels. The equipment conforms to the latest CCIR recommendations.

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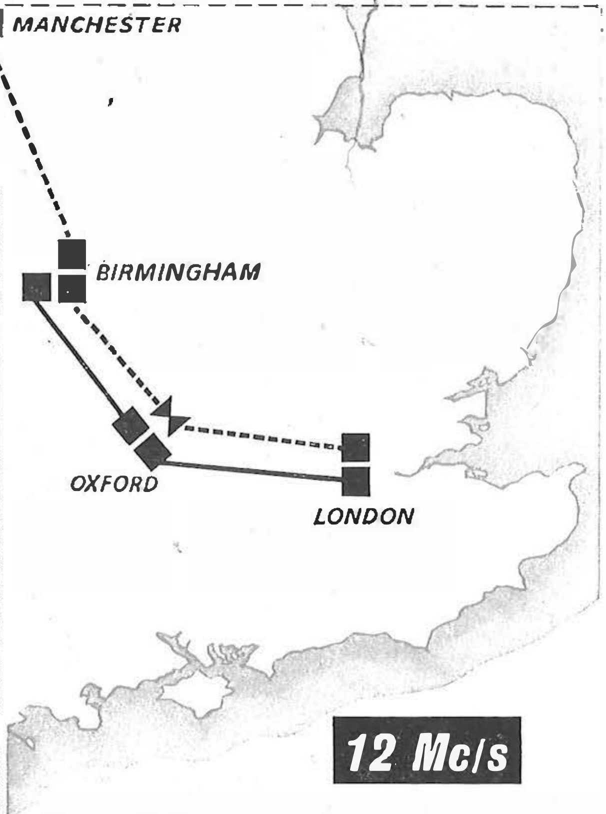
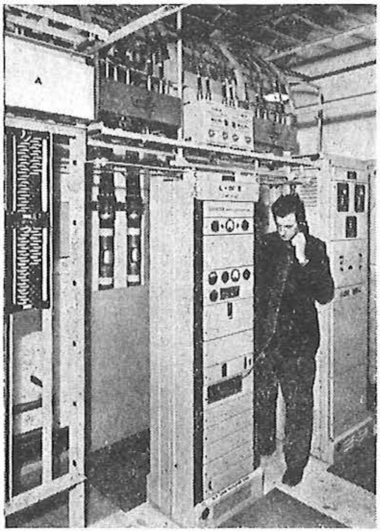
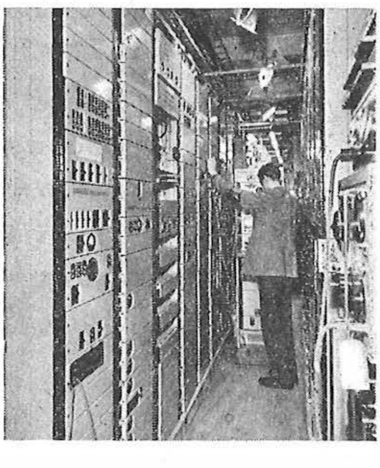
STC Installs *FIRST* 12 Mc/s Line Equipment in Great Britain







12 Mc/s

The new British Post Office telephone trunk coaxial cable system, in traffic between *Oxford and Birmingham*, is the first Coaxial System in Great Britain, having a traffic capacity of 2700 wide-band telephone circuits (alternatively 960 circuits and a high quality television transmission) over one pair of coaxial tubes. The equipment was designed, manufactured and installed by STC.

Equipment for a similar system has already been installed between Oxford and London, and STC will soon be installing a third and parallel system between London and Birmingham. Equipment for a fourth system, extending from Birmingham to Manchester, will also be supplied by STC.

ABOVE:
One of the dependent repeaters which are spaced at 3 mile (5 km) intervals along the routes. These repeaters receive their operating power, fed through the coaxial cable from terminals or main repeaters.

BELOW:
Terminal repeater equipment installed in the Oxford station.

Publication C/2037 gives details of the STC 12-megacycle line equipment

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