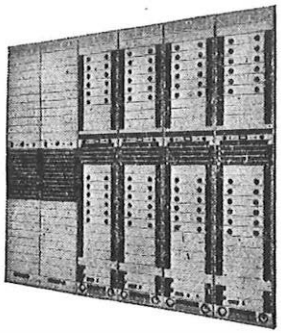
POST OFFICE

telecommunications

JOURNAL

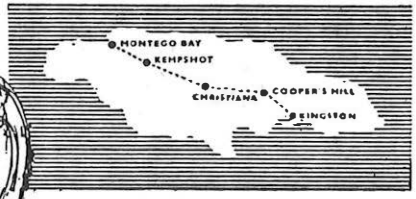
ONE SHILLING
AND
SIXPENCE

SUMMER 1959



NEW RADIO LINK FOR JAMAICA

A great advance in the communication facilities of Jamaica is being made by the installation of a multi-channel v.h.f. radio link between Kingston and Montego Bay. Eight type HM 100 equipments and associated repeaters have been supplied by Marconi's Wireless Telegraph Company. They will provide 24 speech channels with an ultimate of 48. Automatic Telephone & Electric Company is supplying the channelling equipment. The order placed on behalf of the Jamaica Telephone Company by their Consultants and Purchasing Agents Telephone & Associated Services Ltd., is a further example of the valuable contributions being made by A.T.E. and Marconi to the development of Telecommunications throughout the world.



AUTOMATIC TELEPHONE & ELECTRIC COMPANY LTD.

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MARCONI'S WIRELESS TELEGRAPH COMPANY LTD.

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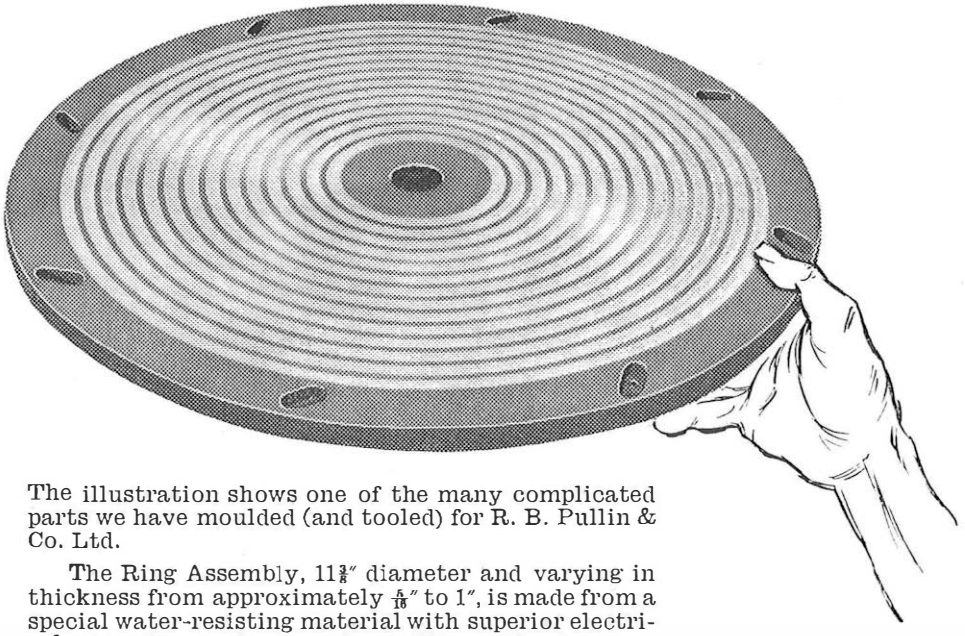

The illustration shows one of the many complicated parts we have moulded (and tooled) for R. B. Pullin & Co. Ltd.

The Ring Assembly, 11¾″ diameter and varying in thickness from approximately $\frac{5}{16}$″ to 1″, is made from a special water-resisting material with superior electrical properties under humid conditions. The fourteen concentric silver rings, shown moulded in position, are so costly that rejects had to be avoided and, indeed, they were.

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Post Office Telecommunications Journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

Contents

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Vol. 11 *Summer*, 1959 *No.* 3

Personal Service

FIFTY-FOUR YEARS AGO TELEPHONE OPERATORS were instructed to cease saying "Good Morning" when taking a call, and to use only such formal phrases as "Number, please".

Now we have reverted to the more human and friendly response. On March 11 the Postmaster General announced the policy of "The Friendly Telephone" which arose out of the Report presented to the Director General by the Post Office party who visited the United States last November to study the American telephone system.

Introducing the Report, "Telephone Service and the Customer", the Postmaster General pointed out that the "Friendly Telephone" policy represents the third of three recent steps towards developing our own system. He described the first step, Group Charging, as *administrative*; the second, Subscriber Trunk Dialling, as *scientific*; and this third step, as *human.*

The new policy, he said, is "to make sure that in a system where automatic machines will play an increasing part the customer can always get friendly service when he wants it. . . . Our operators are friendly people but we have always imposed strict rules about the phrases they use. These rules will now be relaxed. Operators will be given greater freedom so that they can be less formal and more helpful to the customer".

Also arising out of the Report, social surveys are being conducted to discover what our customers want and an organization is being set up to develop facilities to meet their needs as far as possible. The Post Office is determined that the telephone service shall become, even more than hitherto, a personal service developed to meet the needs of the community.

The complete Report begins on the next page.

Telephone Service and the Customer

On the following pages we reproduce in its entirety (except for the Appendices and paragraphs referring to them) the Report presented by the Post Office party which visited the United States last November.

The Postmaster General was so impressed with the Report that he visited America personally in January and in March circulated the Report, with an introduction by himself, to Members of Parliament. Immediately, the "Friendly Telephone" policy was promulgated.

Below is a personal introduction to the Report by Mr. F. I. Ray, C.B., C.B.E., Director of Inland Telecommunications and Chairman of the Journal *Editorial Board, who led the party.*

THE DIRECTOR GENERAL ENTRUSTED US WITH the explicit task of studying the problems which have developed in the United States (telephone) system as it has been mechanized, and the methods used in solving them.

Our attention was drawn particularly to:

(*a*) The effects of long-distance dialling by callers, particularly as regards:—
  (i) reaction from telephone users,
  (ii) the character of the residual traffic to be handled manually.

(*b*) The desirability of using any resulting spare capacity at manual switchboards to improve the standard of service given to the residual traffic.

(*c*) The possibility of increasing the use of the telephone by providing additional services, or extending existing ones.

The American Telephone and Telegraph Company, which controls the Bell System, received us with great hospitality and gave us every facility to achieve our objects. We visited several offices in New York, and spent three days with the Chesapeake and Potomac Telephone Company in Washington. Any success we may have achieved is due very largely to the help we were given everywhere. On the other hand we cannot pretend in so short a visit to have gained more than a superficial, though intensely valuable, impression of the Bell System.

The Report (which starts on the opposite page) speaks, we hope, for itself. But in introducing it I would like to take the opportunity of expressing a few personal impressions which are perhaps hardly suitable for including in an official report.

First and foremost there is my admiration of the ability of the American Telephone and Telegraph Company to run a continent-wide system eight times the size of ours, without losing either its control or its inspiration. From practical experience I know how executive and administrative problems increase with size and distance. And I can appreciate the problems of running a system in a country the size of Europe, but with twice the number of telephones. The A. T. & T. have achieved a balance between centralization and devolution which has enabled them to run this enormous system with efficiency and enterprise.

I admired, too, the accommodation and furnishings, both in the Headquarters offices and in the exchanges. It may be, of course, that we saw only the best, but how good that was!

I was impressed by the sense of purpose and the sense of unity and of enterprise which inspired all those with whom we came into contact. I believe all this sprang from the inspiration and leadership of that famous President of the Company, Theodore Vail, and is founded on the paramount importance of satisfying the customer, of selling service, not merely providing telephones. Vail's inspiration has certainly survived as a potent and lively force which made the American telephone system stand out in comparison with the other public services which we encountered in America.

Finally, there was the realization that both we and the Bell people were really very similar, tackling very similar problems. Indeed, the similarities exceeded the differences and where the latter existed, they were not always in favour of the Bell System; for example, we were a smaller country and had not the complication of State and inter-State rules to impede us. There was no reason why we could not match or even exceed their achievements, providing we could secure their sense of unity and purpose, and could act boldly.

The Post Office Party

(left to right) Miss Nan Whitelaw, Assistant Secretary, Telephone and Telegraph, Union of Post Office Workers; Mr. J. M. Harper, Principal, Inland Telecommunications Department; Mr. F. I. Ray; Mr. L. Hill, Staff Controller, London Telecommunications Region; Miss C. N. Hampton, Supervisor, Welbeck Exchange (London), and Executive Council Member, Association of Post Office Controlling Officers.

THE REPORT

THERE is one thing which stands out as a characteristic of the System as a whole, and which must be mentioned in order to throw into perspective the reports on the particular subjects you asked us to look at. We refer to the desire to please the customer. This underlies everything the System does.

As was to be expected, we found certain ways in which Post Office practice compared well with that of the Bell System. For obvious reasons,this report is confined to those major differences between the systems which seem to us to suggest particular improvements in the Post Office system. The information we obtained on more detailed matters will be incorporated in a series of papers to be issued separately.

I. General

(i) *Objectives of the Bell System*

The development and administration of the whole Bell System has been founded upon:—

(*a*) a clear and concise statement of purpose,

(*b*) the awareness of that purpose by each individual member of the organisation, and its application to every plan, problem, and situation, at all levels within the organisation.

The basic purpose of the Bell System was clearly stated as long ago as 1927, in the A.T. & T. Annual Report for that year:—

> "The American Telephone and Telegraph Company accepts its responsibility for a nationwide telephone service as a public trust. Its duty is to provide the American public with adequate dependable and satisfactory service at a reasonable cost".

This objective is reflected in the Traffic Credo and in the Tariff Policy of the System. . . . The criterion seems to be the value to the customer of the service rather than the cost of giving it.

(ii) *General Character and Degree of Development of Bell System*

Information on the technical characteristics of the Bell System is widely available but it may be useful if we indicate the extent to which the mechanised system has developed, and the lines along which it has done so.

At the end of 1957 the Bell System contained 52,000,000 telephone stations, of which 92 per cent. were connected to automatic exchanges. Of the total stations, 28 per cent. had some Direct Distance Dialling (DDD—the American equivalent of STD) facilities, while 10 per cent. could dial on a nationwide basis. 20 per cent. of all Trunk Traffic was Direct Distance Dialled.

Growth has been very rapid since the war. The number of telephone stations has more than doubled since 1945, and all planning assumes that this rapid expansion will continue. The calling rate of the system as a whole, which increased between 1945 and 1950, is the highest in the world.

The total staff engaged in operating the system is approximately 700,000, of whom some 230,000 are telephone operating staff and supervisors. There are no male operators. The operating staff are distributed among approximately 2,600 assistance centres—a number which is expected to remain substantially constant—and a diminishing number, at present 1,000, of manual exchanges.

(iii) *Organisation of the Bell System*

In general, the relation of the A.T. & T. Co. to the Bell Operating Companies is advisory, and there is no direct control of the companies' activities, except in so far as this follows from the financial holding of A.T. & T. in the Operating Companies. In the majority of cases most, if not all, their stock is held by A.T. & T., although there are exceptions.

Tariffs are regulated by a total of 47 State Regulatory Authorities, who regulate charges for all transactions within a State, and by the Federal Communications Commission, who regulate inter-State communications tariffs. All Bell Operating Companies are independent in this respect and conduct their own negotiations for tariff fixing with the appropriate Authority.

II. Planning to please the Customer

We referred in the introduction to the desire to please the customer which underlies everything the Bell System does. We want now to look at what this means in terms of planning.

(i) *Planning Developments*

A great deal of effort is spent on survey and planning to try to predict what developments will best please the customer and meet his needs.

When a particular line of development has been decided upon, at the earliest possible stage in the actual planning a substantial field trial is started. This is done particularly with subscribers' apparatus but it is done everywhere where it possibly can be—the Wichita Falls experiment in subscriber " all-numeral dialling " is a familiar example in the Post Office.

Having obtained this direct evidence of customer reaction at an early stage in planning the System attaches great weight to it in its final conclusions.

Economic circumstances are bound to limit the use made of field trials in the U.K., but we do feel that the Post Office should review the extent to which information is obtained on customer reaction at an early stage in planning and the weight given to it. This will become more important as the customer comes more and more to deal with equipment, which cannot adapt itself to his wishes and needs in the way which people can.

Many design questions cannot be settled by field trial and have to be decided on a balance between economics and the interests of the people who are going to use the system. The Bell System puts the latter before economics; an example of this is in the layout of exchange boundaries, in which the emphasis is on community of interest rather than line plant economics.

We recognise that there is usually a direct relationship between the extent to which customer convenience is allowed to weigh in planning, and the cost of the developments involved. But a great deal of the reputation of the Bell System is due to the way it caters for the convenience, as well as the wishes, of the users.

(ii) *The Customer's Attitude*

Not only does the System plan to please the customer, it also goes out of its way to help him to use the service he gets.

The following quotation from the A.T. & T. Co's general advice to Companies about DDD conversions shows their approach:—

> " In the overall, probably no other phase of [DDD] preparation is as important to good service results and maximum usage as a well planned and thoroughly executed program of customer education and instruction . . . "

Before the conversion, every possible medium is used to get across to customers how to use the DDD system, and the effect of this main wave of publicity is checked by a telephone survey and followed up. A great deal is done to brief the staff themselves at the same time.

After the conversion, anyone who is known to have had difficulty in dialling is rung up by a special officer (whose duties we will deal with later) who does all she can to assist him and to try and remove the difficulty. General publicity is also given to anything found to be particularly troublesome.

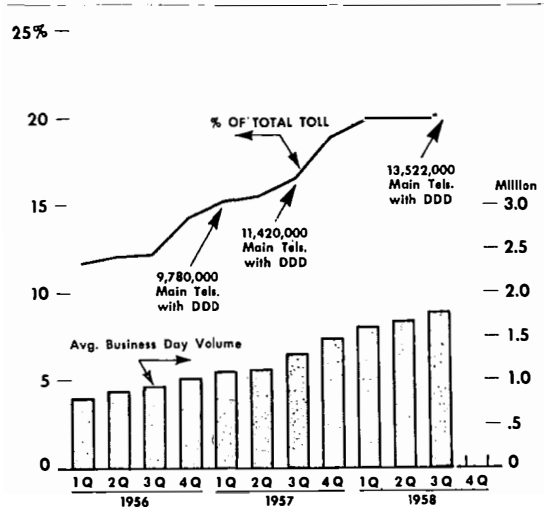
What struck us most was the intensity of the effort spent in this direction, and in many others, in securing the customer's co-operation and hence his satisfaction in using the service.

In planning, the Bell System aims to please as well as to serve its customers. The early stages of STD in the British Post Office bring sharply into focus the need for improving our approach. They also provide both the means and opportunity to do so. Unless the system is planned in this way, management, with which we deal in the next part of the report, cannot really succeed in pleasing the public.

III. Running the Service to please the Customer

(i) *Human Relationships in a Mechanised Service*

It was clear to us that the strong tradition of



Three years of Direct Distance Dialling (STD) in the U.S.A.; rising traffic compared with total Toll traffic.

personal service which the Bell System has developed over the years has been and continues to be one of its biggest assets in mechanisation. The user of a mechanised system comes more and more to encounter machines in his routine contacts with the system. But all calls in which he is in difficulty, suffering inconvenience, or irritated, will continue to be handled manually and these will form an increasing proportion of his contacts with the people of the organisation. In these circumstances the value of the traditional personal service of the Bell System has been immense. We have dealt briefly in Part II with what it has meant in planning the mechanised service and the design of its facilities. We turn now to the managerial problems of such a service, with particular emphasis on those fields in which a direct contact between customer and employee is involved. We shall also examine some of the controls which are employed, to check both the performance of the equipment and the quality of the personal service.

(ii) *Effects of Mechanisation on the Trunk Telephone Service*

(a) *General*

In attempting to relate the results of the DDD system to British conditions, the following points must be borne in mind:—

(1) The extensive use of the person-to-person call service which the American public has always made. In traffic throughout the Bell system in the second quarter of 1957 45 per cent. of business calls and 25 per cent. of residence calls were placed on a person-to-person basis. Each such call requires the intervention of an operator although experiments are in hand to transfer the actual dialling operations to the customer.

(2) No tariff advantage is gained by completion of diallable calls by DDD, as against completion by the operator, and the strong incentive which exists in Britain to use the STD service, is therefore lacking.

(b) *Extent of Use Made of DDD Facilities*

In general small Business and Residential subscribers have welcomed and used the DDD service to the full, whereas PBXs have tended to circulate trunk traffic to the operator. One main reason for this is that PBX traffic tends to contain a high proportion of the following classes of traffic:—

AD & C—particularly of course in the case of hotels and similar institutions

Person-to-person Calls

Calls to Trunk Subscribers

Calls on which identification of a particular Department, Individual or Extension is needed for charging or other purposes.

Excluding these and other calls which require the intervention of an operator, customers are dialling about 98 per cent. of diallable calls. The A.T. & T. efforts are therefore being directed to reducing the proportion of calls in the classes above, and thus to increasing the volume of traffic being dialled.

(c) *General Performance*

The following figures are typical of dialling performance in DDD Areas:—

	Successful (including Busy and No Reply)	*Ineffective Due to Caller*	*Ineffective Due to Company*
Local ... ... (7 Digit numbers)	97%	2%	1%
DDD ... ... (10 Digit numbers)	90%	6%	4%

(d) *Assistance Traffic*

The following statistics relate to the proportion of DDD calls on which requests for operator assistance are expected, during the four weeks after

the opening of a typical DDD exchange:—

1st day after conversion ...	32%
1st week ,, ,, ...	18%
2nd ,, ,, ...	12%
3rd ,, ,, ...	10%
4th ,, ,, ...	9%

85 per cent. of the assistance requests on the 1st day, and 72 per cent. of those in the first week, were calls requiring dial instruction, including cases merely involving advice that the call was diallable.

(e) *Effect on Operating Staffing*

It is very difficult to make useful comparisons between experience in the United States and what is expected in Great Britain, because of the high proportion of person-to-person call traffic, the lack of a tariff incentive to use the DDD service, and the extremely high rate of growth, which has meant generally that reductions in operating staff are very rapidly absorbed. We were told, however, that serious redundancy due to DDD has not occurred. The expectation is that operating force requirements will be back to the pre-DDD level within about two years from conversion, in normal cases, and will continue to grow thereafter.

In a particular exchange which we visited, the traffic and related staffing figures were as follows:—

	Manually handled calls per day	*Staff*
Original condition—peak ...	17,500	164
Extension of dialled local call area	11,500	Not quoted
DDD Conversion	4,000	110

It will be noted that the reduction in staff is nowhere near proportionate to the reduction in traffic. This is because mechanisation has relieved the switchboard of the simpler types of call, and consequently the operators are dealing mainly with difficult ones.

For a year or so prior to the cut-over, new staff are recruited on a strictly temporary basis. If there should be redundancy at the time of the cut-over, after dispensing with the services of temporary staff, directory enquiry circuits are re-routed from other exchanges to increase the load offered. If this is insufficient, operators are offered temporary employment, after suitable training, on trying to sell direct line service over the telephone to party line customers. Should these measures not suffice the redundant officers are offered temporary transfer, with a lodging allowance, to another exchange. In the event of the operator not wishing to avail herself of such a transfer until her employment again becomes justified at her own exchange, she is paid off and given a compensation payment based on her length of service.

(iii) *The Management of the Switchboard Service*

(a) *Terminology*

It may be convenient, at this point, to elucidate certain important differences in terminology between the British and Bell Systems (listed in the panel on the facing page.)

(b) *Recruitment*

The Bell System has a high rate of loss of operating staff—about 35 per cent. p.a. in normal years—and a correspondingly heavy programme of recruitment. The main sources of recruitment are schools, and former employees. Some recruits are obtained also from the general public through advertisement.

Considerable value is attached to securing part-time employees from the high schools at about 17 years. This not only spreads the training load over a long period but also produces a fair number of full-time employees, already trained, a year or so later. A number of films have been made for this purpose. High School "Guidance Counselors"—corresponding to our Careers Mistresses—are not only given excellently prepared brochures about careers in the Bell Companies but are also invited to undertake vacation employment and are given a wide view of the various jobs the Company has to offer women.

A great deal is done to encourage the staff to recommend friends and acquaintances for employment. Introduction cards are issued for use by applicants and preference is given by the employment office to recommended candidates. Each office has a "recruiter", who may be full-time, whose job is to interest the staff in recruiting. She talks to employees—in Company time—suggests possible sources of recruits and supplies any information about the Company which may be asked for, and uses a variety of means to maintain interest, once aroused. In practice 40 to 60 per cent. of new employees are recommended by existing staff and staff recruited in this way are generally of better calibre than average.

When an employee is leaving she is interviewed, if suitable for further employment, and questioned as to the possibility of her taking work again with the Company at any time in the future, either full-time or part-time. As many operators as

possible are recruited by the Chief Operator of the exchange in which they will be employed. This is supplemented as necessary by central recruitment for specific offices. The keynote of the operation is speed. It is normal for a girl to start work on the third day from the date of application.

(c) *Supervision and Training*

Central Offices are limited in size to a total of about 150 staff under the control of a Chief Operator, assisted in an exchange of maximum size by three Asst. C/Os and a Night Chief Operator. The Chief Operator is responsible for the exchange throughout the 24 hours and includes in her duties the recruitment, training and promotion of her staff. She carries out these functions with the close co-operation of her Asst. C/Os, although it was noticeable in the exchanges we visited that the Chief Operators were not only generally well informed on operating questions and effective in imparting their knowledge but also knew their operators sufficiently well to be able to address them by Christian name.

Bell Term	***British Term***
Central Office	*Telephone Exchange*
Toll Call	*Trunk Call*
Information	*Directory Enquiry*
Chief Operator	*Chief Supervisor*
Asst. Chief Operator (A.C.O.)	*Supervisor*
Service Assistant (S.A.)	*Asst. Supervisor*

The Night Chief Operator and each of the Asst. C/Os have Service Assistants, generally three each, to help them and one of the Asst. C/Os has a clerk to perform the necessary clerical work. The Asst. C/Os and the Night C/O are responsible for keeping their Service Assistants up-to-date in both operating procedures and in more general matters of policy and public relations. They also teach their Service Assistants how to talk to people, to listen to people, to teach, to conduct a conference, and how to build a training course.

Every officer who has control of Staff is responsible in this way for their training; indeed, at the first line supervisor (Service Assistant) level we were told that three quarters of the supervisor's time is spent on training her staff. A trainee is allocated to a particular Service Assistant from the first day of her employment and that Service Assistant is responsible for her development and welfare. Each Service Assistant therefore has a "team" of operators in her special care, generally numbering from twelve to fifteen, but it must be made clear that this "team" does not work as an entity and the section of the switchboard for which a Service Assistant is responsible at any time may or may not be staffed by members of her team.

Great emphasis is placed, throughout training and subsequent service, upon the personal relationship between operator and supervisor, and upon the status of the operator as an individual. The aim is to give her confidence, to encourage her to be self-reliant in her day-to-day work, and to regard her Service Assistant as a person available for consultation about any problem, official or personal, rather than a supervisor in the British sense.

This is illustrated by two features of management practice. The trainee receives only a short period (about 15 days) of formal training—and even during this period handles live traffic. At the end of this she is at once placed on full live traffic. The express object of this is to build up her confidence. Again, the high proportion of the supervisor's time spent on training work means that in general experienced operators in her section are left to handle traffic by themselves, and to deal with awkward situations on their own initiative, rather than being under constant supervision.

We feel that the emphasis on the individual responsibility of the operator, her personal relationship with her supervisors and the supervisor's responsibility for the development of the operators who are members of her team is of great value, especially in a mechanised service.

(d) *Tone of the Service*

The Companies strive to make the service they give as personal as possible. As far as operating is concerned the differences between Bell Company procedures and those used in the United Kingdom are subtle rather than obvious. Standard phrases are available for use in all circumstances and appear to be very generally used, although it is quite permissible for the operator to depart from them. She may do this either if she encounters difficulty with a call, or if she feels she would be more readily understood if she expressed herself differently.

In slack periods Service Assistants discuss tone of service with small groups of their team of operators, using tape recorders to let them hear their own voices. In some Companies voice production experts are recruited to run courses and contests. All staff are told that the Company is judged by their actions. Their attitude to each other is regarded as important because it affects their attitude to customers. We were told of an

exchange where all operators, on their own initiative, made a special and successful effort to be exceptionally helpful to two customers well-known for their objectionable manners. Every switchroom which we visited was noticeably quiet, even where "music while you work" was being played. Sound absorbing ceilings seemed to be general and an operator raising her voice was a sufficiently rare event to attract immediate attention.

To English ears the operating appeared a little slow and the expressions a trifle curt, but it did not seem to have this effect on Americans. Letters of commendation are frequent and are posted on a notice board in each switchroom with a certificate of commendation for the operator concerned. Indeed, even during the small amount of listening to operators we were able to do, one of our party heard a most complimentary remark passed to the operator by her customer.

Supervising Officers speaking to customers normally announced themselves by name and operators are allowed to give their names to customers on request. Customers are addressed by name if this is known, or as "Sir" or "Madam" if the operator thinks this is suitable.

The Companies do everything possible to avoid any appearance of dictating to their customers. For example, the courteous phrase "Would you care to make a note of it?" after giving a number on the Directory Enquiry position has been abandoned even though its omission may lead to additional enquiries and therefore additional cost.

There is no doubt that the general atmosphere of the service given at the switchboard, with the emphasis which has been noted on personal service, and on swift adaptation to the caller as an individual, plays a very important part in the standing and smooth operation of the System. What is of particular interest is the way in which the individual operator is not only expected to apply the basic objectives of the System to her work, but is actually given scope by her instructions to do so, and is encouraged to deal with situations on her own initiative, rather than relying on set rules or on her supervisor.

(iv) *The Management of the Automatic Service*

A most important element in the maintenance of the quality of the service is the Dial Service Administration.

The unit is led by a Dial Service Supervisor, who is often a woman. The functions of the unit are of such interest that we include a brief statement of them. There are three parts of the organisation, each headed by a first line supervisor, as follows:—

(a) *Line assignment* ...	performing functions very similar to those of number allocation in the Post Office, except that greater effort is made to distribute traffic equally over line finder and final selector units and to avoid long jumpers on the main frames.
(b) *Loading and Service*	responsibility for reading and interpreting traffic meters in apparatus rooms, for identifying deficiencies in equipment and circuit provision, correlating with evidence of subscriber complaint and initiating remedial action by Plant Staff.
(c) *Customer Instruction*	responsibility for calling back on all numbers originating assistance tickets, for attempting to identify the difficulty, and for checking the caller's actual dial performance. This is, of course, of particular value under DDD conditions, and was referred to in our observations on post conversion subscriber instruction.

We have alluded in Part II to the need to design the mechanised equipment to make it as easy and convenient to use as possible. The Dial Service Administration, in our view, fulfils the parallel need to maintain this ease and convenience in use. The Dial Service unit is designed to one end—to preserve the general quality of service which the user encounters on his dialled calls, which, of course, form the bulk of his calls when the system is mechanised. This is another instance of the application of the Bell principles which we have discussed earlier.

It was claimed that the Dial Service also had the advantage of relieving the Plant Engineer of the need to read meters and to calculate traffic and switch quantities, work which can be performed adequately by non-Engineering personnel.

(v) *The Business Office*

The principal channel for public contacts outside the operational field is the Business Office, which forms part of the Commercial structure. It is staffed by Service Representatives, usually women, each of whom has available at her desk the accounting and other records, including call

A Central Office (Telephone Exchange) at Washington, D.C.

tickets, relating to a group of up to 2,000 subscribers.

The Service Representative is encouraged to take a personal interest in " her " subscribers and she is the one individual whom the subscribers will come to know and to whom they will naturally turn for information and help. She deals with any account queries, reminds those who fail to pay and, if necessary, gently persuades them that it would be in their interest if the service were suspended until payment be made! She must have a wide range of information available because she is expected to deal with any aspect of the company's business.

An interesting feature of the Business Office is the extent to which it makes use of the telephone instead of letter writing. Even applications for telephone service are accepted by telephone.

(vi) *Repair Service*

The endeavour to please the customer finds special scope in the repair service. Those who use this service are usually suffering from a sense of grievance. The Bell System aims at removing this feeling by the prompt and personal way in which fault report calls are handled as well as by the speed with which the faults themselves are cleared. They hope the customers will remember the efficient way in which defects are dealt with, rather than the inconvenience which they cause.

To this end specially trained female clerks are employed to answer calls to the repair service. They work in the test room, close to the test clerks (technicians), and they have at hand the name and address, particulars of the telephone installation and detailed fault history of all the customers for whom they are responsible. Also, they are able to quote the time by which a fault will receive attention. They are therefore well equipped to answer complaints from customers in a personal, helpful and conciliatory manner.

After answering a customer, the repair clerk makes out a docket which is passed to the test clerk for attention. Subsequently she records details of the fault and its treatment on the fault history card.

The repair service clerks are subject to centralised service observations and fault cards are subsequently inspected to see whether the records are properly maintained and whether promises are kept. From these observations and from snap inspections of other fault cards a repair service index is calculated. At one test centre we visited the latest return showed that of 169 calls observed, 168 were answered within 20 seconds, all but 13 of the time commitments were met and 20 subscribers made favourable comment. These results were regarded as being somewhat below standard.

In the British Post Office the duty of answering fault complaints is undertaken at some exchanges by telephonists and at others by test clerks (the ENG service). Neither arrangement is wholly satisfactory and tests have been going on for some years of a compromise system whereby calls are answered by telephonists and then extended to test clerks (the filtered ENG service). The Bell System appeared to us to offer a better solution to the problem.

(vii) *Interception Arrangements*

All calls to unused or changed numbers are intercepted. The interception arrangements are centralised. The installation we visited serves 125 Central Offices. Calls to numbers which are not in service (unallotted, ceased and T.O.S.) are connected first to automatic announcing equipment which says " I am sorry, the number you have reached has been disconnected. Please be sure you are dialling the correct number. This is a recorded announcement." Arrangements are made to ensure that a caller is connected only at the beginning of an announcement. The message is given a second time and if the caller does not then hang up he is automatically transferred to an

operator. This operator has a loose-leaf file in which are recorded the reasons for every non-working number being out of service. Calls to changed numbers or to numbers for which a temporary transfer of calls is in force are treated in the same way except that they are not connected first to the automatic announcer. The operator's record shows the number to which calls are to be referred and whether what is involved is change of number or a temporary transfer of calls. No charge is made to the customer for the calls.

Before an exchange is made accessible to DDD, it must have interception arrangements on this model. The reason is that a spoken announcement is much easier for a subscriber to understand than a tone. Also, if he is still puzzled by what he hears, and holds on, an operator comes on the line to help him.

The differences between the Bell structure and that of the British Post Office are clear and considerable. We would, however, draw two general conclusions from the comparison of the two:—

(*a*) Co-ordination in the United States does not occur at such low levels as in the United Kingdom, despite the greater physical distances involved. The system appears to work well, but we encountered a certain amount of evidence of pressure towards co-ordination at a lower level.

(*b*) The success of the Bell System in adapting itself to changing conditions, and the excellence of the mechanised service, are largely due to the flexibility of the organisation. This flexibility depends to a considerable extent upon the way in which the individual is eligible for administrative, technical, financial, managerial, or commercial duties, subject only to the limitations of his own capabilities and aptitudes, and with no hierarchical restrictions. Individuals, because they move widely within the organisation, develop a sense of loyalty to, and a knowledge of, the organisation, as a whole rather than to a particular functional part of it. We noticed that this applied even at junior levels.

(viii) *Managerial Control of the System*

We were, of course, familiar with the use of Service Observations in the operating field. We found, however, in the Bell System that observation is extended to other types of telephone contact between customer and Company, for example in the business office, in the fault control, or in the dial service customer instruction programme. While we recognise that this is the more necessary in the USA because of the very large proportion of business which is done by telephone, we were interested by it.

The equipment and practices of normal Service Observation are very similar to those in the United Kingdom. In all the observations which are undertaken, however, great emphasis is laid on control of the tone of the service which the caller receives, as well as on the derivation of the usual observation statistics.

A percentage index, based upon the statistical results of observation, is calculated for each service whose activities affect the customer. Not only does this provide management with a quick method of assessing performance, but, because it is published to the staff, it gives them also a clear idea of how far they are achieving their target of service to the customer.

We are very conscious of the different approach to controls in the United Kingdom; nevertheless, analysis of the Bell System's management of the mechanised system would not be complete without reference to the approach to controls of this kind.

IV. The Business Development of the System

(i) *Merchandising*

Since the war the Bell System, like the Post Office, has had to contend with a heavy backlog of orders and with rising costs. Frequent rate increases had to be negotiated with Control Commissions. In some States there have been six rate increases since the war. Concentration of effort on these issues left very little opportunity for developing and introducing new products.

The Bell System has now reached the stage when it can afford to spend time and money on designing new products and to give its customers (and shareholders) the benefits of recent developments in technology.

To achieve more rapid progress the A.T. & T. has appointed a Vice President (Merchandising) to co-ordinate the work of developing new products for sale. Efforts were first directed to the use of colour and as a result the percentage of coloured telephones has increased in the last three years from 3 per cent. to 27 per cent. The Vice President

(Merchandising) is now working on a very wide range of products. In this he is greatly helped by the extensive facilities for the manufacture of prototypes in the Western Electric Company's model shop.

(ii) *The Sales Organisation*

(a) *Business Market*

The principal effort of the Sales specialised organisation is directed at the business market. Any enquiry by a business customer leads to a visit by a System Sales Representative, whose job is not simply to deal with the enquiry, but to encourage the subscriber to develop his installation, and use it to the full. Emphasis has been laid on the profitable development of the small business market, and, although visiting cannot be economic for the whole of this market, efforts have been made to develop it by telephonic canvassing.

For the largest customers intensive studies like those of our Telecommunications Advisory Service are undertaken. We were shown the report of a two-year study recently completed on the communications requirements of the Airline Companies, and we were told of 18 other studies including ones of the requirements of Hotels and Department Stores in progress on a comparable scale at the time of our visit. The importance attached to the needs of large subscribers is illustrated by the fact that a representative may be assigned full time to one concern. The most striking instance is at Idlewild Airport, where we were told that a permanent office is maintained, with a staff of 30.

(b) *Residence Market*

No attempt is at present being made to secure orders by door-to-door canvassing, but a great deal is done, particularly to stimulate calling rate and apparatus sales, by general and business office publicity. Individual enquiries are dealt with either by the Business Office or by Installation staff.

(iii) *Stimulation of Traffic*

One part of the present business policy of the Bell System which is of the greatest interest and application to the Post Office is the carefully planned and intensive campaign to stimulate the use of the telephone. Telephone penetration has advanced further in the Bell System than anywhere in the world. The investment by the Companies involved in this is of course immense, and the incentives to stimulate use of it are very great. As in the United Kingdom, the heavy investment in Trunk Service Mechanisation makes it particularly desirable to stimulate trunk traffic. The following are examples of what is being done to achieve this:—

(a) *Experimental Comparison of Methods of DDD Stimulation*

Experiments are in progress in 6 cities with stimulation of residential DDD traffic. A comparison is being made in each city of the effects of:

Mail advertising on a monthly basis, including an offer to provide " personal telephone directories " with the DDD numbers of subscribers to whom the recipient might make trunk calls specially inserted,

A combination of mail and telephonic approach,

A telephone call, to discuss possible uses of the DDD service, alone.

(b) *Intensive Press and Television Advertising*

Emphasising in particular the cheapness and convenience of the service.

(c) *Special Approaches to School and University Authorities and to Parents*

The value and cheapness of the DDD service in enabling children and students living away from home to be in regular and convenient touch with home is emphasised.

(d) *Use by Travelling Business Representatives*

Approaches to firms to point out to them the immense advantages which the DDD service has to offer; in particular the ability, working from a particular "key town", e.g. New York or Philadelphia, to cover rapidly and comparatively cheaply an area 200 or 300 miles in radius, which otherwise would have to be travelled over laboriously and at considerable expense.

(e) *The "Credit Card" System*

Credit cards, bearing a code number which the caller quotes, and to which the cost of the call is charged, are widely supplied to customers who do a lot of travelling. The facility is very popular and

upwards of 1m. cards are in use at the moment. The convenience of the service is the great attraction so far as customers are concerned; while to the Companies it has proved to be a simple and effective method of stimulating traffic, particularly trunk traffic. Experience has shown that the loss of revenue from repudiated calls made with credit cards is rather higher than the average (1 per cent. compared to 0.2 per cent.), but this is attributable to error rather than to fraud. It is hoped to reduce the loss by a new system of credit card numbers. In any case the additional traffic produced by the credit card system is considered to repay many times over the loss of revenue from repudiated calls.

(f) *Coloured Telephones*

The Bell System has direct evidence that the supply of coloured telephones encourages people to use the telephone more. In controlled tests in hotels, calling rates rose between 17 and 30 per cent. where coloured telephones were fitted.

(g) *Development of the "Enterprise" (Freefone) Service*

The complete stimulation programme of which these operations form part involves at the moment a total of between 400 and 500 staff in the U.S.A., engaged exclusively on this work.

V. Public Relations

(i) *Objects of Bell System Publicity*

The Bell System puts out a great deal of publicity which is not designed for distinct operational purposes. An extreme example is the television film series, which has dealt with abstract scientific subjects like the sun, or the character and functions of human blood, quite unconnected with the formal objects of the System, but calculated to enhance its standing in the eyes of the public.

It is recognised that a satisfactory user/system relation cannot be achieved if publicity is confined to the promulgation of particular objectives, even when these are as wide as stimulation of traffic. The present standing of the System, and hence the customer's willingness to co-operate in new developments like DDD, or to accept rate increases, owes a great deal to the amount of advertising and other public relations material not aimed at specific operational ends, which is produced.

(ii) *Use of Mass Media*

Intensive use is made of films, on purposes ranging from specific subjects through customer instruction to the abstract television series already referred to. A large annual budget is spent, both by A.T. & T. itself and by each Operating Company, on the production of such films. To take an example, the New York Company recently spent $50,000 (about £20,000) on the production of seven training films. We saw examples of films made for the introduction of DDD, including one designed for schools. The value of the film as a vehicle for information and instruction has been very widely exploited. A massive catalogue of films is made available by the System for public use.

Television advertising is, of course, a natural medium in the U.S.A. We were particularly interested by the use made of it in the DDD stimulation campaign. Similarly, wide use is made of Press and display advertising for every purpose.

The differences between Post Office and Bell System practice in this field may be summarised as follows:—

(*a*) A much higher proportion of the total publicity output is devoted to background and interest material than in the United Kingdom, with the objectives noted earlier.

(*b*) The mass publicity machine is regarded as of vital importance both to the general standing of the System and to the customers' grasp of how it works.

(iii) *Approach to Individuals and Groups*

Publicity work in schools forms an important part of this. We have already referred to the films made specially for showing in schools, but another example is the so-called "tele-trainer" course which has been developed for high (secondary) schools. The System attaches great importance, for obvious reasons, to the education of children at school, both in the general status of the telephone service and in its actual use. As the demands made upon the user by telecommunications equipment increase, this importance will grow. We have already mentioned the very close relations with schools in the operator recruitment field.

Direct mail advertising is used extensively, particularly in cases where the mass media are inappropriate because of their wide coverage, and visiting would be uneconomic. We were particularly interested by the practice of sending letters to individual business subscribers and PBX operators, as part of the pre-DDD conversion procedure.

An important part of the machinery of subscriber information is the obligation laid upon *all* System employees to miss no opportunity of mentioning whatever is the current subject, both in their official and private contacts with the public. To take the DDD conversion case again, an important stage in the pre-conversion arrangements is an intensive programme of employee briefing, to this end.

(iv) *Customer Surveys*

In addition to those designed for particular purposes, a regular widely based annual survey is carried out of the public view of the service given by the Bell System. With modifications it has been in operation since 1946, and has proved a very accurate pointer to the state of opinion, both of the System as a whole and of individual facets. It forms an essential tool of management.

Apart from these general ones, surveys are also used for studying individual subjects. These are either carried out by printed questionnaires, or by telephone. In the latter case, which would be used where quick, cheap results were needed, junior female staff are employed, equipped with questionnaires and lists of numbers, and set to secure a completed questionnaire, by telephone.

VI.—General Conclusions and Recommendations

(i) The Bell System has been outstandingly successful in meeting public demand for a satisfactory, convenient and efficient telephone service, and in maintaining its standards of service and public satisfaction while mechanising its system.

We consider the principal factors in the success of the Bell System to be:—

(*a*) Clearly defined basic objectives familiar to every member of the staff

(*b*) The way the system sets out to please the customer and to make him understand and value what is being done for him

(*c*) The personal character of the service

(*d*) The emphasis on the staff as individuals and their personal responsibility and initiative.

(ii) We recommend that the policies and procedures of the British Post Office be re-examined in the light of Bell System practice, in particular, as regards:—

(*a*) The basic objectives of the service,

(*b*) Customer education, particularly for mechanisation,

(*c*) Recruiting, supervision and training of operating staff,

(*d*) Tone of service,

(*e*) Dial service administration,

(*f*) Business office organisation,

(*g*) Repair service,

(*h*) Interception arrangements,

(*j*) Flexibility of organisation,

(*k*) Control and measurement of performance,

(*l*) Merchandising and sales,

(*m*) Stimulation of trunk traffic,

(*n*) Customer service and publicity.

We believe that a review of this sort would be particularly appropriate at the present stage of mechanisation and could greatly facilitate the introduction of STD. It could also profoundly affect the whole public attitude to the Post Office.

See "Personal Service", page 97, and "Subscribers become Customers", page 144.

The Twopenny Telex

A. E. T. Forster, A.M.I.E.E.

D. Pearman, B.Sc.(Eng.)

WHEN the United Kingdom's first two automatic telex exchanges were brought into use at Leeds and London last August, another important phase began in the development of the telex service, and as automatic telex incorporates from the outset the facility of subscriber trunk dialling, 2d. trunk calls became, in the telex service, a reality for the first time in this country.

In an earlier article (Autumn 1956) the plans for converting the system to automatic working were described. Now it is our purpose to fill out the story by describing how these plans are coming to fruition and what facilities the automatic service gives to its subscribers.

The telex service is comparatively little known by the general public, although it has been available in the United Kingdom and many other countries for a considerable number of years and is extensively used in business communications. It is akin to the telephone service in that it is a public service having subscribers who are connected to each other by means of exchanges, but communicating by teleprinters instead of telephones.

The great difference from the telephone service lies in the fact that it is essentially a service for the business community; it has no counterpart to the high proportion of residential and other low calling-rate lines which are such a feature of the telephone

Standard automatic installation

service. In consequence, calling rates are much higher and because of the widespread interests of present-day industry and commerce the nature of the traffic is predominantly long-distance with a high proportion of overseas calls.

This is illustrated by the fact that 42 per cent. of telex calls are inland trunk and another 36 per cent. go overseas, whereas the corresponding figures for telephone calls are 8 per cent. and 0.05 per cent. So marked is this difference on international traffic that although there are about a thousand times as many telephone subscribers as telex, international telex calls are rapidly approaching the telephone figure. In fact, the number of telex calls to some 10 countries already exceeds the telephone calls; but the holding times of telex calls are generally shorter.

The present service, using manual exchanges separate and distinct from the telephone network, was opened in 1947 for the international service and was subsequently extended in 1954 to include the inland service. A measure of the approval given by the business community to the new service is indicated by the fact that the number of lines doubled in the first two years; today, more than 5,000 lines are connected. Traffic has grown in proportion. The manual system was introduced at a time of financial stringency to give a service quickly, but it had known limitations and automatisation was the eventual goal. Before the details of the automatic system to be adopted were finally decided, Post Office men visited a number of European countries and studied the merits of the various automatic systems.

Programme

Having decided on a system, using a national numbering scheme, in which the great bulk of the calls would be obtained by direct dialling, a plan for the complete automatisation of the inland system within five years was embarked on. Of the 50 charging areas, 20 were planned to have physical exchanges initially, to serve the zone and other larger centres, the remainder to be catered for by an exchange in another area.

To start with, a pilot network was chosen, consisting of an exchange at Leeds and another at London (Shoreditch), with trunk lines interconnecting them and the remaining manual exchanges throughout the country; the networks came into service last summer.

The remainder of the plan is already well under way, with Sheffield complete and installation in progress at Liverpool, Manchester, Dundee, Glasgow, Edinburgh, Birmingham and Nottingham. The whole of Scotland and North-West England will be converted by the end of the year with the Midlands beginning early in 1960. This will be followed by the South-West, and the remaining areas are planned to have automatic service by the end of 1960. The largest exchange will be in London (Fleet) and will have initial capacity for over 5,000 lines.

Dialling and metering

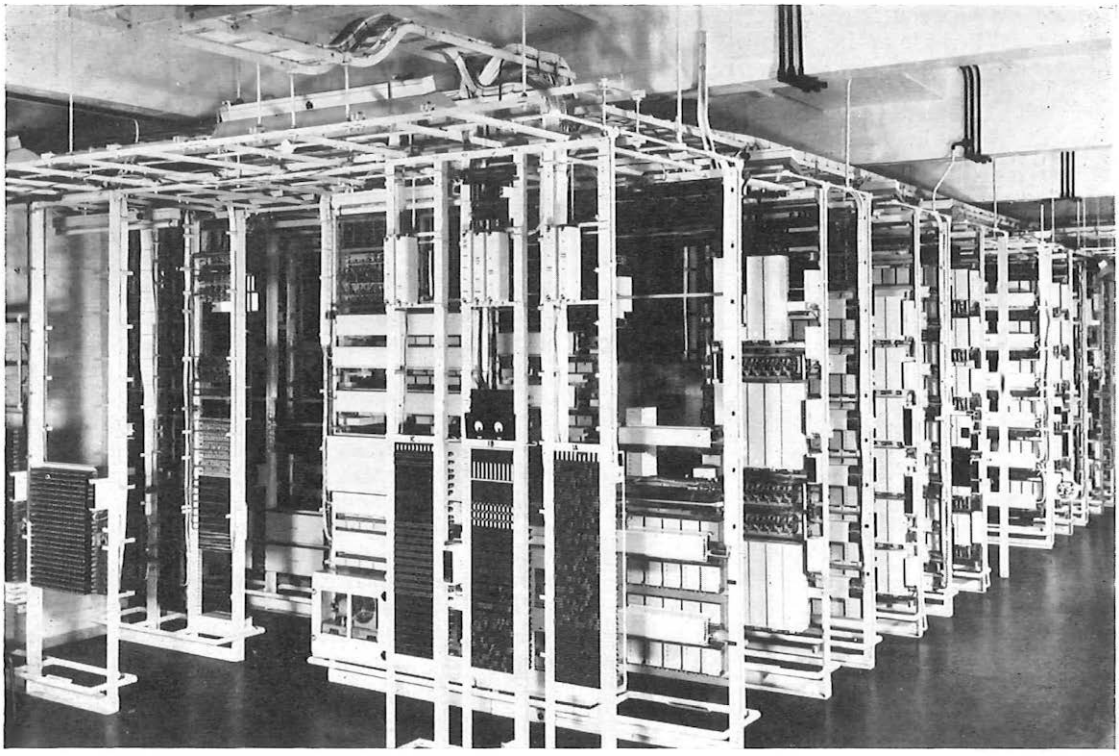
The design of the inland automatic telex system provides for subscriber-dialling to every other automatic subscriber in this country from the outset of automatisation. Clearly this is highly desirable in a service having traffic with a long-distance characteristic, and will enable the most to be made of inland automatisation from the start. With a national numbering scheme, already in use in the manual system, instructions to subscribers are simple, as usually only the called number needs to be dialled. For a proportion of calls, the subscribers on the smaller exchanges will prefix the required national number by the digit "1".

To bring the call charges to account, the system of single-pulse proportionate-time metering is being used in which, after an initial pulse on connexion, metering pulses are applied during the progress of a call at a rate varying with the chargeable distance. The rates of metering are as follows:—

Chargeable distance	*Pulsing interval for 2d. charge*	*Charge per minute*
Local and up to 35 miles	1 minute	2d.
35–50 miles	30 seconds	4d.
50–75 miles	20 seconds	6d.
Over 75 miles	15 seconds	8d.

The metering is controlled by two-motion selectors called Time Zone Metering equipments (TZ's) which decide from the digits dialled whether calls are chargeable (and at what rate), non-chargeable, or are to be barred. This equipment also prevents metering on ineffective calls and performs a number of other important functions as well.

The completion of nation-wide subscriber-dialling at the end of 1960 will be followed soon after by the progressive extension of subscriber-dialling to automatic systems in Western Europe. Subscribers will dial the code "20" to gain access to the international switching equipment in London, a further one or two digits to select the



Shoreditch Automatic Telex Exchange

route to the distant country, and finally dial the number of the required foreign subscriber. There is a variety of different systems in use in other countries, and it has been agreed internationally that the calling country should normally adapt its outgoing circuits to work to the system of the incoming country.

Apart from dealing with the different signalling conditions, the switching equipment has to cater for two main types of traffic; first, traffic to countries having direct selection systems, and second, traffic to those using register systems. With traffic to countries using register systems there is some delay before the equipment is ready to deal with the digits of the required subscriber's number; hence, our equipment has been designed to store the digits dialled by our subscribers until the distant country is ready to accept them. Furthermore, to give our subscribers a reasonably uniform operating procedure, the supervisory information sent back from certain foreign systems is to be converted into the form used in this country.

The same metering system as for the inland service will be used, the equipment being installed initially having been designed to provide for metering rates up to 120 per minute. At the present charge of 2d a unit this will cater, for example, for dialling eventually to the North American continent at the present charge of £1 a minute. To enable subscribers to know the cost of individual calls, particularly the more costly ones to overseas countries, private meters are being developed for those subscribers who wish to rent them. They will consist of a pair of meters incorporated in the signalling unit, one giving the units charge on the call in progress and the other giving a cumulative total.

For those international calls which the subscriber cannot dial, access is obtained to the International Telex Exchange operators in London by dialling a code. The present International Exchange in the Central Telegraph Office is to be replaced in three to four years by a new one in Fleet Building, and a new switchboard of cordless

type is being designed. This will also handle any assistance calls from subscribers experiencing difficulty in dialling either inland or international calls. To make an enquiry, or to despatch an inland or overseas telegram, the subscriber dials a code which connects him to suites of teleprinters provided at certain main centres for this purpose, metering being prevented on all such calls.

Facilities

For automatic working the equipment at a subscriber's premises is somewhat different from that used with the manual service.

First the teleprinter is replaced by a version modified for automatic working, and secondly the signalling unit is replaced by one having a dial. If an automatic transmitter is used, a single signalling unit is provided for controlling both the teleprinter and automatic transmitter, and in addition the automatic transmitter is replaced by one suitable for use on the automatic system. The equipment will at first continue to be mounted on special tables, which hold some of the equipment, but current design work is directed to avoiding this and making it possible to use any suitable available table or desk. This will make it easier to accommodate telex in modern office layouts and, combined with some development of miniature equipment, will eventually facilitate migration of the telex machines from the typing room to the executive's desk.

The dialling and signalling unit fitted adjacent to the teleprinter has on it a dial, a key, a few buttons and a pair of supervisory lamps, one red and one green. All the subscriber's operator has to do to call another automatic subscriber is to press the "dial" button, check that the green lamp lights and so indicates that the exchange equipment has been seized, and then dial the number required. If the called number is free, the line is seized, the "answer-back" code of the required correspondent is printed automatically on the machine and metering starts. The subscriber then transmits the message and the connexion is cleared by the subscriber at either end pressing the "clear" button. If connexion to the distant number cannot be made for some reason, a service signal is printed on the calling teleprinter and the connexion is automatically cleared without any metering taking place. The various printed service signals have an internationally understood significance, for example, when the required number is engaged the letters OCC (*occupé*) are printed. The green lamp also lights, in association with the operation of a buzzer if required, while an incoming call is in progress. The red lamp lights and the buzzer sounds under a number of alarm conditions; one is the "J-bell" facility by which either subscriber can call the other's attention to his machine, and two others are mentioned in the succeeding paragraphs.

So long as some exchanges are still manual, automatic subscribers will gain access to manual subscribers by dialling a code consisting of the first two digits of the required number. This connects the caller to a manual switchboard, either at his own zone centre or at the distant exchange, where the call is controlled, timed and ticketed by an operator in the same way as with the manual service. In the interval between completion of dialling and the answer from the switchboard the service signal MOM (international meaning "wait") is printed at intervals on the calling teleprinter until the switchboard "answer-back" code is received.

Full operator or subscriber-dialling from overseas into our system will take place with the opening of the international switching unit in 1961, but in the meantime a limited amount of dialling-in by operators in a few countries direct to United Kingdom automatic subscribers is being provided via the Shoreditch exchange.

Punched tape

The usefulness of punched tape as an aid to the more efficient use of telex is now being widely recognised, and the system caters for this. Using an automatic transmitter with a prepared tape, a message can be sent at a constant speed of 66 words a minute, and this is particularly useful in economising in call charges over long distances.

Once the automatic transmitter has been started the transmission proceeds without the intervention of the operator until the tape is finished. When this happens the automatic transmitter switches off, the teleprinter is switched back to the line and the operator's attention is drawn by the alarms.

A new field for the use of punched tape now attracting attention is the transmission of data for centralised accounting or other processing by computers.

"In local" working (that is, using the teleprinter to produce a local page copy or punched tape without making a call) is effected by pressing a button on the signalling unit; under the automatic system this does not result in incoming calls

being lost as the line is not put in the engaged condition. When an incoming call is offered to a line which has its teleprinter working "in local" the alarms operate at the called machine and the return of the "answer-back" to the caller is delayed until either the "in local" key is restored or until the "in local" condition is over-ridden by the action of a time pulse after approximately three seconds.

Telegrams can be delivered by telex, and this is particularly useful outside the normal hand-delivery times. To facilitate this, direct access is being provided to the telex network from the teleprinter automatic switching system used for the public telegraph service. This enables transmission of telegrams direct to telex subscribers without involving retransmission in the process.

With a new system, incorporating an entirely new method of metering and a number of new facilities, it is more than usually important to be able to check the quality of service given and equipment has been provided for taking service and meter observations.

Opening the Pilot Network

Although the pilot conversion involved opening only two exchanges, about a quarter of the existing subscribers are now being given automatic service by them. The exchange at Leeds serves all the subscribers in the Bradford, Lincoln, Middlesbrough and York charging areas as well as Leeds, and that at Shoreditch about one-third of those in London. The automatic subscribers in London, unlike those in the Leeds system, are not related to any particular geographical location but are distributed over the whole of the London charging area; they contain a high proportion of the busiest telex users.

Ericsson Telephones started installing the equipment (to Post Office design) towards the end of 1957, and early in 1958 work was begun on converting the subscribers' installations for automatic working using equipment manufactured under contract to Post Office design. As the teleprinter and associated equipment required changing or modifying, the procedure was as far as possible for the new installation complete and mounted on its table to be assembled and tested in a Post Office workshop and then changed bodily, thereby reducing to a minimum any disturbance to subscribers. As these subscribers' conversions were carried out in advance of the opening of the automatic exchange the equipment had, of course, to be designed to work to the manual exchanges in the interim.

One of the difficulties with telex subscribers' conversions, compared with the well-established telephone counterpart, is the complexity and bulkiness of the equipment involved, and good organization was necessary to regulate the flow, storage and transport of so many big items. Besides fitting the modified equipment, it had to be tested and the subscribers' operators instructed in the correct use under both manual and automatic conditions. This was achieved by the Engineering staff working closely with Telegraph Service Representatives and by providing access to a switching train in the Telegraph Laboratory in London.

The exchange equipment was manufactured and installed in accordance with a very closely phased programme in which only 10 months elapsed between the start of installation and the opening of the system to service. This required very close co-operation between Ericssons and the Post Office Engineering staffs. After the contractor had handed over the exchanges and before the exchanges were brought into service, many thousands of test calls, in accordance with a carefully devised programme, were passed from a battery of test positions installed at Leeds and Shoreditch, giving a wide variety of subscribers' equipment and line conditions.

This programme of test calls, which involved a combined operation by Engineering and Traffic staffs, was arranged to be much more searching than the pre-transfer tests customary with telephone exchanges, because of the newness of the design and the need to ensure that this first transfer, involving many important subscribers, would take place smoothly.

Having proved the equipment satisfactory the transfer programme was confirmed and the subscribers were advised. Our first automatic telex subscribers came into service and as soon as they had been cut over and an engineering test carried out on the lines, a message was sent to each subscriber advising him that he now had automatic service. As this was a Saturday afternoon nearly all installations were unattended, but because their power had been left switched on at our request, the message was there for the staff to see on arrival on Monday morning. Receipt of the "answer-back" provided the Post Office with a check in the renter's absence that the line had been successfully transferred.

Installation with reperforating facilities and automatic transmitter—mounted on office table

To mark the occasion, the Assistant Postmaster General presided at an inaugural ceremony at Leeds on September 1 in the presence of local civic dignitaries, including the Lord Mayors of Bradford and Leeds. During this ceremony the Assistant Postmaster General sent a short message of enquiry to his Private Secretary at Post Office Headquarters in London, using a demonstration meter to show how such a message could be sent for 2d and thereby demonstrating publicly, for the first time, the 2d trunk call.

Automation will pave the way for a great expansion of the service. Extension of subscriber-to-subscriber dialling to more countries and the opening of further overseas routes will accelerate the world-wide scale of expansion already started.

Fresh impetus is likely to be given to this when the recently-announced Commonwealth plan for encircling the globe with a coaxial cable system begins to come to fruition. With adequate numbers of stable teleprinter circuits, this will provide scope for the expansion of subscriber-dialling beyond Western Europe to the more distant parts of the world. All this, with the development of new facilities, will widen the scope of telex to the business community and at the same time it is expected to penetrate into different fields of activity. Increased use of the service will depend on the acquisition of the telex habit and may well require some remodelling of business organisations to enable them to exploit its possibilities to the full. We also foresee that many hotels and post offices may have installations that can be used, for example, by travelling representatives to file their day's business with their head offices, and for retailers and distributors to place orders with wholesalers and manufacturers.

With this sort of development in mind, a policy decision was recently taken to plan for double the annual rate of expansion of the service in the first 10 years after automation; the target is a network of 20,000 lines by 1970.

Subscriber Trunk Dialling

Register-Translators for S.T.D.

H. E. Francis

Following is the fourth in our series of articles about Subscriber Trunk Dialling. The previous articles have been Subscriber Trunk Dialling Simply Explained (Summer 1958), Preparation for Subscriber Trunk Dialling at Bristol (Winter, November 1958) and National Telephone Numbers (Spring 1959). We shall discuss the New Coin Box in our Autumn issue, followed by Tariffs in the Winter number.

In this article Mr. Francis outlines the operating principles of Register-Translators, with special reference to the translators developed for S.T.D.

ALTHOUGH REGISTER-TRANSLATORS HAVE recently come into the news as part of GRACE (Group Routing and Charging Equipment) for Subscriber Trunk Dialling, they have been used in this country for more than 30 years under the name of "Director".

Modern register-translators as developed for S.T.D. differ from the director both in the details of the facilities provided and more particularly in the design techniques used, many of which were unknown when the first director designs were produced. This article will describe only the controlling register-translators and associated relay sets used in connexion with S.T.D.

What a Register-Translator Does

The similarity between the functions carried out by a register-translator and those performed by an operator has often been mentioned and it is a useful analogy if the comparison is made for a similar class of traffic. Since a controlling register-translator deals with calls completed over a mechanized trunk network, the comparison is therefore with the work of a controlling operator in a similar network.

Controlling register-translators have, however, been designed to deal only with "demand" calls to automatic exchange subscribers. While equipment could have been designed to "book" calls, to set them up on a delay basis, and to route calls to manual exchanges, the additional cost and complexity were not considered justified. Typical arrangements of the equipment for controlling trunk traffic under both manual and automatic conditions are compared in Figs. 1(a) and 1(b). The operations involved in controlling trunk traffic fall mainly under the headings of storage, identification, translation, sending, charging and supervision, and so will be described in relation to each of these functions.

Storage. To obtain a trunk call automatically a subscriber will dial the digits of the required national number, as explained by Mr. Chandler in the Spring issue. The first digit, which is always "O", connects the caller to the register equipment and can be compared to dialling a code (0, 100, TRU, etc.) to speak to the operator. The next three digits (one or two for the director areas) indicate the charging group required and, with the remaining digits of the national number, are received and stored by the register-translator. On a manually-controlled call, the operator records similar information (exchange name and number) on a ticket.

Identification and Translation. When an operator has ascertained the required exchange, she can refer to an index file (Visible Index File) and identify the required entry. She then notes both the charge rate for such a call and the routing digits she must dial. Similar action takes place in an automatic exchange. A national code is first identified and then the appropriate charge rate and the routing digits are obtained from a "library" of such information. This process is called translation.

Sending. Having obtained the information from the file, an operator dials the routing digits which operate switches in her own exchange and perhaps in intermediate exchanges until the call reaches the required exchange. The operator then dials the distant subscriber's local number. The dialling

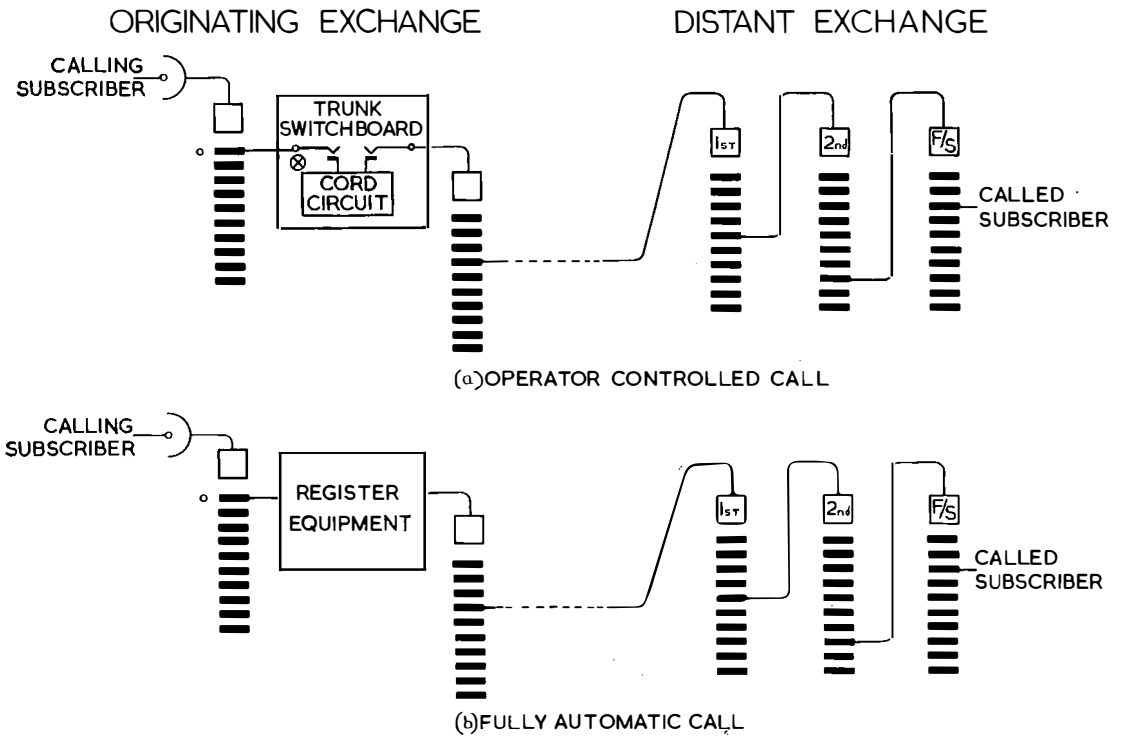


Fig. 1 (a) and (b) : Typical routing of call in a mechanized trunk network

process is referred to as "sending" when carried out by automatic equipment and, for the purpose of this explanation, may be regarded as involving transmission of the routing digits followed by the digits of the distant subscriber's local number.

Charging. With manually-controlled traffic a call is timed by a "clock" associated with the cord circuit; this is started when the called subscriber answers and stops when the calling subscriber hangs up at the end of the call. From a knowledge of the duration and the charge rate, the actual charge for a call can be determined.

On S.T.D. calls one charge unit is recorded on the calling subscriber's meter when the called subscriber answers, and thereafter further charge units are recorded at intervals, depending on the distance over which the call is made. Mr. Kemp described this method of charging for calls, referred to as "periodic metering", in an article in the Summer 1958 *Journal*.

Supervision. The cord circuit on a trunk switchboard also enables an operator to supervise a call and, in particular, indicates when a call is completed and a connexion can be broken down. A similar supervision function is required on S.T.D. calls to ensure that trunk lines are not held unnecessarily, and to safeguard a subscriber against incurring a high charge should he forget to replace his receiver, or replace it incorrectly.

In this comparison between operators and register-translators, no reference has been made to the relative time taken to carry out these various functions. It is of interest, however, to note that at Bristol the average time to set up and clear down a trunk call is about 35 seconds less on subscriber-dialled calls than on similar calls routed via the operator.

Group Routing and Charging Equipment

In the equipment for S.T.D. the six functions of storage, identification, translation, sending, charging and supervision are contained in three separate pieces of equipment called registers, translators and relay sets. Collectively they are referred to as

Group Routing and Charging Equipment—that is, GRACE.

It will be apparent from this outline that the time taken to perform each of these functions can differ widely. Charging and supervision may be required during the whole time a call is set up and consequently these functions are performed by a translator which is common to a number of registers. The arrangement is shown diagrammatically in Fig. 2, which is an expansion of the group routing and charging equipment of Fig. 1(b).

This division of the six main functions between three separate pieces of equipment results in considerable economies. The number of registers and translators required is many times fewer than the number of relay sets. In a typical installation the ratio of translators, registers and relay sets could be about 1:20:250 but the actual figures would depend on both the design techniques employed and the amount of traffic.

Trunking Arrangements

Non-Director Main Exchanges. The method by which the group routing and charging is arranged in a non-director main exchange is shown in Fig. 3. A subscriber on dialling "O", the first digit of the national number, is connected to a relay set having an associated register hunter which searches for a free register. In this arrangement the hunting of both the first selector and the register hunter must take place before a register is connected, and under adverse conditions the time taken may exceed the pause a subscriber makes between dialling the first and second digits of a national number. The relay set therefore stores the second digit temporarily before passing it to the register, but the third and subsequent digits are passed straight into the register, where they are stored. If, for any reason, a register has not been connected before a subscriber starts dialling the third digit, busy tone is applied.

Other Exchanges in Non-Director Areas. The figures already quoted for the ratio of the component parts of the group routing and charging register equipment indicate that registers and translators can be operated more efficiently in large groups. A single exchange rarely originates sufficient trunk traffic to enable the register-translators to be operated at optimum efficiency and it is desirable, therefore, to group exchanges together so that they can share a common group of equipment. A convenient arrangement is for all exchanges in a charging group to work to a common group of register-translators at a trunk switching centre—usually the group switching centre.

The grouping of the register-translators at a central point implies that signals can be transmitted over a junction to the originating exchange so that the charge units appropriate to the call can be recorded on the calling subscriber's meter. This could have been done in one of several ways but it was decided that the charge units should be recorded during the call and that it was more economical if these units were signalled direct from the group routing and charging equipment. The decision made it essential to develop a signalling system which not only gives the highest degree of reliability but which also does not interfere in any way with conversation. The system finally adopted for signalling over audio cables is based on the reversal of line potentials, and in operation is inaudible to the subscriber.

A typical arrangement in non-director areas for access from remote exchanges to the centralized group routing and charging equipment is shown in Fig. 4. For existing designs of satellite exchanges and for other non-director exchanges a separate group of S.T.D. junctions will be required. Probably, however, for U.A.Xs and for future designs of non-director exchanges a common group of junctions will be used for all classes of traffic.

Director Exchanges. A slightly different problem arises in director areas as the 1st code selector is not directly controlled from dialled pulses, but is

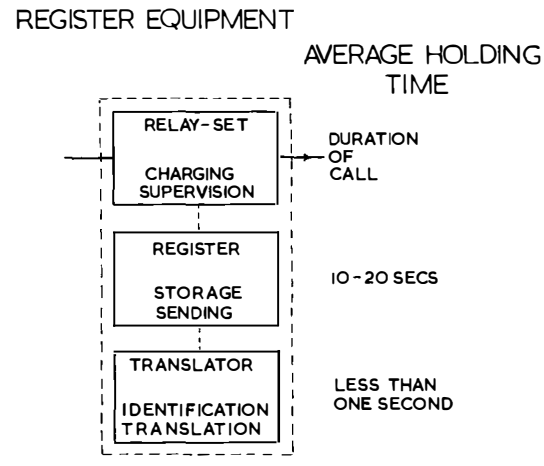


Fig. 2 : Division of equipment according to the average holding time of the function required

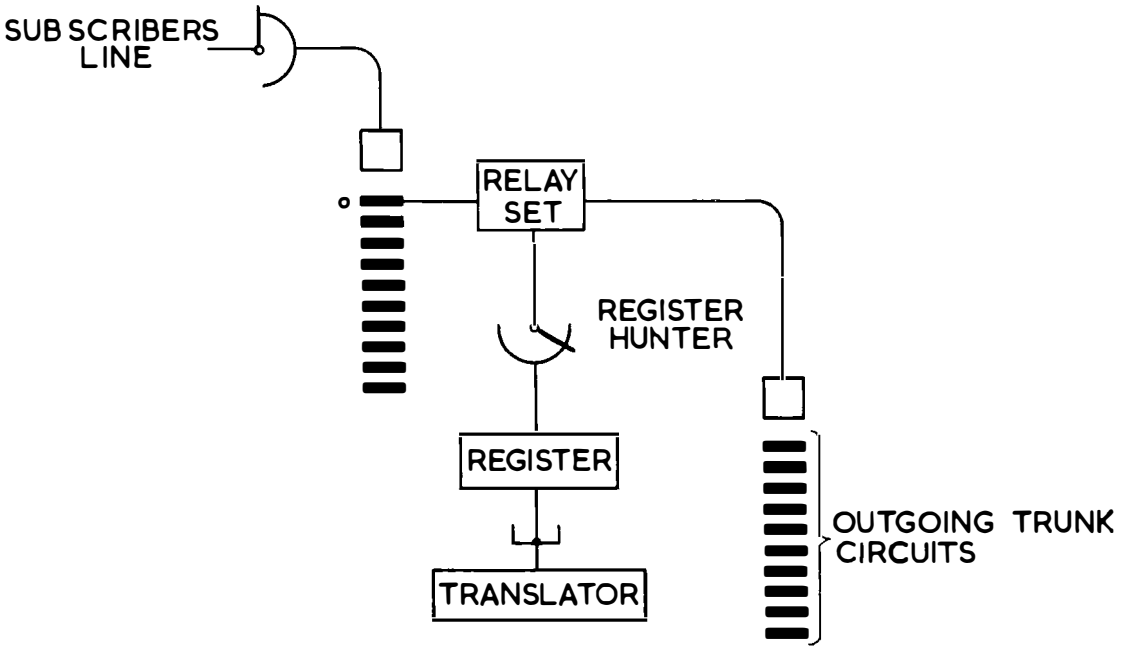


Fig. 3 : Connexion of Register equipment in non-director main exchange

designed to transmit to the A digit selector and director all digits dialled by a subscriber. The solution adopted is to connect a small register called a "local register" to the "O" level of the A digit selector. This register sends out a digit to position the 1st code selector to the level which has access to the S.T.D. junctions, and then repeats forward all digits received from the subscriber. (In practice it will repeat the second and subsequent digits of the national number as the digit "O" has been used in operating the A digit selector.) The arrangement is shown in Fig. 5.

The controlling register-translators can be at a central point but they differ from the non-director equipment in a number of respects. In particular, the need to store a digit in the relay set is avoided as the digits received by a controlling register are transmitted from a local register and a sufficiently long interval is inserted before transmitting the second digit of the national number to cover the dual hunting times of both the 1st code selector and the register hunter. Subsequent digits can be transferred from the local register with intervals between digits (no hunting is involved) so that the sending process tends to "catch-up" on the digits dialled by a subscriber and very little delay is introduced.

As in the non-director area signals indicating the charge units consumed on a call are transmitted over the junction to the originating exchange where they are recorded on the calling subscriber's meter.

Advantages and Disadvantages

The advantages can be stated briefly as flexibility and signal regeneration or conversion. The flexibility gives considerable freedom in the allocation of national numbers, permits the use of significant letter codes and enables the trunk routings to be determined and changed without alteration to subscribers' dialling procedure. Also, the use of registers automatically provides pulse regeneration or alternatively provides a convenient point for conversion from dialled pulses to other forms of signalling, such as fast coded voice frequency signals.

Among the disadvantages the most important is the concentration of so many functions into a relatively few pieces of equipment. This calls for a very high degree of reliability and the inclusion in the design of self-checking features with adequate

alarm and standby arrangements. Another disadvantage is the slight delay in setting up calls compared to the direct control of switches by dial pulses as in a non-director area. An essential feature of register-translators is that they store the digits dialled by the subscriber and when several have been received (usually three) the translation takes place and the routing digits are transmitted, followed by some or all of the stored digits of the national number. Therefore, a short period must elapse between the completion of dialling by the subscriber and the receipt of ringing tone or busy tone.

Assuming normal Strowger pulsing, this period can amount to about 10 seconds per register-translator. In the future as many as four or five register-translators may be involved in a multi-link trunk call, and new methods of signalling and switching will be introduced to avoid long set-up times.

The fundamental design of the director has changed little since it was first introduced more than 30 years ago. In designing register-translators for S.T.D. the position is very different. At present electronic techniques are being extensively developed and this has stimulated designers of electro-mechanical equipment. As a result, apart from separate designs on an electro-mechanical and electronic basis for comparison purposes, different techniques in both fields have been used in the several types of register-translator required. It would be impossible in this short article to attempt to describe the detailed operation of even one type of register-translator, but some of the techniques employed, with one or two other special features, must be referred to.

Register Access Relay Sets. One of the important functions of the register access relay set is generating the meter pulses which record charge units on the calling subscriber's meter. This is carried out by making available to the relay set a number of pulse supplies with repetition rates six times as fast as it is desired to generate meter pulses. For each call one of the pulse supplies is selected by a switch stepping round in accordance with signals sent from the translator via the register, as shown in Fig. 6. The selection of a particular pulse rate is, therefore, a function of translation and is determined from the charging group code of the required subscriber.

Also included in the relay set is a device for counting the supply pulses, and after every sixth pulse a meter pulse is generated to operate the

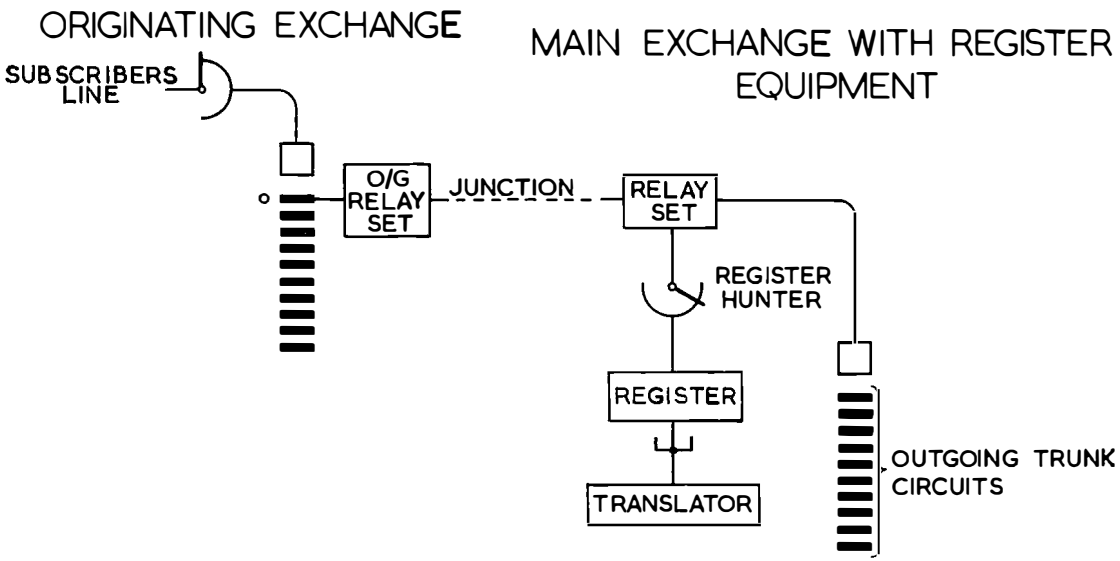


Fig. 4 : Typical trunking arrangement for S.T.D. traffic originating at a group selector satellite or remote non-director exchange. (Note. The registers and translators are common to all exchanges in the charging group)

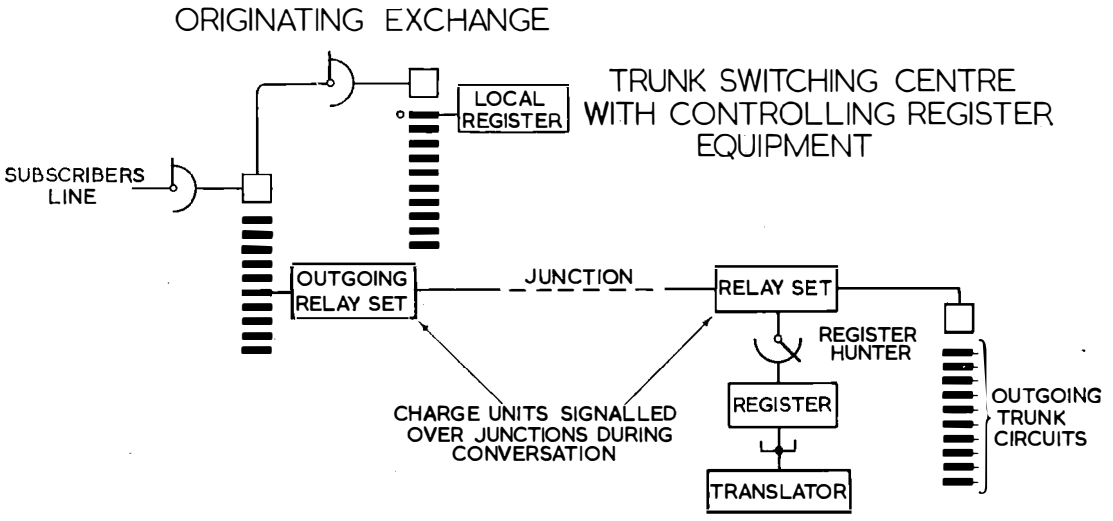


Fig. 5 : Typical trunking arrangement for S.T.D. traffic originating in a director exchange

subscriber's meter. The initial pulse is generated when the called subscriber answers, and as will be explained in an article in a later issue, seven supply pulses are then counted in the first instance to ensure that the subscriber gets the full period to which he is entitled.

These two functions of recording the charge rate and counting the supply pulses are carried out on standard uniselectors and relays for the Bristol equipment and other early installations, but new miniature designs of apparatus specially produced for this purpose are shown in Fig. 7. The miniature uniselector will be used to select the required pulse rate and the ratchet relay to count six of these pulses before generating a meter pulse.

The control of S.T.D. calls is normally vested

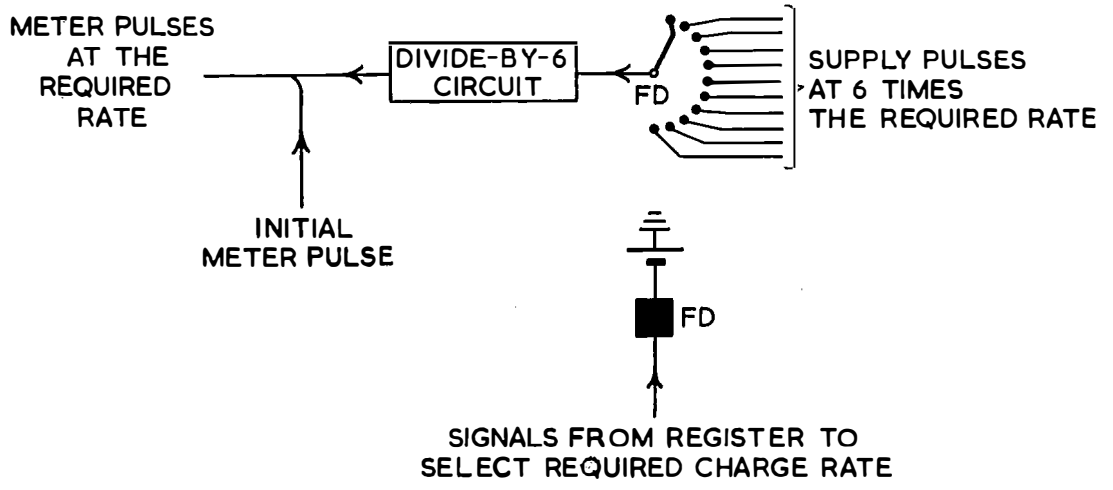


Fig. 6 : Simplified diagram showing selection of charge rate and generation of meter pulses

in the calling subscriber but arrangements are included in the relay set to release the connexion when either a no reply or a called subscriber held condition has existed on a call for one or two minutes respectively. As already mentioned, this prevents trunk lines being held unnecessarily and safeguards a subscriber against inadvertently incurring a high charge through misoperation of his telephone.

Registers. The methods employed to store the digits dialled by a subscriber differ considerably in the various designs of register, and indicate attempts to develop improved and more reliable techniques. In the director, uniselectors are used and the first electro-mechanical designs of register used similar methods. The arrangement is shown in Fig. 8 where each pulse generated by a subscriber's dial causes contact A to operate and energize the magnet of one of the storage uniselectors AR, BR, etc. The wipers of the particular uniselector are thus stepped to the contact corresponding to the value of the digit dialled. At the end of each train of pulses forming a digit, contact CD operates and steps the distributor so that the next digit received is stored on another uniselector. An example of a register of this type is shown in Fig. 9; this will be widely used in non-director areas. More recently, storage on relays in code form has been tried and given satisfaction.

In the electronic field, the registers used at Bristol store the digits in a "two out of five code" on cold cathode tubes, and these registers are proving very reliable. An alternative electronic technique using a magnetic drum is being developed; a binary code is used and the information is "written in" by forming small magnetic "cells" in the nickel plating on a rotating drum. The system is very economical in space and the equipment designed provides storage capacity for 48 registers and the "library" of routing and charging information for the translator on one 9-inch diameter drum. A view of a magnetic drum, with its "reading" and "writing" heads, is shown in Fig. 10.

An interesting development which owes something to both electro-mechanical and electronic techniques is provided by local registers in a director exchange. Storage is required only for a short period, as sending starts soon after the digits are received. A cyclic store with a total capacity of 50 pulses is therefore adequate. A uniselector is arranged to step in response to the dialled pulses and at the end of each digit a small electric charge is stored on a capacitor connected to the corresponding contact. Another uniselector which transmits pulses as it rotates at 10 steps a second counts round until it finds the charge, when it waits for a suitable interval (the inter-digital pause) before starting to count the next digit. The principle is not new but has been made possible

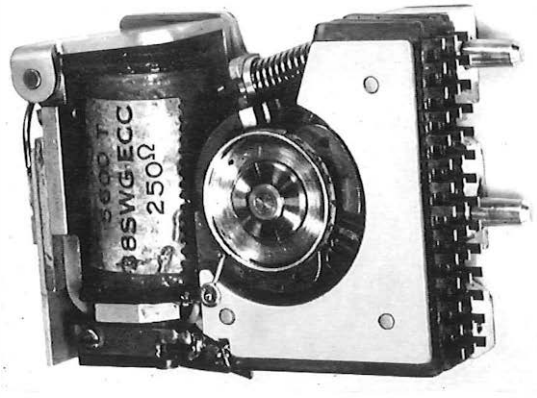
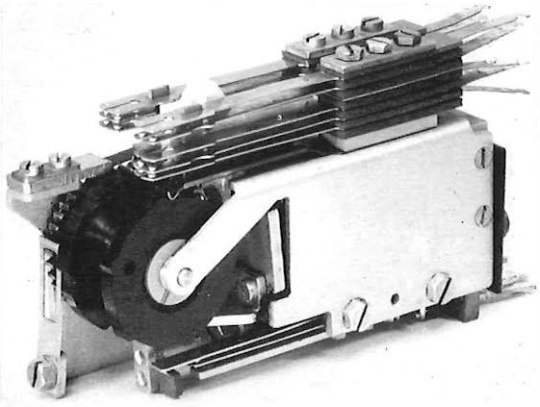


Fig. 7 : Miniature apparatus: above—Uniselector

below—Ratchet relay



economically by introducing transistors to "read" the charge stored on the capacitor.

Another feature of the register is the method used to release it. In a director exchange no difficulty arises as all subscribers' numbers contain 7 digits. National numbers, however, may contain 8, 9 or 10 digits and there is nothing positive to indicate to the register when it has received a

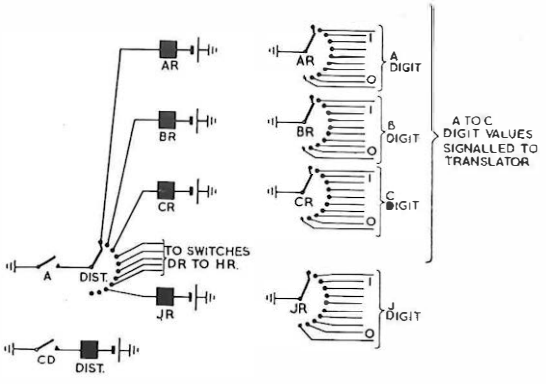


Fig. 8 : Storing digits on uniselectors

complete number. Of the possible technical solutions available, a "time-out" arrangement was adopted, whereby after receiving the 8th digit of the national number, a register would wait four seconds for a possible 9th digit before releasing. If a 9th digit were received during this period it would then wait four more seconds for a possible 10th digit.

The success of the scheme depends on subscribers not delaying more than four seconds between dialling the last one or two digits, and experience at Bristol shows that no difficulty is experienced in practice. The scheme tends to increase the setting-up time slightly, but as a number of routing digits have to be sent by the register before repeating the called subscriber's local number, the increased setting-up time seldom exceeds one second.

Translators. The adoption of the principle of one translator serving a number of registers, although giving economic advantages, does involve a very high usage of the equipment (hundreds or even thousands of operations an hour). This makes the use of electronic techniques very attractive owing to the absence of mechanical wear and tear. Where electro-mechanical translators are used, however, a new design of long life relay has been introduced and should give little trouble over many years of operation.

An essential feature of translators is identification of one out of a possible thousand points from the 3-digit code. (For the purpose of this explanation a 3-digit code has been assumed, but as already mentioned 1 or 2-digit codes are used for director areas, and the equipment is also designed to identify 4-digit or 5-digit codes in a few special cases.) The principle is shown in Fig. 11.

For a 3-digit code a suitable marking condition will appear on one contact of each of the uniselector arcs AR, BR, and CR (Fig. 8). These marking conditions are extended to the translator on three out of 30 wires. The marking condition on the AR uniselector contact causes one of the ten relays (labelled 1 to 10) to operate and the 10 contacts of this relay extend the wires from the bank contacts of the BR uniselector to 10 further relays. One of these 10 relays will operate, depending on the position of the wipers of the BR uniselector. (Relay 34 in Fig. 11.) In a similar manner the 10 contacts of this latter relay extend the wires from the bank contacts of the CR uniselector so that a working condition will appear on one out of a possible thousand points. This point is cross-connected to a translation relay the contacts of

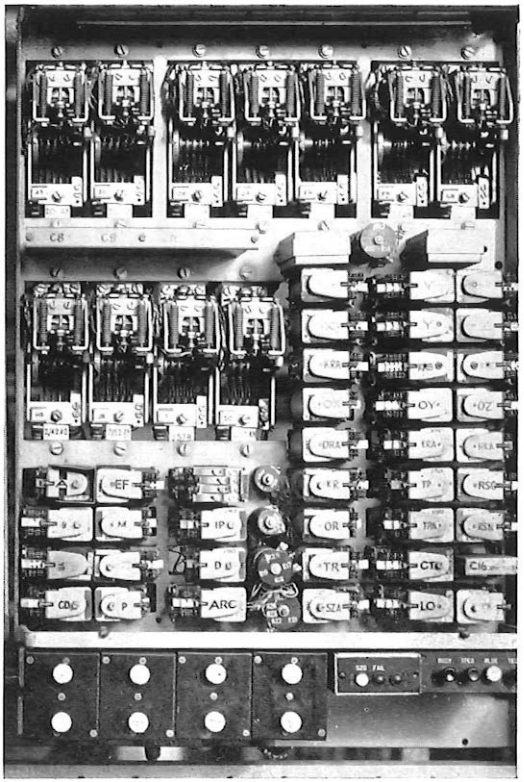


Fig. 9 : Electro-mechanical register with digit storage on uniselectors

which indicate the appropriate charge rate and routing digits.

Except with the magnetic drum design, all translators include a cross-connexion field where connexions are made between the various national codes and the required translations. Experience in director exchanges has suggested that this cross-connexion field is a possible source of trouble, faults being caused as a result of dry joints, blobs of solder and so on, which arise from the changes in translations carried out over the years. With the common translator technique it has been possible economically to build in self-checking devices which avoid such faults affecting the service. The magnetic drum uses a different method and the translations are "written in" by means of a key set. Changes to translations therefore are simple and do not involve mechanical change to the equipment.

Standby Arrangements. With the concentration of so many important functions into a few registers and translators it is necessary to ensure that the service does not suffer appreciably should any particular piece of equipment become faulty. Apart from the built-in testing facilities, some of which have already been referred to, standby equipment has to be available should failure occur

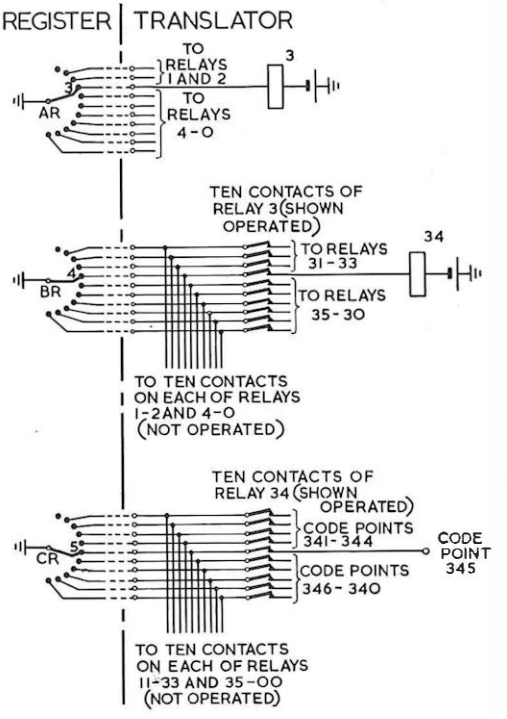


Fig. 11 : Identification of a 3-digit code

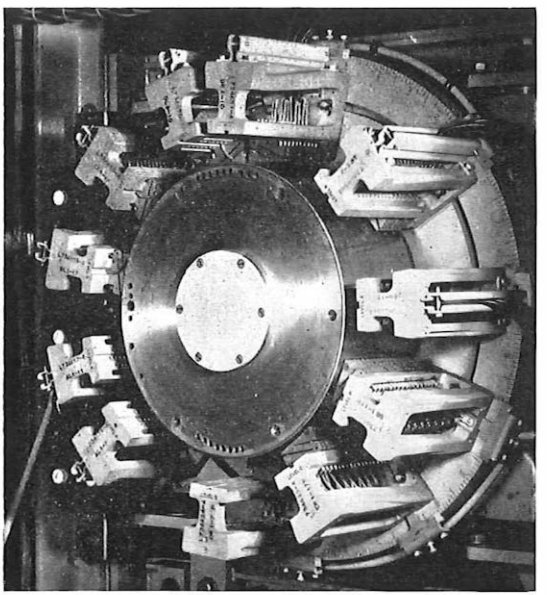


Fig. 10 : Magnetic drum with "reading" and "writing" heads

to an important item such as a translator. At least one additional translator is always provided and comes into use automatically if one of the working translators fails. Depending on the particular design, the additional translator is either normally in use but surplus to traffic requirements, or is normally a standby and brought into use when required. The former method is preferred as it ensures that all equipment is in working order.

Conclusions

In this brief review of register-translators it has been possible to refer to only a few of the special features. It is apparent, however, that as S.T.D. and the mechanisation of the trunk service develops many more register-translators will be used as they give a flexibility to the network essential to any growing system.

S.T.D. will start in Bodmin in November and in Evesham next January.

The Post Office Engineering Department

(left to right) Mr. A. H. MUMFORD, O.B.E., Deputy Engineer-in-Chief; Mr. H. WILLIAMS, Assistant Engineer-in-Chief; Brig. Sir Lionel H. HARRIS, K.B.E., T.D., Engineer-in-Chief; Mr. R. J. HALSEY, C.M.G., Director of Research; Mr. D. A. BARRON, Assistant Engineer-in-Chief; Mr. A. C. WARREN, Assistant Engineer-in-Chief; Mr. G. DALY, O.B.E., Staff Controller.

Mr. C. E. Richards, Deputy Director of Research, and Captain C. F. Booth, C.B.E., Assistant Engineer-in-Chief, were unfortunately unable to appear in the photograph.

THE ENGINEER-IN-CHIEF OF THE POST OFFICE and his staff moved last August from Alder House in the City of London, opposite Post Office Headquarters and on the site of the old Aldersgate, to a new building a few yards away in Gresham Street which may be said to run, broadly, from Headquarters to the Bank. The building is numbered 2–12 but is yet unnamed. The move brought together 1,100 staff from Alder House and six other buildings.

The Department is headed by the Engineer-in-Chief, a Deputy Engineer-in-Chief and four Assistant Engineers-in-Chief. Some miles away, at Dollis Hill in North-West London, the Director and Deputy Director of Research are responsible for the engineering and scientific activities of the Research Station. The Staff Controller, with his office in Gresham Street, is in charge of the general administration of the Department.

The Engineering Department has altogether 18 engineering branches, including Research, Motor Transport and Submarine, and two engineering or scientific units: the Technical Support Unit for automatic digital processing and the Joint Speech Research Unit which is an adjunct of the Research Branch. Each branch or unit is under the control of a Staff Engineer or an officer of equivalent rank.

The Department's work includes basic research, design, development, installation and maintenance of plant required for Post Office services, and the centralized training of all engineering staff. To carry out this work there is a total of 4,400 major

and minor grade engineers, scientists, draughtsmen and cableship officers and ratings. Nine hundred clerical and executive staff in the Department work partly in the engineering branches but mainly in the Accounts, Editorial and Staff branches which are additional to the 18 engineering branches.

The London Regional Motor Transport Organisation, responsible for maintaining the engineering and postal fleets in London, and the four Central Repair depots, which carry out most of the major overhauls of vehicles for the Regions, are under the control of the Engineering Department and employ 1,400 mechanics or other garage staff.

The Engineering Department also acts in an advisory capacity in technical matters influencing the operations of engineering and motor transport staff employed in the Regions and Telephone Areas and retains executive control over works of national and international importance, such as provision of radio stations, long television links, submarine cables, the introduction of new designs of telecommunications equipment and the mechanization of postal machinery.

Sir Stanley Angwin

Sir Stanley Angwin, K.C.M.G., K.B.E., D.S.O., M.C., for 40 years (1906–1946) an engineer in the Post Office and Engineer-in-Chief during his last seven years of service, died on April 12, aged 75.

Among his many "outstanding contributions to the national, international, and intercontinental development of telecommunications" (*The Times*) he was largely responsible for developing radiotelephony, the coaxial cable system, two-voice frequency signalling and submerged repeaters. He contributed considerably in the design and construction of Leafield, Cairo and Rugby radio stations and the inauguration of transatlantic telephony. In 1947 he became Chairman of Cable & Wireless Ltd., and from 1951 to 1956 was Chairman of the Commonwealth Telecommunications Board.

In 1943–1944 he was President of the Institution of Electrical Engineers and was awarded the Institution's Faraday Medal in 1956. During World War I he was Deputy Chief Signal Officer, Supplementary Reserve, Royal Corps of Signals.

Brigadier Sir Lionel Harris, the present Engineer-in-Chief, writes:

His associates soon learnt that behind his rather quiet and casual manner was a fund of wisdom and that his few occasional words of direction or decision invariably covered all that was essential, often enough to set in train a scheme or project of magnitude and lasting importance.

His experience as a Signal Commander throughout the First World War, supplemented between the wars by his continuing association with Signals, became of particular significance when from 1939–1946 he served as Engineer-in-Chief.

In the United Kingdom, the Second World War demanded integration of Civil Services telecommunications, while overseas Post Office staff in uniform formed the framework of the staff and units of the main signal systems. It was fortunate that Sir Stanley, with his service experience, was in the saddle at the right time. Some of us remember him in his office in Aldersgate Street where his only acknowledgment of air raids was to pull down the flimsy blinds " just to keep the bits of glass out of your eyes".

The history of his career is parallel to that of telecommunications itself, culminating with his Chairmanship of Cable & Wireless Ltd. and finally that of the Commonwealth Telecommunications Board, and made as complete and successful 50 years of service as may fall to any man.

Studying the Commonwealth System

A group of External Telecommunications Executive officials concerned with day-to-day staffing and operating of the Post Office overseas telecommunications services has recently visited Australia at the invitation of the Overseas Telecommunications Commission (Australia). The group was led by Mr. C. J. Gill, Deputy Director of the ETE and included Mr. E. Bowden, Chief Telegraph Superintendent (who in April became Deputy Telegraph Manager, Electra House), Mr. H. Beatson, Senior Executive Engineer in charge of Somerton Radio Station, and Mr. A. K. Walker, Senior Traffic Superintendent of ETE's Headquarters Traffic Division. The group visited Singapore on the outward journey and returned via the Pacific, visiting Fiji, Canada and the United States en route.

The group studied the organization of traffic and engineering operations at the overseas service stations in the countries visited, discussed mutual problems concerned with the operation of telephone, telegraph, telex and leased services, and familiarized themselves with the equipment and operating conditions in the countries visited.

The Engineering Test Sections

H. J. Dolton

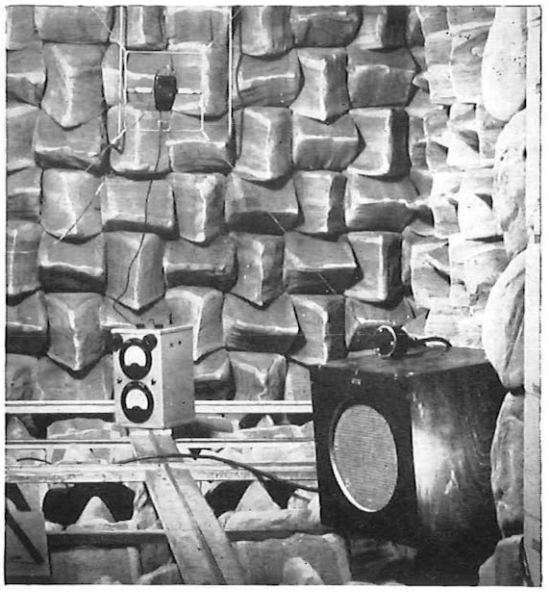


Fig. 1 : Testing a Ministry of Health hearing aid

IN A TYPICAL YEAR, THE POST OFFICE MAY SPEND about £55 million on engineering equipment and stores. Of this about £25 million would be spent on exchange and repeater station equipment and main trunk and junction cables which the manufacturers make and install. The balance of £30 million would be spent in acquiring equipment, apparatus and stores to meet the day-to-day field requirements, the money being divided fairly evenly into three lots, one for cable and wire, one for internal stores, and the third for external line stores, tools and miscellaneous items.

In addition, the Post Office Factories Department repairs equipment for the Engineering Department to the value of about £5 million a year.

This vast quantity of equipment has to be supplied in accordance with Post Office requirements; the Engineering Department is responsible for ensuring this. Clerks of Works from the regions and areas cover installation of cables and of equipment in exchanges and repeater stations, but inspection at works or in Supplies Department's Depots is dealt with by the Test and Inspection Branch of the Engineering Department. They also do a certain amount of work for other authorities such as Dominion Governments.

The Test and Inspection Branch has a small headquarters unit in London and is divided into five sections: three Test Sections—London, Birmingham and Cable Test—and two Materials Sections, one each in London and Birmingham.

The headquarters unit is mainly concerned with administrative and technical control of the Sections, but the cable side is also responsible for preparing cable and wire specifications.

The work of the Cable Test Section consists of inspection at works of cable and wire of all types, the overall acceptance testing of main trunk cables installed by contractors, testing for acceptance and repair of submarine cables, and other special tests and investigations on cables.

The division of work between the two Materials Sections is functional; together, they are responsible for the quality of the various materials used in the equipment supplied to the Engineering Department. They also give advice to Headquarters Branches on matters concerning materials and so on.

Organization

The work and organization of the two Test Sections is similar; in the main their responsibilities are divided territorially, Birmingham taking the country north of the line Wash to Severn, and London south of this line.

Most of the staff, of whom there are between 300 and 400 in each Section, is in the Sections' headquarters in the Supplies Department's Depots at Studd Street, London, and Fordrough Lane, Birmingham. Some, however, are stationed either temporarily or permanently at various outcentres

in Factories or Supplies Department depots, or at contractors' works; others work in towns remote from the Section headquarters—for example, Edinburgh, Sunderland, Bridgwater, and elsewhere. A smaller number spend their time visiting periodically, as necessary, a large number of contractors' works.

The work of the Test Sections consists of:—

1. Inspecting and accepting new items, mainly at the makers' works.
2. Inspecting and accepting items repaired or manufactured by the Factories Department.
3. Servicing and calibration of transmission equipment and test gear.
4. Inspecting stock held by the Supplies Department.
5. Special tests of various types.
6. Work ancillary to testing, such as construction and maintenance of test gear, staff training, and so on.

Most of the apparatus the Post Office buys is produced at the works of the main contractors supplying telephone equipment, and at most of these works much of the equipment is manufactured for that contractor to install in appropriate Post Office premises.

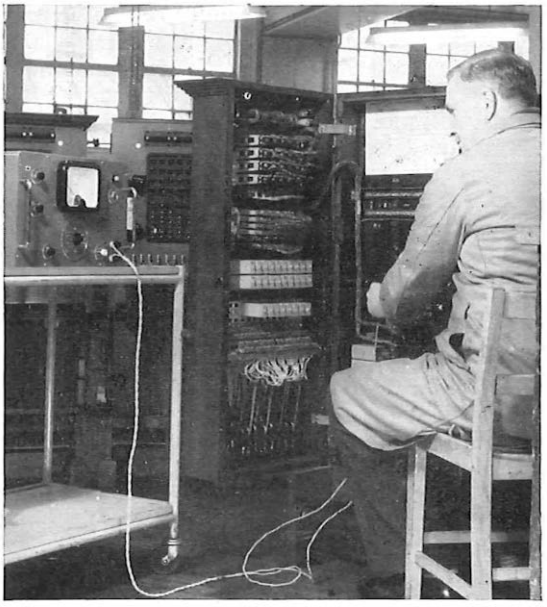


Fig. 2 : Testing a Factory repaired floor pattern PBX switchboard

Such items as telephones, relays, automatic switches, dials and components are produced at the rate of thousands a week. A small Test Section staff, employed full time at the works, inspects the equipment, usually by dividing the production into conveniently sized batches and taking small samples. The samples are inspected and tested to ascertain that they meet Post Office requirements; if they do, the whole batch is approved.

If more than a predetermined number in a sample are found defective, the whole batch is rejected.

The results of the tests are tabulated to form a cumulative record which gives a very clear picture of the quality of the product. This, with the effects of batch rejection on the contractor, enables very good control on quality to be exercised by a reasonably small Post Office staff. In such sampling methods, the batch and sample sizes, the number of defectives permitted, and other features are chosen to suit the item and other circumstances. Some form of sampling technique is used in acceptance inspection of most new items, exceptions being those where personal safety is involved, for example, pole arms, safety belts, ladders, which are 100 per cent. inspected.

At the works of contractors supplying all other types of equipment, the range of items is enormous. It includes such a variety as radio installations, measuring instruments, power plant, tools, mechanical aids—a list far too long to quote in detail. These contractors' works range in size from those of major manufacturing concerns to small units employing a few score people. The Test Section staff visit the majority of these works periodically, depending on the flow of Post Office work; here also, sampling methods are widely used.

In accordance with policy based on a number of considerations, goods are inspected at the maker's works and only a small amount of new items are inspected after delivery at Supplies Department depots. These are mainly special items calling for test gear which the maker cannot supply, small items which it would be uneconomical for an inspector to travel a long distance to inspect at works, or special tests on samples submitted in advance of bulk manufacture.

A considerable part of the Section's efforts is directed towards inspecting items repaired by the Post Office Factories Department. This includes a wide range of items and involves considerations radically differing from those concerned in the inspection of new equipment. The repaired items

Fig. 3 : Gauging the socket of a self-aligning duct

are, of course, already Post Office property and in their repair and return to service economic considerations must balance technical needs, especially with regard to appearance. For example, equipment to be installed in a subscriber's premises must look as good as new, whereas equipment used elsewhere will be satisfactory generally if it functions correctly and is of reasonably good appearance.

The work done in inspecting items held in Supplies Department stock is principally concerned with stores returned after use. This involves grading into the appropriate type of treatment to be given and sometimes listing the features on each item that need attention. In addition, a certain amount of checking of working and reserve stock is necessary from time to time.

The inspection of certain types of equipment calls for very specialized test gear and knowledge of the techniques involved, and results in the Test Sections being able to undertake work other than just acceptance testing. For instance, in servicing radio and television test gear the amount of testing work outweighs the repair work involved and makes the job unsuitable for normal factory repair. The calibration of similar classes of equipment is another aspect of this kind of work done by the Sections.

Advantage of the Sections' facilities is also taken by Headquarters branches and others in carrying out special tests and investigations into such things as prototypes and newly developed apparatus. An instance of this is the work done by the Sections on behalf of the Ministry of Health in connexion with hearing aids. The provision of a room treated to render it substantially free from echo or reverberation has enabled investigation into new developments and related work to be done, in addition to the calibration of standards and the routine acceptance of the aids (see Fig. 1).

Small workshop units are employed in designing and constructing test gear not readily obtainable elsewhere and in maintaining the Sections' large and varied testing plant.

Special groups are concerned with precision dimensional measurements, which are of importance especially when parts must be interchangeable.

Items of equipment which employ mechanical movement, such as dials, automatic switches and coin collecting boxes, introduce special difficulties in inspection. Such items may appear quite satisfactory when stationary or even when subjected to a few operations, but may yet fail after a relatively short running life. Each item cannot be subjected to a prolonged running test, and this has therefore to be done on a few sample items only. These sample items are subjected to many thousands of operations, failures are carefully analysed and the causes taken up with the maker and specially watched for in future.

Very special problems arise in designing and running life test gear, since it must run day and night and thus incorporate adequate safety precautions, with facilities for switching itself off when failure occurs, and recording the operations performed up to that time. Very stringent maintenance is necessary to limit failures of the set itself and reliance cannot be placed on normal mechanical counters such as the subscriber's meter and special electronic counting devices have had to be developed to record the number of operations.

The Sections' responsibility is to ensure that the consignment concerned meets the contractual obligations accepted by the contractor or the Post Office factory, or, in respect of recovered and similar stores to ensure that they can reasonably be

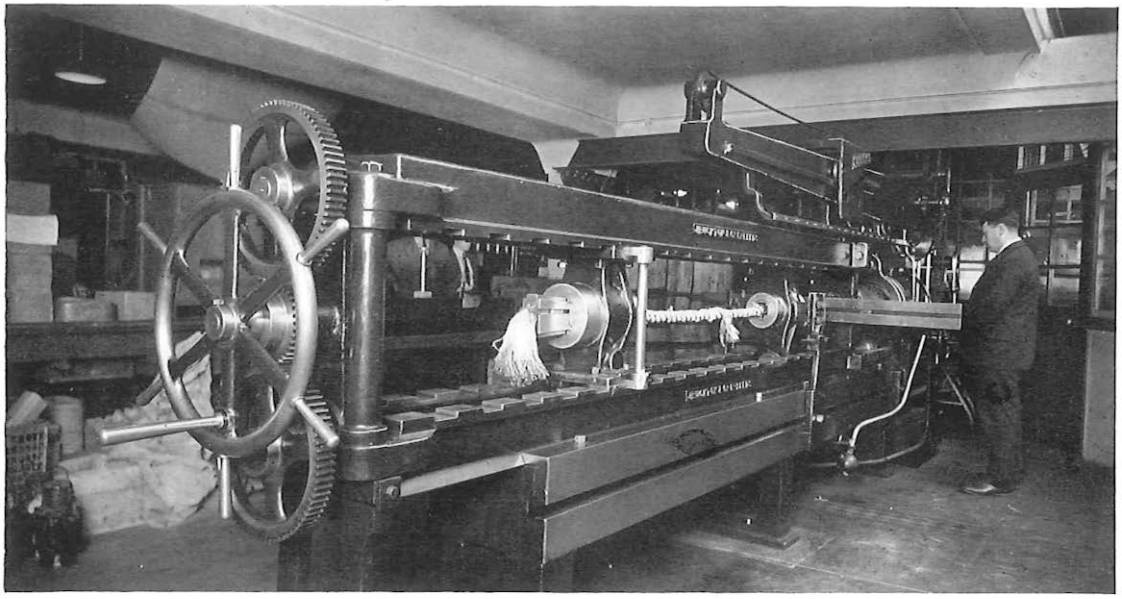


Fig. 4 : Measuring the breaking strength of a rope sample

put into stock as fit for further use. The requirements are set down in a whole range of specifications, drawings and diagrams, most of which are issued by the Post Office, but some by other Government departments, the British Standards Institution and (infrequently, for special equipment) by information supplied by the manufacturer. The information given in these documents varies from the very complete, as for normal telephone apparatus, to the very sketchy, for items which are in the main proprietary or in normal trade production and where the Post Office demand is a small fraction of the total.

The requirements apply to equipment that can be:

(a) wholly electrical but static mechanically, such as amplifiers;
(b) electrical with mechanical movement, such as coin collecting boxes and automatic switches;
(c) mechanical only, such as stamp selling machines;
(d) neither electrical nor mechanical, such as earthenware ducts and ironwork.

All must satisfy dimensional and material requirements, be of good workmanship, and likely to have an adequate life.

Electrical requirements are easy to specify and in the main easy to test for, although for certain equipment such as V.H.F. radio apparatus, very special test equipment and techniques have to be employed.

At contractors' works the contractor provides test gear. The inspector's duties, as well as covering the use of the test gear to make the necessary tests, also involve satisfying himself that the gear is in good condition and accurate.

In the depots the test gear is the property of the Post Office; much of it consists of standard items obtained from normal sources, but a variety of types has been designed and constructed by the Sections' own workshops. An instance is the general purpose test set shown in use in Fig. 2. This instrument, designed to cover as wide a range of uses as possible, is mains driven, and measures conductor and insulation resistance and capacitance as well as supplying test voltage in A.C. or D.C.

Where the amount of work makes it worth while special sets have been constructed to test just one type of item. In these, connexion is usually made by a test jig into which the item is jacked; an automatic switch, by stepping, makes each of the necessary tests in turn, passing on to the next when one has been proved satisfactory but stopping should it meet a fault, a lamp glowing indicating

the location of the fault. Many factors limit the use of such special sets and with the majority of items the inspector must himself make the tests, as shown in Fig. 2. This slower method has its compensations, however, as testing is then combined with a very necessary visual examination of the items under test.

The mechanical requirements are generally difficult to specify adequately, and very difficult to test for, especially with repaired items which can be affected by wear on moving parts in use before the repair. Tests can be made to a limited extent, as of relays and indicators, where a specified current is applied to the coil and satisfactory operation indicated by the springs closing a buzzer or lamp circuit. Even with these, however, and certainly for the great majority of items where no electrical contacts are available, the inspector's judgment in observing the movement must be decisive. For testing such items as coin collecting boxes and stamp selling machines, dummy coins are used to operate the machines a number of times, the operation being closely watched and any failure rendering the item liable to rejection.

Dimensional requirements are covered by suitable drawings and if these are adequately toleranced no difficulty exists in ensuring that they are met. Depending on the degree of accuracy required instruments such as micrometers and tool room microscopes are used either by the inspector or, at his request, by specialists in a central testing group.

Where complex shapes are involved or a large number of items have to be measured it pays to construct gauges; these, which are usually made in pairs to cover the minimum and maximum sizes required, are applied in turn to the item to ensure that its dimensions lie between the two. The use of a gauge in measuring the socket of a self-aligning duct is shown in Fig. 3.

The physical strength of an item is normally ensured by the specification of suitable material. It is usually readily checkable by the inspector, with reference to the appropriate Materials Section when necessary. For certain items such as ropes and earthenware ducts, where failure from lack of strength would have serious consequences, working and proof loads are specified. These features are tested on various types of testing machine, such as that shown in Fig. 4; this machine, which has a maximum load of 30 tons, is capable of testing a wide range of items. Other machines are available for testing paper, wire and lighter materials.

Finish and workmanship can be covered to some extent in specifications, but the satisfactory meeting of them must be a matter for the experienced judgment of the inspector. This involves one of the most difficult aspects of inspection work—visual examination—where the ability to see clearly all the features under review and assess their quality is of paramount importance. These requirements are by no means the least, as frequently the service life of the item depends on them, and they are the first to suffer if the maker's control over his product is not adequate.

This brief sketch gives only a bare outline of the work of the Test Sections, which covers a range too wide to be dealt with in detail and which changes as the Engineering Department's activities change. Much of interest and importance of necessity has had to be omitted or mentioned only very briefly.

More Radio Channels for Private Mobiles

Double the number of radio channels will become available for private mobile services from June 1 as a result of the Postmaster General's approval of the Mobile Radio Committee's recommendations in its Third Report.

The increase in the lower VHF band will be obtained by introducing equipment capable of operating on channels 25 kc/s wide instead of 50 kc/s. The use of narrower channels has been made possible in advances in equipment design by British manufacturers.

The report also includes a revised allocation of channels among the various categories of users.

From June 1, all new land-mobile schemes in the VHF low band will have to use equipment meeting the 25 kc/s specification. With few exceptions, the new equipment standard will also apply to additions or replacements for existing systems. There is a "Five Year Plan" for the change-over of existing services to 25 kc/s equipment to be completed by June 1, 1964.

The new lightweight telephone headsets are now standard equipment. They are being introduced immediately in automatic exchanges and will be supplied to other exchanges as soon as possible. Existing equipment in PBXs will have to be modified before the new headset can be used on them.

Road Improvement Works in London

Frederick Crook

THE INCREASE IN ROAD TRAFFIC DURING THE past decade has caused many points of congestion on the roads. London is no exception. Traffic delays usually occur at points where a number of main roads meet and, in London, the Elephant and Castle and Hyde Park Corner are outstanding examples of these "bottlenecks".

At first, roundabout systems allowing traffic to filter off as required were tried to ease traffic congestion. Experience has shown that the roundabout method is not always successful, and that traffic needs to be segregated into main streams, with arrangements for their flow to be unimpeded even by streams in which the traffic is not so dense. However, each point of congestion has its problems and the solution often appears to be a combination of the two systems.

London County Council in conjunction with the Ministry of Transport and Civil Aviation have embarked on, or are proposing to start, a number of large road works in an endeavour to ease traffic congestion in London. Such road works inevitably involve rearrangements of equipment, such as telecommunication cables, under the roads. The schemes dealt with so far have involved the Post Office in very extensive rearrangements of plant. The following details of two of the larger projects give some idea of the magnitude and complexity of the work involved.

Elephant and Castle

The Elephant and Castle area on the south side of the Thames, which is a bottleneck for traffic to and from south and south-east London and beyond suffered heavy damage from air-raids in 1941 and this provided London County Council, as the planning authority, with the opportunity to embark on a comprehensive reconstruction plan.

Fig. 1 indicates broadly the layout of the roads and underground telephone plant existing before replanning. At such a focal point the amount of Post Office plant was considerable. Actually, 44 pipes (duct-ways) containing 22 audio cables and two carrier cables were affected by the reconstruction proposals.

The reconstruction project shows the provision of two roundabouts and plans the area as a shopping, business and recreational centre. Fig. 2 shows a model of the project. It will be seen that, in all, six main roads converge at this point; these roads form the principal traffic routes to south and south-east London. In the background is the Elephant and Castle roundabout showing the centre to be

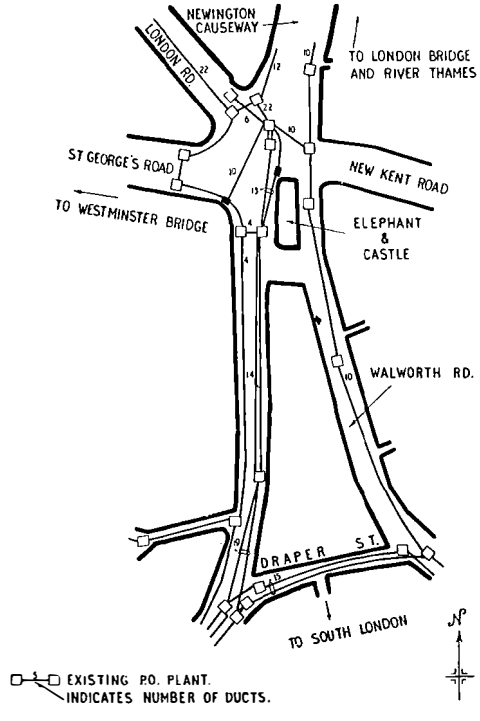


Fig. 1 : Existing Post Office plant

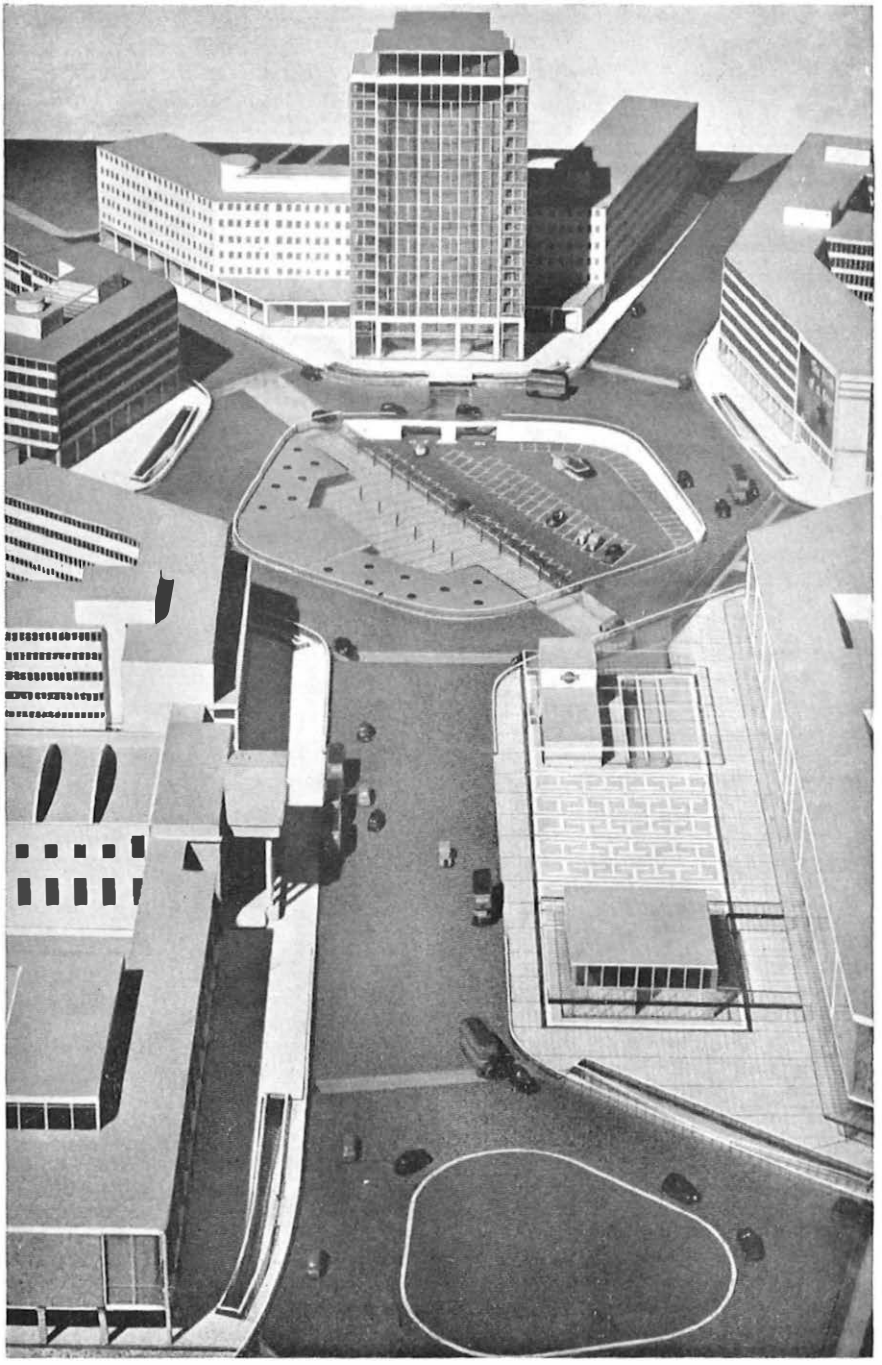


Fig. 2: Model of the Elephant and Castle project

Fig. 3 (above) : Subway being constructed
Fig. 4 (below) : 9-way duct, with cables still working, surrounded by concrete

used as a sub-level car park and shopping centre.

The building shown on the right middle foreground forms the main shopping centre. The main feature of this site is the large area in front of the shops to allow free circulation of shoppers and pedestrians to the underground station. The large building at the background will be an office block with shopping parades at ground level. Two existing cinemas are to be retained and Metropolitan Tabernacle—Spurgeon's—is being reconstructed.

The salient points of the proposals so far as they affect the Post Office are as follows:—

(*a*) An extensive system of pedestrian subways was proposed. Much existing Post Office plant was in the line of the new subways.

(*b*) The subway level car park and shopping centre.

(*c*) A number of existing manholes would have been in the carriage-way after the road widening, thus impeding traffic flow when work is in progress, and causing difficult and perhaps dangerous conditions for working parties.

(*d*) The reconstruction work will be carried out over a number of years.

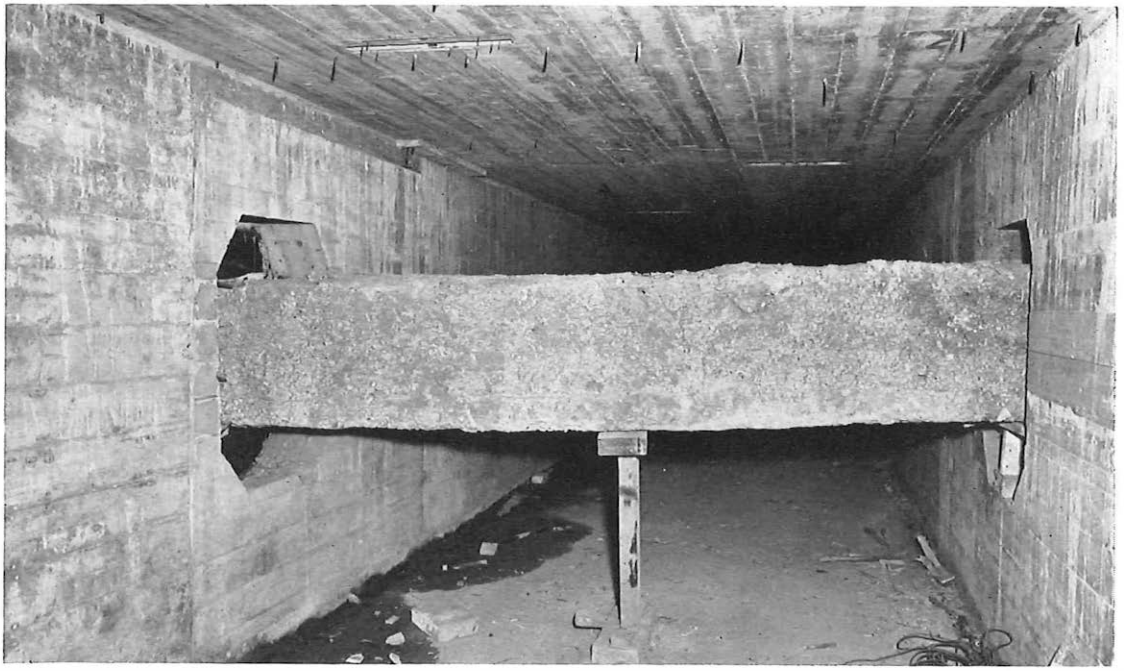


Fig. 5 : Access ramp

The positions and construction of the pedestrian subways proved the greatest obstacle in any plan to retain Post Office plant in its existing position. To provide easy access, subways are very shallow, with the result that very little space over the roof is available for Post Office or other undertakers' plant. This point is illustrated in Fig. 3 which shows a subway under construction at the Draper Street roundabout.

Fig. 4 shows a subway being constructed with a Post Office 9-way duct, with cables still working, surrounded by concrete passing through the walls. After all cables in this multiple duct had been diverted, the route was abandoned, the duct demolished and the subway walls were made good.

The present trend in pedestrian subway design is towards providing a ramp having a gradual slope from footway level. Fig. 5 shows a typical access ramp. This method of construction creates additional difficulties because of the space required.

Consideration of all factors led to the conclusion that the best solution would be to divert Post Office plant completely clear of all reconstruction work, and to abandon existing duct tracks in the centre of the area. There was already a partial by-pass round the east side of the Elephant and Castle railway station and Fig. 6 shows broadly the revised layout. The routes were chosen after consulting London County Council and all the other undertakers.

Due regard was paid to future proposals for re-planning the area, since long-term plans indicate that some roads will be closed.

The new layout provides what is essentially a ring-main round the whole of the Elephant and Castle road junction area. This solution has considerable advantages because it will be more economical and the work can be planned in a continuous flow, since progress will not depend on the progress of the reconstruction work. Also, double diversion of plant is not needed as it would have been if the final layout of the plant had been similar to that existing before the alterations.

After providing for additional future cables, the work involved laying 18 miles of duct ranging from 4 to 36 ways, and building 26 manholes. About $8\frac{3}{4}$ miles of various sizes of cables were drawn in and jointed. The work as planned has now been completed. The total cost of the Post Office work was more than £100,000.

Hyde Park Corner

Congestion at Hyde Park Corner in the heart of the West End between Piccadilly Circus and Kensington is acute because so many routes meet at this point, and traffic is so dense. A one-way roundabout system is at present in use. Here, however, this method does not produce an easy flow, since traffic density in both directions between east and west is exceptionally high.

To ease this condition the L.C.C. propose to construct an underpass—two tunnels passing under

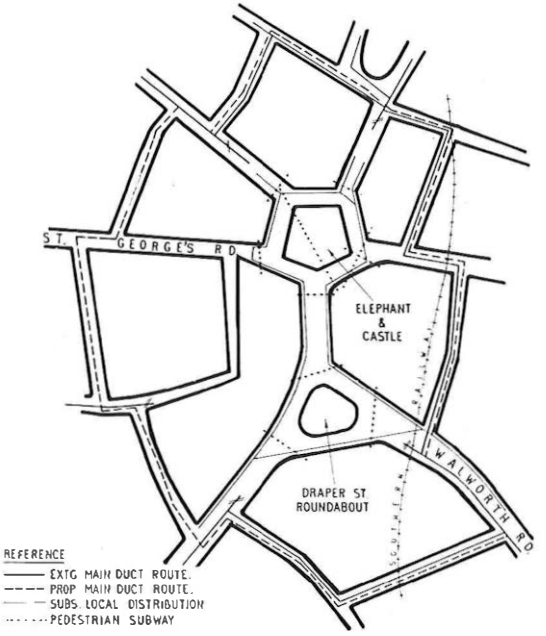
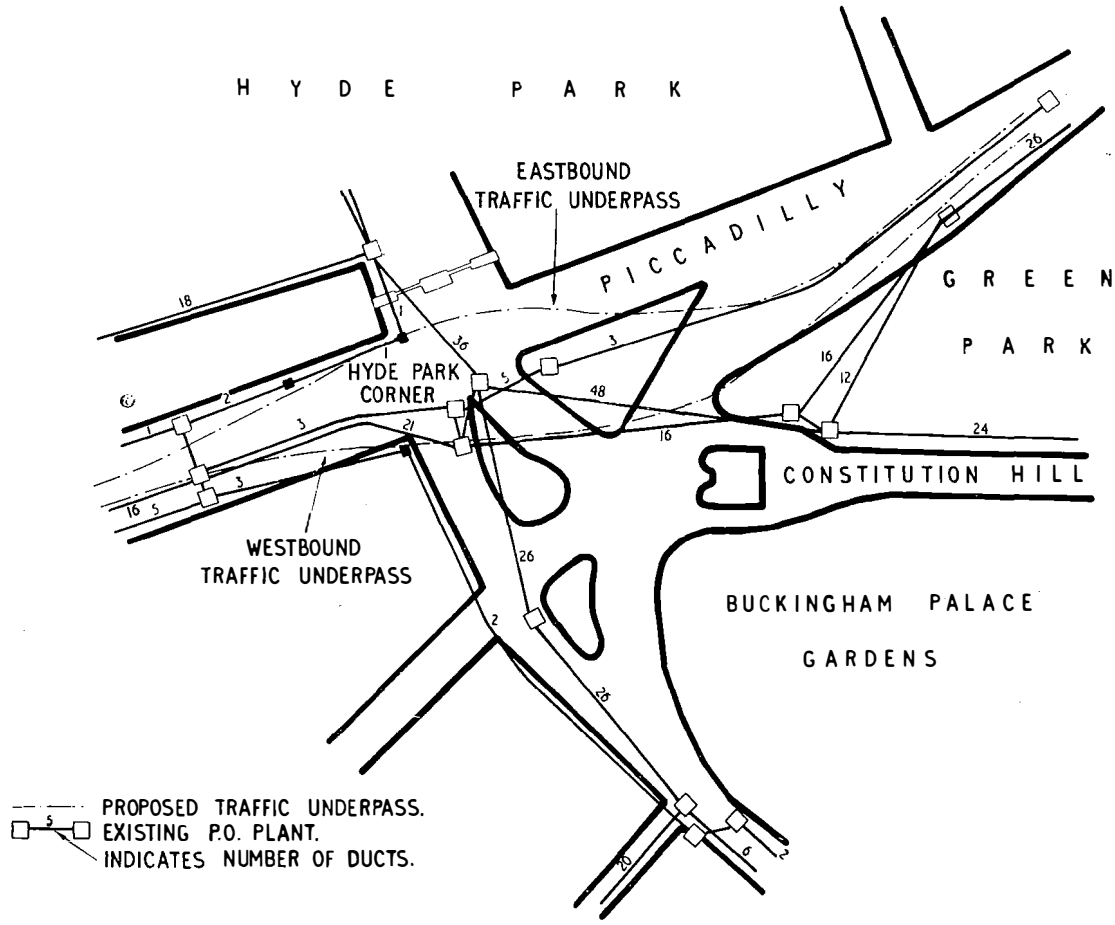


Fig. 6 : Proposed roundabout at Elephant and Castle



Hyde Park Corner, linking Knightsbridge and Piccadilly, through which traffic between east and west will pass. Additional features proposed include extensive systems of pedestrian subways.

The Post Office problem is very similar to that at the Elephant and Castle because a large network of Post Office pipes and cables is affected. For example, crossing the proposed line of the underpass, at such a depth that they would pass through the centre line of the new tunnels, are nests of 16, 26, 36 and 48-way ducts as shown in Fig. 7. Altogether, 57 cables are affected by the carriageway alterations.

Close examination of the road improvement proposals again led to the conclusion that it would be best to divert the Post Office plant completely, on the same lines as at the Elephant and Castle: that is, a scheme by-passing the central area. With this in view, information about the position and depth of other undertakers' plant was obtained and it has been agreed that complete diversion will best meet the situation.

Fig. 8 indicates the final proposals for the new sites of Post Office underground plant. Additional ducts are to be provided to allow for growth, bearing in mind that under plans for the future the Cromwell Road (Hammersmith By-Pass) new main duct route will be extended up to Hyde Park Corner.

About 44 miles of duct ways in groups varying

Fig. 7 (above): Existing Post Office plant at Hyde Park Corner

Fig. 8 (opposite): Proposed underpass at Hyde Park Corner

in size from a single-way to 72 ways will be needed; in addition, 23 miles of cable will be necessary and the total cost to the Post Office will be about £200,000.

Integral with the Hyde Park proposals is a further scheme involving Park Lane, Marble Arch and Edgware Road. A feature of the Marble Arch work is the possible construction of an underground car park in Hyde Park. A preliminary assessment of the cost of altering Post Office plant involved is about £300,000. The London County Council may require the work to be carried out concurrently with the Hyde Park alterations.

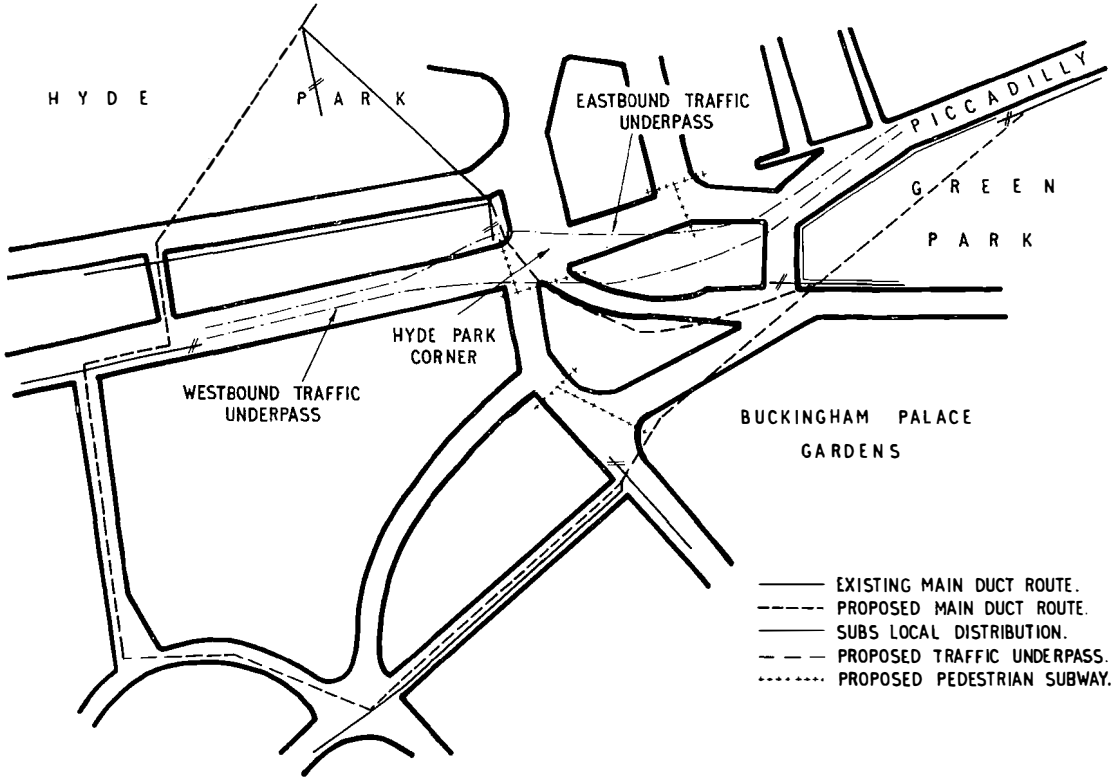
Future trends

Examination of other projects suggests that considerable effort is being made to improve the flow of London traffic. Experience to date suggests that the first attack will be against bottlenecks at large junctions. Since most trunk and junction cables naturally follow the main roads radiating from the centre of London the amount of Post Office plant involved is likely to be large. In addition, it can be appreciated from the description of the Elephant and Castle and Hyde Park Corner projects, that the provision of pedestrian subways, even if little is done to the roads above, can involve the Post Office in very considerable diversion work. A measure of the increase is shown by the rise in expenditure by London Telecommunications Region, for this type of work, from £20,000 in 1952–53 to an estimated figure of £700,000 in 1959–60.

As these two examples show, such major road reconstructions cause a good deal of work for the Post Office and the men employed have to be drawn from the available labour force, which is normally engaged on maintaining the services and expanding the network. They may therefore cause some temporary delay in providing services for applicants.

On the other hand the Post Office does gain by the opportunity presented to renew diverted cables and to lay some additional ducts.

(*continued overleaf*)



Although normally the Post Office is repaid the cost of moving plant (less betterment) necessitated by road works, the cost involved for moving plant caused by major reconstruction falls on the Post Office capital investment programme, from which funds for the purpose are allotted.

Keeping the Post Office informed

Generally speaking the machinery for informing the Post Office of proposed road works operates fairly well in that good preliminary notice of any major improvement work is received. Difficulties are, however, experienced as regards the actual date of starting. Formal notice of the date cannot be given to Telephone Managers until the Borough or County Council receives the Ministry of Transport and Civil Aviation's money grant towards the cost. This results in very short notice being given and causes difficulty since, with overall capital expenditure fixed, a rearrangement of the programme of external works is involved for nearly every project.

Thanks are due to the London County Council for permission to reproduce Figs. 2 and 4.

Submarine Telephone Extensions

SINCE THE FIRST TRANSATLANTIC TELEPHONE cable was opened for service in 1956, a number of new submarine telephone cables has been planned in which the Post Office ship, H.M.T.S. *Monarch*, the largest cable ship in the world, which laid the first TAT, is likely to be actively concerned.

Monarch is, indeed, already laying a second TAT between the United States and Europe, connecting France and Germany. This will be a 2,245 nautical mile route, with two one-way cables of the same pattern as the 1956 transatlantic telephone cable. The main crossing from Europe to Newfoundland will have American-type flexible repeaters every 38 nms and will provide up to 36 channels at 4 kc/s spacing. The single cable for the Newfoundland-Nova Scotia link will again be provided with British Post Office rigid type repeaters designed for two-way operation.

The latest telephone cable to be announced will provide a first step towards the creation of a northern route linking the Old and New Worlds. Early in April the Post Office, the Danish and Icelandic administrations and the Great Northern Telegraph Company agreed to lay a 684 nautical mile telephone cable between Gairloch, Scotland and Iceland by way of the Faroes.

This £1,000,000 project, which has been christened SCOTICE, will be a single both-way cable containing 25 British design submarine repeaters and provide about 20 telephone circuits, with circuits for telegraphs and telex. Civil aviation authorities will use some of the circuits to control transatlantic air routes.

The Scotland-Faroes-Iceland cable—to be laid in 1961—will eventually link with a telephone cable known as ICECAN to be laid in 1962 between Iceland, Greenland and Canada, jointly by the Iceland Administration, the Great Northern Telegraph Company and the Canadian Overseas Telecommunication Corporation, thereby providing circuits from the United Kingdom to Canada via Iceland and Greenland.

Then there is the CANTAT project planned in conjunction with the Post Office by Cable & Wireless Ltd. and the Canadian Overseas Telecommunication Corporation. This will be constructed of the new lightweight cable developed by the Post Office. On its 2,152 nautical mile route the single both-way cable will contain 92 British-style repeaters and will provide 60 telephone circuits or a number of telegraph channels in place of any one of them.

Ultimately CANTAT will be the first ocean link in the 300,000 mile Commonwealth round-the-world telephone cable.

Next year a new Anglo-Swedish both-way telephone cable 530 nautical miles in length with 28 British repeaters is to be laid between Middlesbrough and Gothenburg, providing 60 telephone circuits and telegraph facilities. This will provide relief on the Anglo-Dutch cables over which most of the United Kingdom-Sweden telephone traffic passes and at the same time provide a direct and more economic routing for the growing volume of telephone and telex traffic between the United Kingdom and Sweden and via Sweden to Finland.

Automation at Ongar Radio Station

A. R. Lash, M.I.E.E.

On February 19 Lord Chesham, the Post Office spokesman in the House of Lords, opened an extension to Ongar (Essex) Radio Station. Seven new transmitters, fully remotely controlled, have been added to the existing 30 which provide world-wide long and short wave radiotelegraph and phototelegraph services. The Power House has been modernised and extended to provide additional power.

In the Winter 1956 Journal *Mr. Lash, Manager-Engineer of the Station, outlined its development from 1920 until 1955. In the following article he describes its further evolution up to the opening of the new extension.*

In the age which one might now describe as "steam radio" all operations were performed manually from the starting of the engines which drove the dynamos to the complicated process of bringing a transmitter into action on the frequency required for its particular service and time of day. This operation could entail a delay of 25 minutes in the despatch of telegrams.

In 1957 the power supplies at Ongar were brought into line with the best modern practice by installing new emergency Diesel-generators and modern switchgear which enables the Power House to be left unattended for most of the time.

Now, one of the remotely controlled transmitting stations known as "D" Station has been extended to accommodate seven new 30 kW peak power radio transmitters built to a Post Office specification and installed by Standard Telephones.

The installation and testing were satisfactorily completed in February and 100 seconds after Lord Chesham had pressed a push-button in a Control Room at the Main Station one of the transmitters was ready to send its first message to H.R.H. the Duke of Edinburgh on board H.M.Y. *Britannia*; a channel in the homeward radio link from Singapore was extended to Ongar so that the progress of the message to the yacht via Singapore could be recorded and the reply from Prince Philip printed on the originating teleprinter.

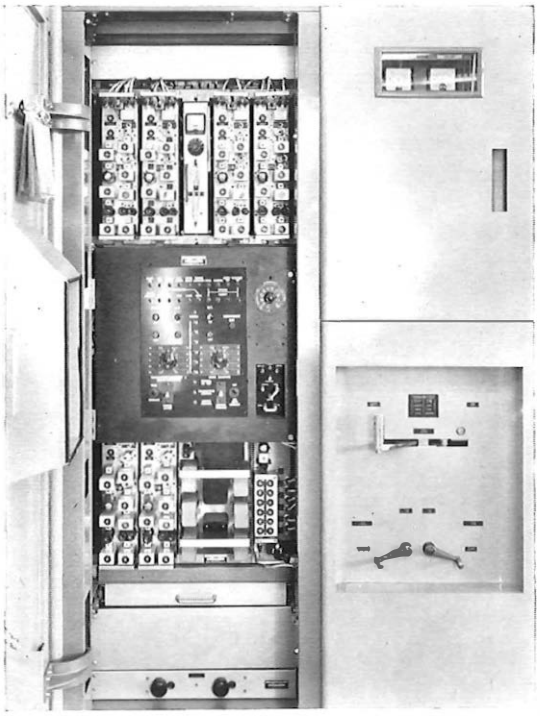


Fig. 1: Left, Converter unit: right, Isolating unit

When the guests later examined the new equipment, which includes the most modern developments in remote-controlled high power, high frequency transmitter design, points of special interest included the exceptional care taken to ensure safety to both staff and equipment. Within seconds of pressing the "stop" button of the transmitter which had just spread its waves to Singapore the visitors were able to handle the transmitter both inside and out in conditions of perfect safety.

The other radio equipment is equally protected, since these modern transmitters represent considerable capital investment which should earn money for a number of years without the risk of a

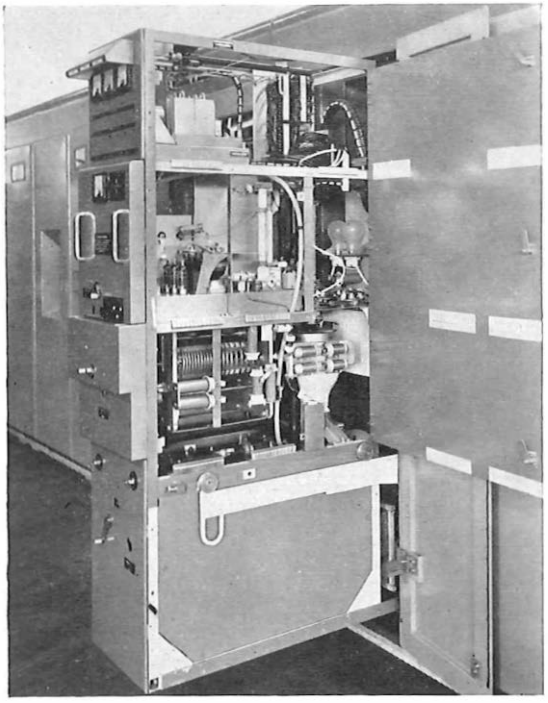


Fig. 2 : Withdrawable truck

serious breakdown. If anything should go wrong the transmitter should automatically take whatever action is necessary to safeguard itself.

For example, if there is an abnormal rise in temperature in one of the power cubicles where the oil-filled transformers are housed, a device will drop an asbestos mat over the ventilator and then shower the room with carbon-dioxide gas, a good fire quencher. Having done its best to deal with the emergency it will then call the Technical Officer from the Main Station to check up and replace the gas cylinder.

The feature that perhaps attracted most attention was the automatic frequency changing, which allows a choice of six frequencies and completes retuning in less than 30 seconds. This compares with up to 25 minutes with two skilled officers dealing with a manually controlled transmitter.

One of the oldest electrical principles, that of the Wheatstone Bridge, is employed in this ingenious circuit for rapid frequency changing. Six circuits require retuning at each change of frequency and each of the six controlling motors rotates until its Bridge is balanced. The motors always take the shorter route when changing from one frequency to another and travel faster when they have further to go.

Stability of frequency is maintained within one part in one million by using crystal oscillators (type 35) of Post Office design. A good example of the use of miniature components can be seen in the photograph of the six Frequency Converters (Fig. 1) which, with the demodulation circuits and control equipment, occupy one panel of the transmitters.

Amplifiers Stages 3, 4 and 5 in a withdrawable truck (Fig. 2) also represent a compromise between accessibility and compactness.

The more technically minded visitors were interested in the versatility of the transmitters. The transmitters can be used for telephony by single sideband methods, as well as for telegraphy by on/off or frequency shift keying. These alternatives give a high degree of flexibility and a choice of method for multi-channel telegraph transmission, so that the transmission system can be made acceptable to the receiver.

When multi-channel telegraph working is required, the information in the form of voice frequency signals is delivered to the transmitter from the drive equipment and magnified 120,000

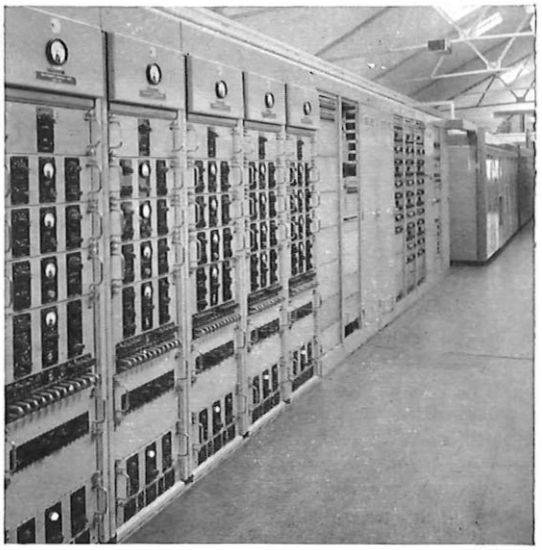


Fig. 3 : SSB drive units at Unattended "D" Station

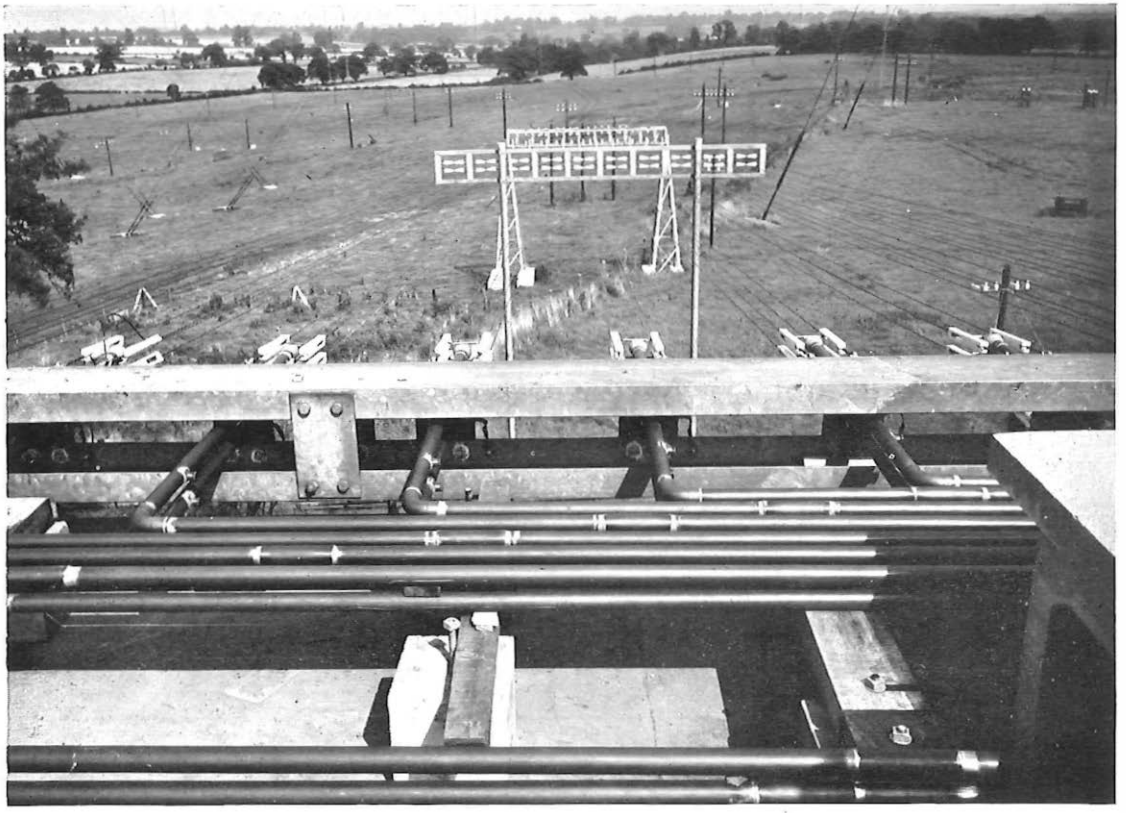


Fig. 4 : Feeders and exponential lines "D" Station

times through a chain of six amplifiers before being fed to an aerial. The signals must be amplified without introducing significant distortion. That this can be achieved is due in no small measure to the adoption of grounded-grid techniques in the final amplifier and the use of negative feedback.

An improvement in design which affects the tuned circuits of the high power stages when compared with the older transmitters is that fixed capacitors and variable inductances have replaced fixed inductances and variable capacitors. This change has followed the development of inductances having sliding contacts which can withstand heavy radio frequency currents without deterioration. A saving of space has been achieved by the introduction of vacuum condensers in place of the more conventional air dielectric type.

The control equipment for the seven transmitters which acts as the intermediary between the Control Room and the transmitters is grouped in "D" Station. To avoid delay when fault tracing in this relatively complicated gear the equipment for each transmitter is divided into four jack-in units which can be exchanged with spare units and then individually tested in a "simulator" which proves that the operation is correct (or incorrect) and gives indication of the position of a fault. This test apparatus simulates the control points, the behaviour of the transmitter and its auxiliary equipment in response to signals from the control point, and the action of monitoring and alarm equipments.

The outputs of the transmitters connect by twin 200 ohm coaxial feeders to an aerial commutator. Each transmitter normally feeds either the upper or lower of a pair of rhombic aerials directed on the route. The change from upper to lower rhombic is automatically controlled by a switch energized from the transmitter according to whether the frequency is above or below about 13 Mc/s.

Both the transmitter output feeders, which are fed in horizontally to these aerial switches, and the aerial inputs which rise vertically from these switches, are telescopic to enable any abnormal connexion between transmitters and aerials to be made manually. This additional flexibility is expected to cover all requirements, because we intend covering all maintenance periods by spare transmitters from the continuously manned main station building. From the roof of the commutator room the ends of the 200 ohm coaxial feeders connect to the exponential lines (Fig. 4) which transform from 200 ohms balanced to 600 ohms balanced over the complete range of transmitter frequencies; that is, between 4 and 27.5 Mc/s.

The successful use of remote-controlled transmitters depends on an efficient centralized monitoring system. This is arranged at the transmitter end by demodulating a leak from the radiated output successively to 3.1 Mc/s and then to 10 kc/s. Both these signals contain the radiated intelligence and either signal can be selected by remote controlled switches and passed back over cable to the Control Room at the main station.

In the Control Room the 3.1 Mc/s signal, viewed on a spectrum analyser, provides all information about sidebands and spread, while the 10 kc/s signal used to produce a D.C. output may be displayed on an oscilloscope, printed on an undulator tape or passed back to London where it may be compared with the signals going to line.

The heat generated in the transmitters is dissipated by forced air cooling. The necessary fans, air filters and so on for each transmitter are in a separate cooler cubicle. During the summer, if the temperature is high in the transmitting room, the fans blow the hot air to waste; in the winter the hot air is returned to warm the building.

This installation, which raises the total number of high power transmitters in this remote station to 12, makes Ongar probably the most up-to-date unattended transmitting station in the world.

Telecommunications Statistics

	Quarter ended 31st December, 1958	*Quarter ended 30th September, 1958*	*Quarter ended 31st December, 1957*
Telegraph Service			
Inland telegrams (excluding Press and Railway) ...	3,117,000	3,749,000	3,327,000
Greetings telegrams	705,000	888,000	892,000*
Telephone Service			
Gross demand	99,977	94,737	74,136
Connexions supplied	95,693	83,157	75,870
Outstanding applications	146,339	157,375	184,364
Total working connexions	4,568,781	4,537,000	4,481,856
Shared service connexions	1,140,039	1,141,383	1,153,115
Total inland trunk calls	86,232,000	87,815,000	80,473,000
Cheap rate trunk calls	19,286,000	22,400,000	17,380,000
Telex Service			
Total working lines	4,827	4,595	4,159
Total oversea calls	502,000	468,000	419,000
Inland calls from manual exchange subscribers ...	632,000	†	†
Inland calls from automatic exchange subscribers ...	169,000	†	†
Metered units from automatic exchange subscribers	762,000	†	†
Staff			
Telegraphists (including staff employed on Telex)	5,849	5,947*	5,879
Telephonists	45,609	45,511	44,649
Engineering workmen	64,124	64,092	64,501

* Amended figure.
† No comparable figures.

How Post Office Capital is Being Spent

Post Office Capital Expenditure, 1959–60 (Cmnd. 690), issued in March, was the first of a new series of annual White Papers designed to give more information about Post Office capital expenditure than the Annual Estimates give.

The Annual Estimates already show the total capital expenditure proposed for the following year (£90 million for 1959–60), and divide it under a dozen headings including Trunk and Junction Circuits (£14.9 million for 1959–60), Exchange Equipment (£18.4 million), Sites and Buildings (£13 million) and so on. These broad totals do not, however, give the reader any idea of how many new circuits will be provided, how many new customers will be connected to the telephone, whether the buildings will be big or small, or where they will be.

The White Paper adds a general explanation of the effect of the year's capital programme and details of some individual schemes. In place of the simple heading "Exchange Equipment, £18.4 million", the Paper explains that during the year the contractors will start installing equipment in 60 new automatic exchanges, including 40 conversions from manual working, and 80 extensions. A list is given of 20 individual schemes each costing about £200,000 or more, the biggest being the new Leicester Exchange, with STD, at an estimated cost of about £1.1 million.

The Paper states that, during 1959–60, the Post Office proposes to bring telephone service to about 370,000 applicants and estimates that there will be about 7,750,000 telephones in the country by 31st March 1960; 265,000 pairs of wires will be added to the local line network, trunk circuits will increase by about 800 to a total of 25,000, and junction circuits are being added to cater for a 4 per cent. increase in traffic.

During the year 154 new buildings are due to begin, including 67 telephone exchanges and repeater stations. Names and costs are given of 13 new large telephone exchange buildings, each costing over £100,000, the largest being the Edinburgh (Woodcroft) Exchange at an estimated cost of £490,000.

Similar information is given about Telegraph and Postal capital expenditure, and about wireless works.

OUR CONTRIBUTORS

F. CROOK ("Road Improvement Works in London") is an Executive Engineer in London Telecommunications Region. He entered the Post Office in 1925 as a Youth-in-Training in the Central Power Section. In 1933 he was promoted to Probationary Inspector and was engaged on external maintenance and construction duties. On promotion to Chief Inspector he was employed on external planning duties in East Area, London Telecommunications Region. In 1954 he was transferred to Regional Headquarters Junction Planning Group.

H. J. DOLTON ("The Engineering Test Sections") started his career with the Post Office as a Youth-in-Training in the London Engineering District in 1920 and transferred to the Research Branch of the Engineering Department a year later. In 1923 he was promoted to acting rank as an Inspector on cable testing and after nine years on all aspects of this work he moved to the Physics Group where he was engaged on investigations concerning insulation metals and batteries. In 1935 he passed the limited competition for Executive Engineers and was posted to the Test and Inspection Branch of the Engineering Department where he dealt with cable, wire and line stores. He was promoted in December 1949 to his present position of Senior Executive Engineer in charge of the London Test Section.

A. E. T. FORSTER (joint author, "The Twopenny Telex") contributed an article "Automatic Dialling for Telex" to the Autumn 1956 *Journal* and his career was outlined in that issue.

H. E. FRANCIS ("Register-Translators for S.T.D.") has spent the past five years in charge of a team of engineers developing S.T.D. and the necessary equipment. He joined the Post Office Engineering Department as a Probationary Inspector in 1926 and is now an Assistant Staff Engineer. Mr. Francis has seen much service abroad; he was seconded to Anglo-Iranian in Persia for six months, spent five years in New Delhi planning for the Government of India and while with the U.N. Technical Assistance Board, advised Yugoslavia on planning an automatic trunk network.

A. R. LASH ("Automation at Ongar Radio Station") wrote an article "Ongar Radio Station 1920-1955" for the Winter 1956 *Journal* and his career was outlined in that issue.

D. PEARMAN (joint author, "The Twopenny Telex") is a Chief Telecommunications Superintendent concerned with the planning aspects of the public telegraph and telex services. Entering the Post Office as a Trainee Assistant Traffic Superintendent at Birmingham in 1937, he was later transferred to his native Sussex for a short period at Brighton before becoming a founder-member of the Tunbridge Wells Area at the end of 1938. After 4½ years with the RAF as an Electrical Engineering officer, including an itinerant spell in India, Burma and Malaya, he returned to Tunbridge Wells and later came to Headquarters on promotion at the end of 1950. Before transferring to telegraph work two years ago, he was engaged on telephone exchange equipment work, first on trunk design aspects and then with programming and exchange economics.

Notes and News

Subscribers become Customers

Telephone "subscribers" are now known as "customers", according to the Postmaster General's wishes expressed when he announced the new Friendly Telephone policy—referred to in our leader—in the Commons at a Press Conference on March 11.

Telephone Managers held conferences for the Press in their own Areas.

As well as sending signed copies of booklets outlining the policy to all grades in the telephone service Mr. Marples tape-recorded a personal message to all operators, to which they could listen by ringing a special number. Posters summarising the objects of the service were put up in all exchanges, and a special edition of the JPC wall newspaper, *Post Office Press*, were posted throughout the country.

In his recorded talk the PMG emphasised that telephonists had always given "jolly good service" and pointed out that when all ordinary calls are dialled "you will be left with the difficult calls. You will have to cope with people who need help. You will have to tackle angry people and frustrated people. Now, not only must we be efficient and friendly, we must be 'seen' to be efficient and friendly . . .

"We are giving you greater freedom to vary standard expressions . . . and if you do alter (them) *please* do be careful not to sound too familiar or unbusinesslike. It is really a question of the right balance, and we shall rely on your discretion to please the customer."

Replying to a Parliamentary question, the Postmaster General said on March 26 that the cost of publicising the Friendly Telephone certainly did not exceed £1,500.

* * *

Experiment on Ascension.—The Department of Scientific and Industrial Research is setting up an experimental radio station in June on Ascension Island, the Cable and Wireless Ltd. station, to investigate radio wave propagation over long distances. Test transmissions will be made for a year to the D.S.I.R.'s Radio Research Station at Slough.

Sir Ronald German, C.M.G.

Sir Ronald German, C.M.G. has been appointed a Deputy Director General of the Post Office. He had been, until his recent retirement, Postmaster General in East Africa, and contributed an article on telecommunications in East Africa to our February 1953 issue.

Previously, from 1942 to 1945, he was Assistant Director of the Post and Telegraphs Department in the Sudan. Since joining the Post Office in 1925 he has had wide experience on both the administrative and traffic sides.

New Dialling Codes in London

The new dialling codes, preliminary to the start of Subscriber Trunk Dialling in London, were introduced in the London Director Area on April 6.

"O for Operator"—which was introduced in London in 1928 when the first automatic director exchange was opened in London—TRU for Trunks and TOL for Toll, are replaced by 100. DIR replaced TKD for Trunk Directory Enquiries. INF was introduced for customers seeking general information about the service, or to call the Supervisor.

ENG (Engineers), CON (Continental), INT (International) and TEL (Telegrams) with 999 for emergencies, remain.

When the Cable was Broken

On Saturday, February 21, the East-West Transatlantic (TAT) cable carrying 51 telephone and telegraph circuits between North America and the United Kingdom was interrupted by a break caused by trawler damage at a point about 200 miles off Newfoundland. The Western Union Telegraph Company cable ship *Lord Kelvin* sailed from Halifax, Nova Scotia, to the fault which was repaired on Sunday, March 1.

Telephone service with North America was maintained by using the stand-by radio circuits to New York and Montreal. With the co-operation of other administrations additional radio systems were made available by a rearrangement of services to other parts of the world so that a maximum of 29 telephone circuits were provided for the public service and for leased circuits, in comparison with the normal number of 43 on the cable. Because of the limited number of channels, and the vagaries of radio transmission, delays of up to two hours were experienced; demand fell off but there were very few complaints.

The eight United Kingdom-Canada telex circuits were also interrupted. At first, service was obtained by the roundabout radio route via Sydney and Vancouver, some 20 per cent. of the telex traffic to Canada handled during the breakdown being sent in this way, although three direct telex circuits over radio were eventually established to Montreal.

The public telegraph traffic with Canada, which was carried through Cable & Wireless Ltd. telegraph cables, was not delayed by the breakdown. Special arrangements were made to carry a considerable volume of traffic for Western Union when their telegraph cables were similarly interrupted during the same period.

The flexibility of the international telecommunications systems to meet a major breakdown of this character was proved to be reasonably effective. All concerned are to be congratulated on the excellent work done in maintaining the public services during the breakdown and restoring them to normal.

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 telecommunication field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Department.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Headquarters G.P.O., London, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

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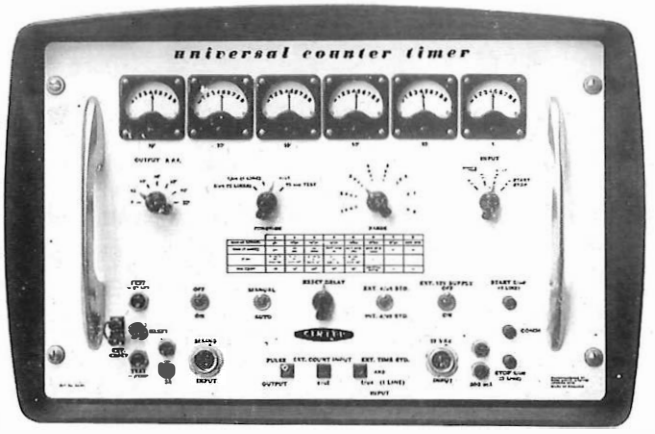

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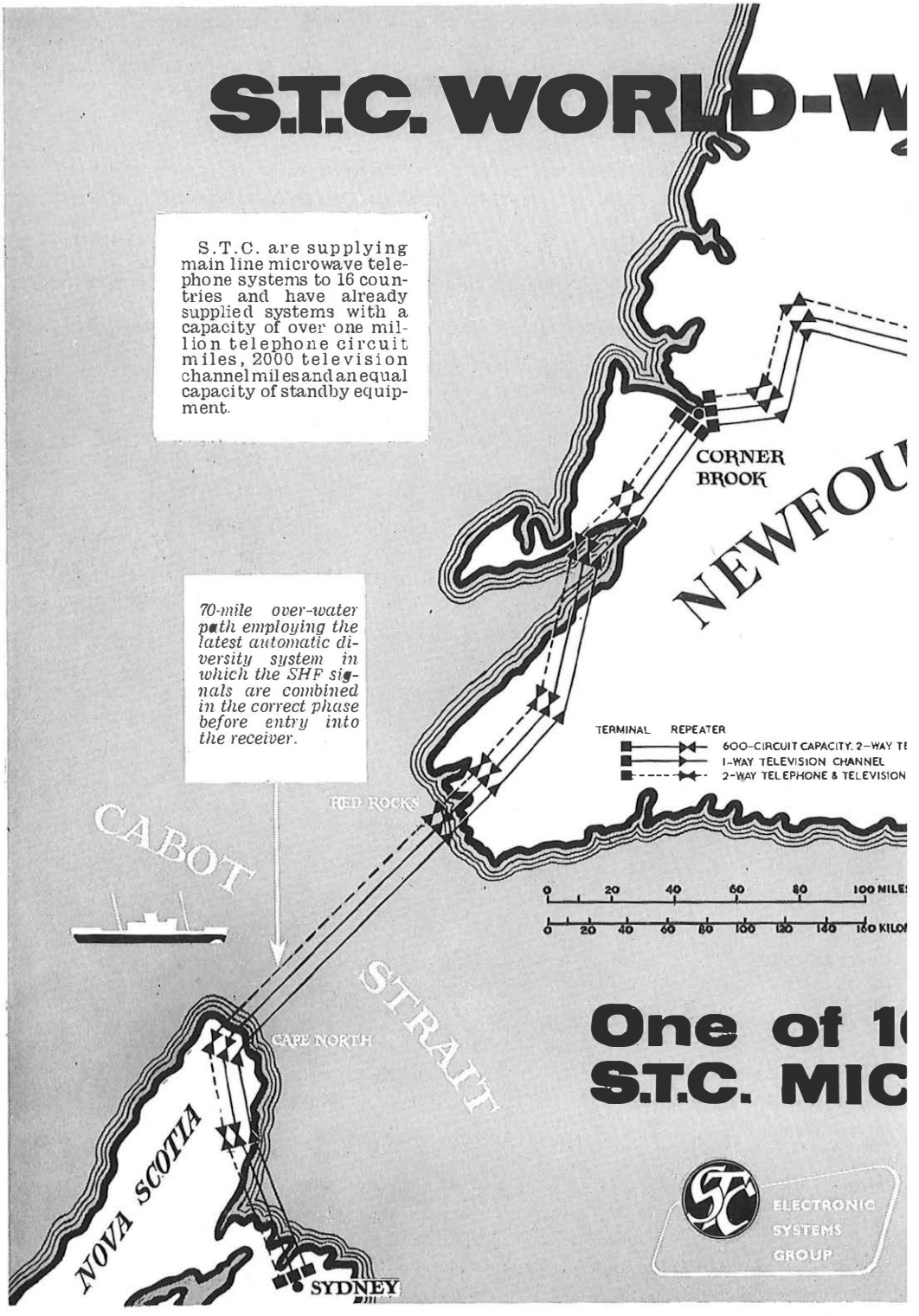
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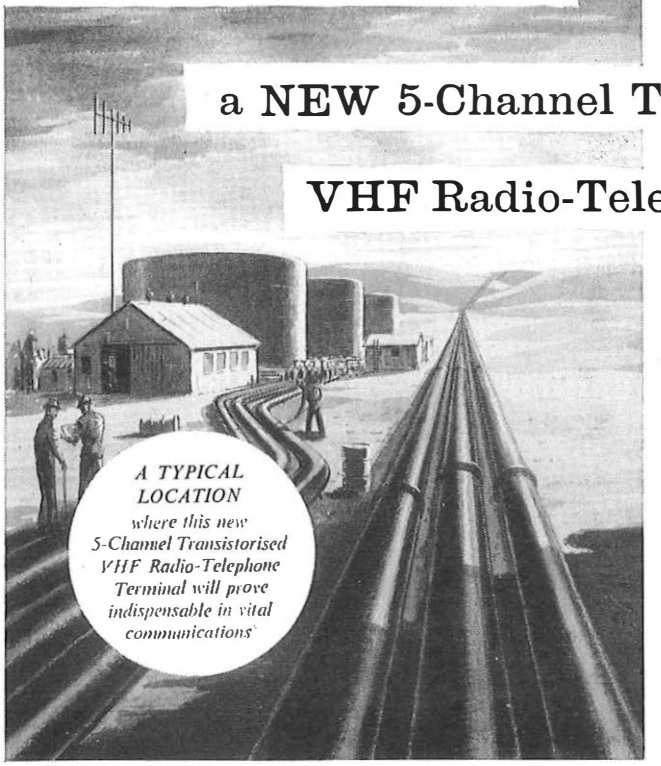

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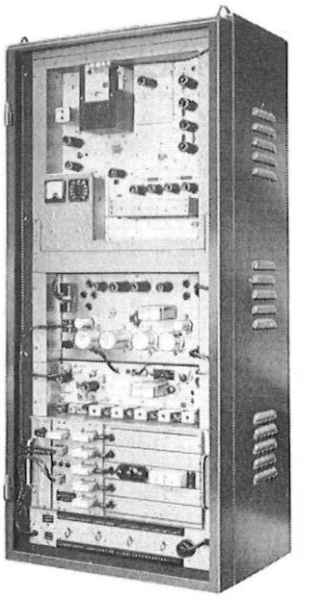

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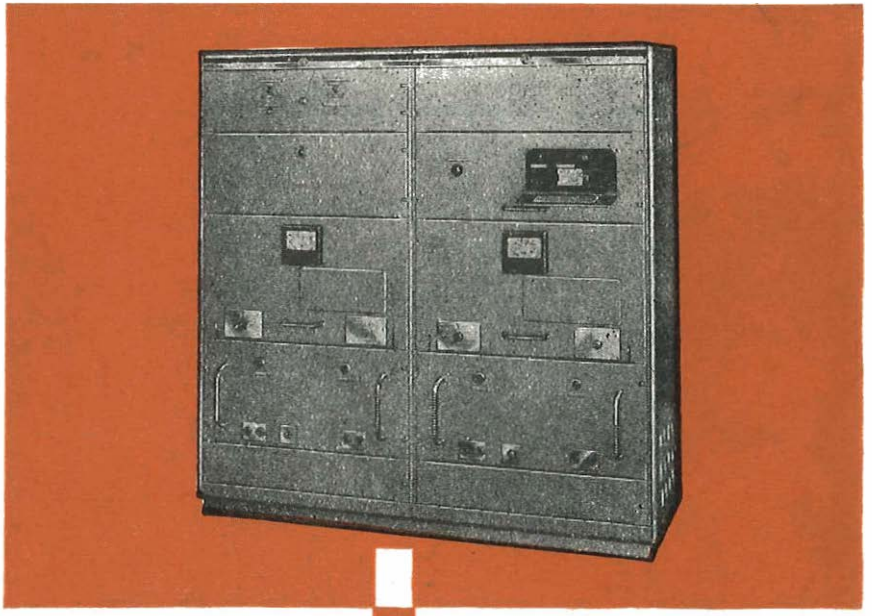

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