Post Office Telecommunications Journal

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Weathering the Storm

THE BRITISH CLIMATE IS A NEVER-ENDING topic. Our article, on p. 127, tells something of what the Post Office engineers and their colleagues in the field experienced during what has surely been one of the toughest winters on record.

Even after the article went to press, the last week-end in March brought more storm news—some 7,000 lines in Birmingham alone were out of action, the great majority by flood-water. In Birmingham and the surrounding Midland towns the total was more like 10,000. More than 30 of the 54 exchanges in Birmingham Telephone Area were affected and a thousand-pair cable in Sutton Coldfield failed during what a Post Office official described to the *Birmingham Mail* as "one of the worst week-ends ever known". The *Birmingham Gazette* described the effects of the floods as "the city's worst telephone shut-down since the war".

The snow-storms, blizzards and floods over four months threw an immense strain, not only on the men on the job but also on the resources of the Post Office—and at a time when, as the Postmaster General said in November, the Post Office is on the offensive against the order list. The fact that that offensive has been maintained despite the weather is a great tribute to the men of the telephone service. Indeed, the offensive has been intensified; in 1954-55, 410,000 telephones were installed.

Latest returns show that there are now more than 6,500,000 telephones in the country, and that we should install 465,000 new connections this year. We plan to spend £81 million on telephone development during 1955-56.

The Work of the Post Office Inland Telecommunications Department

J. F. Greenwood, C.B., Director

THE DIRECTOR OF THE POST OFFICE INLAND Telecommunications Department and his staff are responsible for advising on and (subject to direction by the Minister and General Directorate, and to Treasury authority) determining the broad policy within which Regional Directors plan the development, operation and finances of the telegraph and telephone services of the country.

The Inland Telecommunications Department (I.T.D.) at present comprises three branches: Planning (P.B.), Subscribers' Services (S.S.B.) and Operations and Organization (O.B.). The Telegraph branch, which had been specially constituted in 1953 to deal with the problem of the growing deficit on the public inland telegraph service, was dissolved in January, 1955, and its divisions were merged in the Planning and Operations branches.

Planning Branch

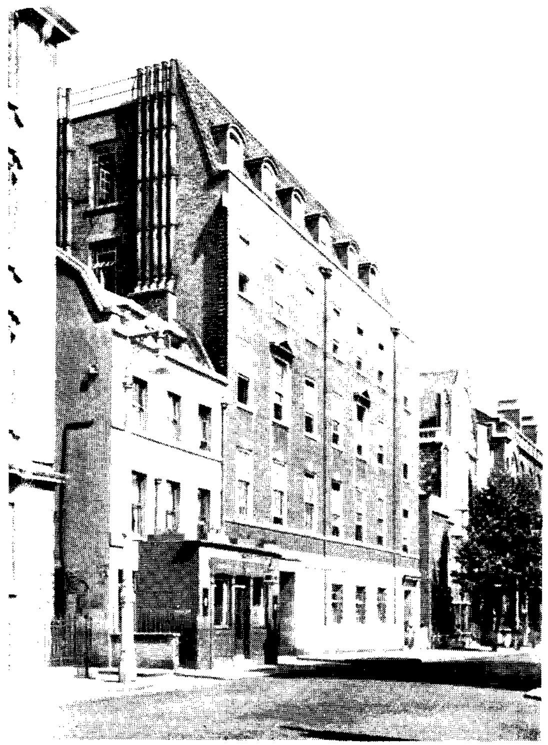
The Planning Branch deals with the development of the telephone and telegraph system. Expansion and modernization of the system to meet the country's need for an efficient telecommunications service call for heavy capital investment and the Planning Branch is responsible for initiating proposals covering the requirements of the service for investment.

To plan for orderly development the prospects for some years ahead must be taken into account. In recent years the competing claims for capital have been greater than the nation could meet in full, with the consequence that it has been necessary to allocate the available resources with due regard to the best interests of the country as a whole, and in particular to give preference to developments which enable the country to increase exports and to the requirements of defence.

In consequence, the capital which it has been possible to make available for developing the telecommunications service has been limited. Although there has been an increase in the capital funds for telecommunications development, these have not been adequate to enable the Department to make all the progress it would desire in clearing the accumulated arrears of work and meeting the increasing demand for telephone service. It has therefore been necessary to plan programmes with the object of securing the maximum immediate return.

When the permissible level of investment for a particular year has been determined the I.T.D. prepares and issues guidance to Regions for the preparation of their annual estimates of engineering expenditure for that year. It is the primary responsibility of the Planning Branch to ensure that the engineering estimates are in accordance with the policy directive and with the amount of capital investment which has been allotted to the Post Office, and to arrange that each Region gets a fair share of the available resources.

The scrutiny and final approval of the estimates is the responsibility of the Standing Telecommunications Advisory Committee, under the chairmanship of the Director of Inland Telecommunications, on which sit representatives of all the departments concerned with the engineering programme —the I.T.D., the Engineering, Supplies, Contracts and Accountant General's departments. The Planning Branch is responsible for submitting the agreed programme to the Director General for approval before it is submitted to the Treasury for



A modern telephone exchange: Mayfair Building, London, which contains four exchanges handling a total of some 300,000 calls a day

formal agreement.

The Planning Branch is also responsible for co-ordinating the development and mechanization of the long distance trunk network and the development of automatic switching systems, and for the traffic design of telephone exchange equipment as, for example, the cordless switchboard.

The Branch is also responsible for planning the telegraph service. Although, as we all know, the public inland telegraph traffic is contracting, the private wire services and the modernised telex service introduced in November, 1954, are developing; the telex service in particular has a great future before it. The contraction in the public telegraph service calls for constant study of the various possibilities of economising in the plant provided, thus releasing circuits and equipment for the telex services and for private wire networks. In particular studies are being made of the possibility of integrating the Teleprinter Automatic Switching network of the public service with the automatic telex network which will replace the present manually-operated system.

Subscribers' Services Branch

The Subscribers' Services Branch deals with the conditions under which telephone service is provided, including tariff questions; and, in consultation with the Solicitor's Department, with the application and interpretation of the Telephone Regulations. It is concerned with the demand for telephones; its great preoccupation at the present time is the telephone order list. Arising out of this it has been compelled to introduce a system of priorities for seeing that essential requirements are met as quickly as possible, but this system is under constant review with the object of simplifying and reducing the complications inherent in a priority system as quickly as circumstances permit.

The Subscribers' Services Branch is also responsible for questions relating to telephone private wires, including those for Government departments, the Defence Services and the B.B.C. It is also concerned with the development of new facilities such as the proposed Weather Service and with the administration of the Postmaster General's statutory wayleave powers. Through the Controller of Sales and his division it is responsible for the sales organization throughout the country and for the methods and procedures used in all sales offices. The important element of this function is the study and preparation of forecasts of development on which the planning of efficient and economical development of the service depends.

Operations and Organization

The Operations and Organization Branch is concerned mainly with the nature and quality of the service that the Post Office gives to users. In services which cover the whole country it is necessary to have a substantially uniform practice and the Branch is the focal point for interpreting, co-ordinating and reconciling all the interests concerned: that is to say, the interests of the general public, other Post Office departments and Regional Directors' offices, Staff associations, other Government departments and so on. Although the Regions are responsible for the day-to-day operation of the telephone service the background of policy against which they work and the procedures applied are largely provided by the Operations and Organization Branch.

This Branch is concerned also with all aspects of national policy on telephone exchange staffing and lays down the general standards of staffing, principles of exchange management and the operating procedures to be followed in handling telephone traffic. It also frames training programmes for exchange staff and exercises general oversight over their implementation.

The telephone service is constantly growing and changing and as manual operation continues to be replaced by automatic operation new facilities become available to subscribers and to telephone operators for getting calls automatically. It is a special responsibility of the Operations and Organization Branch to match these facilities to the tastes and capacities of both public and operators and in this respect it has an important part to play in considering all proposals for expansion and mechanization.

The Branch is also responsible for the operational and service aspects of the telegraph service; its object is to keep under review operating procedures, training and staffing standards so as to make sure that full advantage is taken of modern methods and developments. Sample analyses are being made of telegraph traffic to assist the examination of operational problems. Special traffic studies are being made of telegraph operating based on timed observations; this is being done by a Joint Committee of official and staff side representatives. The Branch is also exhaustively reviewing the possibility of securing further economies in the delivery of telegrams.

The Branch contains an Organization and Methods unit which investigates the specialized problems of the I.T.D. in much the same way as the Post Office Central Organization and Methods branch looks into the broader problems of organization and methods in the Post Office as a whole.

To sum up, the Inland Telecommunications Department is the central point for determining policy in all aspects of telecommunications work but, to carry out its functions, it must collaborate with and receive the advice of Regional Directors, other Post Office departments (especially the Engineering Department), the Staff associations and other Government departments. It also has to pay close attention to public opinion as expressed in Parliament and through such bodies as local authorities, trade associations and the Press.

At present, the I.T.D. is faced with the formidable problem of clearing large arrears of work and at the same time endeavouring to meet current demands for telephone service, which has now reached double the pre-war level, but it looks forward to and is already planning for the time when it will not only be able to meet demands as they arise but to embark on new developments which will give its customers an even more efficient service with greater facilities than they now enjoy.

Telecommunications Statistics

	Quarter ended 31st December, 1954	*Quarter ended 30th September, 1954*	*Quarter ended 31st December, 1953*
Telephone Service			
Gross Demand	118,750	110,567	106,811
Connections Supplied	116,000	107,000	100,300
Outstanding Applications	358,181	372,318	—
Total working connections	3,937,111	3,869,858	—
Shared Service connections	864,800	815,100	702,000
Traffic			
Total Inland Trunk Calls	77,374,000	79,068,000	69,876,000
Cheap rate	18,881,000	21,319,000	17,054,000
Inland Telegrams (excluding Railway and Press)	5,302,000	7,449,000	7,935,000
Greetings Telegrams	1,014,000	1,402,000	1,458,000
Staff			
No. of telephonists	46,458	46,933	47,146
No. of telegraphists	7,875	8,067	8,861
No. of engineering workmen	57,461	55,849	55,167

Setting Up the Independent Television Authority

A. Wolstencroft, Secretary

THE INDEPENDENT TELEVISION AUTHORITY'S actual existence started on August 4, 1954, but its origins go back to the autumn of 1951 when the 1951-55 Government found, on taking office, that one of its first tasks was to renew the expiring B.B.C. Charter—an occasion when the Government of the day normally reviews the whole field of broadcasting, usually after an enquiry by an independent commission. Such a commission—the Beveridge Committee—had already sat and reported, but Parliament had not yet adopted or rejected its recommendations. The Beveridge Committee had come down in favour of a continuation of the B.B.C. monopoly. In May, 1952, the new Government produced a White Paper saying that they had "come to the conclusion that in the expanding field of television provision should be made to permit some element of competition", with safeguards, under a controlling body, on whose advice the Postmaster General would license new stations.

This meant that the B.B.C. were to keep their monopoly of sound broadcasting, but in television were henceforth to have competition. Although the White Paper did not say how the proposed competitive services should be financed, what was in mind—as was made clear in the subsequent debates —was an arrangement similar to that already existing in the U.S.A. and in parts of the British Commonwealth; namely, privately owned broadcasting stations licensed by the Government, supervised by a semi-Governmental controlling body, and financing themselves by revenue from advertisements. The proposal might thus have been thought to have respectable precedents and reputable antecedents.

Broadcasting, however, is a subject which seems to rouse men's deepest and darkest passions. The White Paper gave the signal for a two-year battle; desperate legions swept into the fray on both sides, the one party carrying the banner of "Down with monopoly" and the other having "Preserve our heritage" inscribed on its flag. Clouds of words swirled above the battle field, and every ally was pressed into service on one side or the other, from John Milton, an English poet, whose words about "a puissant nation rousing itself from sleep" were quoted with approval, to J. Fred Muggs, a naturalized American chimpanzee, who was alleged to have monkeyed about with the Coronation. In spite of the tumult in the Press and in Parliament, however, there is no evidence that the man in the street lost any sleep over the issue.

The debates on the White Paper revealed that the question cut to some extent across party lines, and that there was widespread apprehension—or misapprehension, according to the point of view—about the probable effect of advertising influence on the programmes.

The skeleton was now well and truly out of the cupboard and was rattling its bones defiantly. It remained to put some flesh on them. As a first step, the Postmaster General asked his Television Advisory Committee to look into the technical side of the problem. The Committee very soon un-

This article is based on a talk given by the author at the Headquarters of the General Post Office, London.

earthed the craggy and unyielding fact that extremely few frequencies were available for any new television service. In brief, television broadcasting must use either the very high frequencies or the ultra high frequencies; ultra high frequencies are not yet usable in this country because the necessary techniques for transmitting and receiving are not sufficiently developed.

There remain the very high frequencies where two blocks are available for television, called, for convenience, Bands I and III. Band I contains five channels and all of these are in full use by the B.B.C. for their existing programme. Band III can provide eight channels, but since many other non-broadcasting services are already operating in this Band and cannot easily be moved, only two channels could be made immediately available. This means that if these Band III frequencies are to be used as they should be, at fairly high power to cover a fairly wide area, it is possible to set up initially only four or five stations in the United Kingdom and not more than one of these in any one place.

No "Free-for-all"

This clearly meant goodbye for the time being to any idea of a free-for-all of small private stations competing with one another and with the B.B.C. up and down the country. The picture was rather of a few regional stations each enjoying a monopoly of advertising in its own area.

Faced by the shortage of frequencies, and widely-expressed apprehensions about the effect that advertising might have on programme standards, the Government produced a second White Paper in November, 1953. This proposed a new two-tier system of broadcasting. First a public body was to be brought into being, with the double task of building and owning the transmitting stations and controlling what went out over the air. This was the controlling body of the earlier White Paper, with its hands strengthened by giving it the ownership of the stations. There were no longer to be a number of independent landlords, with the controlling body as a local council drawing up by-laws which they must observe. The council itself was now to own the properties, and thus to be in a position to turn out any unsatisfactory tenants. Next there were to be programme companies who, under contracts with the public body, were to produce the actual programmes. Finally, there was to be the advertiser who was to provide the finance for the whole venture by buying space on the air for his advertisements.

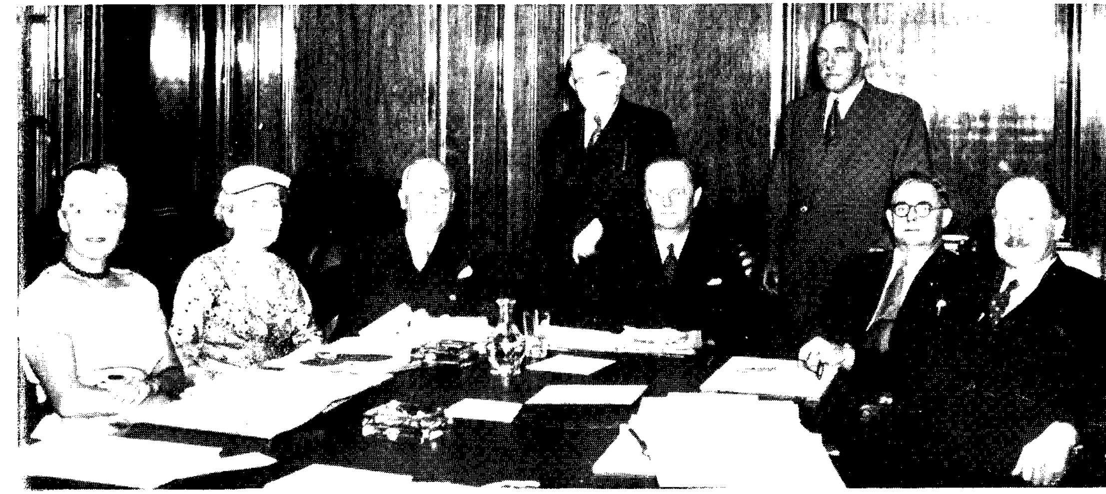
There were several novel features in this scheme. The separation between the ownership of the stations and the production of the programmes was not exactly paralleled anywhere else in the world. The second separation, that between the programme producers and the advertising interests, was also novel and was designed to prevent certain familiar features of American television which had come in for severe criticism in this country: in particular, the sponsoring of programmes by advertisers and the interruption of the programme by advertisements at inappropriate points. Advertisements and programmes were to be kept entirely separate, just as they are in the Press and in the cinema.

One might perhaps have expected the new scheme to be hailed as a rather bold piece of constructive thinking, combining in a novel manner public ownership and private enterprise, and avoiding any new calls upon the public purse. But, surprisingly, it was not received with universal acclamation. In fact, one may perhaps detect a note of mild criticism in the remarks of Lord Hailsham who said, in the debate on this new White Paper, "It is a mule with which we have been presented—a dangerous and unworkable animal, a ludicrous and inglorious hybrid, a creature proverbially without pride of ancestry, and devoid of any hope of legitimate posterity"—which goes to show how hard is the way of the man who would produce an acceptable compromise.

Ensuring Independence

The Government's scheme was also criticised very strongly because the sole source of revenue in mind was from advertisements. It was argued that this would mean that the advertiser's commercial interests would be bound to predominate over everything else. It was suggested that the proposed public authority should be fortified by a grant of public funds which would enable it not only to retain a greater independence but also, if necessary, to finance programmes needed to balance the output as a whole—for example, the kind of programme which would not be likely to attract advertisements, or which clearly should not be associated with them. The Government promised to consider carefully all that had been said in the debates when it came to the next step, which was to embody the proposals in legislation.

Things now moved very speedily. A Bill was produced in a staggeringly short space of time, although before this could be done the proposals had to be hammered out in full detail, since broad



The first meeting of the Independent Television Authority at Post Office Headquarters, London. Left to right: Miss Dilys Powell, Miss Margaret Popham, Sir Charles Colston* (Deputy Chairman), Dr. T. J. Honeyman (standing), Sir Kenneth Clark (Chairman), Lt.-Col. Arthur Chichester (standing), Mr. G. B. Thorneycroft and Sir Henry Hinchliffe
(*Sir Ronald Matthews is now Deputy Chairman)

statements of principle and well-sounding phrases, all very well in a White Paper, do not necessarily commend themselves to the stern realism of the Parliamentary draftsman, who has to produce a piece of legislation which should have a precise and unequivocal meaning.

The Bill when it appeared was found to contain several new features. Perhaps the most important was that the new public body—which was to consist of 10 members and for which some nameless genius had now devised the name of the Independent Television Authority—was to have the possibility of drawing up to £750,000 a year from public funds if Parliament decided to vote them. Other important provisions, which had, however, been foreshadowed in the White Paper, were that the Authority was to have an initial life of ten years, and was to finance itself to start with by means of a loan from the Exchequer; it could draw up to £1 million in the first year from the passing of the Bill, and up to £2 million in all. Religious and political broadcasting were to be allowed under safeguards. The Authority was to ensure impartiality and objectivity in the news and in political broadcasting.

The Bill resulted in another tremendous spate of words. At every stage the Parliamentary Opposition fought it tooth and nail, putting down a vast number of amendments. Someone with a statistical turn of mind calculated well before the end of the debates that the number of words which had by then been spoken on the subject in Parliament considerably exceeded those in the Old Testament. There was something of a tug-of-war over the Independent Television Authority itself; one side would have liked to stretch it into something very like a second B.B.C., while those of an opposite persuasion would have liked to shrink it until it had almost disappeared from view. In the event the Authority retained more or less its original shape, but the Bill was amended to make it quite clear that the Authority was not itself to put on programmes unless no programme contractors could be found. While it could use the Parliamentary grant to finance parts of programmes which might be necessary to balance the whole output, it had to go out to contract for them.

The Bill made the Authority responsible for selecting the programme contractors and they were enjoined to "do all that they can to secure that there is adequate competition to supply programmes among a number of programme contractors independent of each other both as to finance and as to control"; they were also made responsible for enforcing high standards for both programmes and advertisements, and for ensuring that there was no sponsoring of programmes by advertisers. The instrument of control was to be the contract between the Authority and the programme contractors, and the Bill went to town with two pages of "special provisions to be included in contracts"; they were clearly going to be most formidable documents. To assist it in maintaining standards the Authority was required by the Bill to set up three advisory committees to advise itself and the contractors on standards of advertising, including in particular medical advertising, on children's and on religious programmes.

On most matters of detail, Government speakers refused to commit the Authority in advance; but on one very important matter, the timetable of the new broadcasting services, they did opine that the Authority should find it possible before the end of 1955 to come on the air with three stations, to serve the London, Birmingham and South Lancashire areas, the stations being linked together by cable or radio links which the Post Office would provide. Although the Bill was pressed through with great speed the nature of Parliamentary procedure meant that it was July 30 before it received the Royal Assent and became part of the law of the land.

Immediately, on August 4 to be precise, the Postmaster General announced the names of Members of the Independent Television Authority, of which Sir Kenneth Clark was to be Chairman. The Members were handed copies of the Television Act and told to go to it. All they now needed to enable them to begin broadcasting were stations, transmitters, Post Office links, programme contractors, advisory committees, staff, premises, note-paper, pens and ink and someone to make the tea in the morning. The somewhat bleak prospect was, however, brightened by the fact that the Post Office was able to produce some temporary accommodation and temporary staff for them so that they could get things going.

Director General

The first step was to appoint a Director General, and this post went to Sir Robert Fraser. The Authority next obtained its own temporary offices, and turned to the two main tasks confronting it—building its stations and choosing the programme contractors.

First, the stations. A television station is a specialized and complicated thing which needs (to over-simplify) a site, transmitters, a mast and an aerial. The B.B.C. television stations have been built mainly on what has been called the "Tibetan monastery principle", which consists of choosing the highest mountain in sight and erecting on it a 500- or 750-foot mast. These great stations were designed to give optimum coverage throughout the country, and the B.B.C. might therefore have said to the Authority "You want the best sites, we have them".

Furthermore, the radio industry had started to say that it would be a good thing for the two broadcasting authorities to share the same sites for their transmitting stations, because it would save viewers inconvenience or expense, and to suggest that the Authority should arrange with the B.B.C. for its transmitting aerials to be placed on the Corporation's masts. The Authority accordingly entered into discussions with the B.B.C. on this question of sharing masts. Meanwhile, they placed orders for Band III transmitters, none of which yet existed and which would take many months to develop and manufacture.

Selecting Contractors

The second part of the task—and a most delicate and vital one—was the selection of the initial programme contractors for the first three stations. Applications were invited through an advertisement in the Press. But, of course, the Authority had to take a preliminary decision: on what structural principle were the contracts to be allocated to give the "adequate competition" required by the Act? This was a subject which had excited a deal of interest, and for which several solutions had already been propounded.

One school of thought advocated the allocation of contracts on the basis of "one station per contractor". Others, who feared the creation of a powerful advertising monopoly if the London station, in particular, was in the hands of a single contractor, favoured treating the three stations as an integrated network and allocating the whole network to different contractors on different days of the week. The Authority decided to split each station by weekdays and week-ends, allotting at each station Monday to Friday to one contractor and Saturday and Sunday to another. This they considered to correspond to a real editorial distinction, with a basis in the social habits of the population. Weekday newspapers differ from Sunday newspapers, and Saturday newspapers have started to resemble the Sunday rather than the weekday style, as the habit of the five-day week spreads.

Having reached this decision, the Authority interviewed a short list of applicants for contracts and decided on the following pattern: the London station was to be offered weekdays to a company formed by Associated Newspapers (the Daily Mail group) and British Relay Services (the Rediffusion group); the London week-end and the Birmingham weekdays were to be offered to the Associated Broadcasting Development Company—this Company has subsequently merged with another Company headed by Prince Littler and called the Incorporated Television Programme Company Ltd., the joint company now being known as the Associated Broadcasting Company; the Birmingham week-end and the Lancashire week-end were offered to a group which included the Kemsley Press and Maurice Winnick; and, finally, the Lancashire weekdays to a company formed by Granada Theatres. The question of providing the news was to be reserved for special treatment; individual contractors were not to be allowed to put on news programmes.

The initial network was thus to be divided among four groups of approximately equal weight and importance. Direct competition in the fullest sense was, of course, impossible because two contractors could not broadcast in the same place at the same time. But apart from the fact that there was everywhere direct competition with the B.B.C., the Authority's system also provides competition for the use of the network. Each contractor will be anxious to sell his programmes to the others because any revenue he gets in this way will be sheer profit to him. He will also be anxious to buy good programmes because he should be able to buy a programme for less than it would cost him to produce one himself. Competition to produce good programmes ought thus to be stimulated both by financial considerations and by public demand.

Meeting Criticism

There was some criticism of these arrangements in the Press and also in Parliament, on the ground that they would increase the power of the Press and, in particular, the right-wing Press. This criticism died down, however, after the Authority had explained that no left-wing newspapers had applied for contracts and that there were only three obvious main sources for which programme contractors with the necessary capital could come—electronic manufacturers, entertainment interests and newspapers.

This brings matters more or less up-to-date at the moment of writing, but this is a time of tremendous activity and of incessant development, growth and change. New situations continually call for new responses in the unexplored field where the Authority is operating and where it is confronted by novel and difficult problems of radio engineering on the one hand and by the hundred and one questions arising from the Television Act on the other. This sketch must therefore fade out in mid-air like the smile of the Cheshire cat. But you will be able to judge the success of this most interesting new experiment in television on your television screens before many months have passed; the Authority is aiming to begin transmitting in London in September of this year.

Lake District Incident

An incident which illustrates the difficulty in maintaining telephone service in the Lake District occurred in December of last year. Weeks of almost continuous rain raised the waters of Bassenthwaite, Derwentwater and the River Derwent to a dangerous level. By December 4, the flood waters had risen twelve feet and the lakes Bassenthwaite and Derwentwater had merged to form an expanse of water some five miles in length.

The floods carried away the centre arch of the picturesque Portinscale Bridge which crosses the River Derwent between the two lakes. This bridge, built in the late seventeenth or early eighteenth century and scheduled as an ancient monument, carried on its upstream side, some local Keswick cables and also the Keswick-Cockermouth junction cable. On the downstream side it carried gas and electricity mains. The road over the bridge was closed to traffic and arrangements made for the erection of a temporary structure to be placed on the existing bridge abutments.

Because of the risk of the bridge being washed away the Post Office arranged for periodic inspections, and as a further safeguard decided to put temporary ducts which, in the event of failure of the old bridge, could be used to carry the Post Office cables on the new structure. The temporary bridge was placed in position on January 9 and shortly afterwards the downstream portion of the old bridge was washed away.

The remaining portion of the old bridge withstood the floods. It has now been strengthened and continues to carry the Post Office cables. The County Council are planning to erect a permanent bridge on a new site. The temporary bridge will then be removed and the remaining section of the old bridge—still scheduled as an ancient monument—will be converted to a foot bridge.

Civil Engineering for Radio Stations

L. L. Hall, A.I.E.E.,

Engineer-in-Chief's Office

THE POST OFFICE PROVIDES AND OPERATES several kinds of radio stations, including main transmitting and receiving stations for long distance overseas communications, coast stations for communications with shipping within a range of about 300 miles, and a large number of stations forming part of the inland telecommunications network.

The provision of radio stations, especially main transmitting stations, involves many branches of engineering other than that directly concerned with transmitters and receivers. The purpose of this article is to illustrate the extent to which these allied skills are involved and to outline the more interesting types of essentially non-radio work entailed and generally undertaken by the Post Office. Perhaps the best way of doing this will be to describe the general order of events in providing a new station and to illustrate the kinds of civil engineering work involved by examples from the construction of some existing stations.

We will assume that a new station has been generally planned and that a suitable site has been decided on. At this stage, the service the station is to carry being known, the numbers and types of transmitters or receivers and aerials needed for immediate purposes will have been determined, and appropriate allowances should have been made for growth. The electrical power needed will also have been estimated; the ease or difficulty, and therefore the cost of obtaining it from the mains, will

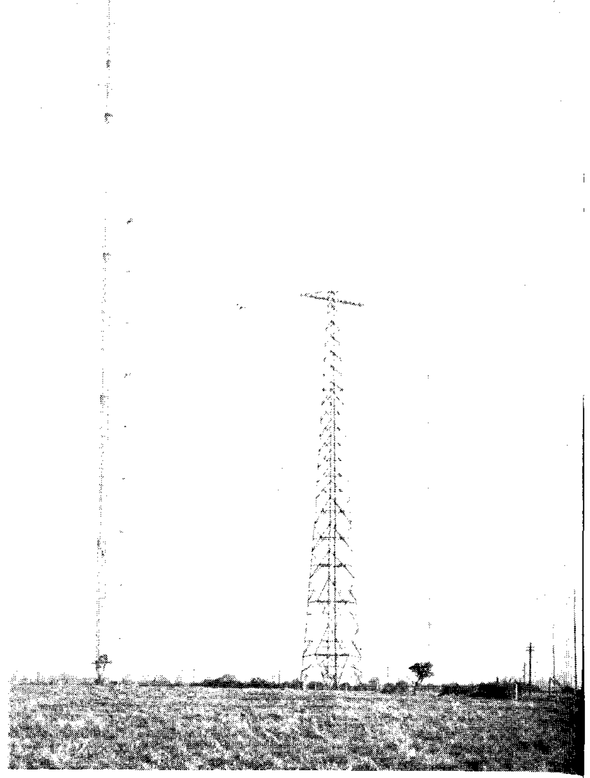


Fig. 1 : Prototype mast tested to destruction

have been one of the many factors considered in selecting the site. As power supplies do fail occasionally, and serious interruptions of the services cannot be risked, engine-driven generators will usually be needed to supply stand-by power in emergencies. If the station is to contain high-power transmitters, forced cooling of the valves must be provided by either water or air; a river or lake on or bordering the site will have been a great attraction.

The aerials and the internal equipment needed having been determined and the staff required having been assessed, a suitable lay-out is evolved for the station buildings (to be provided by the Ministry of Works) and designs for the other plant can be put in hand.

The aerials will be designed first from the radio aspect to determine the necessary disposition in space of the wires which radiate energy into or collect it from the atmosphere. A short-wave aerial, such as is commonly used at main stations, usually takes the form either of a vertical curtain of radiators slung from steel masts between 100 and 300 feet high, or of a horizontal rhombus (oblique

parallelogram) of wires supported on poles or masts about 100 feet high. On the other hand, a long-wave aerial consists of a more or less vertical uplead connected to some form of roof of horizontal wires supported as high above the ground as possible—usually something between 300 and 800 feet.

The disposition of the radiating wires in space having been decided, arrangements for supporting them must be designed, and here the structural engineer must be called in. The loadings on the wires and insulators that will be imposed by a coating of ice and the strains caused by a simultaneous gale must be considered; the suspension system must be designed to withstand such loads and strains safely. One may, for example, hang the radiators from catenary (chain) cables in much the same way as a suspension bridge is hung from its main supporting cables. For a long-wave aerial a more complicated suspension system might be necessary; or again, as with the rhombic aerials, the radiator wires may simply be made strong enough to carry their own total loading. Then, suitable structures must be designed to withstand the pulls of the aerial supporting wires at the appropriate heights and, what is often more important, the wind and ice loading on the structures themselves. Such structures may vary from tall wooden poles for the smallest short-wave aerials to steel masts up to several hundred feet high for the largest long-wave aerials.

These masts may rely on one or more sets of stays to hold them up, or they may be self-rigid structures requiring relatively large foundations to resist overturning. If sets of stays are to be used, and the mast is stayed at a number of points, the design of the most economical structure that will safely withstand all the loading conditions to which it may conceivably be subject is a very tricky problem. Since the stays cannot possibly be made straight and inextensible, the stay points will move under the influence of the aerial and wind loads on the masts, and under certain conditions they will not even be so obliging as to move in the same direction. The mast will then act like a continuous bridge supported on piers that move by different amounts and in various directions. In addition to

Fig. 2 : Piles being driven : for each foundation a cluster of piles was capped by a massive concrete block

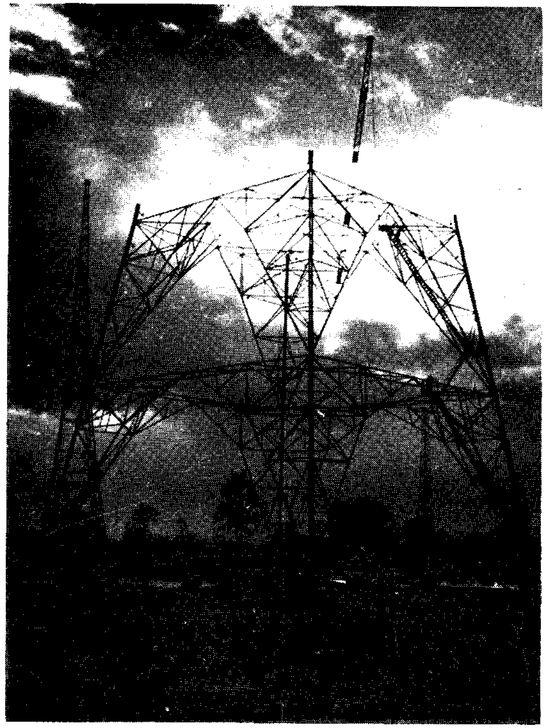


Fig. 3: Masts being erected using the "floating derrick" (foreground); a complete mast can be seen in the background

the stresses resulting from such deflections of the structure, there is a very considerable compressive load because of the cumulative vertical component of the stay tensions and the dead weight of the structure, and this load, acting on an already deflected structure, increases the deflections still more: yet the mast must not buckle. How one longs for sky hooks!

A small and light mast of this type, 150 feet high, was recently designed to withstand aerial loads at 75 and 150 feet above ground level, plus a uniform wind load. To check the adequacy of the design and workmanship (welded construction was employed throughout except at main section joints) a prototype mast was tested to destruction. Fig. 1 shows the mast after destruction had occurred at loads several times the maximum aerial loads allowed for. This tested the design and permitted the mass production of this type of mast to proceed with confidence. In Fig.1 the taller stayed mast behind the prototype under test is one of the twelve 820-foot main masts at Rugby Radio Station used for supporting the long-wave aerial (G.B.R.)—which works on a wavelength of about $11\frac{1}{2}$ miles! The self-supporting mast with the cross arm at the top is 180 feet high and is used, with others, to support short-wave "beam" aerials (consisting of vertical curtains of radiators and reflectors) working on wavelengths in the range of 50 to 150 feet.

Self-rigid masts

The design of a self-rigid mast or tower is a less complicated problem, but when such a tower has a cross arm at the top for supporting "beam" aerials, or carries aerials with large dish-shaped reflectors for micro-wave links in the inland network, adequate strength against twisting must also be ensured. For such micro-wave aerials, since the beam width is very narrow indeed, the towers must be strong enough not to bend or twist by more than one degree under the action of the highest wind velocity to which they are likely to be exposed. For the stayed masts, the stay blocks must be large enough not to be pulled out of the ground or dragged forcibly through the ground by the maximum pull of the stays, and the mast foundation must be big enough not to sink into the ground under the weight of the mast and the total vertical pull of the stays. As an example, the foundation block for each of the 820-foot high masts at Rugby can safely withstand a total vertical load of 400 tons.

For the self-rigid towers the foundation blocks must be capable of resisting both the maximum possible downward thrust and the maximum uplift due to wind and aerial loads in any direction. In designing such foundations one becomes involved with soil mechanics and assumes another of the mantles of the civil engineer. Borings on the site will be taken to discover the nature of the subsoil, and if desirable the geological survey will be consulted for further information. From these data and the known properties of soils, the engineer can determine the maximum safe pressures that may be imposed vertically or horizontally on the soil at various depths, and how much soil he can rely on dislodging with a stay or foundation block if the towers should be forcibly uprooted.

The standing water level in the ground and the general moisture content of the soil are important considerations, as the mechanical properties of soils can be radically altered by the moisture content. It is always wise to know what lies beneath the surface of the earth to a much greater depth than that to which the foundations will penetrate, as was proved at one station where a 10-foot thick crust of silt overlaid soft clay some 300 feet deep. The broad valley in which the station is located had been scored out by a glacier and the soft clay, known as glacial drift, was the aftermath. The silt crust is good enough for all shallow foundations but not for deep ones.

Self-supporting masts 600 feet high were erected and the foundation for the corner legs, which are 100 feet apart, had not only to withstand compressive loads of 200 tons and uplifts of 100 tons, but also to remain fixed relative to one another to within a fraction of an inch. Since the sub-soil could not be trusted, piling was resorted to and in this instance the Ministry of Works designed and provided the foundations. The piles could not be driven to a solid sub-stratum because none existed at a practicable depth, and stability was obtained by the adhesion of the sub-soil to the piles.

Fig. 2 shows the piles being driven; for each foundation a cluster of piles was capped by a massive concrete block to distribute the downward thrust over the piles and to resist the uplift. The foundation blocks were also connected by reinforced concrete ties, and sloping piles were driven to resist lateral movement. The pile driver shown on the left of Fig. 2 is driving vertical piles, and the one on the right is driving raking piles. The masts themselves, one of which is shown being erected in the foreground of Fig. 3, with a completed one in the background, act as cantilevers and depend on the rigidity of the foundations for their stability.

To check that the blocks did not move appreciably, a special form of levelling instrument was devised, consisting of two cups which stood on the mast base plates and were connected by 150 feet of rubber tubing filled with water. The level of the water in each cup relative to its base was measured by a micrometer so that movements of a few 1,000ths of an inch could be detected. The design of the instrument for the degree of accuracy desired involved a few subtleties, such as the method of observing the exact height of the water surface in each cup (which is not as easy as it sounds) and the determination of the bore of the rubber tube needed to damp out oscillations of the water.

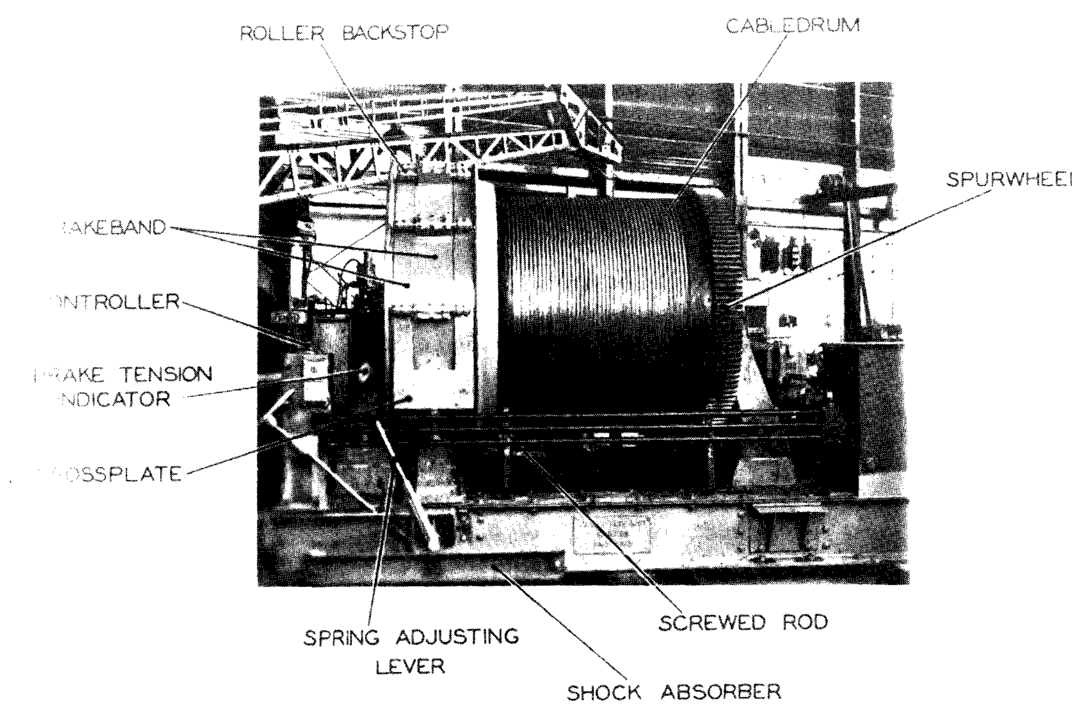


Fig. 4 : One of the winches at a contractor's works

Large and heavy winches are needed to lift large and heavy aerials, and when the aerials are in position the effects of high velocity and gusty winds and heavy accumulations of ice must be allowed for. The safety of the aerial and of its supporting structures can be improved by adding to the winches a device which will ensure that the aerial halyards can be paid out at substantially constant tensions when the wind or ice loading becomes excessive. Since excessive wind loading will be caused by gusts, and the halyards must be paid out rapidly under such conditions, the device must be capable of absorbing high power in short bursts.

This intriguing problem in mechanical engineering was solved at one station by fitting a flexible band brake to each of the heavy winches, the bands being spring-loaded at their leading ends (instead of being rigidly anchored as is usual) and contacting the brake drum over 1¾ turns. The braking effort of such a device is substantially independent of the variations of the coefficient of friction which occur when movement begins and also when the speed changes, and these particular brakes are designed to let the halyards slip at a tension of 33,000 lb. to maintain the braking effort constant to within 1,000 lb. while slipping, and to be capable of suddenly absorbing 1,000 h.p. each. One of the winches at the contractor's works is shown in Fig. 4, and the method of obtaining the 1¾ turns of the brake band by bifurcating the trailing end is indicated. The brake drum is 6 feet 6 inches in diameter and 2 feet wide.

Water or air can be used for cooling the valves in transmitters. If the valves are water cooled, the water that comes into contact with the anodes of radio valves, which are at high electrical potential, has virtually to be an insulator, so distilled water is normally used and is pumped rapidly through the valve water jackets to remove the heat and prevent the formation of steam bubbles which might cause local overheating of the anodes. The heat removed from the valves by the distilled water must then be transferred by way of heat exchangers into natural water pumped from a river or cooling pond, or dissipated into the atmosphere via air-blast radiators.

In the design of the water cooling system, one first ensures that the water pipe work is large enough to convey the necessary flow of water without causing undesirable losses of pressure due to friction. The pumps must be such that, although they are powerful enough to deliver the necessary quantity of water, yet should a stoppage occur by the operation of control valves or otherwise, the pump pressure will not rise to such an extent as to break the pipes or to damage the radio valves. If the water pipes are very long the designer must be par-

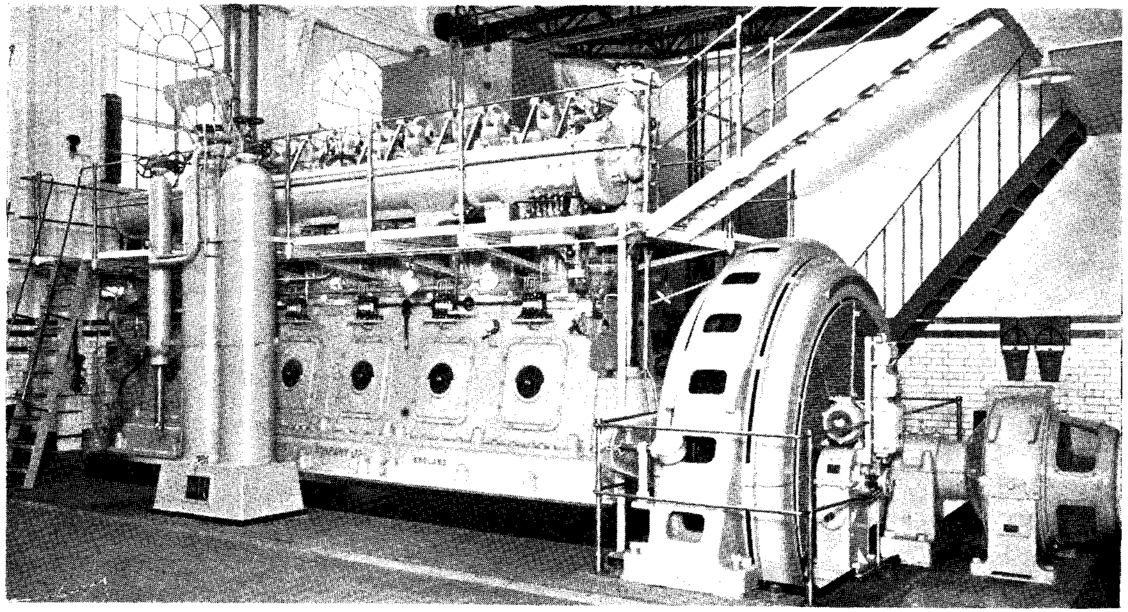


Fig. 5 : A large engine-generator set which is started by normal manual procedure

Fig. 6 : The British climate !

ticularly careful to see that control valves cannot be closed too quickly or the pipes may be broken by "water-hammer" effect.

At one station, for example, where pipes nearly half a mile long convey water from a river to the transmitter buildings, it was necessary to ensure that control valves at the buildings could not be closed in under seven seconds. About 20 tons of water flow in each pipe and to try and stop this flow quickly would have invited disaster.

If a river or lake is not available for an unlimited supply of natural water, a cooling pond is normally used. The size of the pond is calculated from data on the rate of evaporation from water surfaces under natural conditions, since the heat required for the evaporation is largely extracted from the water itself, thereby cooling it. Meteorological records have to be consulted to determine the most adverse weather conditions under which the pond is likely to have to work.

If the radio valves are air cooled, as they would be on a site lacking adequate natural water supplies, the loss of pressure in the air flowing through ducts, similar to those for water flowing in pipes, must be considered; but, in addition, it is important to avoid noise. The services of an acoustics engineer are then required to ensure that sound absorbing material is incorporated in the right quantities at the right points to reduce the noise to an acceptable level.

An adequate supply of power must, of course, be supplied to all the apparatus on the station, and if there is more than one building on the site, the power engineer must design a suitable distribution system. The mains supply for the whole station will be provided by the electricity authority at a stipulated point on the site where the supply would be metered and, if necessary, transformed to a suitable voltage for distribution. If the power demand is large enough and the buildings are sufficiently dispersed, the power will be distributed at high voltage and transformed at each building for local distribution to the apparatus. Damage to the power feeders by overloads must be guarded against by providing circuit breakers capable of safely breaking the maximum current that could flow in the event of a short circuit at any point in the system. These circuit breakers must be so arranged that only those necessary to isolate a fault operate, thus leaving the power supply still available to the rest of the system.

Engine-generators for supplying power under emergency conditions have often to be provided and, according to the size of the engine and operating conditions of the station, the engines, on failure of the mains supply, would be started automatically or by push-button control or by normal manual starting procedure. A large engine-generator set with normal manual starting is shown in Fig. 5.

While the designs of all the plant are being evolved and the materials ordered, the most suitable lay-out of the aerials and buildings is decided by drawing them to scale on ordnance survey maps of the site. The next job is to mark the positions of the various items of plant accurately on the site itself, and here it is necessary to use the technique of the surveyor and the calculations of the navigator. Directional ("beam") aerials have to be so directed that they will radiate mainly along the great circle path joining the transmitting and receiving stations. The latitudes and longitudes of the stations being known, the bearings of the great circle paths at the station relative to true north can be calculated; true north is determined and marked out on the site with the aid of a theodolite—that is, by the methods used by the navigator in observing the bearings of the sun or stars at known times.

The directions of the aerials and the positions of the supporting structures are also determined with the theodolite. This surveying procedure always calls for accurate linear and angular measurement.

Two-mile Aerial System

An outstanding example is given by a special aerial system consisting of 16 identical aerials in line, stretching for a distance of two miles. Because the quotas of energy picked up by all the aerials had to be added in an exact phase relationship on one receiver, the aerials had to be spaced uniformly to the limit of precision reasonably obtainable; an error of not more than one inch in a mile was desired. The technique used by the ordnance surveyor when measuring a base line for the start of a main trigonometrical survey of the country was therefore adopted. A 100-foot steel measuring tape was checked for accuracy at a known temperature, and was used to mark two points on rigid tables elevated at a few feet above the ground and at the desired aerial spacing of 200 metres. A steel wire was then stretched between the tables and calibrated against the accurately determined marks so that the wire could thereafter be used for marking out the aerials and so reduce any cumulative error.

In these measurements the tape and the wire were pulled up to predetermined and accurately measurable sags, so that the apparent reduction in length due to the sag was exactly counter-balanced by the increase in length due to the tension. Of course, corrections were made for temperature and, as far as possible, sunless and windless days were chosen for the measurements to eliminate doubts as to the temperature and loading of the wire or tape.

Having marked out the positions on the site for the various items of external plant (poles, masts, water pipe and cable trenches) excavating for the foundation and pole holes and stay blocks follows normal procedure, full use being made wherever possible of mechanical aids. The foundation steel work for masts is placed accurately in the holes by templates and concreted in.

The method of erecting the masts varies with the type and size of the mast, the smaller and lighter masts up to about 150 feet high being assembled on the ground and raised *in toto* by a derrick, and the larger and heavier masts being erected piecemeal. For piecemeal erection a "floating derrick" (a derrick which is entirely supported by steel ropes within the top of the completed portion of the mast, and which can be luffed and slewed into any convenient position) is generally used for raising individual members or sub-assemblies into position. Fig. 3 shows such a derrick in use, protruding from the top of a mast. This type of work requires toughness and complete absence of "nerves" in the steel erectors who clamber about the open steel members with little other than a long drop between them and the ground.

Aerial erection entails little novelty, only great care in restraining a mass of wires from exercising its uncanny predilection for tying itself in knots. The aerial feeders may be of the open wire type, or coaxial tubes or waveguides, according to the wavelengths used and station conditions. Coaxial tubes and waveguides are usually pressurized with nitrogen or dry air to prevent moisture from entering; this is particularly necessary if the feeders are buried. At one station where several miles of coaxial feeders were made on site and buried in waterlogged ground, leaks occurred and had to be corrected. The leaks were traced by pumping an evil-smelling gas into the feeders and using a specially trained dog to locate the points of emergence of the gas. Anyone using the gas had a most embarrassing time in public for several hours afterwards!

It will be seen that knowledge and practice of many branches of civil engineering is required in the construction of a radio station. To those directly concerned, this variety is one of the great attractions of the job. Great satisfaction can be derived from designing the plant and building it on site—usually, it seems, in the face of all that the British climate can do!



Telephone Service for Government Departments

R. H. McGann,
London Telecommunications Region

THE VALUE OF THE TELEPHONE, SAID OSCAR Wilde, is the value of what two people have to say. Today—half a century later—we perhaps place a rather higher value on the ease and speed with which the telephone enables them to say

A study group in the London Telecommunications Region has been looking at all the conditions and facilities contributing to the ease and speed with which telephone calls can be made in two very important but diverse fields: namely, hotels and Government offices. This article reports the group's examination of private branch exchanges serving Government departments; a later article will deal with telephones in hotels.

A visit to each of the 600 private branch exchanges (P.B.X.) serving Government departments and offices in the London Telecommunications Region might occupy one person fully for several months. A visitor who followed this formidable itinerary would find his footsteps directed along most of London's world-famed thoroughfares; he would also make his way along Regency terraces, up Dickensian by-ways and across sequestered and leafy Victorian squares.

The Foreign Office P.B.X., for example, is in Carlton House Terrace, the Land Registry in Lincoln's Inn Fields and the Ministry of Transport and Civil Aviation in Berkeley Square. Justice, deliberating on its stern but splendid course, is served by the P.B.X. of the Royal Courts of Justice in the Strand. The Royal Mint P.B.X. is at Tower Hill. And justice enforcing deserved but depressing penalties—not always wholly unconnected with the Mint—is served by the P.B.X. of the Prison Commission at Wormwood Scrubs.

Let it not be even vaguely thought that 600 P.B.Xs represent as many Government departments. Many departments have several P.B.Xs serving scattered units, each of which is either naturally self-contained or is outhoused because of accommodation difficulties. The Post Office, for example, with its 40 P.B.Xs in London, could not very well combine in one building the functions of the Post Office Factory and the Accountant General's Departments, or the Savings Bank and the Long Distance Telephone Area. Nor could the multifarious activities of the Post Office be efficiently and conveniently housed in one gigantic building even if space could be found and one could be built.

Government P.B.Xs in the London Telecommunications Region range from one to 40 positions; a P.B.X. may have a small cordless switchboard or it may be the counterpart of a fully-equipped public telephone exchange with supervisor's desk and monitorial positions. The problems of maintenance, service, removal, extension and replacement may

A small P.B.X. serving a Government department; operating combined with typing duties

be judged from the fact that, in total, the Government have in the London Telecommunications Region more than 2,000 P.B.X. operating positions; small wonder that in the Centre Telephone Area, where the concentration is greatest, a specialist staff is needed to deal exclusively with the day-to-day problems of these installations.

Staff

At 200 of the largest and busiest of these Government P.B.Xs the operating staff is recruited, trained, controlled and paid by the Post Office. They have a staff of 2,000 telephonists and supervising officers. About 25 new telephonists are needed every month to replace those who leave. Many of the vacancies are filled by recruits who, during interview or training, have given evidence of aptitude for P.B.X. work, but some are filled by experienced telephonists, with similar aptitude, transferred from the public exchanges. The transfer of experienced telephonists to the P.B.Xs ensures that there are enough senior staff to fill supervising vacancies as they occur.

In addition to the P.B.Xs staffed by the Post Office, there are in the London Telecommunications Region more than 400 P.B.Xs in Government departments which are themselves responsible for staffing the switchboards. The majority of these switchboards have only one operating position. Many do not warrant a full time telephonist, and the operating work is combined with other duties. There are some larger P.B.Xs serving naval, military and air force establishments which are—and must be—staffed by uniformed members of the forces. But when a P.B.X. serving a civil department in the Region grows to a size requiring as many as three full time operators, it is time to consider transferring control to the Post Office.

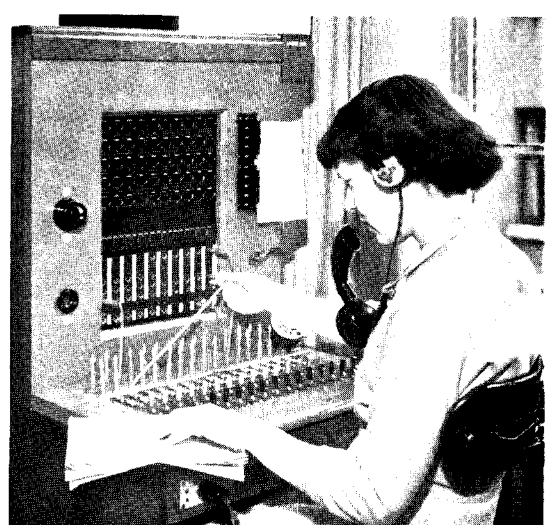
Blind Operators

Blind telephonists can be employed at suitable single position P.B.Xs after the equipment has been slightly modified. The operator hears the indicator drop and, guided by a small stud placed at the top and bottom of the calling field, feels with each hand from the centre of the field to the right and left simultaneously until the dropped indicator is identified. The answering jack, lower down on the face of the switchboard, corresponds with the position of the calling indicator. When the glass-covered supervisory signal on the keyshelf is operated it causes a pin to be raised through the glass cover and this is quickly identified by touch. The switchboard record of the extension users is in Braille.

Training and Service

The telephonist at a Government P.B.X. is often the first contact a member of the public has with the department she serves. Much depends, therefore, on the manner in which she deals with callers and the Post Office is responsible for ensuring that she does this courteously, effectively and quickly.

Blind operator at a modified single position Government department P.B.X.



A large P.B.X. serving Government departments, showing four enquiry positions on the left

The new recruit for the Post Office-controlled P.B.X. spends two weeks in the school and two weeks in training on live traffic; during this time such training is given, a high quality tape recorder being used to correct speech faults. Enunciation must be clear and without marked accent or affectation, and it is constantly impressed on the trainee that a caller must find a well modulated and pleasantly business-like voice at the P.B.X.; a willingness—if not an anxiety—must be implied that the caller will be given what he wants precisely and quickly.

The service given on calls incoming to the larger Government P.B.Xs is now regularly sampled at the centralized observation centres. The observers record details of the way in which the operators handle calls; they also give attention to the operators' phraseology, and to their tone, manner, helpfulness and intelligent understanding should a caller be vague or uncertain about his requirements.

These sample checks show that at present the operators answer calls in very good time and that operating faults are few. Even so, any weaknesses disclosed by these regular checks are discussed with operators at their periodical refresher training meetings. In the specialized field of Government P.B.Xs employing large numbers of staff there is room for the use of educational cinematograph films, but film strips with sound accompaniment would be less costly and it remains to be seen whether these would serve the purpose just as well.

Some of the Government P.B.Xs have as many as 1,000 to 2,000 extensions; one even has 3,000. It is of the utmost importance that information about departmental staff changes affecting extension numbers and duties should be available to the operating staff in the shortest possible time. At one large P.B.X. there is an average of 1,500 changes monthly.

Constant amendment of files at each operating position would be difficult. At the largest installation it is more convenient to record these changes at a directory enquiry position where a monitor can give the latest information to any of the P.B.X. operators who asks for it. The names and extension numbers of the Minister and his principal officers must be well known to all the operators; these particulars are always available at the operating positions.

At the largest P.B.Xs a directory may be specially printed, but others may have a rota-printed directory for which amendment sheets are issued periodically. Each department is responsible for the form and frequency of issue of its own directory and, as might be expected, these vary a good deal between one department and another. The question arises whether uniformity of presentation, production and currency based on advice given by the

P.B.X. training class listening to reproduction by tape recorder of their own voices

telephone administration would result in increased efficiency and possibly lower costs. The use already being made by the Post Office of the "Flexoprint" process for the London directories and for London Directory Enquiry information suggests that this same process might be looked at to see if it can be usefully extended to the not inconsiderable field of the larger Government P.B.Xs.

Shared Buildings

Many Government departments in London share buildings. There are, for example, eight buildings each shared by three different departments, two others are each shared by four, and one is shared by seven. The interesting point is that in each building the departments share one P.B.X. and one or two departments even share a common telephone number. An objection to this arrangement is that the operators have difficulty in getting a good knowledge of the organization and functions of each department and that they cannot identify themselves with any one of them. The service given at these P.B.Xs, judged by the time taken to answer and the number of operating faults, is, contrary to what might be expected, just as good as at a Government P.B.X. which serves only one department.

A Centralized Exchange?

Government, said Burke, is a contrivance of human wisdom to provide for human wants; and these human wants possibly account for the fact that Government departments are obliged to move in and out of buildings because of the increasing or diminishing requirements of new legislation, changes in Government policy and departmental organization. The expiry of building leases also plays a part in this movement. Most departments are served by private manual branch exchanges (P.M.B.Xs) which are interchangeable and adaptable to new surroundings and conditions, but a private automatic branch exchange (P.A.B.X.) is much less accommodating and if it were left behind when a department moved out of a building, the chances are that it would be unsuitable to the needs of the incoming departments. There is no thumb-rule solution to the problem of choosing an auto or a manual P.B.X.; it is just one of those things which has to be carefully considered when the installation is planned.

With accommodation at a premium in London, a Government department may be obliged to have a number of scattered units, each with its own P.B.X. and distinctive telephone number, in office space where it can be found. The suggestion could reasonably be made that a more efficient service would be given by having all these scattered offices served by one P.B.X., with external extensions. The advantages would be substantial for callers who would no longer have to decide which office to ring —and sometimes having got that office to find that it should have been another! Inter-departmental calls would also be made more easily because the assistance of only one operator would be required instead of two.

It has been held that the main disadvantages of a central P.B.X. would be increased cost, and that a

scheme of this kind can turn out to be inflexible or costly when rearrangements have to be made. To check the validity of these views a department with scattered offices fairly close to one another, each with a separate P.B.X., was studied. One study was made of a scheme for a central P.M.B.X. and another of a parent P.A.B.X. with two satellite P.A.B.Xs at other addresses, all sharing a centralized auto-manual switchboard.

The P.M.B.X. study showed that the annual rental would increase at each of five office buildings ... charge borne by the renting department—and that the work necessary to centralize the P.M.B.X. would involve the Post Office in a fairly big initial capital expenditure. This scheme had nothing to recommend it.

The P.A.B.X. scheme, on the other hand, gave a much higher estimated capital expenditure for the Post Office but a substantial annual saving in rental and accommodation costs to the department using it. In the long run it was shown that the P.A.B.X. scheme would result ultimately in saving public money, but it was not overlooked that the movement liability of a Government department might affect this saving, which could be fully realized only if the central P.A.B.X. were installed in a building with long term security of tenure. Any movement of the central P.A.B.X. might result in costly rearrangements and complete replanning of all the external extensions.

The Automatic Unit

An automatic unit adds much to the efficiency of the telephone service in a Government office; it offers a 24-hour service and eliminates delays caused by operator switching and disconnecting. Fewer operating staff and manual positions are required and the demands on valuable office space are less. Within technical limits direct dialling can be given over extensions to other buildings of the same or another department. The auto unit raised to its highest peak of efficiency and usefulness is to be seen in one big block of Government offices in London—a Government-owned building—where there is a non-director unit with inter-dialling over external extensions which link 25 different offices and departments in other buildings.

When there is security of tenure the installation of a P.A.B.X. No. 3 can at least be considered. This unit has a cord switchboard and capacity of 50 to 200 extensions. The cost of the apparatus for a Government department is met from Post Office capital and the user is charged a rental for the apparatus, in addition to the normal rental for exchange lines and extensions.

In general, the comparative costs of P.M.B.X. and P.A.B.X. working favour automatic working when a high proportion of the total traffic can be completed automatically, and a substantial saving can therefore be effected in positions and staff. The conditions vary so much between one P.M.B.X. and another, however, that each must be examined on its merits if automatic working is proposed. It would be true to say that very few of the smaller P.M.B.Xs, if they were replaced by P.A.B.Xs, would offer financial saving. But whatever the size of the P.M.B.X. it might be desirable to allow some limit of excess costs—as shown by the financial study—to secure the manifold advantages of automatic working.

Among other things the study group urged the extension to all Government P.B.Xs of the "Good Morning" salutation; the attendance of P.B.X. operators at lectures on organization given by Government departments to newly recruited staff; the conversion of long private wires from generator to automatic signalling; the design of a standard telephone unit for ministers and senior officials; and the use of a telephone lecture brief—prepared by the Post Office—for use in training clerical and executive staff in Government departments.

The vision, purpose and method brought to bear on problems today will fashion the service of tomorrow. The many and enlarging fields of Post Office responsibility are constantly creating new problems, and these fields must be regularly surveyed if we are to face tomorrow with confidence and assurance. The survey, just completed, of the hotels' and Government departments' P.B.X. service in London, fits philosophy to action.

Loading Cables.—Mullard Ltd., have developed a process for loading small telephone cables which enables the reduction of the space occupied by the loading coils, which are inserted at intervals along the line to maintain quality of transmission. The process depends on the use of coils cast in resin so designed that they can fit in the same size sleeve as that used when two ends of telephone cable are spliced to form a simple join. It is claimed, for example, that with the aid of these resin coils, one of these special joints (in which loading coils are used) can be made in a conventional 14-pair cable so that it occupies a space only 19 inches long by three in diameter.

Timber Buildings for Unattended Automatic Exchanges

G. J. Alston, A.M.I.E.E., Shrewsbury Telephone Area

MOST OF US ARE FAMILIAR WITH SECTIONAL timber buildings which are erected as garages, sheds, hen houses and so on. Most people think of them as cheap constructions which any amateur can assemble, and as having no architectural value; they are not thought of as suitable for the work of a Government department.

Nevertheless, the Post Office realized a few years ago that if sectional timber buildings could be adapted to meet the needs of the telephone service, particularly for unattended automatic exchange equipment, they would help provide telephone service in rural areas more quickly and at less cost than by using normal brick buildings. The essential requirements were that the construction should be suitable for the equipment, and for access and work by the maintenance engineers; that it should be acceptable to planning authorities; and that, architecturally, it should not be a discredit to the Post Office.

In 1953 the Post Office architects designed such a building and produced a prototype. This was accepted and introduced, and enough sectional timber U.A.X. buildings are now being mass-produced to meet the needs of the telephone areas.

The buildings have been produced in three sizes:—

	Internal dimensions
Type A	14′ 11¼″ × 7′ 11½″
Type B	19′ 11¼″ × 11′ 5¼″
Type B1	22′ 5¼″ × 14′ 5¼″

These are now generally provided instead of the three corresponding types of brick buildings, which are a common feature of the country-side (Fig. a).

Essentially, the structure is made of wall sections which are bolted together, the whole being locked with wooden roof trusses. Wooden purlins are used to support the roof, which is protected with bitumen proofed felt and covered with corrugated asbestos sheets. The building is erected on the usual concrete base and bolted in position with rag bolts set in the concrete (see Fig. b). The outside timber boarding is 3-inch tongued and grooved Meranti (a Malayan hardwood) nailed over a framework of 3-inch by 2-inch studding. In between, Sisalcraft (paper-backed bituminous treated Sisal) is inserted (see Fig. c). The wood is very hard and of a rich brown colour which, when treated with raw linseed oil, the only finish permitted, is quite attractive and thoroughly weather-proof.

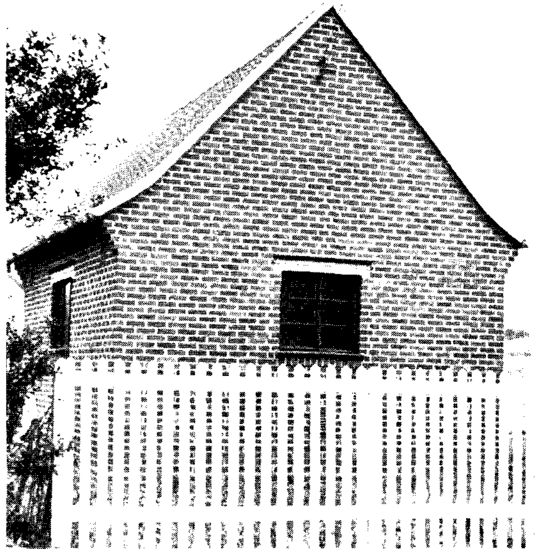


Fig. a: Typical standard B1 brick type building (Hanwood U.A.X., Shropshire)

After the building has been erected, the inside is lined with plaster board which is insulated with metal foil backing. A false ceiling is introduced at 9 feet 3 inches with an angular coved section, also of plaster board. All joints are covered with paper-faced cotton tape and the whole of the inside is painted in a light attractive colour. Fig. d shows the false ceiling and walls in a B1 building, containing a Unit Automatic Exchange No. 13.

There are windows at each end. The rest of the fittings—for example, the cable trench, lead in, gutters and so on—are almost identical with those of the standard brick building.

Timber buildings are normally erected with the door facing the road instead of at the rear, the door opening inwards and not outwards, as in brick buildings.

A petrol engine charging set cannot be installed in a timber building. Where there is no suitable mains supply a separate standard engine house must be built at the rear of the timber building; for this ...rpose the building is turned round with the en...ance at the rear to ease the maintenance officer's ...ovement between the buildings.

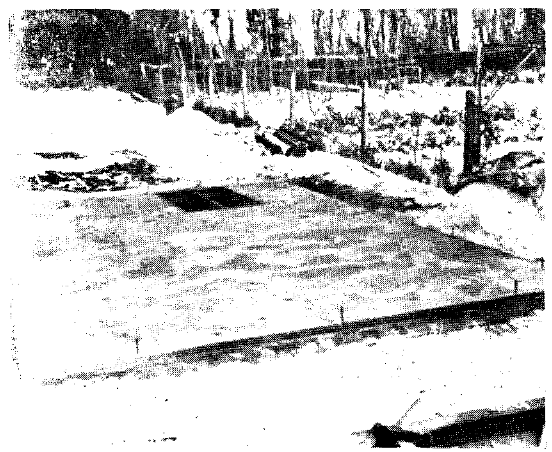
The overall effect of the building gives the ...pression of a substantial structure (for a sectional ...ilding), only slightly marred, in the opinion of ...me people, by the asbestos cement corrugated ...ofing. Fig. e shows a complete building. The ...pearance of the roof is improved by painting it a ...sset brown colour. Before it was decided to use ...sset as a standard colour where required, experi...ents had been tried with terra cotta, mid-leaf ...een and grass green, which were favourably ...ceived.

The floor surface is smooth finished granolithic ...ncrete, warmly coloured by adding a buff colour...g liquid when the concrete is being mixed.

There is little doubt that the use of timber build...gs for U.A.Xs has greatly eased the problem of ...oviding buildings in rural areas. It is often diffi...lt to get builders to submit tenders for brick ...ldings in remote districts. Even those tenders ...ich are submitted frequently quote exorbitant ...ices, and often only one firm submits a tender. ...ices in excess of £1,000 for a B1 building, with ...le site work, are not unknown. To my knowledge, ...one place only one tender was submitted and this ...s for £1,400!

These timber buildings can be erected with less ...lled labour in little over half the time usually ...en for a standard brick building. Typical costs ... the Shrewsbury Telephone Area are: B type ...00; B1 type £540, compared with £700 and £800 ... comparable brick buildings. Further, of still greater advantage is the fact that it is quite practicable to erect these buildings with Post Office labour. Most telephone areas have a Joint Box Building Party, who are well equipped and experienced for foundation and site working.

...g. b: Concrete base of a B type building showing cable ...ench and rag bolts for bolting timber sections to the base



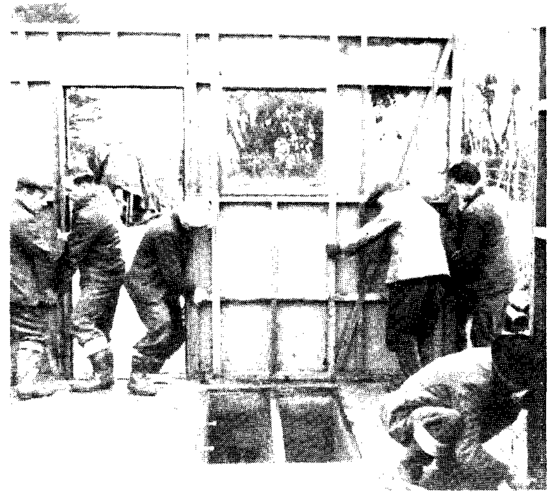


Fig. c: Front end section (old type) B building being lifted into position

The first timber building in the country was erected at Harewood End, Herefordshire, by a Post Office engineering party. Since then, several exchanges have been built by Post Office staff where it was impossible to obtain tenders from builders. The average time allowed for the normal site work, erecting and painting is 800 man-hours.

This ability to erect its own buildings has enabled the Post Office to achieve a degree of independence and has certainly been responsible for saving thousands of pounds in building costs. Another feature not to be overlooked is that U.A.Xs are frequently required at very short notice because of unforeseen contingencies—for example, the resignation of a caretaker operator at a small manual exchange. The quicker the replacement exchange is brought into service the greater the saving to the Post Office, since temporary services will then be needed to a less extent. Sectional timber buildings have certainly helped in this respect.

To simplify cartage, the two ends of the earlier buildings were made of two portions, each joined horizontally, a rectangular portion and a triangular gable end portion. The result was a joint in the wood sections, leaving an unsightly line at gutter level across the two ends of the building. As the shades of colour in the timbers vary slightly the two

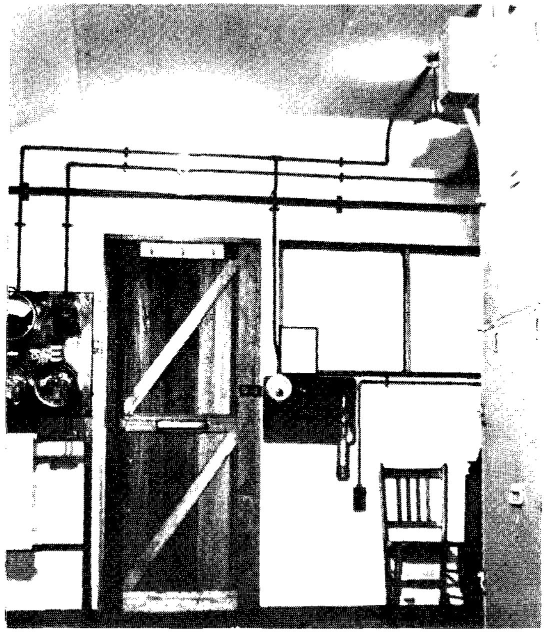


Fig. d : Inside of a B1 timber building showing entrance, power charging panel and units

sections may differ and this detracts from the appearance of the building. This has been overcome in the more recent buildings by having the sections split vertically, the joints being completely concealed by the tongue and groove end pieces fully interlocking.

One of the constructional difficulties encountered was the very limited space available between the wind brace (wooden supporting member for the roof) and the C units in the B1 type building. This was improved by moving the cable trench towards the centre of the floor by approximately three inches. Several other minor "snags" were met in the first few buildings erected but all have been now satisfactorily overcome.

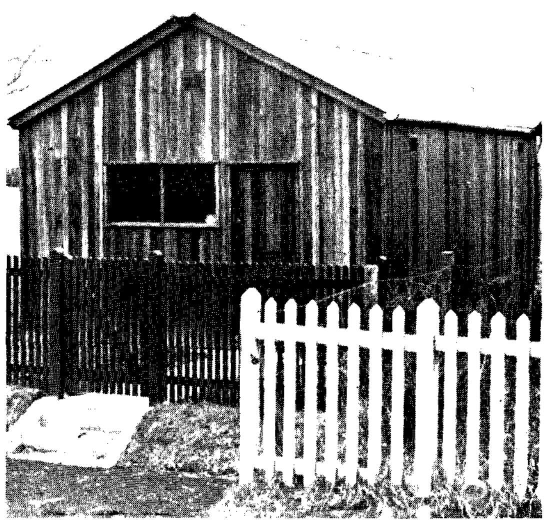
The extent to which these buildings are used can be judged by the fact that the forecast of requirements for the last nine months of 1954-1955 was: 6 A type, 13 B type and 182 B1 type. A fair number of these, 22 in all, are being used in the Shrewsbury Telephone Area, which has 195 exchanges altogether in the size range suitable for these buildings. Very few planning objections have been received, and these have largely been initial doubts and queries.

The forecast future demands for the country for the three types are roughly 150 a year. From experience gained the economies achieved on individual buildings, if indicative of the national trend, will result in a considerable cumulative saving to the Post Office.

Not the least important feature of this type of construction is the resultant working conditions. The staff of Shrewsbury Area are unanimous in their praise of these buildings, which are undoubtedly far more comfortable for installation and maintenance work than their brick counterparts. The cavity walls, with the plaster board lining and false ceiling, definitely help towards increased light and warmth. The largest type (B1 building) heats more quickly than the brick B1 type from the standard small source of heating, that is, two bowl-type electric fires of 750 watts each. This is of particular importance to maintenance staff who may be employed in the building only for a short period. The light painted ceiling and walls also render working conditions far more attractive.

There is little doubt that timber buildings for U.A.Xs have brought several distinct advantages to the Post Office. It seems likely that Planning Authorities who have hitherto objected to these buildings may change their views when they have been able to see them actually erected elsewhere. Though U.A.X buildings in brick and other special materials will still have their place it is probable that the majority of buildings for the smaller exchanges will in future be in timber.

Fig. e : Outside view of a B1 building



The Teleprinter

- How it Works

D. J. A. Howard.

Engineering Branch. North West Region

SEVERAL ARTICLES HAVE APPEARED IN THE *Telecommunications Journal* describing features of the public and private telegraph networks in this country. The setting up of these complex communications networks has been made practicable only by the development of a reliable and easily operated direct printing telegraph machine, the teleprinter, on which telegraph signals can be transmitted by using a keyboard much like a typewriter keyboard, while received signals can be automatically decoded and the message printed in clear type, either in page form or on a continuous narrow paper tape. The training required by operators is thus reduced to accurate "touch typing" at a speed of about 60 words a minute and a thorough knowledge of the operating procedure adopted by the network on which he or (usually) she is employed.

Signalling Principles

Before describing how the teleprinter works, it is necessary to explain the principles of the telegraph signalling system it employs.

A receiving teleprinter is kept continually informed by electrical means that one of two conditions, termed mark and space, exists at the transmitting instrument. There are several ways of achieving this. The presence or absence of a current in the circuit is the simplest way, but for technical reasons the method in general use in the Post Office today is the "double current system". In the simplest form of this system, a single wire connects transmitter and receiver and the conducting path through the earth is used to complete the circuit between the two. A source of current at the transmitting end is controlled so that the current flows outwards to the receiver along the wire to indicate space and in the reverse direction to indicate mark. The current-detecting element of the receiver is polarized; that is to say, it takes up one of two positions, depending on the direction of flow of the current.

Fig. 1 shows the arrangement of such a circuit. It is usual to provide a second wire between the two teleprinters, to form a second signalling path, so that two-way communication can be established.

Codes

A telegraph code is built up by variations in the duration and grouping of these mark and space signals. One example of this is the well-known Morse code. Another example is the 5-unit code in which each character is represented by a different arrangement of five equal length mark or space signals: for example, E — space, mark, mark, mark, mark and Y — space, mark, space, mark, space.

The teleprinter employs the 5-unit code, each unit being of 20 milliseconds duration (a millisecond is one thousandth part of a second) but, in addition, the signals corresponding to each character are preceded by a "start" signal (20 milliseconds of "space") and followed by a "stop" signal (30 milliseconds of "mark"); the functions of these signals are described in the next section.

The 5-unit code provides for 32 different combinations of space and mark signals. This is insufficient for the necessary range of characters, that is, the complete alphabet, numerals, punctuation signs and symbols such as £ and ",, so a "shift" facility is introduced, controlled by the depression of the "letters" and "figures" keys; this

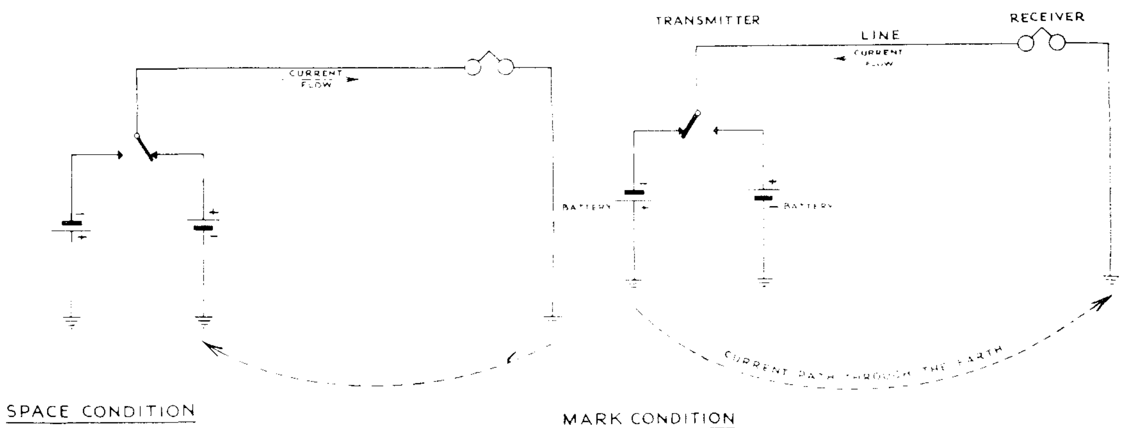


Fig. 1 : Double current system

doubles the number of characters available. Most keys on the keyboard represent two characters, and the receiving mechanism is arranged so that following the reception of the "letters" combination the primary characters (letters) are printed, and following the "figures" combination the secondary characters (figures, punctuation and other signs) are printed.

Start-Stop Principle

The receiving teleprinter has to identify and decode the signals received from the transmitting teleprinter, and must therefore perform a succession of operations in a definite time sequence in close unison with the transmitter. To this end the driving motors are controlled by a sensitive governor to within plus or minus $\frac{1}{2}$ per cent. of a standard speed. Even so, the effect of any difference in speed within these limits between the sending and receiving machines would be cumulative, and the sending and receiving mechanisms would tend to get "out of step".

To avoid these difficulties, both mechanisms are arranged so that they are at rest when no transmission is taking place although their driving motors continue to run. The depression of any key on the keyboard couples the transmitting mechanism to its motor by means of a clutch, and a "start" signal (20 milliseconds of space) is sent automatically, causing the coupling of the receiving mechanism to its own motor in a similar manner. The five code signals appropriate to the particular key follow in sequence and on completion of these the transmitter sends a "stop" signal (30 milliseconds of mark) to indicate that the transmission is completed. The clutches in both machines are disengaged and both mechanisms come to rest again. The term "Start-Stop Telegraphy" is derived from this method of working.

Keyboard

Fig. 2 shows the lay-out of a typical teleprinter keyboard and the 5-unit code allotted to each key.

It will be seen that there are only 31 keys; the code combination of five space elements is not used because this condition is given by a type of circuit fault. The arrangement of the alphabetical characters is the same as on the commercial typewriter, but only capital letters are provided as there are not enough 5-unit combinations to provide both capital and small letters as well as the numerals, punctuation and other signs that are required. There are figure and letter shift keys and a space bar in approximately the same position as on the typewriter; in addition, there are two keys at the extreme right of the board which are used to return the carriage and feed up fresh paper at the distant machine when the end of a line is reached, or at other times as required. These are termed functional keys.

There are two other functions, allotted to secondary positions of the letters D and J. The secondary position of D, labelled "Who are you" on the keyboard, trips a unit associated with the keyboard of the receiving machine and causes it to return a sequence of characters called the "Answer back", which (i) assures the sending operator that the circuit and distant teleprinter are in working order, and (ii) confirms to her that a connection has been established with the office required. The J secon-

ry signal causes a bell to ring continuously in the ceiving office until some signal is sent from that ffice; it is used as a warning that the attention of an perator is required at the receiving teleprinter.

As the transmitting mechanism takes 150 milliconds to encode and send out the signals for a lected key, the keyboard unit retains each selecn until after the appropriate code combination s been sent even if the operator releases the key fore this period has elapsed. At the same time the maining keys are locked to prevent their being pressed too soon and so interfering with the ansmission.

In addition to providing these guards against s-operation, the keyboard unit encodes the lected character by a purely mechanical operan. Five combination bars, each representing one ement of the 5-unit code, are arranged transrsely behind the keyboard. A horizontal extension a depressed keybar is brought down across the mbination bars and by interaction between this d projections provided on the upper edges of the mbination bars, the latter are displaced longdinally according to the space and mark signals the code appropriate to the key.

ransmitting from a Teleprinter

When a key is depressed the clutch of the transtting unit is caused to engage and this drives the ansmitting cam, which is a cylindrical sleeve in hich a series of grooves is cut. A lever rides in each oove and the grooves are so shaped that each lever turn, in an accurate time sequence, is allowed to ntrol the operation of the transmitter. After one revolution, occupying 150 milliseconds, the clutch is automatically disengaged and the cam-sleeve is arrested even if the key is held down by the operator.

The first operation performed by the cam-following levers is to transfer the tongue, or movable contact arm of the transmitting switch, from the mark contact on which it is resting to the opposite or space contact while the combination bars are being set in the keyboard unit. This sends the start signal to line.

As the cam-sleeve continues its rotation, control of the tongue is passed in turn to five code selecting levers, each of which either maintains or reverses the position of the tongue according to the position of the associated combination bar. The five code elements are thus sent out in turn and on completion of these the tongue is restored to the mark contact to send the stop signal.

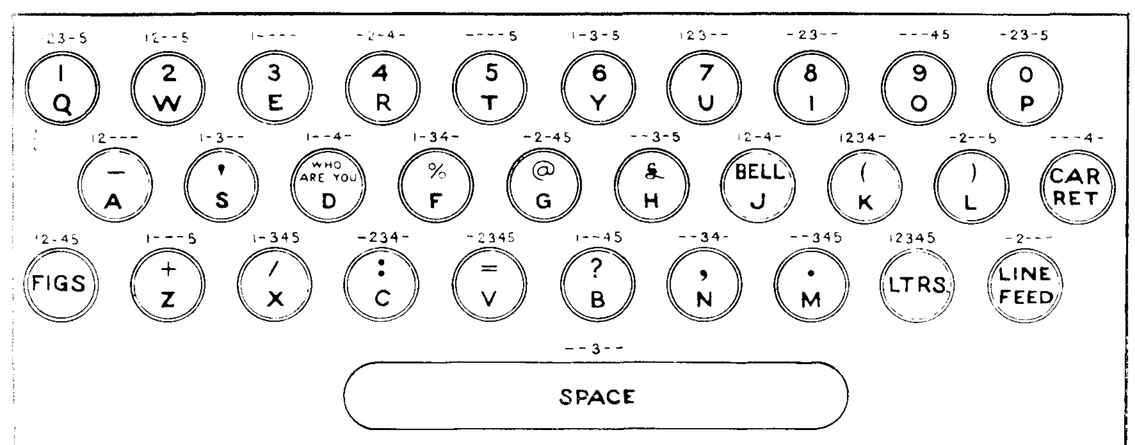
The final operation of the cam-sleeve before coming to rest is to restore the displaced combination bars ready for the next selection.

Receiving by Teleprinter

Line current signals operate a receiving electromagnet, and depending whether they are mark or space actuate a pivoted armature (the moving part of an electromagnet) to the left or right against a stop. This mechanical movement is used to control the starting and stopping of the receiver, and to identify the five code elements of the received signal preparatory to the decoding and printing operations.

On receiving a start signal the electromagnet armature moves to the space side and through a

Fig. 2 : Lay-out of a typical teleprinter keyboard



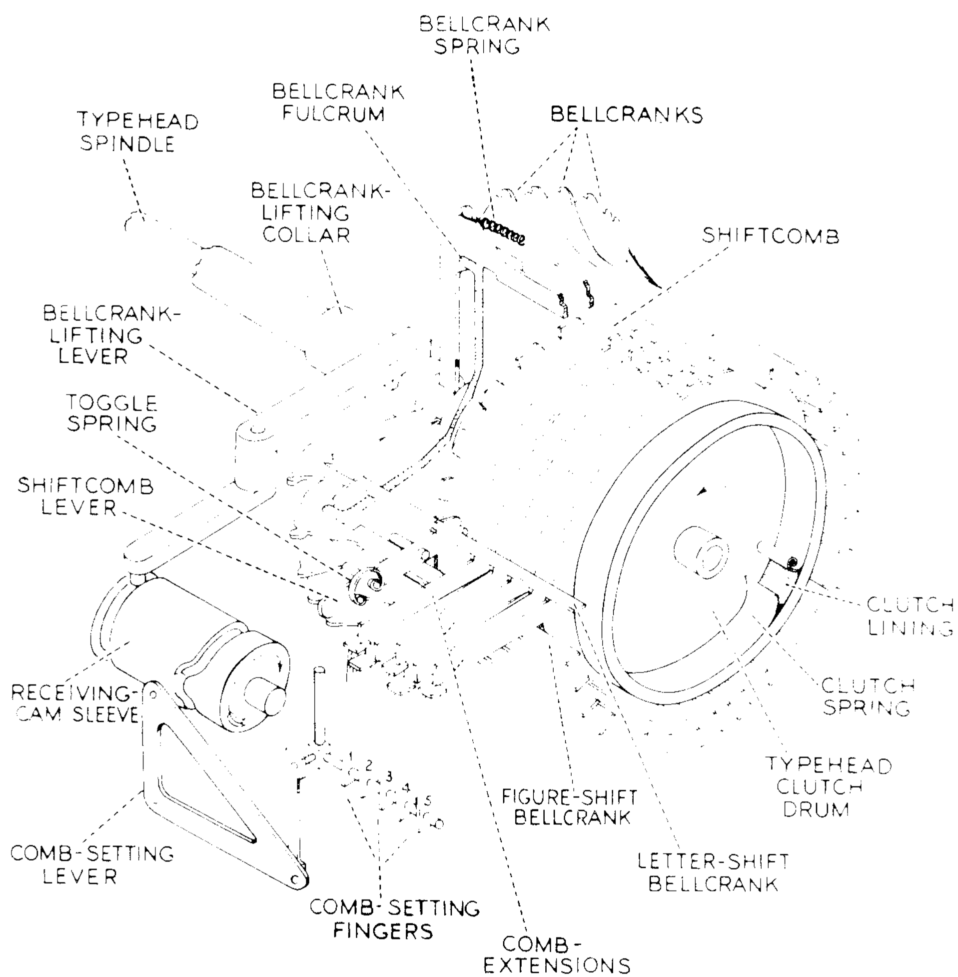
system of links engages a clutch to lock the receiving cam-sleeve (a cylinder carrying five cam tracks) to its continuously rotating driving shaft. Once engaged, the clutch is not withdrawn unless a mark signal is present at the completion of a revolution.

After the cam-sleeve is set in motion the next action is to store in the machine an indication of whether each of the succeeding five code elements is mark or space.

This information is retained on the comb-setting fingers, which are five small levers in parallel vertical slots in the face of a metal block. Each finger is pivoted at its lower end and can be driven deeper into its slot if required. The fingers are retained in position in their slots by friction, flat springs pressing them to one side. Rotation of the cam-sleeve causes a small punch, the finger setting pin, to be traversed across the face of the block at such a speed that the pin is opposite No. 1 finger as the first code element is received and so on. Another track on the cam-sleeve causes the edge of a flexible blade to strike at the rear of the pin as it comes opposite each of the fingers. This blade is carried in guides extending from a shaft which may be rotated a few degrees by the movement of the electromagnet armature and consequently takes up positions corresponding to mark and space.

When in the space position the blade as it strikes

Fig. 3 : The combination head



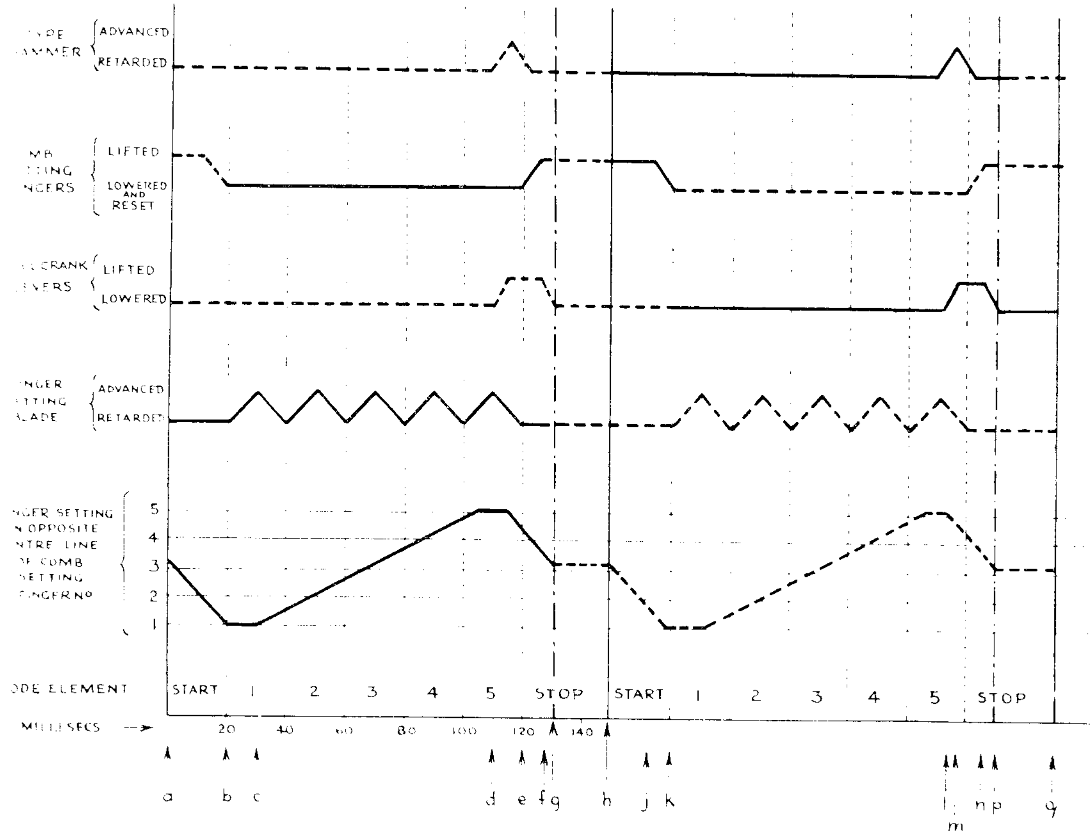


Fig. 4 : This shows in diagrammatic form the time relationship of the various actions of receiving mechanism

a–b	Start signal received, cam-sleeve set in motion
c–d	Five code elements received and stored on comb setting fingers
e–f	Lifted comb setting fingers transfer code to combs
g	Cam-sleeve halted at end of revolution
g–h	Cam-sleeve at rest
h	New start signal sets cam-sleeve in motion once more
j–k	Comb setting fingers lowered and aligned for next code storage
l	Type hammer prints
m–n	Bell cranks lifted, typehead released and combs restored
p	Cam-sleeve halted at end of revolution
q	End of stop signal

Sequence c–f for new code incoming superimposed on this action

deflected below the pin; in the mark position it hits the pin and drives the finger home into its slot. The code elements are thus stored on the upper ends of the comb-setting fingers, mark elements being represented by fingers displaced from the normal position.

The stored code is next transferred to the decoding and printing mechanism (the combination head unit) by driving the five fingers upwards under the control of yet another cam track and follower.

In the combination head (Fig. 3) five discs or combs are arranged side by side on a hub and are free to be rotated individually a short distance against spring tension. Projecting from the edge of each disc is a lever extending over the position occupied by the corresponding comb-setting finger when the finger is displaced, so that when the fingers are raised combs associated with mark storing fingers are rotated slightly.

Slots of irregular length are cut round the edge of each comb, so proportioned that for any given combination of the five mark and space positions there is only one point at which an unobstructed path exists through the slots across their edges; each of the 32 mark-space combinations of the 5-unit code opens this path at a different point on the circumference of the combs. A sixth comb under the control of the "shift" signals has evenly spaced slots and closes half the width of this unobstructed path; the portion closed is dependent on the shift last selected.

Sixty-two bell-cranks or L shaped levers are pivoted at their angles on the rim of a disc secured to the hub of the combination head. They are arranged round the comb assembly, each with one limb terminating in a sliding collar at the centre of the disc, the other limb extending across the edges of the six combs on to which it is pressed by a tension spring. The open path across the code combs is wide enough to allow two adjacent bell-cranks representing primary and secondary characters to drop into it under this pressure, but only one falls as the other is prevented by the shift comb. The fall of the bell-crank retains the combs in position during the subsequent withdrawal of the comb-setting fingers.

Passing through the axis of the combination head is a continuously rotating shaft which by a friction clutch drives a rotary type-head having type positions corresponding to each bell-crank. The projecting end of a dropped bell-crank enters the path of the type-head and arrests its motion to bring the appropriate type into the printing position. The letter is not, however, printed at this stage. As a result of the sudden stoppage the inertia of the clutch parts drives forward a latch which engages with the rear face of the bell-crank and locks the type-head in position, preventing rebound; at the same time the clutch spring tension is reduced to minimize wear on the mechanism.

Functional Codes

When a functional code (for example, "carriage return" or "line feed") is received the fall of the bell-crank performs or initiates the required operation in the teleprinter; the type-head carries no type in the corresponding position except that the "Who are you" position may have a Maltese cross symbol to record for future reference that the signal has been received.

Figure and Letter Shift

The figure and letter shift bell-cranks are arranged in adjacent positions on the combination head with a pivoted lever between them. This lever is held in one of two alternative positions by means of a toggle action spring, similar to the snap-action spring of an electric light switch. When a change of shift is signalled the falling bell-crank strikes a sloping shoulder on the lever and pushes it over to the opposite position. This movement alters the position of the shift comb, as there is a stud on the shift comb in a slot at the inner end of the lever. It follows that once the lever and shift comb have been set they will remain so during subsequent printing until the opposite shift signal is received.

Answer Back

The answer back bell-crank has a lever resting on its extremity by which its movement is transferred to the answer back unit. Here the motion withdraws a stop which normally holds a shaft at rest against the drive of a friction clutch. The shaft carries a drum which, while rotating, presents to the transmitting unit, in turn, a series of wards on its periphery. One character of the answer back message is sent out for each ward, the character being determined by the 5-unit code recorded, as a series of slots and projections on its outer edge.

Paper Feed

The carriage return and line feed functions of a page printing machine require more power to operate than can be provided directly by the bell-crank followers, whose movement is in consequence used only to control the engagement of actuating levers with a reciprocating cross-head driven by one of the receiving cam followers.

After each character is printed, the paper must be fed forward ready for the next. This operation also is performed by the receiving cam through a system of links. To prevent certain functional codes causing unnecessary spaces in the printed message their bell-cranks are provided with following levers similar to those of the answer back, which when operated disengage the feed mechanism. In passing it should be mentioned that the receiver is arranged to accept and decode the "All space" combination but the dropped bell-crank disengages the paper feed and selects a blank position on the type-head.

Deferred Printing

It is an interesting characteristic of the teleprinter that a received code is stored in the machine but not printed until the next is being accepted; then, the receiving cam-sleeve, once more in motion, advances a hammer to drive forward the previously selected type and interposes an inked ribbon between it and the paper. Immediately after this the bell-cranks are lifted clear of the combs by the sliding collar which engages their inner ends. This clears the combination head in readiness for

the transfer of the code now being received, and also releases the type-head which rotates until stopped for the printing of the next character.

Fig. 4 shows in diagrammatic form the time relationship of the various actions of the receiving mechanism while two consecutive characters are being received. It will be noticed that the cam-sleeve completes a revolution and is brought to rest in 130 milliseconds. This ensures that the receiving mechanism finishes its cycle of operations before the start element of the next code is received, even if this should arrive early—for example, if the transmitter were running slightly fast. The fact that the receiving cycle lasts for only 130 milliseconds allows signals to be accepted from those continental offices which send a stop signal of one unit duration, giving a character length of 140 milliseconds only.

The teleprinter originally standardized by the British Post Office in 1928 for use on the inland public telegraph service was the model No. 3, a tape printing machine. A page printing model, No. 7, was subsequently introduced in 1932 for the Private Wire and Telex service. In the light of experience gained during the following years model No. 3 has now been superseded by model No. 11, of improved performance and facilities; concurrent with the introduction of the teleprinter automatic switching scheme, the first of the new type was brought into service in October, 1950.

The Ship-Shore Radio Services

Ships' Distress Signals.—During 1954 the 13 Post Office wireless coast stations dealt with 253 distress calls and 429 Medical Messages.

Post Office Wireless Operator Praised.—A letter of thanks and appreciation has been received by the officer-in-charge of the Post Office Coast Radio Station at North Foreland, following an incident in which an operator there showed initiative and helpfulness when a ship needed advice, gives an example of the medical advice service.

When the Captain of the South Eastern Gas Board's M V *Mitcham* became seriously ill when the ship was in the lower reaches of the Thames, the Chief Officer made a radiotelephone call to the owners for instructions. The Post Office wireless operator who handled the call at North Foreland Radio was quick to point out that he could obtain free medical advice if this would help, and it was agreed that he should connect the Chief Officer of the *Mitcham* with the Port Medical Authorities at Gravesend.

After hearing the symptoms, Gravesend suggested that the ship should make contact by lamp with Lloyds Signal Station where a doctor was always available. Still keep a watching brief, the operator at North Foreland stood by and finally connected the *Mitcham* to the Signal Station by radiotelephone after they had been unable to establish contact by lamp because of adverse weather conditions. As a result a doctor from the Signal Station was taken to the *Mitcham* by Southend Lifeboat.

An "S.O.S." call sent out by ships navigating in the seas round the British Isles invariably finds its first shore contact at one of the Post Office wireless coast stations. They all maintain continuous watch for distress calls from ships at sea. On receiving an "S.O.S." call the station immediately ceases all commercial transmitting to establish communication with the calling ship. The nature of her distress and the assistance needed is passed at once to the appropriate authorities.

★ ★ ★

Tribute to Gallantry.—Following the loss at sea of Donald Macneil, radio operator on the *Tresillian*, two Post Office radio operators at Wick Station wrote:—

"We, the undersigned radio operators on duty at this station during the period 0520 to 0639 G.M.T. on November 30, when the ill-fated s.s. *Tresillian* was in distress, would very much appreciate it if the following could be recorded and conveyed to the relatives of this brave young officer.

"Throughout the period we listened with ever-increasing anxiety—as the situation worsened—to the radio signals between the *Tresillian* and the ships racing to her assistance.

"It was with the highest admiration that we listened to the excellent and unparalleled standard of operating in circumstances of dire mental and physical distress, and to the unfailing courtesy exercised by the Radio Officer even to the last signal.

"It was with the deepest regret that we realized that the *Tresillian* had ceased radio communication, but our hearts were consoled at the extreme courage of this very gallant Radio Officer, who had upheld the tradition of the British Mercantile Marine in the finest possible manner".

O. R. Owen, R.O. and A. Ogilvy, R.O.

TWO MIDLAND TELEPHONE AREAS

LEICESTER

The Quorn moving off   By courtesy of *Leicester Mercury*

The Leicester Area is about 1,300 square miles in extent and covers the County of Leicestershire and parts of eight surrounding counties. It is a pleasant and gently undulating country-side; in fact, hunting country. The famous Quorn, Pytchley, Belvoir, Cottesmore and Ferney hunts are still a regular feature of this east Midlands country-side.

The City of Leicester dates back to pre-Roman days being one of the five Danish Burhs and it was an important station in Roman times. The battlefields of Bosworth and Naseby are within the boundaries of the Area, and Cardinal Wolsey died in the old Abbey at Leicester. Ashby de la Zouch awakens memories of Ivanhoe and was the scene of the imprisonment of Mary, Queen of Scots. The ruins of Lady Jane Grey's home still stand in Bradgate Park in Leicester and there is also the incomparable Belvoir Castle, a majestic spectacle set on a hill which catches the imagination.

More recently, there is one of the oldest tunnels in the country, built by Stephenson, at Glenfield, and the second rail road in England from West Bridge to Swannington. The first railway excursion was from Leicester to Loughborough. Among the notable men born in the county were Robert Herrick, Lord Macaulay and Latimer, Bishop of Worcester.

The Area's industries and products are diverse, ranging from brewing to textiles and from heavy engineering to plastic toys and optical glass. Loughborough has literally sent its name ringing round the world by its famous bells and carillons. The county's granite is famous and everyone knows the association of Leicester with the hosiery trade. It may not be so well known that nearly all the boot and shoe machinery used in this country is made here and that most of the women's shoes manufactured in Britain are made in Leicester.

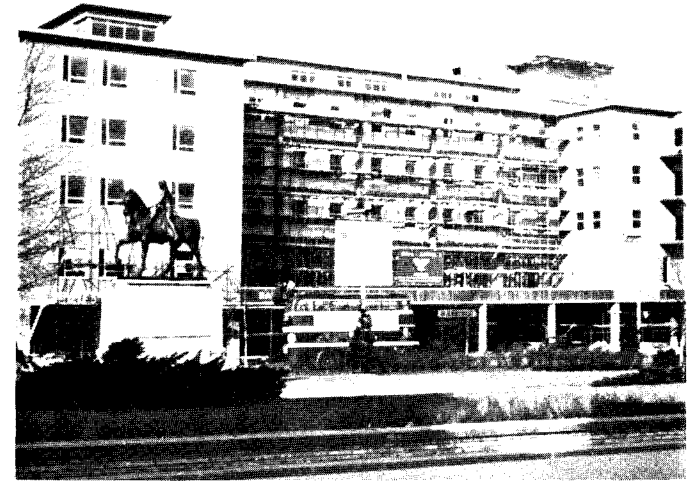
Leicester is served in the main by automatic exchanges of the Siemens No. 16 type opened in 1926. Burton-on-Trent is notable in the telephone world for its Bypath automatic system opened in April, 1932, which is to be replaced by standard equipment in a few years' time.

The Area contains 109 exchanges with 57,500 exchange connexions and 92,150 stations.

The total staff (excluding telephonists) is 1,100.

Left to Right: W. I. GERMAN, Senior Sales Superintendent; G. EVANS, Area Engineer; E. L. PERKINS, Telephone Manager; MISS V. WATTS, Secretary; H. FENNA, Chief Clerk; W. M. COULSELL, Chief Telecommunications Superintendent; J. H. FACER, Acting Area Engineer.

COVENTRY



Reconstruction in Coventry; Hotel Leofric (centre). The "Lady Godiva" statue is on the left

The Coventry Area covers about 1,100 square miles, mainly in Warwickshire and Northamptonshire. It includes the interesting towns of Northampton, which has one of the few remaining round churches in England; Warwick, recalling the days of medieval chivalry with the battlements and towers of Warwick Castle; Leamington with its 900 years old "Midland Oak" which reputedly marks the centre of England; Rugby with its famous public school founded in 1567 and, of Post Office interest, its high powered radio station; Nuneaton which takes its name from a 12th century Benedictine nunnery now in ruins; Stratford-on-Avon with its Shakespearean associations and Wellingborough in addition to the rapidly growing City of Coventry.

The scenery is attractive outside the main towns and surprisingly rural considering its proximity to the industrial concentration of the Midlands.

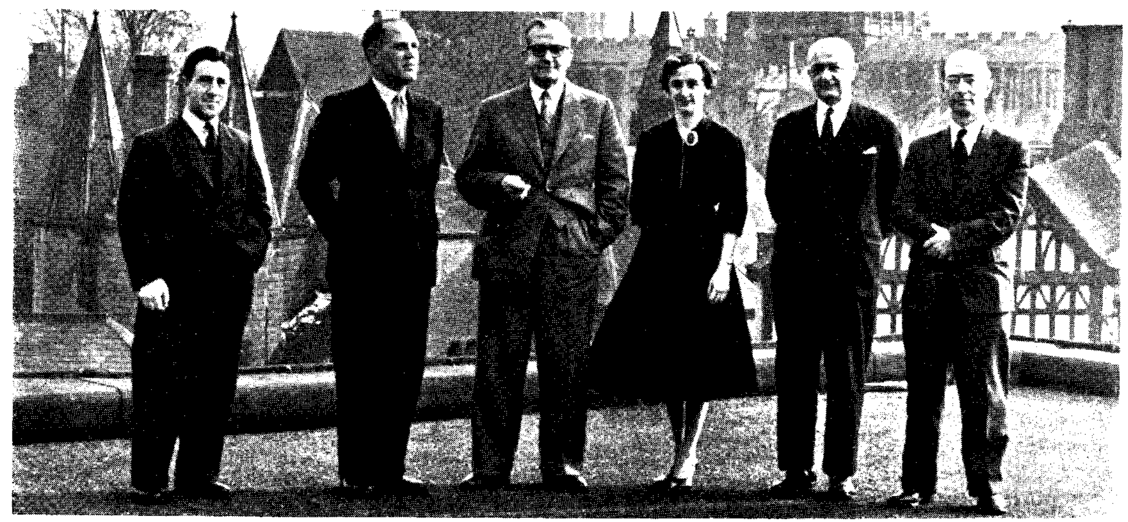
Coventry itself is probably best known because of the bombing it suffered during the second world war and the coining of the word "Coventration". Despite the destruction to its historic buildings, there still remain houses with projecting fronts which belong to the 15th and 16th century and two of the city gates. The town grew up around the magnificent Benedictine abbey founded by Leofric, Earl Mercia, in 1043; his wife was the "Lady Godiva" of the well-known legend.

Coventry is an interesting and versatile city. Throughout the ages it has changed its predominant industry to suit the most profitable market available at the time and has therefore for most of the time maintained a high degree of prosperity. In the middle ages the main industry was woollen textiles, but this changed to silk, then clocks and watches followed by cycles, motor cycles and cars.

The clock and cycle industries have almost disappeared now and motor cycle production is greatly reduced, but there is still a thriving textile industry and it is the headquarters and location of one of the country's largest manufacturer of rayon yarn. The main products are, however, motor cars, machine tools and aero engines. One of the large manufacturers of telephone equipment also has a factory in the city.

The Area contains 81 exchanges with approximately 45,000 exchange connexions and 79,000 stations.

The total staff (excluding telephonists) is 925 and the annual revenue is £1,600,000.



Left to Right: J. MURDOCH, Chief Clerk; S. PAYTON, Senior Telecommunications Superintendent; W. BEWICK, M.Eng., Telephone Manager; MISS A. J. O. MEAKIN, Secretary; A. J. SMITH, Senior Sales Superintendent; H. HOBBS, A.M.I.E.E., Area Engineer.

The new light-weight operating instrument showing the internal components

A New Telephone Operating Instrument

J. C. Rennison,

Inland Telecommunications Department

A NEW TELEPHONE OPERATING INSTRUMENT which weighs only 4½ ounces, compared with the 19 ounces of the standard instrument at present in use, is to be put on trial shortly at a number of exchanges. Readers may be interested in an account of the developments leading up to the new design.

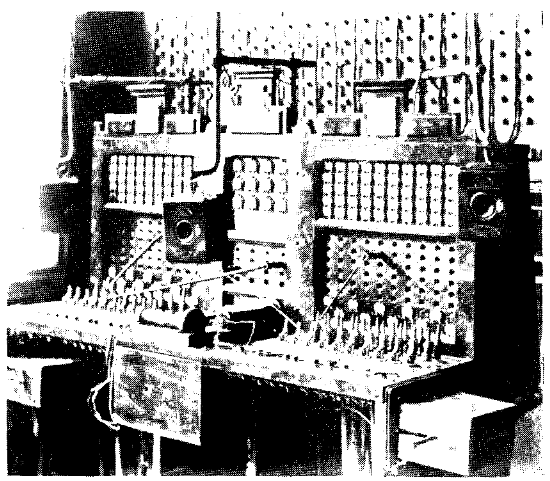
Historical

The first operating instruments consisted of a Bell receiver, which had to be held in the hand, and a Blake carbon microphone in a large wooden box which was fitted either on the switchboards, as illustrated in Fig. 1, or on the wall where the cordless type of switchboards were in use. This cumbersome arrangement was in general use for about ten years from 1879, when the first switchboard was opened in Coleman Street, London.

The first attempt to dissociate the operating instrument from the switchboard seems to have been made in America, where a Mr. Gilliland produced a harness for holding the Bell receiver and an Edison transmitter, which was very similar in size and shape to the Blake transmitter. The weight of this instrument, which was carried on the operator's shoulders, was 6½ lb.!

Before 1880, however, a much more convenient operating instrument, illustrated in Fig. 2, was

Fig. 1 : United Telephone Company's exchange at Middlesbrough in 1885, showing microphones fixed to switchboard and Bell receiver to be held in the hand



rought into service; this had a headband to carry he receiver and a breast-plate to support the trans-nitter. In 1900 the head-gear receiver and the reast-plate transmitter had already taken on a hape (see Fig. 3) similar to the one we know today.

Development of the New Instrument

Before the war Standard Telephones and Cables Ltd. had developed an instrument with both the nicrophone and receiver suspended from the head-and. The Post Office tried this, but the staff found uncomfortable to wear for long periods, as it was not well balanced, though its transmission and re-eption qualities were better than the standard nodel. During the war and in the immediate post-var period further development work on this pro-ect had to give way to more pressing commitments.

In the meantime, several foreign telephone ad-ninistrations had already developed a combined nstrument with both the microphone and receiver uspended from the head-band, and a fresh impetus o restart our own development work came when he telephone staff associations showed preference or a light-weight combined type of head-set. Standard Telephones and Cables Ltd. undertook he necessary development work for the Post Office nd preliminary trials were made in 1953 with a few and-made models similar to the one illustrated in Fig. 4.

It will be seen that with this model the micro-phone is remote from the mouth, the sound being onveyed by means of a horn at the side of the face to a microphone housed in the same container as the ear-piece. This is in marked contrast to all the foreign combined instruments which have the microphone mounted on a movable arm immediately in front of the mouth. Putting the microphone in the ear-piece enables a more comfortably balanced instrument to be designed.

Fig. 2 : First multiple type switchboard at Glasgow, 1880–1889, showing the operators wearing one of the earliest head-gear instruments used in the United Kingdom

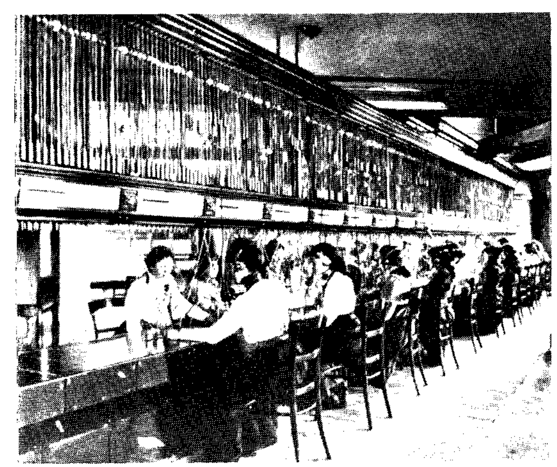


Fig. 3 : A typical telephonist about 1900 wearing a type of head-gear receiver and breast-plate transmitter very similar to the present standard operating instrument

The 1953 trials revealed that the general design was sufficiently promising to justify further production and about 1,000 instruments, some black and some ivory, are now being made for extensive field trials. Some modifications of detail are being incorporated in the production models. In particular a differently shaped horn has been designed to cater better for all shapes and sizes of heads.

Constructional Details

The ear-piece containing the receiver and microphone is made from nylon plastic and is very light and tough. The receiver employs a rocking armature principle of operation, the diaphragm being made from a very light non-magnetic alloy coupled at the centre to an armature which moves in sympathy with the received electric currents. The use of this more efficient principle and of improved magnetic materials results in the complete receiver being smaller and lighter than the present one.

The microphone insert is also very much smaller than the one used in the present standard instrument, the sound being conveyed by the transmitter horn to the microphone capsule. The head-band is a very light strip of plastic material which, besides adding to general comfort, minimises disturbance to hair styles, a matter of considerable importance to women. The head-band and the transmitter horn can be readily removed for cleaning when necessary.

As the new head-set is so light it was thought that plug No. 404 was too large and heavy and a new one, similar in shape but about one seventh the size, is being used for the trials. This will mean that if the new plug is found satisfactory it will be necessary to modify the instrument sockets of all telephone operating positions before the new instruments can be introduced generally.

The frequency responses of the microphone and the receiver are much more even over the voice frequency range than those of the present standard operating instruments.

Preliminary trials have shown that the light weight of the new instrument considerably reduces the strain on the operator and the fact that the transmitter horn is permanently held in the same position in relation to the operator's mouth ensures that transmission is not impaired when she moves her head as, for example, when referring to routing records.

Details of the weights of the new and present instruments are set out in the table below.

Present Instrument

	ozs.
Transmitter weighs	9¼
Receiver weighs	6¼
Plug weighs	3½
TOTAL weight	19

New Instrument

	ozs.
Receiver and Transmitter combined weigh about	4
Plug weighs	½
TOTAL weight about	4½

Fig. 4 : Telephonist wearing the new instrument

A number of overseas administrations, Australia and New Zealand in particular, have shown considerable interest in the new instrument and the manufacturers have already received some orders.

Death of Donald Macadie, M.B.E.—The inventor of the AvoMeter, Donald Macadie, M.B.E., who died recently, joined the National Telephone Company after a spell with the Edison-Bell Phonograph Company. On being transferred to the Post Office in 1911 he went to the Birmingham Factory and later to Holloway.

Among his inventions were a machine for binding telephone cords, apparatus for testing telephones, and a key sender for private branch exchanges which reduced the time for transmitting 7 digit outward calls from 10 seconds to 2½ seconds.

After his retirement in 1933 he spent a considerable part of his time with the Automatic Coil Winder & Electrical Equipment Co., Ltd.

★ ★ ★

Sh-h!—A Danish woman subscriber has been forbidden to laugh when telephoning; tests, made because her telephone frequently failed, have shown that her laugh automatically cuts out the line.

Radio Control of Mobile Faultsmen

W. H. Owens,
London Telecommunications Region

When any public system is provided, comprehensive arrangements to maintain the standard of service are essential. The telephone service is no exception to this rule and by the very nature of its intricate equipment it is much more difficult to maintain than such public utilities as the gas, water or electric light systems.

The switching equipment at the exchange can be maintained by a group of engineers specializing in this work, but the connection from the exchange to the subscriber's instrument presents a different problem, as it consists of three separate types of plant: the external cable, the overhead section of wire to the subscriber's house, and the wiring and instrument. In telephonically dense areas different groups of maintenance staff deal with each section, but in more scattered areas the same man may deal with more than one type of work.

On receiving a complaint from a subscriber, engineering testing staff at the exchange try to determine the type of fault which has to be handled and thus to send the appropriate man to deal with the trouble. This organization to distribute faults to the outside staff is known as Maintenance Control.

One function of the Maintenance Control staff is to distribute faults to the men is such a way as to keep the fault duration to a minimum, together with economy in travelling about the Telephone Area.

This scheme works well, but has certain drawbacks in rural areas. A man on a fault may want assistance or advice and be unable to get help over the circuit he is working on. He may be a long way from the next telephone and to leave the job will waste time and vehicle mileage, as well as give a bad impression to the subscriber.

Two-way short wave radio communication offers a solution to this problem and, as an experiment, its use by maintenance faultsmen has therefore been arranged by the Engineering Department. All the vehicles working to the Dartford (Kent) Maintenance Control in the London South East Telephone Manager's Area have been equipped with this facility.

The area controlled from Dartford comprises 11 exchange areas and contains about 10,600 exchange lines and 14,800 stations. The types of subscribers' equipment include both automatic and manual (C.B. and C.B.S.) with a concentration of lines in the two main towns of Dartford and Gravesend and the rest scattered over the hundred square miles of territory. The main transmitter and receiver are installed at Stonewood Repeater Station, which is at a greater height and more central than the exchange. Remote control of the equipment is available in the exchange test room three miles away.

The transmitter is rated at 6 watts output, is amplitude modulated and capable of transmitting on the frequency range 60 to 100 mc/s with crystal control of the selected frequency. The receiver is of the double super-heterodyne type with a very wide range of automatic volume control. The complete equipment is shown in Fig. 1.

The control unit in the test room is shown in Fig. 2. This comprises microphone and loud-speaker and facilities for switching the main equipment power supply on and off.

The 13 vehicles equipped to work in conjunction with this scheme comprise:

One two-ton general utility vehicle carrying a gang to deal with major overhead work.

One 30-cwt. vehicle carrying two men and equipment to deal with either an overhead or underground fault.

Four Morris Minors carrying overhead linemen working as individual units.

Four Morris Minors carrying subscribers' apparatus maintenance men.

Three one-ton vans carrying the Technician Class I and two underground cable maintenance units.

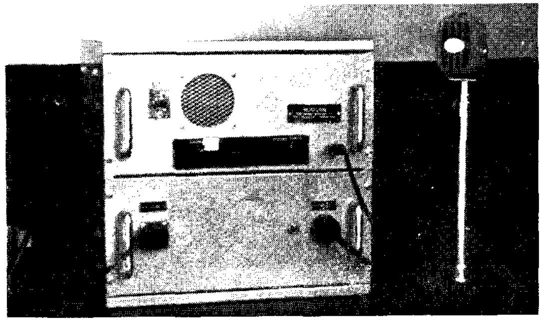


Fig. 1: Main transmitter and receiver

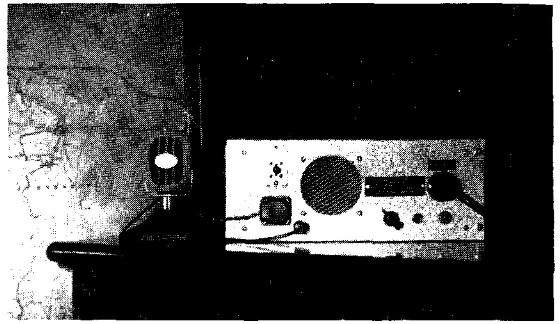


Fig. 2: Test room control unit

Each vehicle is equipped with a 5-watt transmitter-receiver powered by a small rotary converter run by the 12-volt car battery on new vehicles and by an auxiliary battery on the older vans. The set is normally kept working and is switched off only if the vehicle is going to be left for some time. All calls are received on the loudspeaker and the microphone is fitted in a handset: the general arrangement of a typical installation mounted under the vehicle dashboard is shown in Fig. 3.

The vehicle aerial is a short rod in a semi-flexible mounting and the metal body of the van acts as the earth connection of the set; a perforated zinc sheet is mounted inside the roof of the older wooden body type vehicles to act as a counterpoise earth. A view of a Morris Minor with aerial is given in Fig. 4. One frequency is used for the main station to all vehicles and another for communication in the reverse direction; thus, vehicles cannot talk to each other direct.

The introduction of radio communication between maintenance control and field staff has made it necessary to approach the whole question of organization from a new angle. To get the full advantage of the scheme it is necessary to know the relative positions of vehicles and faults and so to be able to direct the nearest man to deal with each case and avoid wasting vehicle mileage. To provide this information, a six-inch-to-the-mile metal backed map has been mounted on a wall near the control position, and vehicles and faults are plotted by coloured magnetic counters, thus giving a clear picture of the situation throughout the area.

The scheme has been operating since April, 1954. Inevitably it has produced a different outlook among the men using it. It is necessary to give only one fault out to a man at a time and when it is cleared, or if it is a "no access" case, the control can be advised immediately and another fault handed out.

If, for example, no faults exist for an overhead lineman he can be sent on preventive maintenance work but can be called on to deal with a fault when required. In the same way, if a man is faced with a job requiring help or if his vehicle breaks down, he can call for immediate assistance instead of having

Fig. 3: Typical installation under the dashboard of a vehicle

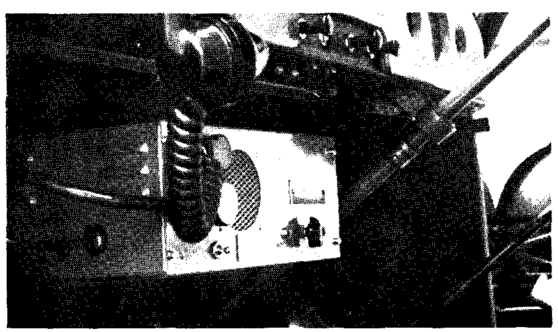


Fig. 4: Morris Minor with aerial

to find the nearest telephone, which may be some distance away. It is significant that practically all communications between staff and control take place over the radio rather than by telephone.

The radio equipment has been found of use in unexpected ways. On one occasion a cable breakdown caused a hospital to be isolated, so the faultsmen offered to relay any urgent messages over the radio for the hospital authorities until service was restored. Another vehicle was used to pass a " 999 " call when an accident occurred on an isolated stretch of one of the arterial roads. On another occasion the radio was used to help the police to intercept a person misusing the telephones in call offices.

The initial reaction of the staff to the scheme has been favourable and the experiment shows that, in the area in which it has been used, it improves the movement control of staff. The experiment in Dartford is being continued in an effort to determine whether the overall economies gained by radio control of mobile faultsmen are such as to justify its more general introduction.

The Weather and the Telephone Service: A Testing Time

METEOROLOGICAL EXPERTS AGREED THAT the winter of 1955 was one of the most severe for many years.

As the House of Commons rose for the Christmas recess the Assistant Postmaster General paid tribute to the engineers, who had worked so hard to clear the damage after the November and December storms.

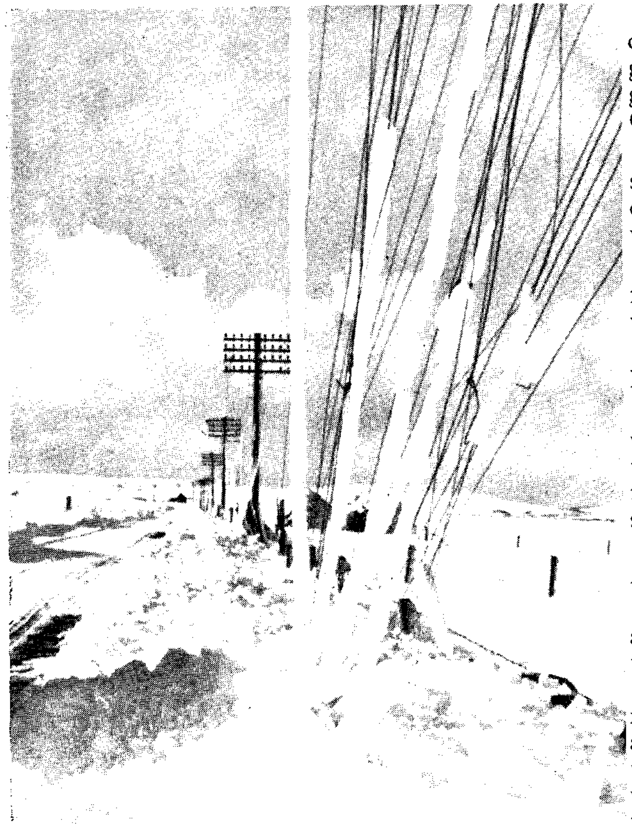
As we went to press with our last issue in mid-January, reports were coming in of damage to telephone lines from snow-storms and blizzards, particularly in Scotland and the North East Region. Again in February there were snow-storms, blizzards and prolonged frost. To the men in the Post Office telecommunications service the winter of 1955 presented a sharp and constant challenge, a challenge met with resource and endurance.

A technical officer and a technician from Lerwick, in Scotland, for example, had to reach the amplifier station at Sullom Voe to recharge the batteries and prevent the main communications to the north islands from failing. They managed to get as far as Voe in their vehicle but beyond this conditions were extremely bad. They started off on the last nine miles of their journey dragging fuel supplies on a ladder used as a sledge. They had to abandon the ladder and carry the fuel on the last lap, involving them in a four-hour battle with deep snow and very bad weather. The total distance they covered was thirty miles and it took them from 9 o'clock in the morning until 7 o'clock at night. If it had not been for their determination in getting to the station, communications to the north islands off the Shetlands would have failed.

Again, a technical officer and a technician from Lairg had to get from Lairg to Tongue, a distance of 37 miles, to charge the exchange batteries and clear emergency faults. Tongue is a switching centre and it was essential that they should get through before the batteries failed. After fifteen hours they covered the 37 miles through snowdrifts, frequently as high as 20 feet. They were cut off from their headquarters by additional snow-falls and carried on for two days attending to faults on the north coast. Then they managed to get back to their headquarters to tackle the work which awaited them there.

A technical officer and a working party from Inverness worked for four days in deep snow, locating and clearing a fault on the main trunk outlet cable from Lewis to the mainland which threatened to cut off the major part of the trunk services. Apart from fighting their way through deep snow to get to the work, they had to dig through sometimes four feet of snow before they could find couplings and cable joint boxes. It was only as a result of their very great efforts that this fault was cleared before it had time to affect communications seriously.

Two technicians from Kirkwall were taken from Scapa by an Admiralty Drifter to clear faults on the Island of Hoy. They walked seven miles to Melsetter clearing faults until it was too dark to get about any more. There were faults in the Longhope area to be cleared, and as the roads were blocked they borrowed a rowing boat the next morning and took a short cut of a mile across the water and by evening had cleared the emergency faults. They left their



Damage on the main Kirkwall-Finstown Road, Orkney
Photo. by Douglas Shearer, Kirkwall

ladder, which hampered their speed, in the deep snow, and climbed poles by slinging a rope over a pole step and scrambling up. These men were completely on their own and although not normally employed on overhead line work, made up for lack of experience by will power and ingenuity.

Men out for days working under appalling conditions, isolated and left to their own resources, walking where vehicles could not get through; a gale blowing and temperature readings of forenoon 4° F.; afternoon 6° F.; 4 p.m. 2° below zero; very often the first to reach farms and isolated communities: so the reports went on.

The above are only some of the large number of "citations" sent in to the Director, Scotland, on the basis of which he has sent 50 personal letters of commendation to the men who had fought so well to maintain the tradition of the Post Office service.

The Director, when visiting the Aberdeen Area on March 1, 1955, estimated that it would take 24 gangs of Post Office engineers two months to make good the damage to the telephone system in Orkney, Shetland and the north east of Scotland.

At the peak of the storm, 800 telephone subscribers were cut off in the islands and the north east. The figure had then been reduced to 400, of whom over 200 are in the Orkney.

Gangs of engineers had to be borrowed from as far as Dundee, Glasgow and Edinburgh, complete with their own equipment and vehicles.

North Eastern Region

Although the North Eastern Region experienced very severe storms, the telecommunication services were less affected than in Scotland. Many roads in the dales and the hilly districts were blocked by snow-drifts, some for several days.

Middlesbrough Area

The linemen were among the first to get through as soon as the roads were opened, but fortunately telephone services were not seriously interrupted. Such breaks as occurred on overhead wires were isolated instances widely scattered over the area, and it was only odd wires and not complete beds which were broken by the intense cold and high winds. There were a few instances of snow icing on the wires.

The technical officer in charge of Arncliffe Wood Television Relay Station was unable to get to the station until a bulldozer had cleared the way. Because of continued snow-storms and drifting a bulldozer was used for several days, at one time for three entire days in succession.

The Director in Scotland, Mr. A. G. Robertson, C.B.E., M.M., who visited the affected area during the February storm, photographing damage at Dunnet

A fault on the Middlesbrough-Whitby No. 1 cable was localized at a point underneath deep snow-drifts where, for a time, the Saltburn-Whitby road was entirely blocked and thereafter was working only on the basis of a narrow single line track cut through the deep drifts. Many tons of snow had to be dug away before the jointers could get to the cable to repair it. The accuracy of tests made by a technical officer, who localized the faults by means of precision testing apparatus, saved much time and labour.

A cable fault occurred on Victoria Bridge, which joins north Yorkshire to south Durham, crossing the River Tees between Thornaby and Stockton-on-Tees. A large water main which had been cracked by the intense cold (21° of frost) let water escape on to the bridge at the rate of thousands of gallons and made repair urgent. The Water Board's work-men excavating the break on the water pipe drove a pneumatic pick through the steel pipes which carried the telephone trunk cables. The jagged edges of these holes made it impracticable to repair the cable by the normal method of drawing out a faulty length and replacing it; the cable had been pierced in several places. The maintenance staff showed commendable initiative and effort in cutting away the steel pipes with high speed abrasive discs. The work was done in a difficult situation, but eventually they were able to expose and repair the damaged portions of the cables.

South Western Region and Wales

Although the post-Christmas snow in Devon and Cornwall was severe and even reputed to be the worst in living memory, its effect on the telephone system, because of prevailing weather conditions which prevented the snow from piling up on wires and poles, was not of the same order as the damage caused by the November gales.

The main difficulties were of movement; transport was seriously handicapped. It was commonplace to find on roads and moors snow-drifts of 14 to 18 feet deep. Moorland ponies were seen with icicles hanging from their long manes.

In Wales the gales at the end of November and the severe snow-storms early in December caused widespread damage to telephone plant, over 15,000 subscribers' lines were put out of order and 107 telephone exchanges isolated. A failure of the public power supply affected a number of exchanges in west Wales and service had to be restricted to emergency subscribers only in some areas. The snow-storms in mid-January mainly affected south Wales where the subsequent thaw revealed damage in underground cables at Newport (Mon.), Rhiwbina, Llandaff and Penarth. Faults on more than 1,000 subscribers' lines served by these cables were repaired very quickly, most within two days.

Northern Ireland

Northern Ireland had a severe winter but did not suffer exceptional storms. A few small exchanges were isolated but there was no major breakdown.

The worst dislocation of the service was in the last ten days of November, when the recorded rainfall was 55 per cent. above the average for November. On the 22nd, 24th and 26th of the month an inch of rain fell each day causing flooding in low-lying areas and considerable damage to underground cables; 186 trunks and junctions were faulty and 2,000 subscribers were affected. Despite the rain, engineers cleared most of the faults by the 27th and all subscribers' circuits were restored by the end of the month.

As always, the more rigorous the conditions the greater the devotion to duty. As the Postmaster-General said:—

"The recent bad weather has tested the resource and endurance of Post Office staff all over the country and, as usual, they have responded magnificently.

"I know just how great the difficulties were but I know, too, how warmly the public we serve has appreciated what has been done.

"My sincere thanks and congratulations to you all".

WEA.—Telephone weather forecast service, planned by the Post Office with Air Ministry help, will start in London as soon as equipment has been made and installed—probably early in 1956. The Meteorological Office will make the forecasts for recording; subscribers on London automatic exchanges will be able to get them by dialling WEA and four numerical digits. The service will cover an area of roughly 20 miles round the centre of London and the charge will be the same as for ordinary calls to central London. The forecasts will be changed about four times a day.

The service will be extended later to other parts of the country, where justified.

NOTES and NEWS

Operational Telecommunications.—A scheme of departmental examination is being developed to provide in the telecommunications operational field a qualification similar to that already available in telecommunications engineering through the City and Guild Institute. The emphasis, in the operational telecommunications course, will be more on the traffic and service aspects of running telecommunications services and less on those of a technical nature. Correspondence courses are being prepared and it is hoped to hold the first examinations in the Spring of 1956.

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Wireless Licence Comb.—Northern Ireland has had a continuous comb for radio licences since June, 1947, except for a short break of two months in 1954. The work has been done by a Regional team—originally six Postal and Telegraph officers, but later by three.

During this period more than 275,000 visits have been made and the number of licences has risen from just over 155,000 to 241,000, an increase of 55 per cent. Some of this increase would have taken place without the comb, but most of it is the direct result of the work of the Enquiry Officers. Almost 2,000 people were prosecuted for working unlicensed sets and about 10,000 licences were backdated.

It has been found that in rural districts nearly half the population do not have wireless sets. Some had had sets installed, which had gone out of order and not been repaired.

About 80 per cent. of the farms in Northern Ireland are under 50 acres and few have electric power supply; consequently, battery sets are commonly used and these are troublesome and expensive for the small farmer to maintain.

Telex.—Our photograph shows the Post Office telex stand which was in the exhibition held at the Royal Exchange, London, from February 25 to March 5. A similar stand was in a recent exhibition at Hull.

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Replacement of Keith-Line switches.—Early this year Chepstow Remote Non Director automatic exchange was transferred to modern equipment in a new building. The old equipment, which was installed in 1913, contained units recovered from the first automatic exchange to be installed in the United Kingdom at Epsom. Some of this equipment was manufactured in the U.S.A., one complete unit of which may be preserved in the museum at Post Office headquarters.

Chepstow was the first automatic exchange in the country to have a remote manual switchboard. All assistance calls were handled at Newport about 16 miles away.

The residue of the old Keith-line switch equipment was taken out of service at Newport, Mon., on February 9. This was the final stage of several operations to replace the old equipment by modern switching apparatus. Another stage will be reached in a few months' time when the space occupied by the old apparatus will be filled with multi-metering equipment.

The change-over divided the existing exchange into two separate exchanges, Central and South. The switching apparatus, main frame and so on for Central remains in the old apparatus room, but South is in a new wing built on to the Head Post Office. More than 4,000 subscribers' number changes were involved.

20,000 Rural Telephone Kiosks.—There are now 20,000 telephone kiosks in the United Kingdom in rural areas. In 1955-56 the Post Office proposes to spend more than £135,000 on increasing the number. Each new kiosk costs about £250.

★ ★ ★

All Scotland Crusade, 1955.—The arrangements made by the Post Office for the relaying of the Kelvin Hall services conducted by Dr. Billy Graham during March and April to all parts of the British Isles were probably the most extensive ever undertaken for a private, as distinct from a Service, organization. The relays, concentrated into the last four weeks of the campaign, ranged from Lerwick in the Shetlands to the Channel Islands, and from Londonderry to Cork in Ireland.

Public address equipment at the 600 centres concerned was provided and maintained by private firms and had to be officially approved for connection to Post Office lines. Extensive use was made of the high grade permanent uni-directional O.P. (occasional programme) circuits which exist between strategic centres throughout the country—such circuits are normally used for the transmission of programmes (outside broadcasts and so on) for the B.B.C. Where such circuits do not exist or are not available, public trunk circuits are utilized. As only a spoken address was to be transmitted such circuits were quite suitable.

A typical element of a relay to the north east of Scotland would be—local end Kelvin Hall to Glasgow Repeater Station—O.P. circuit to Aberdeen—cluster of trunk circuits to the various centres plus any local ends in Aberdeen connected to the O.P. line at Aberdeen Repeater Station. At each relay centre the public address equipment is isolated from the Post Office line by means of a transformer and each line of a cluster at any repeater station is connected through a separate amplifier to ensure that fault conditions on one line do not upset transmissions to other centres.

The circuit mileage in use during any one relay ran into several thousands and Post Office engineers at the key repeater stations had to be on their toes to ensure that the relays took place without a hitch.

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The photographs in the article "Overland V.H.F. for Welsh kiosk," pp. 62-63, in our last issue were reproduced by courtesy of the *Western Mail & Echo Ltd., Cardiff.*—Editor.

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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."

GPO

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(*Continued overleaf*)

GROUP INDEX