POST OFFICE

tele*communications*

JOURNAL

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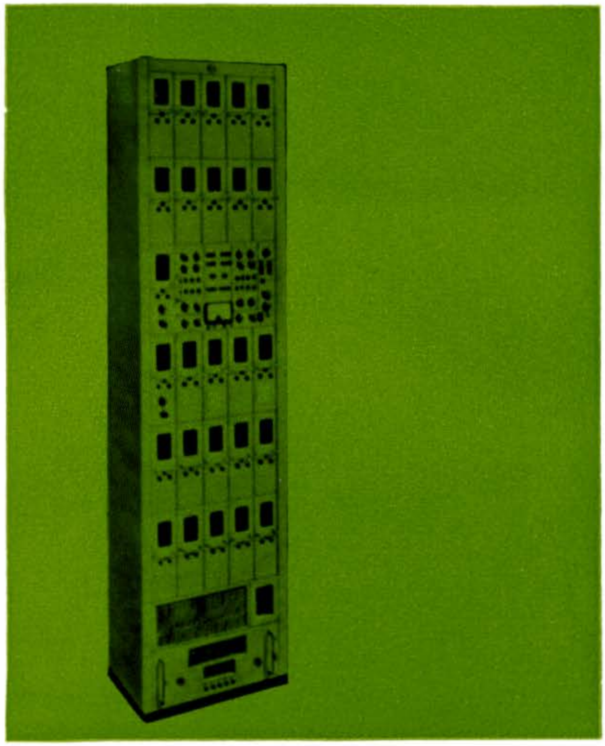
STC TELECOMMUNICATIONS REVIEW

FEBRUARY 1966

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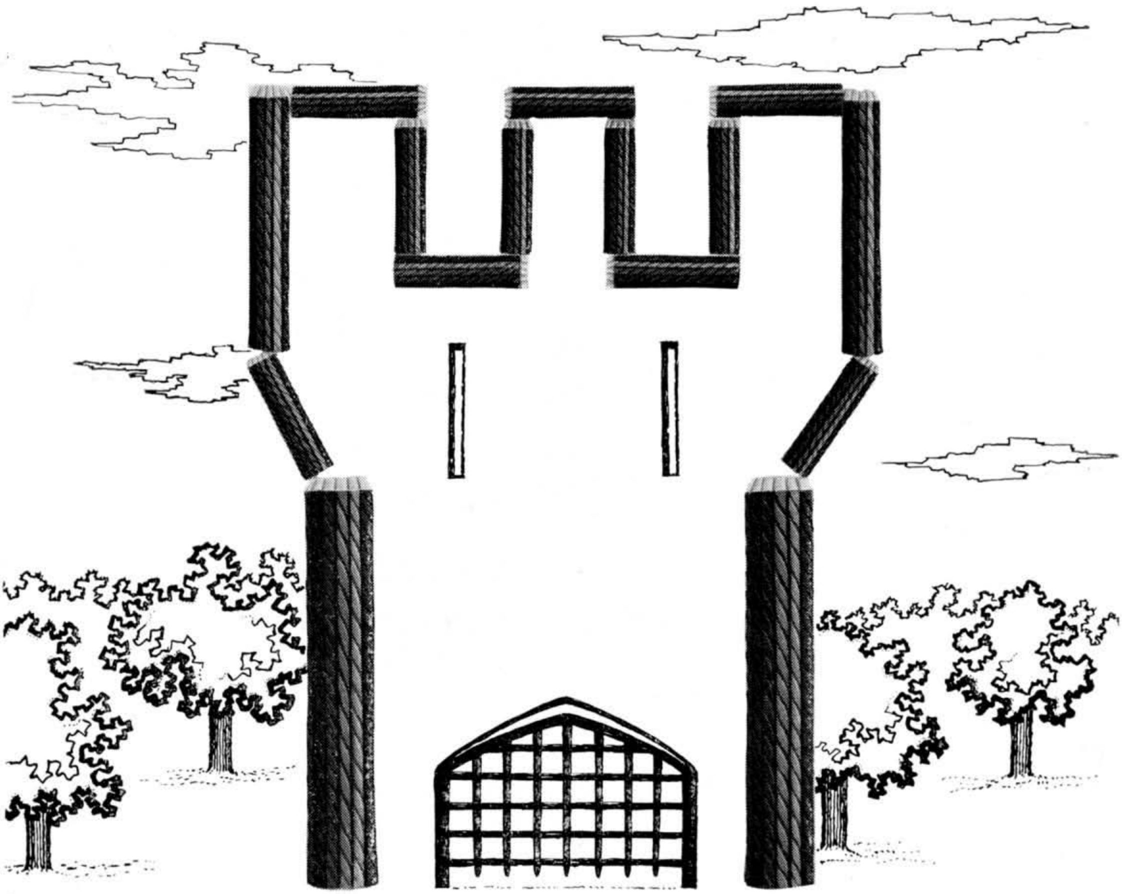

Post Office Telecommunications Journal

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INTO THE ELECTRONIC ERA

THE telephone system in Britain enters a new and exciting era with the recent announcement that all new small and medium-size exchanges ordered in future will be electronic.

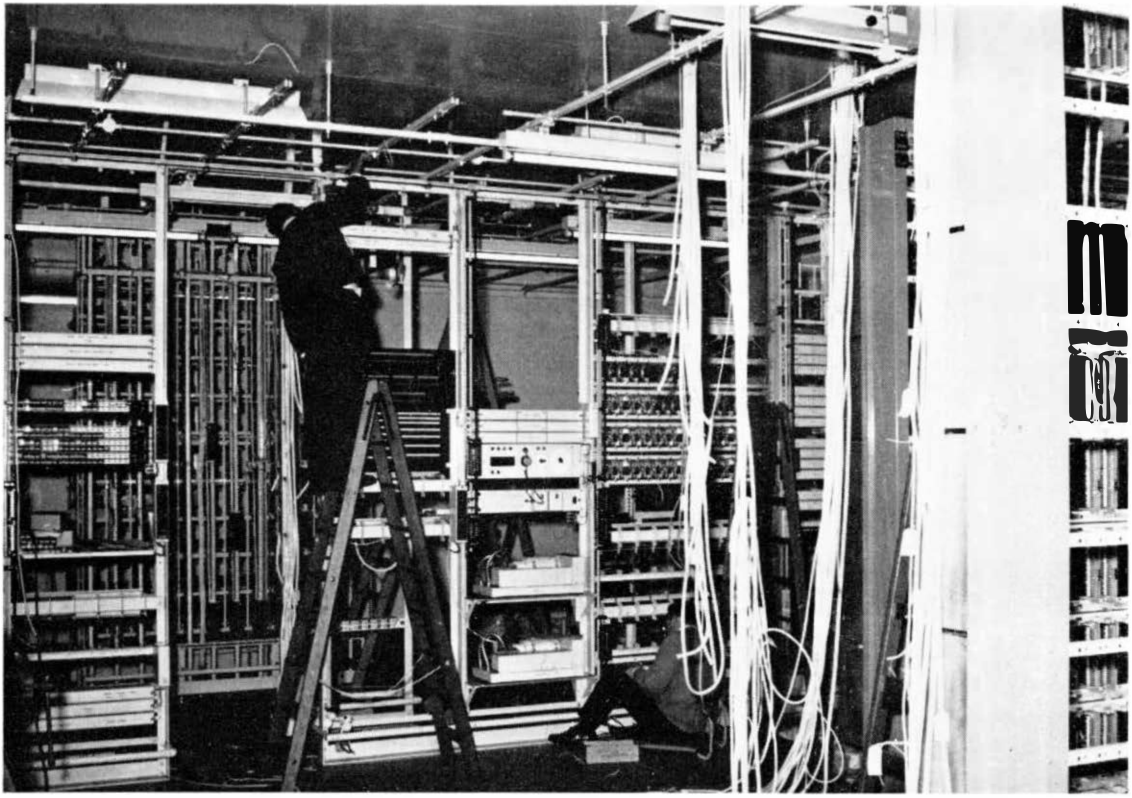
Speaking at the annual dinner of the Telecommunication Engineering and Manufacturing Association, the Postmaster General, the Rt. Hon. Anthony Wedgwood Benn, said that the Post Office and the British telephone equipment industry had achieved a major breakthrough in the design and production of a commercially viable electronic system for exchanges of up to about 2,000 lines* and that it had been decided to order all exchanges in the smaller and medium-size range in the electronic form from now on.

"This puts Britain among the leading telephone administrations in the world in the development of electronic exchanges," said Mr. Wedgwood Benn. "We have decided to make the maximum use of electronic equipment and production of advanced systems will be built up as fast as development and design allow."

Emphasising the great advantages of electronic exchanges—greater reliability, faster connections, additional subscriber services, lower maintenance costs and smaller space requirements—the Postmaster General said that a design for new large electronic exchanges was also well developed, as was electronic equipment for extending and eventually replacing the Strowger-type electro-mechanical exchanges at present in use.

The change-over to electronic exchanges will not, of course, happen overnight. "Although we shall take as much electronic equipment as we can, by far the largest contribution for some years must be electro-mechanical equipment," said Mr. Wedgwood Benn. "For this reason, the manufacturers have undertaken more than to double their present output of Strowger-type electro-mechanical equipment and part of the Post Office's rapidly-increasing requirements will be met by buying some exchange equipment in the British-designed 5005 crossbar system which will provide a number of new exchanges in areas that would otherwise have to wait longer for service. We are also considering the use of other systems to augment the supply."

* *See the article "A Breakthrough for Britain" on pages 2-6.*



Racks of new electronic equipment being installed in the apparatus room at the Ambergate electronic exchange. This is one of five TXE 2 production exchanges to be recently ordered.

A BREAKTHROUGH FOR BRITAIN

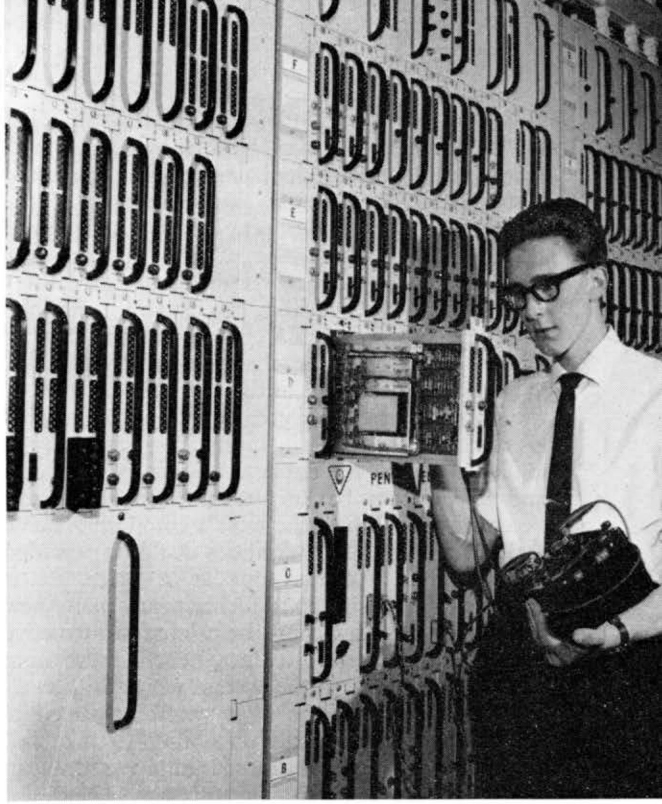
By J. A. LAWRENCE and H. BEASTALL

The Post Office and the telecommunications industry have broken through the electronic exchange barrier and in future all new small and medium size exchanges will be electronic. This article explains the background to this important and exciting development and discusses what it may mean to the Post Office and its customers

FOR more than 15 years the British Post Office and the telecommunications industry have been searching for an electronic solution to current and future telephone switching problems which would be both technically sound and economically viable.

Tremendous effort has been put into research in other countries, too, but a completely acceptable system has not yet been put into full operation anywhere in the world.

In the United States millions of dollars have been spent on developing a system intended primarily for the larger exchanges, and the first practical installation was brought into public service at Succasunna, New Jersey, in 1965. But



An engineer tests a supervisory relay set in the small reed electronic exchange at Peterborough. This kind of equipment is being installed at Ambergate and will be used in some of the other small electronic exchanges of the future.

this system—the Electronic Exchange System No. 1 (ESS 1)—is believed to be economically acceptable only in very large sizes and attention is now being given to a modified system—ESS 2—which will be economical in smaller sizes (but still large by British standards).

In Britain, rapid progress has been made with three systems which, together, are intended to cover the whole range of our requirements. The first system is for a large electronic exchange (over about 2,000 lines); the second is for equipment suitable for extending existing electro-mechanical exchanges; and the third is for a small to medium size exchange (up to about 2,000 lines). Development of the first two systems is nearing completion and the third is now ready for introduction.

Two units of small electronic exchange equipment (known as the Telephone Exchange Electronic No. 2—or TXE 2 for short) have been on trial at Peterborough and Leamington Spa since early in 1965 and have proved so successful that orders were recently placed for five complete production exchanges of this type to be installed at Ambergate (Derbyshire), Bishopton (Renfrewshire), Odiham (Hants), Llanwern (Monmouthshire) and Brampton (Cumberland). Now, the Post Office has decided to turn over its ordering programme so that all new exchanges of appropriate size will use this new electronic system.

We are not, of course, on the brink of a sudden revolution that is going to change our system overnight. Although about two-thirds of our exchanges are in the size range of the TXE 2, they carry little more than a quarter of our customers. The large electronic exchange will cover the larger size range but we must remember that a large part of our ordering programmes is devoted to equipment to extend or replace existing Strowger equipment. If we are thinking of a revolution in telephone switching, the development of extension and replacement equipment is perhaps even more important than any complete exchange system.

What makes the TXE 2 exchange system so attractive? Many of its advantages are common to most electronic systems. First, the new equipment is not subject to mechanical wear nor do any of its components require mechanical adjustment. It is expected, therefore, to need considerably less maintenance than our traditional electro-mechanical equipment. Experience gained so far confirms this and suggests that the consequent benefit to the Post Office (in terms of reduced costs) and to our customers (in greater reliability of service) will be substantial.

The new equipment also takes up much less space than electro-mechanical equipment. It is not yet possible to judge exactly what this will mean in practical terms because of our limited experience in designing actual electronic exchanges in which—however much we reduce the floor space required for the equipment—we must continue to provide circulating space for people of traditional size! At Ambergate, where the first production small exchange is being installed, the building was designed in the first place for Strowger equipment and is being used without modification. It is estimated that the available floor space there will take about two-and-a-half times as much electronic equipment—in terms of multiple—as would have been possible using Strowger equipment. We do not yet know how typical this will turn out to be.

The earlier installations of the new TXE 2 equipment have been arranged to provide essen-

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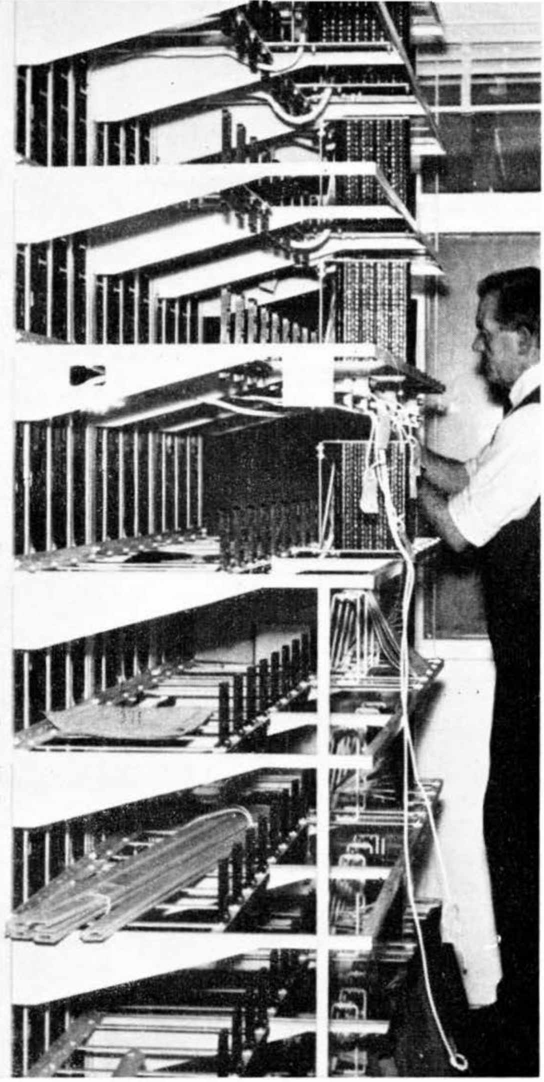
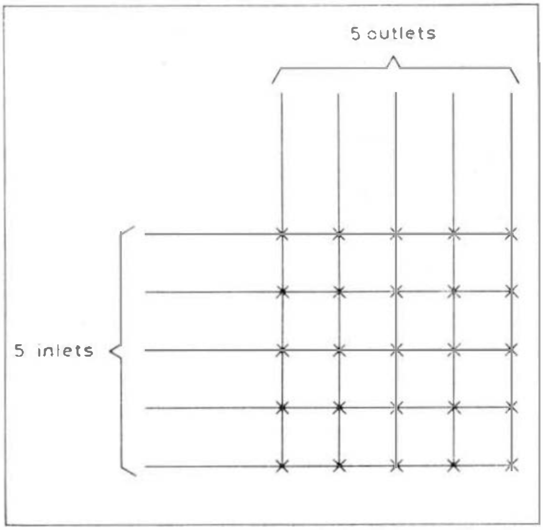
tially Strowger facilities. Nevertheless, they will allow push-button telephones to be connected later, thus enabling the fast operation of the switching system to be exploited. Other novel features will include the ability to work any exchange lines, not necessarily consecutive, as a PBX group and, indeed, to expand from one exchange line to a PBX group without further encroachment on the exchange numbering range.

Much has been said in the last year or so about the wonderful new facilities which may be offered by electronic systems, including, for example, the ability to control the domestic cooker by telephone and to perform banking transactions by direct "conversations" with the bank's computer. These and many other luxury facilities could be provided by electronic systems—but at a price. It is impossible at this stage to forecast how many new customers' facilities could be offered at attractive rates. Customers may, in fact, benefit more from improvements within the system which will result from, for example, the high switching speed of the new equipment and its ability to take full advantage of possible future improvements in signalling and transmission systems.

How does the new TXE 2 system differ from what we already have? The main change from the Strowger tradition lies in the departure from the "step-by-step" principle of operation in which stages of switching are operated sequentially, each selection corresponding to a digit dialled by the customer (or, in a director system, transmitted from the director). The basic switching element



An engineer busy on installation work at the new Ambergate electronic exchange.



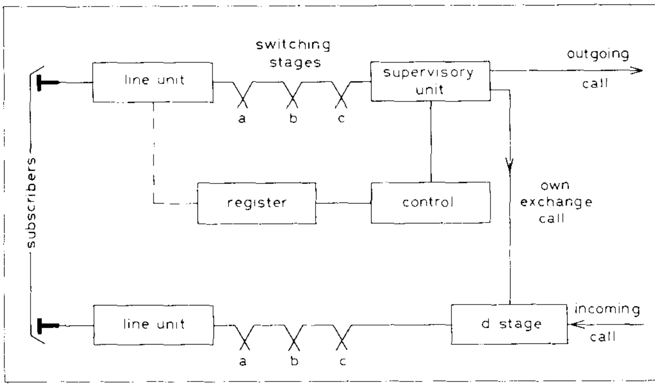
in the new system is the crosspoint which allows an inlet to a switching matrix to be connected to an outlet. The diagram (left) shows in outline the concept of the basic 5×5 (five inlets and five outlets) switch which is typical of practice in this country. Any inlet may be connected to any outlet, at their point of inter-section, by the operation of one of the crosspoints.

The crosspoint is, in fact, a form of relay. In present designs the reed relay is used since this is currently the most reliable and cheapest component for the job. One 5×5 switch can carry up to five simultaneous inlet-outlet connections and contains 25 crosspoints. If this simple switching scheme were extended in a practical exchange having only one stage of switching the number of crosspoints required (the product of inlets and outlets) would make the system quite uneconomic. A 100×100 switch, for example, would need 10,000 crosspoints and would carry up to 100 simultaneous connections—a ratio of 100 crosspoints per connection compared with the five crosspoints per connection in a 5×5 switch. Switches are, therefore, kept small and are grouped in stages inter-connected by only a sufficient number of links to carry the total traffic through the exchange. This results in substantial reductions in the ratio of crosspoints to maximum possible simultaneous connections.

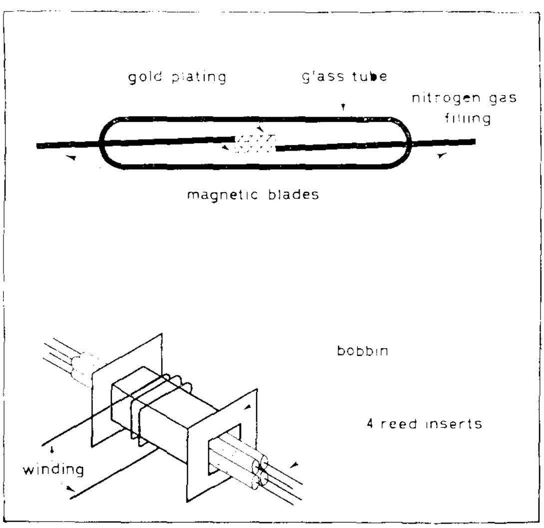
How is a connection set up? A caller is allotted one from a pool of registers which records the caller's identity and his demand in the form of dialled digits. The register passes the caller's identity and the identity of the outlet required to the common control and the register is then released. A complete path through the exchange, from inlet to required outlet, is selected by the control which also operates the appropriate crosspoints in the various switching stages. The control is then released and further supervision of the connection is left to a supervisory unit.

The common control is, in effect, a kind of automatic operator. It can deal with only one call at a time but, such is its speed of operation, that this is no limitation in a small exchange where only one control is normally required to deal with all the connections through the exchange. This element is vital to the operation of the exchange and, in current practical designs, duplication of the control equipment guards against failure.

The diagram below illustrates this and shows how an outgoing call passes through A, B and C stages; how an incoming call passes through a D stage, followed by the first three stages in reverse order (the A, B and C stage switch groups can carry calls in either direction); and how an own-exchange call passes through seven stages—A-B-C-D-C-B-A.



These illustrations show the complete reed relay (below) and (above) one of the "inserts."



Limitations are set to the practical utilisation of the TXE 2 system in relation to the size of the installation. The upper limit for a single unit is controlled by the ability of the common control to handle demands for calls on a one-at-a-time basis without noticeable delays. It is, however, feasible to couple two units together to double the capacity. The lower limit is an economic one and is set by the fact that the common control has a traffic handling capacity which, in an exchange with fewer than perhaps 200 lines, would considerably exceed requirements and therefore be too costly. Exchanges of smaller capacity will, however, eventually be produced.

Although we believe we have now achieved real success, we are only approaching the end of the first phase in developing practical electronic exchanges. Developments in the electronic field are so rapid that many changes in telephone switching possibilities are likely in the next few years. The over-riding need for compatibility with

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what is already in our system will continue for many years to exercise powerful constraints on exploitation. Nevertheless, within our current basic designs there is considerable scope for adaption to changes in components and techniques.

It is no exaggeration to say that we are at the beginning of a new era of telephone development, comparable in some ways with our position about 50 years ago when the automatic telephone system was being introduced.

THE AUTHORS

MR. J. A. LAWRENCE, *a Staff Engineer in the Engineer-in-Chief's Office, joined the Post Office in 1929 and is now head of the Telephone Electronic Exchange Systems Development Branch. He has long been closely involved in electronic developments and has travelled widely in this connection.*

MR. H. BEASTALL, *who joined the Post Office in 1936, came to the Inland Telecommunications Department at Post Office Headquarters after World War Two. He is now Principal in charge of the Electronics and Facilities Division.*

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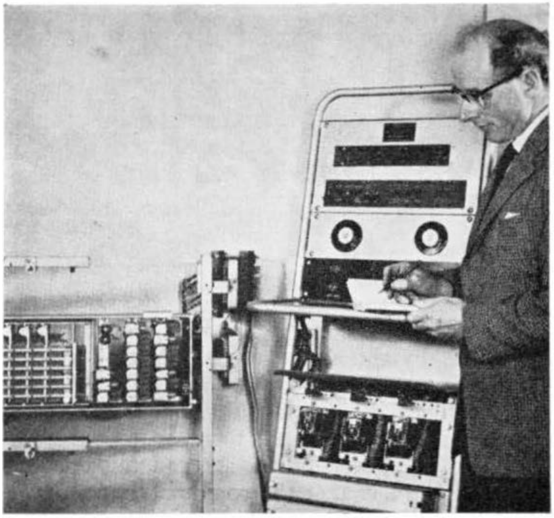
How The Crossbar System Will Help



Shelf testing, showing the mobile test stand and an automatic test set.

THE Post Office is planning its largest-ever programme of expansion of the telephone system. During the next four years it needs more than £350 million-worth of exchange equipment—three times what was bought in the last four years.

Most of this additional exchange equipment will be of the well-tried Strowger type which has been in use in the United Kingdom and throughout the world for many years. The major portion of it will go to extend existing exchanges. The Post Office will also take as much of the newly-developed electronic exchange equipment as it can (the decision to order all new exchanges of small and medium size in this type of equipment, and other developments that are expected to come to fruition during the next few years, are described elsewhere in this issue).

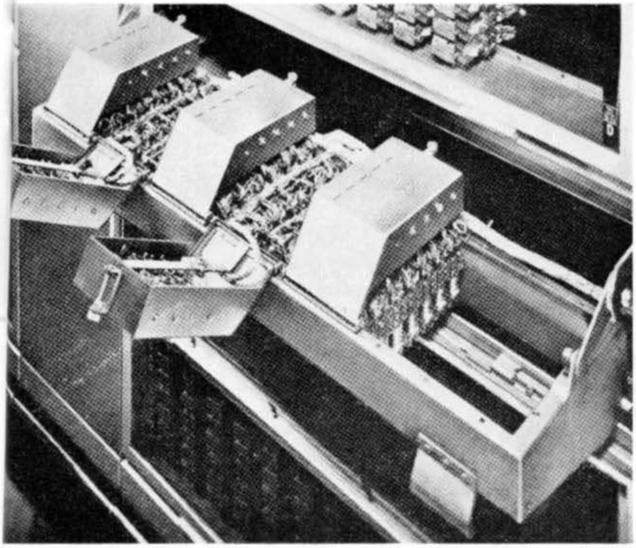
But the Post Office has also decided to meet part of its rapidly-increasing requirements by taking some new exchanges in the British-designed crossbar system, which was successfully developed for the export market by the Automatic Telephone and Electric Company, Ltd., of the Plessey Telecommunications Group. A trial exchange in the ATE 5005 equipment, as it is known and which has a capacity for 1,200 lines, has been operating in public service at Broughton (in the North-Western Region) for well over a year with satisfactory results.

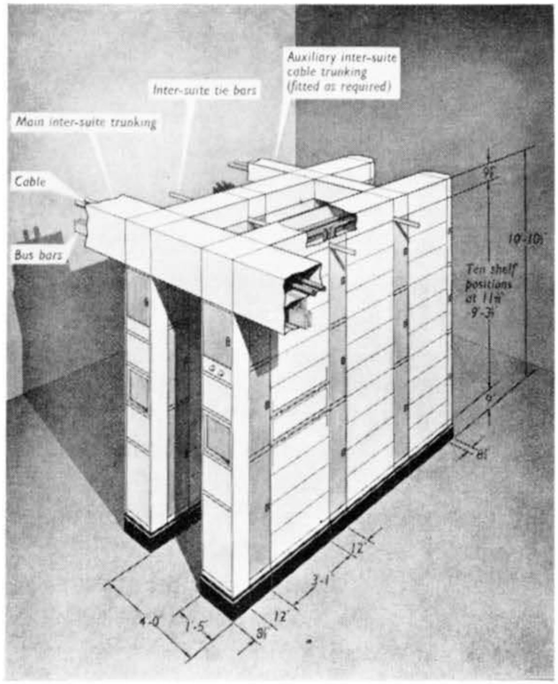
The scope for crossbar equipment in the British system is small in relation to the total Post Office requirements but it will enable us to provide new exchanges in some areas that would otherwise have to wait longer. Orders are to be placed in the near future for crossbar exchanges in both director and non-director areas.

Crossbar systems of various makes have been in use in some other countries for a number of years. Indeed, the first crossbar switch was designed as long ago as 1919. Despite the added

***Right:* A perspective view showing the principle of suite construction with the main cabling and bus bar arrangement.**

***Below:* A shelf unit with capacitor boxes.**

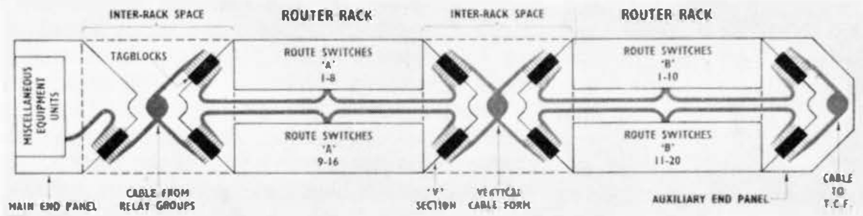




sophistication of the latest designs, the crossbar switch has remained fundamentally unchanged. Its operation is quite different from that of the Strowger switch in which the required outlet is selected by a sequential search over all the outlets from the switch. As in the electronic exchange, connections are set up by the operation of "cross-points"—in this case at the points of intersection of horizontal and vertical rows of contacts operated electro-mechanically. The rectangular arrangement of contacts forming the crossbar switch is very similar in principle and function to the switching matrix used in electronic exchanges.

Another similarity is the use, in the crossbar exchange, of a "common control" to select an appropriate path through the exchange for the call being set up and to cause the required cross-points to be operated. In many ways, the crossbar system is the electro-mechanical forerunner of our current electronic developments.

The crossbar system is faster than the Strowger system in setting up calls, though it is not so fast as electronic switching. The higher speed of both the crossbar and electronic systems will be particularly noticeable when push-button telephones are used. Unlike the electronic designs, crossbar exchanges will not bring substantial savings in space but experience does lead to the expectation that they will give as good service as Strowger installations with less maintenance effort. Thus, not only will they make a valuable contribution to the supply of equipment to meet the present huge demands for service but they will also play their part in improving the service.



Typical schematic plan view of a two-rack suite, showing the cable arrangements. The plan is not to scale.

As the *Journal* went to press, a four-man team from the British Post Office — led by the Postmaster General, the Rt. Hon. Anthony Wedgwood Benn — landed at London Airport after completing a brief but intensive survey of the Japanese telecommunications and postal systems.

During their seven-days visit, Mr. Wedgwood Benn and his party had long and frank discussions with Mr. Yuichi Kohri, the Minister of Posts and Telecommunications, and with his senior officials; with the Presidents and senior officials of the Nippon Telegraph and Telephone Public Corporation, which provides the inland services, of the Kokusai Denshin Denwa Company (KDD), which provides the overseas services, and of the Nippon Hoso Kyokai, the Japanese Broadcasting Corporation.

They were shown around inland and overseas telephone exchanges and telegraph offices, sorting offices, television broadcasting studios, a television circuit switching centre, and two factories making telecommunications and postal mechanisation equipment. They examined the Japanese public telephone systems, paid a visit to the telecommunications museum and, for good measure, made telephone calls from the New Tokaido Line express train as it sped at 125 miles an hour to Tokio.

The article which follows is based on a preliminary report by Mr. F. E. Jones, Assistant Secretary in charge of the Inland Telecommunications Department's Planning Branch I, who was one of the study group. The other members of the team were Mr. D. Wesil, Assistant Secretary in charge of the Postal Services Department's Postal Mechanisation Branch, and Mr. D. P. Wratten, the Postmaster General's Private Secretary

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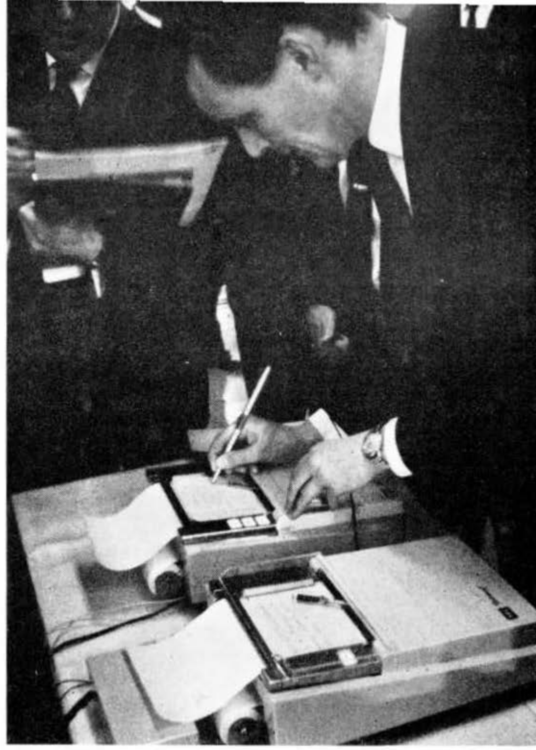
THE purpose of the visit was to study on a broad front the telecommunications and postal systems in Japan and to exchange ideas on matters of common interest.

Japan has slightly more telephone subscribers lines than Britain (6.3 million compared with 6 million on 31 March, 1965) but nearly 80 per cent are business connections compared with about 57 per cent in Britain. Japan has fewer telephones per head of population (about 12 per 100 people, allowing for wire broadcasting telephones, compared with 18 per 100 in Britain).

However, the Japanese use their telephones more intensively, making on average about twice as many calls per person a year as the British.

Both countries have many problems in common. Both are facing soaring demand for telephone

Left: The Postmaster General tries out a public coinbox telephone in Kyoto. Above: On a tour of inspection of the Tokyo Toll Telephone Office. Visitors have to wear overshoes to avoid dust decontaminating equipment. On the PMG's left is Mr. F. E. Jones and on Mr. Jones' left is Mr. D. P. Wratten.



The PMG writes a message on a Tele-Mail machine produced by the NTT Corporation. The message is reproduced instantaneously for transmission over the public telephone network direct to the recipient.

日本視察旅行*

service and are trying to expand and improve their systems as rapidly and as economically as possible at a time when technology is changing and costs are rising. Both are trying to do this through the application of technology and increased efficiency, including the use of computers and the development of modern management techniques. Both are working to five-year plans which aim to provide nation-wide subscriber dialling in a fully automatic system within the next few years. Both, too, have waiting lists for telephones—the Japanese total now running at about 1.6 million applicants compared with Britain's 71,000.

We were very impressed with what we saw, both operationally and technically, and with the products of the Japanese telecommunications industry.

Features of particular interest to us were an experimental directory inquiry bureau, in which the records are on microfilm; a system in which a number of ground stations can have random multiple access to a single communications satellite; and the experimental work being carried out on electronic exchanges. There were also some attractive cordless switchboards.

We studied the Japanese public telephones. They have far fewer kiosks than we do in Britain but very many portable coin boxes—about 200,000—in and outside such places as railway stations, hotels, cafes and shops. Renters' coin boxes are also used extensively. Vandalism is not a serious problem for the Japanese. The lack of privacy and the higher charge for calls from these "semi-public" telephones seems no deterrent to their use.

OVER

* A SEVEN-DAY STUDY IN JAPAN

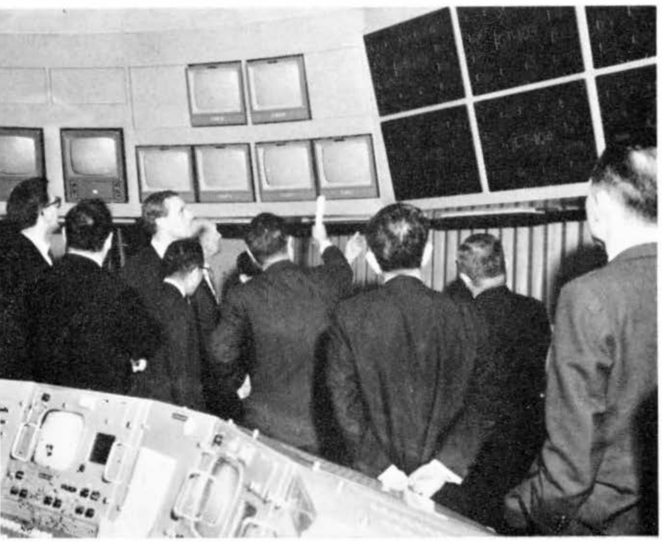
The coin boxes outside the shops are taken inside when the shops close or when the weather is very bad.

We were intrigued by the telephone service on board the New Tokaido Line express and made several calls from a small booth in our railway compartment to numbers in Tokyo as the train made its way from Kyoto. The connections were made quickly and the quality of speech, although a little faint, was excellent.

Like the British Post Office, the Nippon Telegraph and Telephone Public Corporation ploughs back its entire surplus into the further development of the system and provides about half its capital requirements from provision for depreciation and retained earnings. A novel feature of the Japanese system is that a large part of the remainder is obtained from new subscribers who, in addition to an installation charge, have to subscribe to a bond which is, in effect, a loan to the NTT Corporation. These bonds bear a fixed rate of interest and the subscribers can sell them on the open market.

The Japanese telegraph service is substantially larger than in Britain but, like the British service and others elsewhere, it is run at a loss.

All the Japanese telecommunications services appeared to be vigorous enterprises, imbued with the most modern ideas and a determination to reach the highest standards as rapidly as possible.



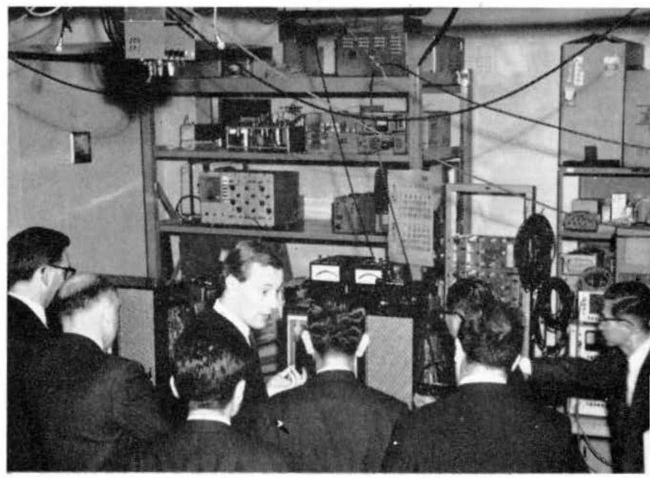
Left: The PMG pays a visit to the recently completed NHK Broadcasting Centre in Tokyo. Above: In conference with the President and senior officials of the NTT Corporation.

Left: A busy scene in the crossbar switch assembly room of a NTT factory. Above: Operators at work on cordless switchboards in Tokyo's international telephone exchange.

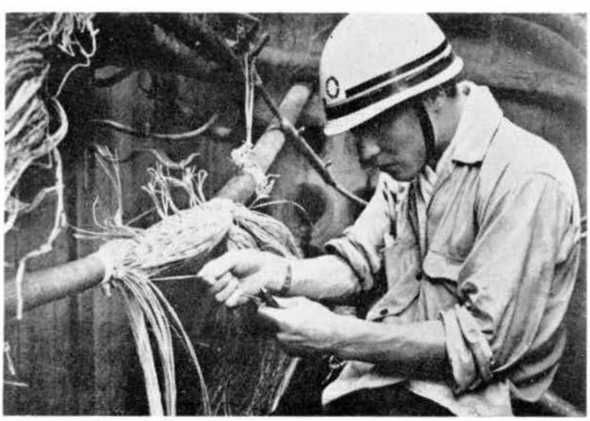
Both the inland and overseas services seem to have been invigorated by their reconstitution as a public corporation and a private company respectively. The Ministry of Posts and Telegraphs, having shed most of its responsibility for the practical running of the services, is anxious to encourage the initiative and prosperity of the NTT and KDD.

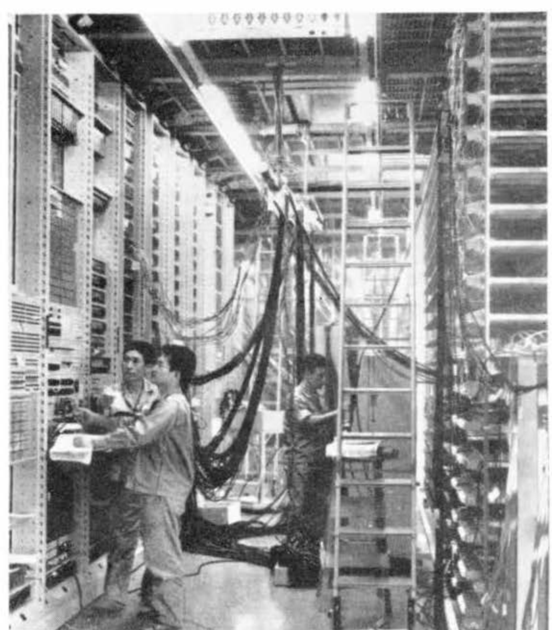
Our visit was in every way a great success and we are greatly indebted to all our Japanese hosts who gave very generously of their time when they were hard-pressed with the affairs of their annual Budget, and provided voluminous literature and other information. Many of our hosts spoke good English and we also had excellent assistance from the British Embassy who provided interpreters and made the arrangements for our visit. Everywhere we went we were charmingly and cordially received.

We left Japan with many regrets, much impressed by the great efforts the Japanese are making to develop and modernise their telecommunications systems. By 1968 they plan to have 10 million subscribers' lines with 15 million telephones, 90 per cent of the connections being automatic. Nation-wide subscriber dialling is expected to be completed by 1973, when the number of subscribers' lines is likely to reach 18 million. The telex service and data transmission facilities are also being rapidly developed.



Above: Examining a PCM repeater at the NEC factory in Tamagawa. Right: Studying equipment simulating a telephone conversation over a satellite link in the NHK Research laboratory.





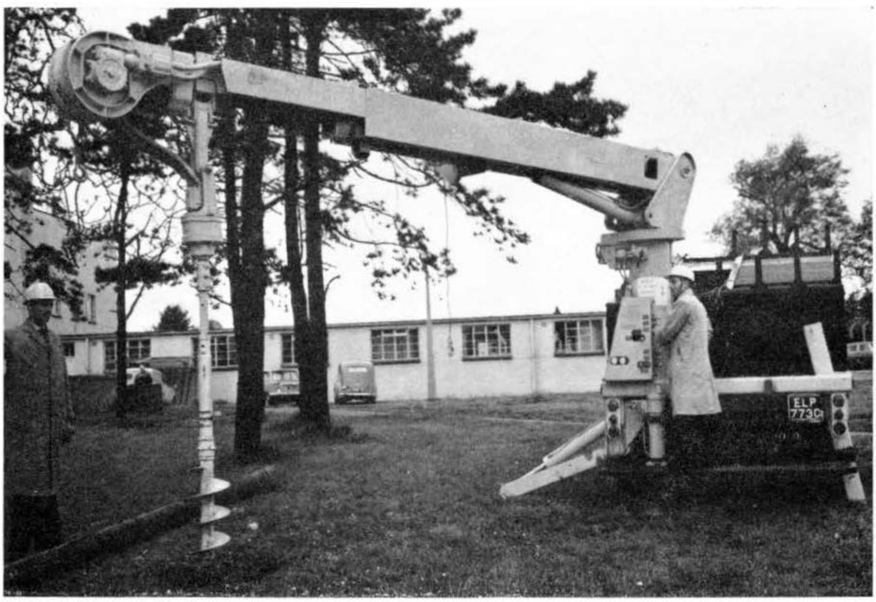
Above: A Japanese engineer splices a cable. Right: Japanese engineers testing telephone switching equipment as it is installed in Tokyo's new toll exchange.

BIG STRIDES

IN THE GREAT OUTDOORS

By W. C. WARD

This article—the fourth in a series describing how the Post Office is improving efficiency and productivity in the telephone service—tells how new tools and machinery are speeding work, cutting costs and reducing manpower needs



A two-man party prepares to erect a pole with the new pole erection unit. The hydraulic jack, at the rear of the vehicle, can exert a lift of 20 tons for pulling old poles out of the ground.

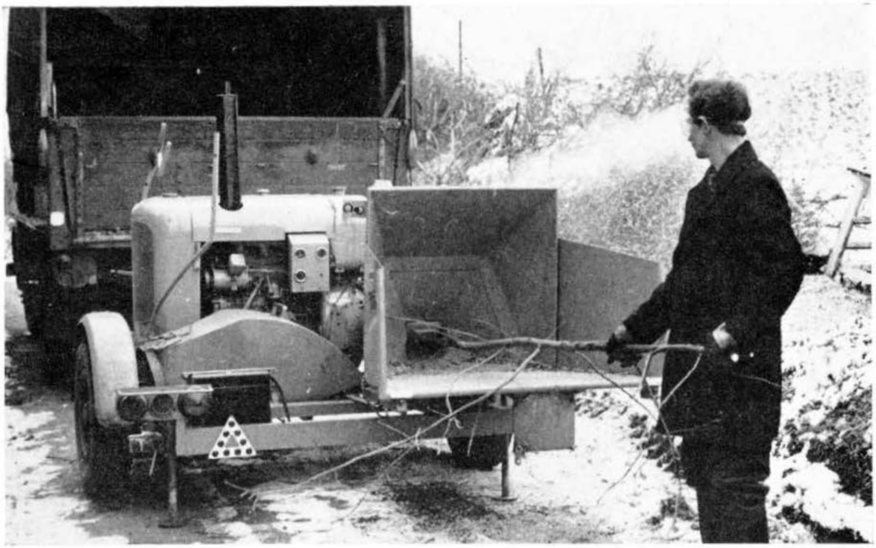
EXTERNAL Plant may not have such a glamorous image as some other branches in the Post Office's telecommunications field. Nevertheless the wind of change is blowing with near gale force in this sphere and since external construction accounts for something like one-third of all engineering expenditure, it is clear that the changes are of the greatest importance when considering increased productivity.

For overhead work the Post Office has ceased to use bare wires and the old familiar scene of rows of poles and serried ranks of insulators is fast disappearing. Thin insulated twin wire with steel-cored conductors is now used for subscribers services while small aerial cables, with the steel suspension wire incorporated in the cable sheath, are taking the place of the numerous bare wires. These measures have reduced construction costs and greatly increased immunity to faults.

An increasing amount of cable is being buried in the ground but overhead construction will remain for many years to come. While it persists it will be necessary to put up poles and to take them down. Previously this meant long hours of manual hard digging, but soon nearly all the work will be done mechanically by Pole Erection Units. These units have been developed from the Line

Right: The new electrically-driven wood-chipping machine in action. It can dispose of a branch similar to that shown here in about three seconds.

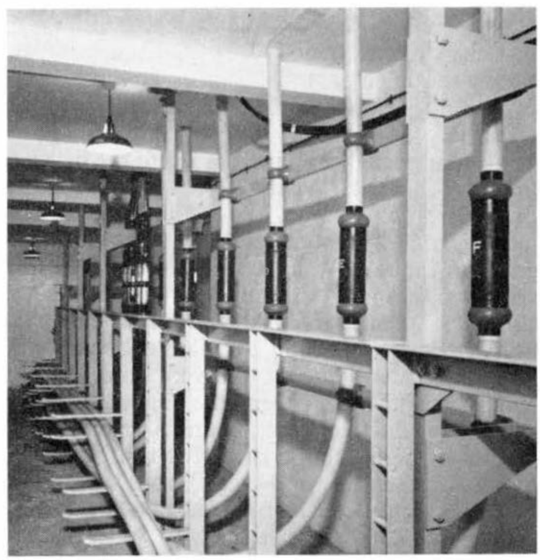
Right (below): A group of poly-thene-sheathed cables in an exchange cable chamber. The new cables are lighter and cleaner to handle than the old lead-sheathed variety.



Construction Vehicles (*see Spring, 1963 issue*) and are arranged so that they can carry a load of nine poles. They are manned by two-man crews and can dig the hole and set a pole in a few minutes. Moreover, because they carry out all the heavy work expected of the normal overhead working party, it is no longer necessary to maintain large gangs for overhead work and two-man parties are large enough for most requirements. The exception is the erection of aerial cables, but machines are now being developed which will also enable this work to be carried out by two-man units.

While aerial plant still exists, a certain amount of tree-cutting will be necessary in wooded areas and in some suburban areas. In the past this work has been carried out with ladders, pruning hooks and saws. The modern method is to use electrically-driven tools in conjunction with a hydraulic elevating platform mounted on a Land Rover. This is so efficient that two vehicles are needed to take away the cuttings produced by one tree-cutting unit. Machines are now being provided, however, that can be towed behind Land Rovers and reduce quite large branches to shreds in a few seconds. In rural areas land owners are usually willing to allow the shreds to be blown by the machine straight into a hedgerow. Where this cannot be done, the chips are bagged for later disposal.

In the underground field the picture has been transformed by the introduction of polythene-



sheathed cable. The use of polythene instead of the traditional lead sheathing for cables produced an immediate saving of about eight per cent on the price of local subscribers' cables. There have also been other very far-reaching results from the change. Because polythene is much lighter than lead, it is possible to pull in lengths of the new cable three times as great as those of the equivalent lead-covered cable. This not only reduces the cost

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A technician uses a portable radio to report the arrival of a cable at a jointing point. A loudspeaker is incorporated in the set to leave the technician's hands free when it is necessary for him only to listen.

of the actual pulling-in of the cable, but also means that many joints can be saved—sometimes as many as two-thirds of the total. Since a large joint may cost up to £100, very substantial savings are being achieved.

This long-length cabling has led to the development of special "walkie-talkie" radio sets for communication between the feeding end and the pulling end of the cable length. All new subscribers' cables now have polythene sheaths and very soon most new trunk and junction cables will also have them, which should bring about an overall saving of about £2 million each year.

Another development derived from cabling longer lengths has been the introduction of mechanical duct rodding. There is a limit to the lengths of underground duct that can be rodded by the conventional "sweeps" rods or by the continuous steel rod and it is not possible to rod the full cabling distance without having intermediate access points. When a new duct line is laid, some access points are required solely for rodding purposes so that there is a strong incentive for finding ways to rod these long lengths. An ingenious two-man mechanical duct rodding machine has now been developed by the Post Office Engineering Department which can carry out duct rodding—one of the heaviest jobs a cabling gang is called upon to perform—as efficiently and much more rapidly. Because of this task a cabling gang formerly needed six men. Now only four men are required and even this number will probably be reduced if trials with a machine based on a cabling unit used in Canada, are successful.

The challenge of rodding ducts for long-length cabling has prompted an Engineering Department investigation of the type of duct used for underground systems. Although very successful, the duct rodding machine takes about half-an-hour to traverse a 500 yard section. The job could be done in one-tenth of this time if it were possible to blow a simple missile through the duct by compressed air or, alternatively, to suck it through by a partial vacuum. Such a system is not practicable in ducts which already contain one or more existing cables, but it has a useful sphere of application, particularly in multiple-way duct-lines. Unfortunately, the individual bores of multiple-way earthenware duct commonly used by the Department cannot be made sufficiently air-tight for the pneumatic rodding system to be used.

Two new duct systems have recently been introduced which are not only airtight throughout, but also have other important advantages. For

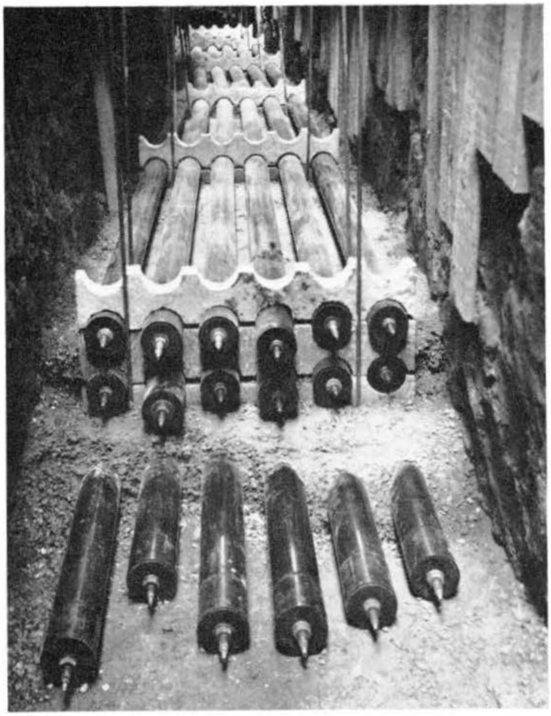
An 18-way formation of the new earthenware duct. The formation can be changed to negotiate obstacles and thus often save costly methods of construction.

A large formation of plastic ducts being laid in a deep trench. Precast concrete spacers are used to keep the ducts in position and the whole formation is embedded in concrete. The plastic tube is only 1½ mm thick.

single-way and small multiple-way formations a new type of earthenware duct is now available. This duct does not have spigot and socket joints which have been characteristic of the "drain pipe" type of duct used hitherto, but instead has a special plastic sleeve joint which is of the same diameter as the barrel of the duct. The earthenware duct has a reduced external diameter extending just over one inch from each end, and a plastic sleeve about two inches long partially embraces and is sealed on to one end of the duct. The free end of the plastic sleeve has a tongue on its inner surface which grips the opposite end of the adjacent duct which is a "push-in" fit. This joint is simple in use and does not need any jointing compound. Considerable relative movement between adjacent ducts does not lead to opening of the joint and, because the ducts are of uniform diameter, they can be laid in close contact to form multiple-way formations in which the individual bores are airtight. In this way one standard item fulfils the functions of a number of different types of duct used previously. This, and the ease of laying, leads to considerable financial savings.

The new duct also needs very few manual processes in its production compared with earlier types. It is far less liable to damage in transit than the old duct because it has no projecting sockets and no fragile linings on the spigots. Larger loads can be carried by the same vehicle because, having no sockets, the ducts can be stacked on a lorry more compactly. The new duct should lend itself well to developments in mechanical duct laying which it is hoped to introduce in the future.

For large duct formations, plastic tubes embedded in concrete are now being used. The plastic tube is 1½ millimeters thick with a 3½-inch bore, and is supplied in 20 ft lengths. It is very light and easy to handle, while joints between lengths are easily made, each length of pipe having a parallel socket at one end into which the plain end of the next pipe fits snugly. The application



of a little special cement when the joint is made ensures that it will be air- and water-tight. Duct lines constructed in this manner have an unexcelled smoothness of bore and provide excellent cabling conditions. The plastic pipe is now supplied at very competitive prices and the method

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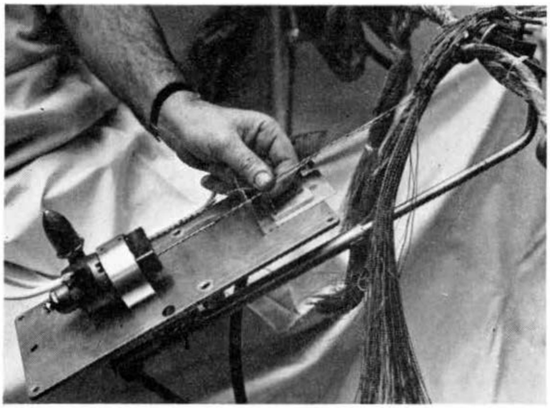
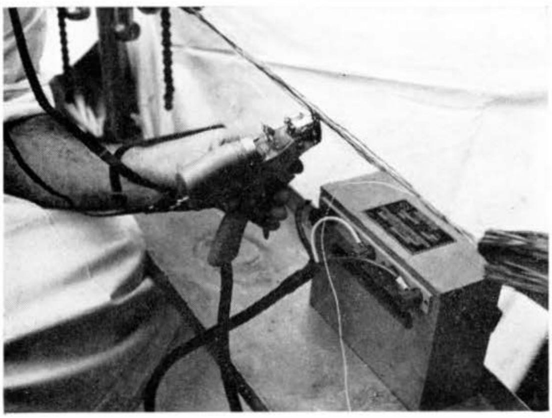
Two men lay a plastic duct using one of the new mole ploughs. This method of duct laying is quick, saves money and little restoration of the surface is needed.



of construction is very economical where large formations of duct—as for leading-in to large exchanges—are needed. There are no troubles over watertightness and individual ducts can be readily sealed into the walls of new exchange buildings without the need to construct elaborate duct seals.

One of the most testing problems faced by the external plant engineer is the provision of services on new housing estates. This is because much of the plant has to be provided piecemeal as the dwellings are occupied one by one, while other dwellings have probably not been started. Underground services are often provided for this purpose and where applicable the easiest method of installing the cables is to plough them into the ground with a mole plough.

Jointing a cable with the new Japanese jointing gun which is being tried out in the Engineering Department. A battery is used to drive the gun and weld the wires together.



Twisting two wire joints simultaneously with the Canadian Miller jointing machine. The Miller is driven by compressed air and operates at a very high speed.

Much development work has been carried out recently to produce really satisfactory plough machines and there is now a wide field of use for such appliances. Recently, for example, they have been used to plough a plastic duct direct into the ground without any excavation. This cannot be done, of course, where there are other services whose positions are not accurately known, but, where it is possible, the savings are considerable.

One of the long-term trends which is achieving considerable economies is the use of lighter gauge conductors in external cables. This stems from the development of more efficient transmission systems in the exchange apparatus. Very fine wires are now being used and the limit is being approached in the gauge of wire that can be handled for jointing purposes. This points to the need for jointing machines which place less tax on human skill and two types of machine—one of Canadian origin, the other of Japanese—are being tried out. Both show considerable savings in jointing time. Active development work is also being carried out in the Engineering Department to produce a jointing machine which is faster in operation and more adaptable than the Canadian and Japanese machines and which will carry out the sleeving of the conductor joint automatically. The conductor joints themselves will also have better integrity than the twisted wire joints which are at present universal in the local line network. This is likely to assume greater importance as the use of the network for more demanding services, such as data transmission, increases.

It can justifiably be claimed that there is no branch of external work which is not changing radically. The full impact of the advances made so far has yet to be felt, but the increases in productivity they will produce will be remarkable.

The glamour may be with the satellites in the sky, but it is not the only place where exciting developments are happening.

★ ★ ★

ON TARGET

In the Spring 1965 issue of the Journal an article described the use of the Critical Path Method technique in planning the new Cavendish Trunk Exchange in London. The CPM Group of LTR report that planning work is exactly on target and that building is due to start in July, 1966.

Senior Machine Operator Peter Strawson at the control console of the new computer. In the background, SMO Christine Anderson rewinds a programme tape.

The most important task for the Engineering Department's new digital computer is to simulate electronic exchange switching systems. In this and in many other ways it will help in . . .

Speeding Research and Development

By D. J. ROCHE

THE Engineering Department has a new high-speed, digital computer—operating at least 60 times faster than its predecessor—which will considerably speed telephone research and development and help to reduce costs in the provision of telephone exchange equipment.

The new computer—the Elliott 503—which was recently installed in the Engineering Department Headquarters' new computer room in Gresham Street, London, will carry out a wide range of scientific and engineering studies. Its most valuable and spectacular task, however, will be to simulate electronic exchange switching systems and produce answers which will ensure much more accurate design than has hitherto been possible.

The need for the new computer has arisen largely because the mathematical methods and analogue computer techniques, until now used for designing electro-mechanical exchange systems, are inadequate for designing electronic exchange systems. The Elliott 503 has a large random

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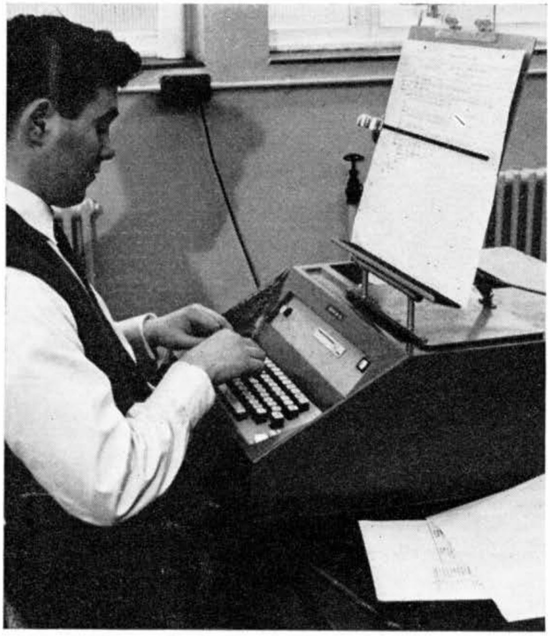


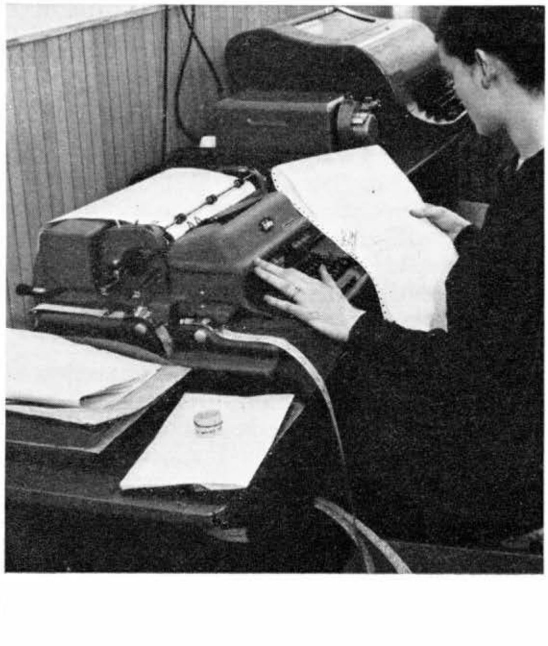
Left: Machine Operator Terry McEvoy converts a manuscript programme into punched paper tape form. This tape is verified by punching a second tape which is then fed into the computer.

access store in which the design engineer can specify a logical model of the exchange to be simulated. This model is fed with artificial telephone calls generated within the computer itself. The response of the system is continuously recorded so that an extremely accurate assessment can be made of the amount and type of equipment needed to provide an efficient system under every kind of condition.

To simulate the larger and more complex exchanges, a digital computer must be very fast and have a large random access store. Some simulation problems require as much as 10 hours of computer running time to produce the answers and the risk of a machine breakdown during this time makes it advisable to arrange for all intermediate results and data to be transferred on to magnetic tape at regular intervals. In addition, the intermediate results should ideally be printed by means of a line-printer without significantly lengthening the duration of the run. Since developing a programme for simulating a telephone exchange is a very involved operation, the programming language should be easy to learn and use and enable programmes to be prepared in days rather than months.

The new Elliott 503 computer meets all these requirements. It has four magnetic tape decks, a line-printer and a 65,436-word auxiliary magnetic core store. The programming language requirements are met by the Elliott Simulation Package which is ALGOL-based and can, therefore, be readily learned by those familiar with ALGOL (a universal programming language specially designed to meet the needs of mathematicians).

A major portion of the new computer's time will be spent on simulating existing and proposed future designs of electro-mechanical and electronic telephone exchanges. It is also likely to be used to study the staffing levels required at repair depots; to provide a specified quality of service for given fault rates; to work out the most economic number of spare vans which should be held in motor transport pools and of spare items of equipment and apparatus to be kept in stock.



Right: Machine Operator Christine Hemmings operates the flexoprinter which is used to correct errors discovered by the computer or to insert amendments made by the programmer. The flexoprinter will reproduce information on tape or print it on line.

The vastly increased speed of the new computer will relieve the pressure on the slower Elliott 803 B computer, which was installed at the Post Office Research Station at Dollis Hill in 1961, and produce answers much more rapidly for the 100 or so engineers and scientists who regularly use the Engineering Department's computer facilities.

During its recent 10-day trials, the Elliott 503 achieved an efficiency rating of 97.5 per cent. The average performance ratio (that is, the test criterion representing the number of tests concluded without failure) was 99.6 per cent and 100 per cent on nine days out of the 10.

One of the new computer's first tasks, successfully completed the day after the Elliott 503 was brought into operational service, was to find the answers to a programme designed to determine the practical, as against the theoretical, locations of Telephone Engineering Centres throughout the country. Later, the same programme will be used to discover the practical locations of exchange and switching centres.

To meet the need for more far-reaching research and design studies, the Engineering Department is facing a growing demand for more computer facilities. In the near future the computers in the Engineering Department's Headquarters and at the Research Station will be linked by a switched data transmission system so that information can be rapidly exchanged. It will also be necessary soon to increase the size of the store of the Elliott 503 computer to cater for bigger simulation problems and, possibly, to install a larger and more up-to-date computer at the Research Station for work in the scientific field. This computer would most likely have a number of remote consoles connected to it to enable programmers to have direct access to the computer at any time.

THE AUTHOR

MR. D. J. ROCHE *is a Senior Executive Engineer in the Organisations and Efficiency (Maintenance and Computers) Branch of the Engineering Department. He joined the Post Office in 1939, as a Youth in Training in the Telephone Branch (Circuit Laboratory) Engineering Department.*

THE Post Office Engineering Department has long been in the forefront of computer usage. As far back as 1949 an analogue computer, which was subsequently used to test the efficiency of automatic exchange switching systems, was designed and constructed at the Research Station. And, in 1953, the Research Station designed a general purpose electronic computer, called *Mosaic*, for the Ministry of Supply.

Because of the increasing amount of computer time which was then being hired by the Post Office from industry, coupled with the steadily rising demand for more computer facilities, the Engineering Department decided in 1960 to have its own scientific computer. By this time, general interest in scientific computers had grown considerably and it was cheaper to buy a commercial model than for the Engineering Department to design and construct its own. So the Post Office bought an Elliott 803 B computer, with a store size of 4,096 words, which it installed at Dollis Hill.

Since 1961, the Elliott 803 B has averaged 60 hours' work a week and has been used on a very wide variety of scientific and engineering programmes, including fundamental research into the properties of valves and transistors (mainly in connection with the design of underwater amplifiers for the trans-Atlantic and Commonwealth submarine cables); calculating the transmission characteristics of satellite systems and submarine cables; and producing navigational tables for laying submarine cables so as to reduce spare cable lengths and the number of days cable ships spend at sea carrying out fault repairs.

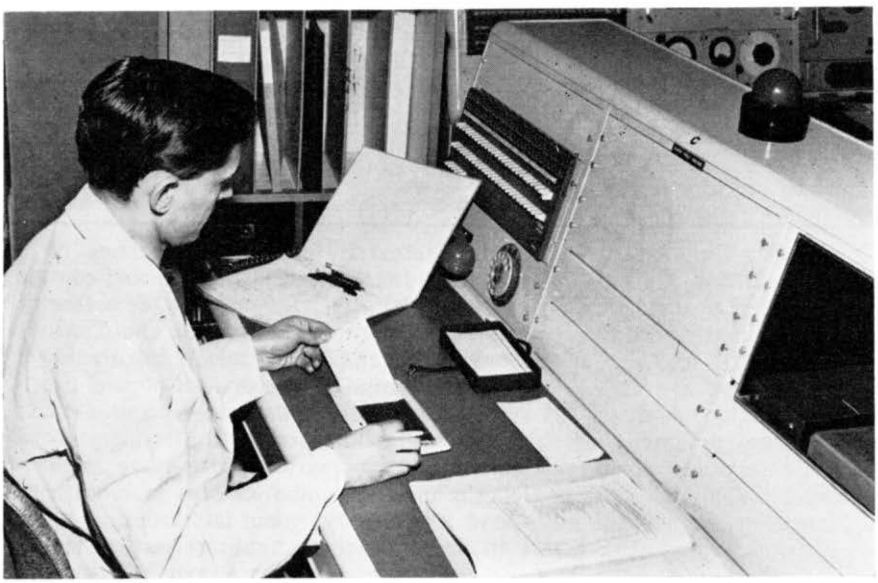
In addition, the computer has carried out work on speech analysis for new methods of speech transmission and developed programmes to produce the steering tapes for the tracking aerial at the Post Office Satellite Communications earth station at Goonhilly.

By simulating traffic conditions, the Elliott 803 B computer has been able to achieve economies in the provision of telephone equipment. Recently, for example, this computer worked out in about 30 minutes that equipment needed in one installation would cost £50,000 less than the estimated cost which would have been given had the calculations been carried out by any other means.

To maintain the highest possible standard on the television and telephony radio network and thus avoid conditions which may mean the loss or deterioration of television programmes, the Post Office is experimenting with a new system in which . . .

PUNCHED CARDS SPEED THE FAULT REPORTS

By F. E. DIDCOCK



Tech. Officer M. Saunders, at the London Television Switching Centre, transfers fault reports from a list (left) to punched cards. The cards are then fed into a LEAPS unit for processing.

A NEW system which involves using portable manual punch boards and the Punched Card Unit of LEAPS—the London Electronic Agency for Pay and Statistics—is being adopted experimentally throughout the country to collect and collate information about equipment and circuit faults on the Post Office network of television and telephony radio links.

As a result, it is hoped that the delay in submitting reports for investigation and appropriate action by the Engineering Department will be considerably reduced and many man-hours of tedious clerical work saved.

Post Office development and maintenance engineers depend on accurate fault reports which can be statistically analysed if they are to maintain the network to the highest possible standard and so avoid conditions which may mean the loss or deterioration of television programmes.

For almost a decade, these faults have been recorded in writing on fault dockets originally designed for the telephone network. The face of the docket, which is completed by the circuit control station, gives details of the faulty circuit, lost circuit time, clearance, and so on. The reverse side of the docket, which is completed by the station where the fault occurs, lists details of faulty equipment, the number and type of faults found, the clearance time, and so on. Since a fault can occur in a station other than the controlling station two dockets are sometimes submitted for one fault.

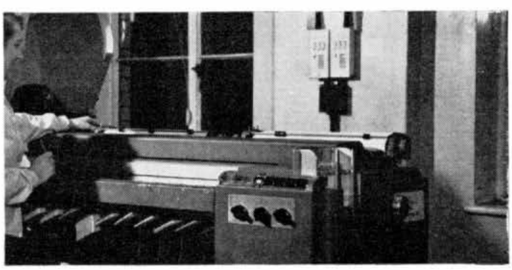
Under this system, fault reports are circulated by way of the Area and Regional transmission groups to the Engineering Department and on the way local statistics are compiled at each level. This means that the dockets are delayed—in reaching the Engineering Department.

Because of this delay it became necessary some time ago for each of the 18 Post Office network switching centres throughout the country to submit weekly summaries of faults reported by the British Broadcasting Corporation and the Independent Television Authority direct to the Engineering Department's Television Group so that an up-to-date record is always available of the causes of lost circuit and programme time for each vision channel.

This requirement is difficult to meet, however, because of the problems involved in assimilating sufficiently quickly the data contained in the equipment fault reports—problems which will increase with the growth of the television network for BBC-2 and the "pay-as-you-view" installations.

It was against this background that Maintenance Groups, particularly for television and radio systems, decided to investigate the possibility of adopting a data recording method which could accommodate the wide range of equipments used and be used in conjunction with the LEAPS Punched Card Unit.

In the new experimental system, a reporting officer at each control station uses a commercial portable manual punch board—called a Port-a-Punch (see the Winter, 1962, issue of the *Journal*) to record faults merely by punching holes in



A LEAPS Punched Card Statistical Analyser processing the data on the punched cards, producing the results on printed sheets.

Before the new system was introduced, a lecture on how it operates was given over closed-circuit television to an audience of some 250 television and radio maintenance engineers throughout the country, including Northern Ireland. This is believed to be the first occasion on which closed-circuit television has been used for such training in the Post Office.

appropriate places on a punched card.

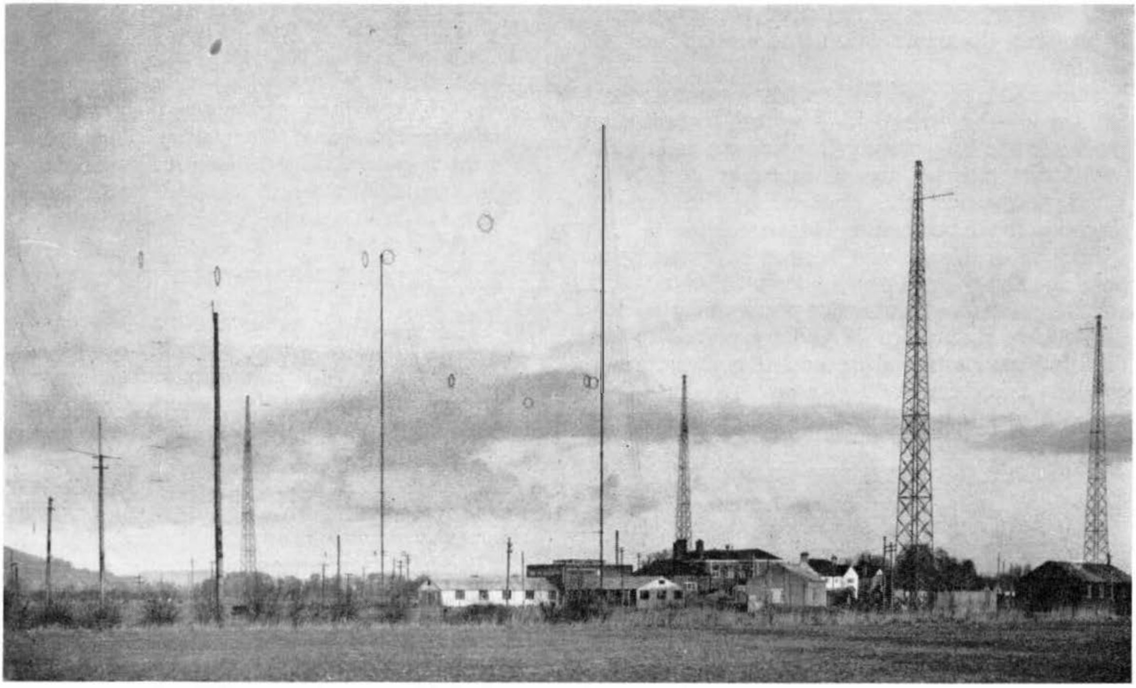
Since the station code, circuit, equipment, faulty component and fault duration are written in full on the present fault docket, the new punched card could not be a simple translation of the reverse of the existing docket. At first, each station, route, equipment and component was given a punched card code number but this produced so many columns that the punched data had to be drastically pruned. On the new card the month and year of the fault occurrence, which originally required five columns, has been reduced to one which shows only the month. Similarly, the equipment codes have been reduced from four to three and the sub-division of fault categories was cut from eight to three.

From the experience gained in setting out the new equipment fault card a new circuit fault punched card has been produced to replace the face of the present fault docket. On this, codes allotted for the equipment fault punched codes have been used wherever possible. Initially, the new circuit fault punched card will be used to prepare quarterly circuit statistics but is intended ultimately to replace the weekly renter reported fault summary.

Under the new system, every quarter completed cards will be sent direct to the Engineering Department which will forward them to the LEAPS Punched Card Unit for processing to a pre-set programme. The results will then be edited by the Engineering Department and the information distributed to Regional Transmission Groups within a week of the receipt of the cards.

THE AUTHOR

MR. F. E. DIDCOCK, *joined the Post Office in 1939 as a Youth in Training in the Radio Branch. After service with the Royal Signals during World War Two he was promoted Assistant Engineer in 1951, and transferred to Main Lines Development and Maintenance Branch, Engineering Department.*



Burnham Radio Station where all messages from ships at sea are received.

LINKS ACROSS THE SEA

By T. N. CARTER

Through its radio stations in Somerset, the Post Office keeps in constant touch with ships at sea anywhere in the World, handling some 44,000 messages a month and nearly double that number in December. One of the vital tasks is providing a medical service between shore and ship.

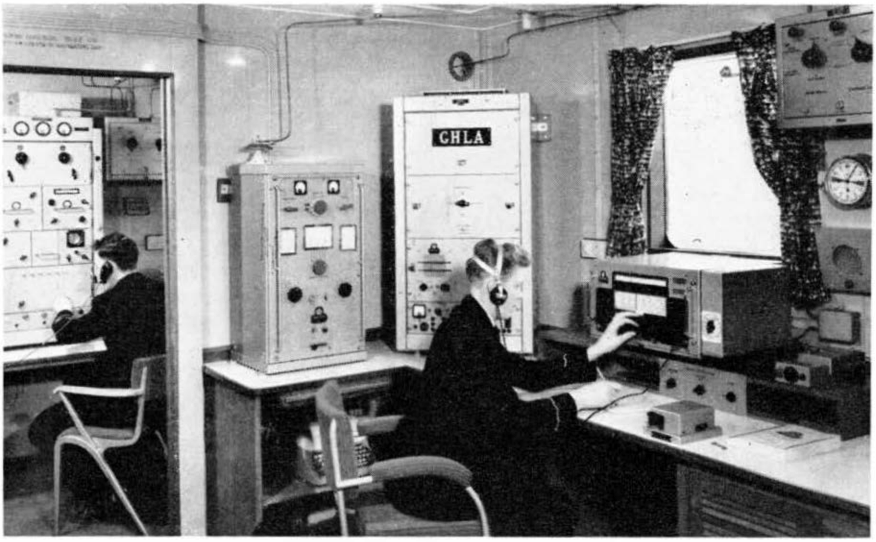
TO seafarers, the name of the small West Country town of Portishead has a significance out of all proportion to its size. It is through Portishead Radio and the operational controlling radio station at nearby Burnham-on-Sea that the Post Office operates its long-distance ship-shore radio-telegraph service.

Although Burnham (the receiving station) and Portishead (the transmitting station) are inter-dependent, they are sited some 20 miles apart to avoid interaction between received and transmitted signals.

World-wide communication with ships is most economically provided in the high-frequency range between 4 and 22 megacycles a second. Equipment to operate on these frequencies was first provided at Burnham/Portishead in 1926. By 1939, 15 receivers and six transmitters were in use, handling something like 3,500,000 paid words each year.

An increase in the demand for long-distance ship-shore communication during and immediately after World War Two gave rise to a major reconstruction and re-equipping programme in 1948. Since then further modifications and additions have been made.

Today Burnham is surrounded by a grid of directional aerials which provide reception from ships anywhere in the world. At peak periods 32



Ships radio officers on board the* Empress of Canada *receiving radiotelegraph messages from Portishead radio.

receivers and 23 transmitters may be in simultaneous operation. Messages are exchanged over direct radio links with ships irrespective of their whereabouts and it is not uncommon to find one radio operator at Burnham communicating in morse with a ship off some South Sea island while his adjacent colleague is receiving a message from a trawler pitching in the Arctic seas. The Burnham operator can select any one of 15 aerials to give best reception from a particular ship. Today traffic has grown to over 10,000,000 paid words a year. Total operating and engineering maintenance staff at Burnham is about 130, including a contingent of Royal Naval radio operators. At Portishead, 32 engineers maintain the transmitters and aerial systems.

In common with most other Post Office services, the peak traffic month at Burnham/Portishead is December, when greetings messages swell the total traffic load from the average of 44,000 messages a month to about 77,000. Most radiotelegrams are of a business or social nature, but the station also handles meteorological, navi-

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A radio operating room at Burnham where messages are received direct from ships at sea.

The Control Room at Burnham Radio where details are kept of the voyages and positions of over 3,000 ships.

gational, distress and Press messages, as well as a medical service.

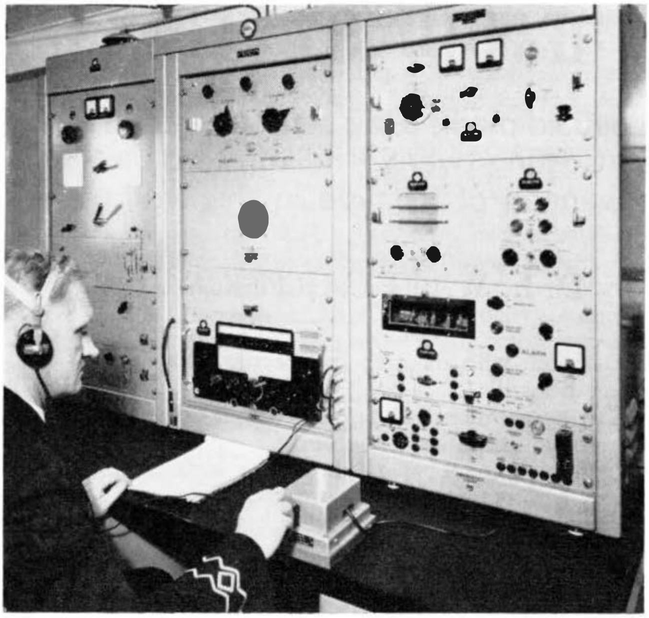
On request, Burnham Radio obtains medical advice for ships by referring a report of a patient's symptoms to the General Hospital at Weston-super-Mare. Diagnosis and advice on treatment is provided by the hospital doctors who are aware of the special needs and limitations of shipboard cases. Most ships do not carry a doctor and the radio advice is usually given to a ship's officer, who acts as the first-aider.

Meteorological reports are received from ships, mainly those in the North Atlantic, and the information they contain is passed to the Meteorological Office at Bracknell for forecasting purposes. The Meteorological Office originate the regular weather bulletins and storm warnings which are broadcast by Portishead to ships in Atlantic and European waters.

Many ships' messages, particularly during the festive seasons, are addressed to agencies in Britain who arrange to deliver flowers and a wide variety of other gifts. A scheme to enable seafarers to send their weekly football pools forecasts by radio to pools promoters in Britain is now being considered. Two lengthy news bulletins are broadcast during the late evening and night for incorporation in ships' newspapers for delivery on board at breakfast time.

Long-distance communication largely depends on the reflection of radio waves between the earth's surface and the ionised layers of the upper atmosphere and the degree of reflection depends chiefly upon the sun's activity. For these reasons, there are fairly distinct cycles of radio conditions following the 24-hour day and night pattern, the seasonal variations between the extremes of mid-summer and mid-winter and the sequence of sunspot activity over a cycle of 11 to 14 years. Long-distance communication can be difficult and almost impossible at times, and it is occasionally necessary to wait patiently for several hours until the daily cycle reaches peak conditions for communication with distant areas. When reception conditions are difficult and signals fade, operating skills and experience become a prime factor in the reception of a radiotelegram.

The Post Office, in collaboration with the Royal Navy, developed the Long Range Area Communications Scheme because of the vagaries of radio conditions, and in this were helped by the valuable experience gained in long-distance communications during World War Two. Under this Scheme several radio stations in various parts of the world relay traffic to and from ships of the Commonwealth, the Irish Republic and the Republic of South Africa. For example, a message filed in this country destined for a ship in the



Left: A radio officer on board the Shell tanker* Serenia *sends a Morse message to Burnham for onward transmission to the Shell Centre in London. Above: The teleprinter room at Burnham from where circuits connect to the inland telegraph network and also to telex subscribers, Lloyds, the Admiralty and the Meteorological Office.

North Pacific may be forwarded through Burnham to Vancouver Radio, over fixed radio networks, and then broadcast from Vancouver to the ship. The ship's reply may be made either by direct contact with Burnham, or, if radio conditions are poor, by way of Vancouver or any other radio station in the scheme. To expedite the routeing of radiotelegrams over the Area system, Burnham maintains an up-to-date card index of the voyages and positions of over 3,000 ships. Much of this information is also of value to Lloyds, who are in direct teleprinter contact with the station.

Some of the work at Burnham is of an international nature, the service catering for both British and foreign ships. In the international language of Morse there are no barriers to communication. There is, in fact, an international three-letter "Q" code which covers all commonplace maritime and communication requirements —for example, "*QTO*"—"*I am leaving port.*" "*QRD*"—"*I am bound for . . .*" "*QUM*"—"*The distress traffic is ended.*" This code is readily understood by all radio operators of whatever nationality.

The teleprinter automatic switching, telex and telephone facilities at Burnham allow speedy access to inland communications services and much ships' business traffic is now handled over direct telex communication links with the offices of individual shipping interests.

Manipulative work at Burnham is of course performed by radio operators who are highly skilled in sending and receiving Morse at speeds of up to 27 words a minute. An automatic radio teleprinter service for naval messages has, however, been in operation for some years. More recently, a data-handling service has been opened between the Shell Centre, in London, and Shell oil tankers in any part of the world. The tankers prepare data which is transmitted by way of Burnham Radio to Shell Centre. This information when fed into computers permits a comprehensive study to be made of a ship's performance and sea efficiency. Other shipping concerns have expressed interest in this service which, it is expected, will develop quickly for everyday communications purposes.

THE AUTHOR

MR. T. N. CARTER *is a Radio Superintendent in the Wireless Telegraph Section of the Radio Services Department. He joined the Post Office in 1946, after 10 years as a seagoing Radio Officer. He was made Radio Overseer at Burnham in 1954, and has since spent two years on Ship Radio Inspection Duties at London Docks followed by four years at WTS Headquarters. He took up appointment as Officer-in-Charge Burnham Radio in 1962.*

THE NEW LEAFIELD RADIO STATION

The Post Office's new radio station at Leafield marks a big step forward in high-frequency radio communications. Costing over £1 million to build and equip, it is probably the most advanced of its type in the world

By D. E. WATT-CARTER, MIEE

A NEW, remotely controlled, Post Office High Frequency Station—possibly the most advanced of its kind in the world—becomes fully operational at Leafield, Oxfordshire, this spring.

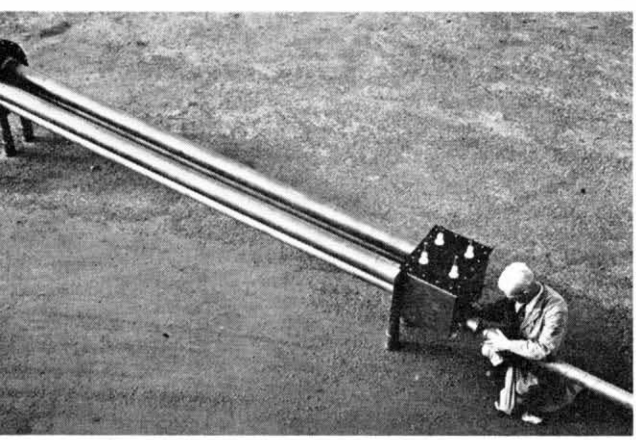
Built and equipped at a cost of £1.1 million, it has been erected on the site of the old Leafield Radio Station which, since 1921, has played a prominent part in the history of radio communications.

The old station catered for multi-destination Press services—the rapid dissemination of news by radio to widely scattered recipients within broad zones of common ethnographical interest. This service will not be neglected by the new station which has six transmitters of 85 kW (CW) capacity to carry out this task. At the same time, the currently expanding needs of the overseas public radiotelegraph and Telex services are served by 12 transmitters of 30 kW peak envelope power (p.e.p.) capacity. These 18 transmitters, together with their drive and control equipments, are housed in the new building adjacent to the old station, with its nine transmitters, which is being dismantled.

The new station will provide a high degree of equipment utilisation, the utmost reliability, uninterrupted circuit operation on at least some routes and require the minimum staffing costs. Recent technological advances have in large measure made these achievements possible. The most significant of these advances include the change-over to solid-state circuitry, not only in low power radio-frequency equipment, but in HTDC power-supplies of transmitters; auto-tuned self-loading transmitters and associated frequency-synthesizer carrier-generators; and the development of reliable motorised switching exchanges and wide-band impedance matching devices, both capable of large radio-frequency power throughputs.

In integrating the various components into a system capable of eventual remote control,

A high-power balun transformer is prepared for erection. This transformer, which can carry 85 kW, has been developed for the Press services.



A wing of the transmitter hall showing six of the 30 kW transmitters which are shared impartially among a group of services.

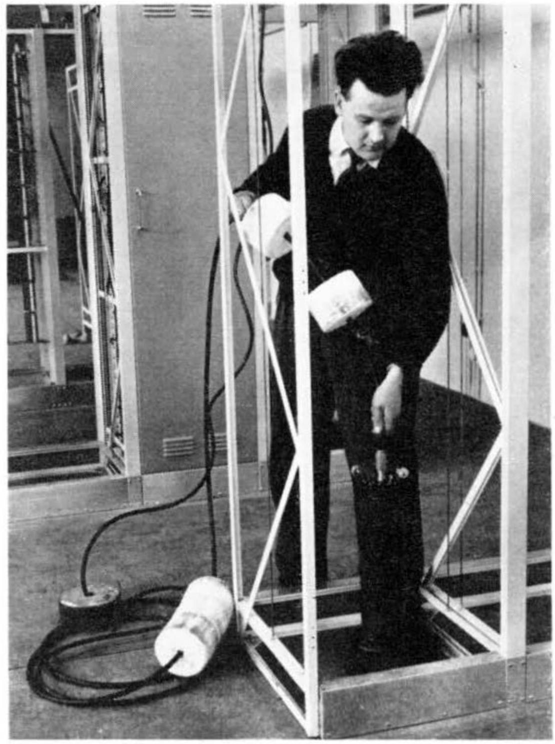
emphasis was placed on the service as the basic unit, rather than the transmitter. This led to the idea of allocating a number of transmitters to be shared impatially among a group of services, the size of the group being determined by the need to balance complexity against utilisation efficiency. A number between six and eight transmitters is optimum and in fact three groups of six were chosen at Leafield. The concept, not unfamiliar to telephone switching engineers, is nevertheless a breakthrough in the radio field.

The present trend in HF transmitter design is towards automatic self-tuning and continuously adjustable coupling to the load so that optimum operating conditions are always secured. At Leafield the transmitters employ conventional tuned-amplifier stages with motorised drives of the variable capacitors and inductors controlled by phase discriminators. Their technical performance is well within current international standards. It is in the spheres of reliability and ease of control that the main advantages are apparent. A significant contribution to reliability has been the use of solid state (silicon diode) HT rectifiers in place of mercury vapour types. Experience to date has demonstrated that, if properly designed and protected, these units are virtually fault-free.

The new station is able to emit almost all types of radio-telegraph signal in common use. Frequency-division multiplex systems in conjunction with independent-sideband drive units account for the greater part of the fixed service traffic, though single or twin-channel frequency-shift keyers are also available. The Press broadcast services, for the most part, use amplitude modulation (A1, A2) though frequency-shift methods are likely to become more widely used.

The master-oscillator system for controlling carrier supplies is of interest in that, for the first time at a commercial station, the crystals and their transistor maintaining oscillators are sunk in sealed containers down shafts 30 feet below ground as an alternative to using conventional ovens. This gives conditions which are almost ideal for precision oscillators and an accuracy better than one in 100 million over a month is obtainable.

Maximum use of the 287 acre site has been achieved by using concentric tiered rhombics for the fixed services and wideband log-periodic aerials for the Press services and for standby purposes. The log-periodic aerial is a comparative newcomer in the HF field and has been used by the Post Office for the first time at Leafield.



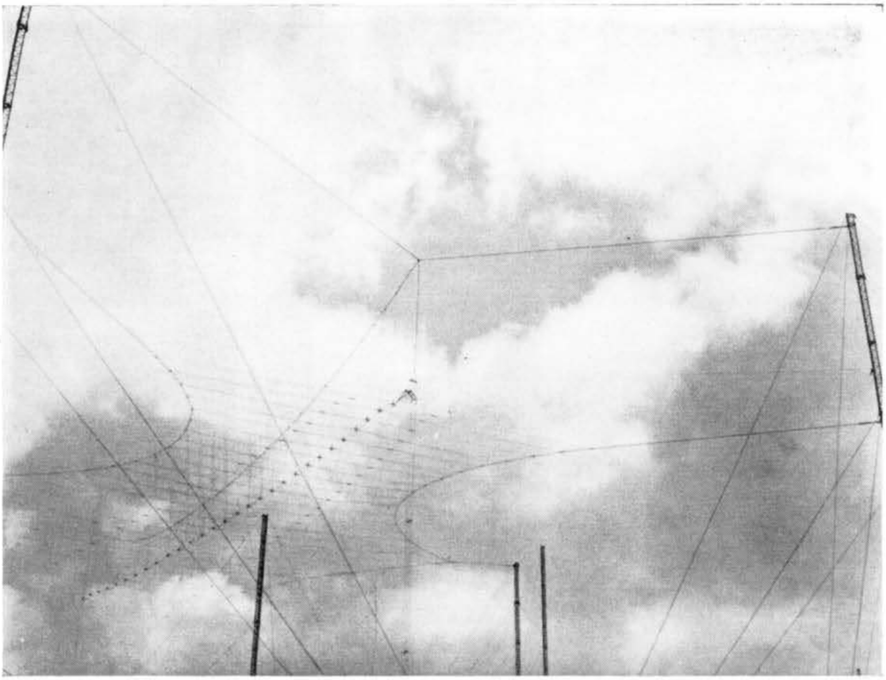
One of the master oscillator assemblies which are sunk in sealed containers 30 ft below ground.

The provision of adequate flexibility between transmitters and aerials—always a difficult problem—assumes even more fundamental importance when the aim is interruption-free, unattended operation. It is necessary for the switching arrangements to permit the day-to-day selection of aerials appropriate to the frequencies used, to allow for the speedy replacement of faulty transmitters or aerials, and to enable the longer-term changes arising from service alteration to be made. The matrix switch type of aerial exchange has been successfully used in a number of post-war schemes and has been further developed at Leafield in the directions of greater robustness and maintainability.

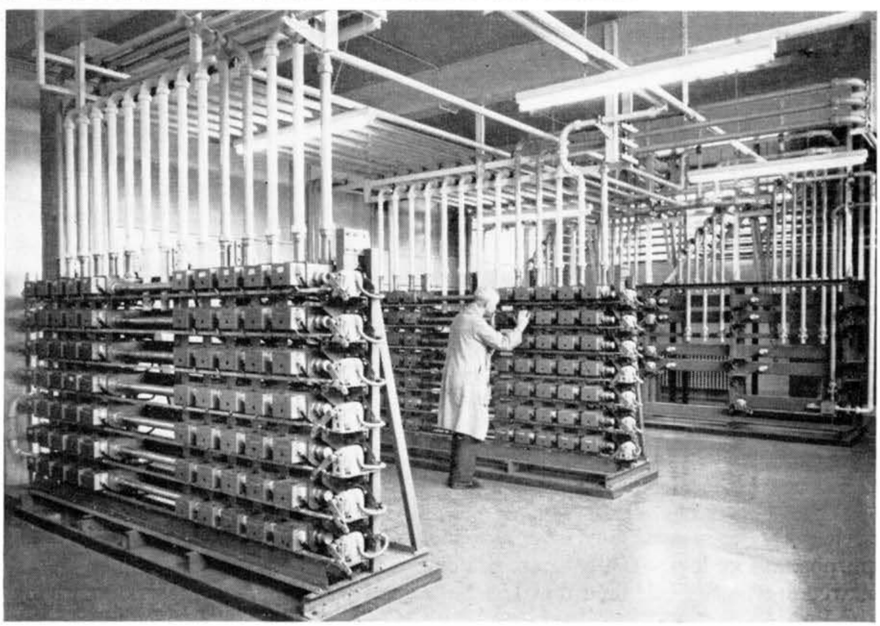
The aim in designing the control system, has been to reduce the operation of the station to its simplest terms so that continuity, or near-continuity, of service can be maintained without direct involvement in the comparatively complex operations accompanying frequency and aerial

OVER

changes. The operator at the control point, and eventually at the traffic terminal, is enabled to start up and shut down services, to initiate frequency changes and to satisfy himself by simple supervisory signals that performance is satisfactory. Provision for replacing faulty transmitters or aerials, the most vulnerable links in the chain, are an integral part of the system.



A view from below of a wideband log-periodic aerial as used for the Press services and for standby purposes.



The aerial switchroom at Leafield. The new switching arrangements permit rapid selection of the aerial appropriate to the frequency in use.

These new concepts reflect the great strides that HF radio communication has taken since the first transmissions were made from Leafield in 1921 using arc transmitters, and bear witness to the efforts of engineers past and present who have worked in this field to make the present station possible. It also reflects the confidence of the Post Office in the ability of HF long distance services to play a useful role alongside the newer, and in many ways more naturally favoured undersea cable and satellite systems in the foreseeable future.

THE AUTHOR

MR. D. E. WATT-CARTER *is a Staff Engineer in the Overseas Radio Branch (WO) of the Engineering Department concerned with the planning and equipping of Radio Stations for the overseas services. He joined the Post Office in 1933 as a Probationary Inspector (Old Style) and before taking up his present post in 1962 he worked in the Regions, the Radio Branch, and at Dollis Hill, where he was concerned with the design of crystal filters, networks, and their microwave aspects.*

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DIAL 1 2 3 FOR TIM

TELEPHONE subscribers in London, Edinburgh, Birmingham, Glasgow, Liverpool and Manchester who want to know the time in future will dial 123 and not TIM. When they want to know the latest Test Match score they will dial 160 and not UMP.

These are two of the changes which will result from the introduction of All-Figure Telephone Numbering.

Other subscribers' codes to obtain various services are also being changed to all-figure numbers. For example, Directory Inquiries (previously DIR) will become 192; Inquiries (INF), 191; Inland Telegrams (TEL), 190; and Overseas Telegrams (557/559), 193. The new number for the Recorded Information Services (now ASK 80—) will be changed to 246 80—, but will not become available in London until July or August of this year and perhaps not until 1970 in Liverpool.

The following codes have been reserved for other future service code demands: 212;234;321; and 484.

Although the new codes are not the figure equivalents of the present letters they are, as far as possible, easily remembered combinations of figures. They will be used side by side with the present codes until such times as subscribers become familiar with the changes.

Before All-Figure Numbering is introduced, all subscribers will be sent a leaflet explaining why it has become necessary, telling them how to make calls to all-figure numbers and giving those in director areas an indication of the date by which their numbers will first appear in all-figure form in directories. They will not, at this stage, be told what their new numbers will be but they will be advised to get into touch with their local Telephone Manager or exchange if they wish to show on their stationery their all-figure numbers before they would normally appear in a reset directory.

All-Figure Numbering will be introduced in all director areas between March and June, 1966. During the first stage of the change-over, all-figure numbers will be given only to new and removing subscribers. The numbers for other subscribers will be changed as new directories, reset entirely in all-figure form, can be issued, that is, from mid-1967 until completion in mid-1969. All London Postal Area and outer London directories will be reset between mid-1967 and mid-1968.

During the transition period it will not be possible to arrange for all records and publications to be changed to all-figures at the same time. Operators will quote numbers in the form in which they find them but since calls will continue to be connected whether the old or the new number is used, subscribers will suffer little inconvenience.

Exchange names in director areas will cease to exist for the purpose of making calls by 1969 when all director exchange subscribers have their numbers published in all-figure form in new directories.

Dialling code booklets will also be affected by all-figure numbering. Reprints of existing issues appearing after the All-Figure Numbering scheme begins will show all-figure STD codes for exchanges outside director areas but will continue to show letters used for local and STD codes for exchanges in director areas until the exchanges disappear as all subscribers on them are given all-figure numbers.

New dialling code booklets for exchanges converted to STD after the start of all-figure numbering will show all-figure codes for everything. It will thus no longer be necessary on such exchanges to change figured dials to lettered dials before STD can be provided.

Many novel items of telephone apparatus will be needed to meet the rapidly-advancing requirements of a technological society. Market research is one of the instruments used by management to anticipate subscribers' needs and to examine and appraise new ideas and prototypes, among them . . .

PRESS-BUTTON TELEPHONES

By H. W. JOSE

Left: One of the new press-button telephones now on trial by Langham subscribers. Some subscribers on the new electronic exchange soon to be opened at Leighton Buzzard will also try out a number of experimental PBTs.

AUTOMATIC switching systems faster than the present Strowger system are becoming available. The cross-bar system is one and the electronic exchanges, now being developed for the Post Office in collaboration with the British telecommunications industry, are designed to reduce running costs and, what may be equally important in the long run, to set up a call in a few thousandths of a second.

For these and other economic reasons it is highly probable that within the next few years a considerable number of new exchanges will be electronic and that electronic equipment will start to be used for exchange extensions and replacements. In the next few decades the whole network will probably be based on electronic terminal and transit switching equipment.

If these high-speed electronic exchanges are to achieve maximum efficiency they must be complemented by a "dial" which can operate as fast as is humanly possible. It is impossible for any person to beat the speed of an electronic exchange.

A possible solution is the press-button telephone which has 10 buttons or keys that can be pressed one after the other without pause. But how would subscribers react to such a fundamental change in the method of using a telephone? Would they reject it as unmanageable, accept it reluctantly or welcome it to the extent that they would be willing to pay extra for it (as they have with the modern coloured telephone)? Also, would the general introduction of press-button telephones effect any significant change in the "dialling" error rate? It would be foolish to introduce in large numbers a new telephone which subscribers did not like and which degraded, even marginally, the quality of service.

The first wholly electronic public exchange is planned to open later this year at Leighton Buzzard, Buckinghamshire, where some subscribers will be given an opportunity to try out a small number of experimental press-button telephones. The combined advantages of high-speed keying and exchange switching will be apparent only on local

Post Office Fitter Arthur Aylott installs the first press-button telephone to be brought into public service.

calls and it will be well into 1967 before the results of even these limited trials are available. Meanwhile, orders for other electronic exchanges have had to be placed well in advance and it needs to be known as soon as possible whether or not press-button telephones are to be provided and, if so, how many.

Market research into press-button telephones started in 1962 with the installation on Post Office Headquarters' automatic (Strowger type) exchange of a special unit to accommodate 24 press-button telephones. Each telephone contained two small tone generators (about the size of small cotton reels), each of which sent one of four tones to line whenever a button was pressed. The special unit at the exchange identified these tone signals, stored the information at high speed and then regenerated the signals in the form of the slow-motion pulses needed to operate the standard exchange equipment. This system of signalling is known as Voice Frequency Press-Button Telephone (VF PBT).

Staff in non-technical departments at Headquarters were specially included in the trial and all users said after some weeks of operation that they preferred the press-button telephone to the usual dialling system and experienced fewer wrong numbers. Remote service observations were not possible. A significant feature of these first trials was the way they highlighted the speed with which numbers could be keyed and the comparatively long time subsequently taken by the standard exchange equipment to process the information. Most of these telephones are still in use today and those who have them would give them up with some reluctance.

The results of these trials, together with information about developments overseas, led to the idea that there might be an application for press-button telephones on existing Strowger-type exchanges. Indeed, it was foreseen that if PBTs were made available later at electronic exchanges, subscribers on Strowger-type exchanges would want them despite the delay between keying a number and getting ringing tone. To test this theory and estimate the numbers likely to be

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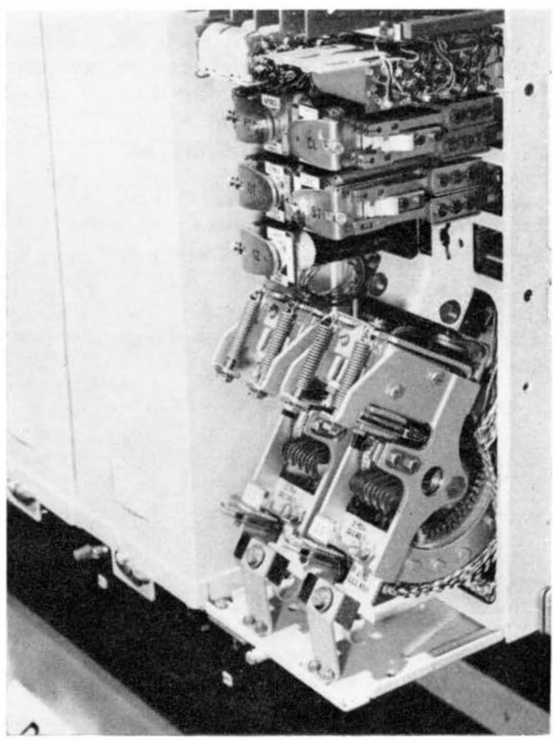
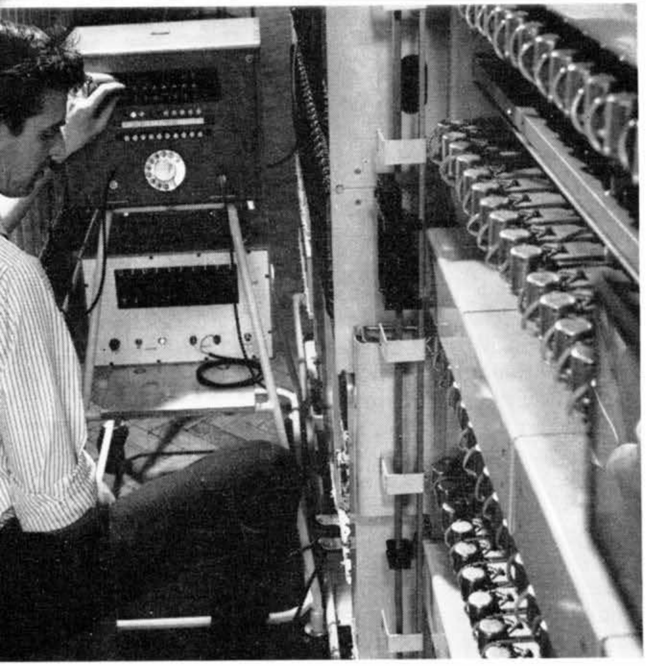
This is the special register equipment installed at Langham Exchange for converting from press-button to Strowger dialling.





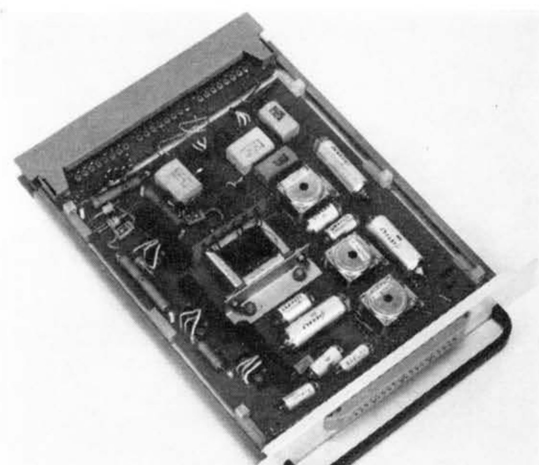
Technical Officer W. T. Fitzgerald operates a register testing equipment with "digitron" display at the Langham Exchange. The special register identifies the tone signals, stores the information at high speed and regenerates the signals in the form of slow-motion pulses needed to operate the standard exchange equipment.

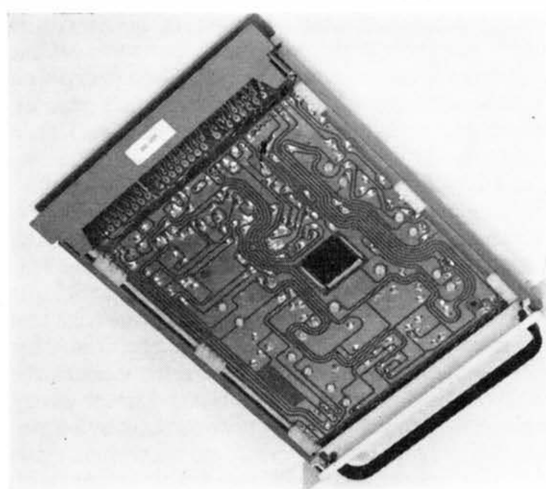
ordered, it was decided in 1964 to order 300 PBTs and use them in one exchange area to test subscribers' reactions—particularly their willingness to pay extra for this novel facility—and to assess the effect of PBTs on the "dialling" error rate and on the service generally.

However, the Voice Frequency Press-Button Telephone needs to be directly and permanently connected over an exchange line to the special equipment at the exchange and this ruled out those business subscribers who might want PBTs on extensions served by existing private automatic branch exchanges (PABXs). On PABXs, VF PBTs could not be used to set up internal calls or get access to an outgoing exchange line. Other problems were associated with PMBXs and particular plan extension arrangements. To provide PBT facilities for subscribers on these installations it was decided to produce a self-contained instrument which comprised a mains-operated storage and regenerative device in a "black box" which could be installed beneath the subscriber's desk or in another unobtrusive position near the PBT. Without this form of press-button telephone it would not be possible to explore properly the reactions of all classes of subscriber.

The exchange chosen for the trials of these two experimental systems was Langham, in central London. Langham has a good mixture of business and high-income residential subscribers; it is close enough to the Headquarters' engineering and administrative units to ensure on-the-spot attention, and there was enough space in the exchange building to erect the new racks and special equipment needed. Contracts for the apparatus and

Below (left) the front and (right) the reverse sides of a power and miscellaneous panel of a press-button telephone multi-frequency receiver.





equipment were placed in 1964 with General Electric Company Ltd. and Ericsson Telephone Ltd.

The first PBT brought into public service in the Langham area was installed on 10 January, 1966, by Post Officer Fitter Arthur Aylott in the office of Mr. F. Scott Matthews, Chairman and Managing Director of Colgate-Palmolive Ltd., in Oxford Street. Before this, however, the Post Office sent illustrated postal questionnaires to a random sample of nearly 400 Langham subscribers. These questionnaires were despatched before it became public knowledge that the trials were to be held. Suitable questions were included to find out how interested subscribers were in Trimphone and automatic dialling aids as well as PBTs, thus screening the main purpose. About 160 respondents said that they were interested in PBTs but of these only 100 (about 25 per cent) were sufficiently interested to want to know when, if at all, PBTs would become available. These 100 subscribers formed the nucleus of the trial and the balance of 200 was made up by more random sampling of Langham subscribers who were informed at the outset that the Post Office needed people to help test the experimental PBTs.

An essential feature of the trials is that for the first three months the equipment is provided free of charge. This gives the Post Office and the customer a fair opportunity to assess all aspects of the new equipment. At the end of the free trial and if the Post Office decides to keep the experimental systems in operation, the subscribers will be given an option to retain their PBT for an extra rental or have their old installation reinstated. The outcome of these offers will be an important factor in determining future marketing policy for PBTs on both Strowger and electronic exchanges.

The problem of relating the results of the Langham, and later the Leighton Buzzard, market trials with national requirements has already been explored. One step towards a possible solution is the despatch to a random sample of subscribers all over the country of a postal questionnaire similar to that sent at the outset to the Langham subscribers. It may then be possible to compare the attitudes in Langham with the attitudes over the whole country and make some assumptions regarding the final outcome in Langham with the likely outcome if press-button telephones are introduced nationally.

THE AUTHOR

MR. H. W. JOSE, *Assistant Controller in the Apparatus and Services Group of the Forecasting and Market Research Division of the ITD's Marketing Branch, joined the Post Office as a Telegraphist in 1940. He was promoted Assistant-Supervisor in 1950 and Telecommunications Traffic Officer in 1955 before becoming Assistant-Sales Investigation Officer in 1956 and Sales Investigation Officer in 1962.*

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SATELLITE CONTRACTS FOR THE POST OFFICE

THE United States Communications Satellite Corporation has awarded three study contracts to the British Post Office totalling 240,000 dollars (about £80,000) for research into three major areas of technology in communication by means of satellites.

The studies are being carried out in co-operation with five British companies: The Marconi Company, Plessey, The General Electric Company, Mullard and Standard Telephone Laboratories, who will act as sub-contractors to the Post Office.

The object of one of these studies is to compare the cost of using the various alternative methods which might be adopted for modulating the radio carrier.

A second study will involve measurements to check in practice the theoretical solutions proposed to allow a satellite transponder to relay signals from several earth stations at once. This would allow a very important advance to be made on the *Early Bird* satellite, in which each of the two transponders can handle only one signal at a time. Considerable importance attaches to this study which may well influence the way in which satellites of the global system to be launched in 1968 will be used.

The third study is concerned with so-called medium altitude satellite systems. With such satellites, particular problems arise because of compression or stretching of the frequency spectrum due to Doppler effect. In addition, a very brief loss of continuity occurs every few hours when it is necessary to change over from one satellite passing out of sight to another coming into view. Techniques to cope with these problems are the subject of the third study.

TAKE 625 LINES, BOY — By Post Office Cable!

By P. M. NEWEY

The Post Office will be supplying the coaxial cable network for the new closed circuit television-education service which will be made available to 1,300 schools and colleges in Inner London by 1970

Student teachers at the Avery Hill College of Education watch a map-reading class in progress at the Kidbrooke Girls Comprehensive School, a mile away.

THE Post Office will play a big part in the closed circuit television education service which the Inner London Education Authority will be setting up in the next few years.

It will provide the whole of the coaxial cable network which will carry the service to 1,300 schools and colleges in the Inner London area.

The new scheme—the biggest project of its type in the country and probably the largest in the world—is expected to be brought into operation in some of the London schools by September, 1968, and in all schools and colleges by 1970. The first to receive the service will be schools in the three boroughs of Islington, Hackney and Tower Hamlets.

The transmitting studio, which will be set up in an old school building at present used by the Laycock Secondary School in Highbury, will be equipped by contractors to the Inner London Education Authority who will also provide the receivers in the schools. Ultimately, the system will be able to transmit simultaneously at least six programmes on 405 or 625 lines and in colour when required. For a teacher to be able to select from a number of programmes at classroom level is an essential aid to proper educational time-table planning. This flexibility, coupled with the facility

An Avery Hill College lecturer and pupils at Kidbrooke during a map-reading lesson. The TV camera transmits the scene to the student teachers.

to plan programmes to meet a local education authority's own requirements, gives multi-channel closed circuit television its special attraction.

The Post Office network will be based on a transmission system designed to operate on a single pair coaxial cable and, by means of frequency division multiplex techniques, to transmit the six television channels in vision and sound in the very high frequency range of about 40–140 Mc/s.

After leaving the Highbury studio, the network will branch into a number of main and subsidiary feeders to serve the schools. Transistor line amplifiers and branching devices recently developed by the Engineering Department and designed for mounting underground will be installed mainly in existing underground accommodation or in telephone exchanges. The use of modern transistors is expected to provide a high degree of reliability within a very compact design.

The integrated planning which a scheme of this type allows, and its extensive use of existing ducts has made Post Office rentals highly competitive. The total annual cost to the Inner London Education Authority of providing and maintaining the 300 or so miles of coaxial cable and about 1,700 amplifiers which the system will use will be about £100,000.

Local authority interest in closed-circuit television education began in a big way in 1963 with the introduction of television programmes for schools in Glasgow over a network provided by a relay company. At about the same time, the Engineering Department of the Post Office was carrying out studies into ways of reducing the cost of closed-circuit television. These studies led to the conclusion that for schools television requiring the simultaneous distribution of several programmes, a VHF system was likely to be more economical. On the other hand, single channel point-to-point links are more economically provided by means of low loss pair type cable, each pair being equipped for transmitting one vision channel in the 0–5 Mc/s range. Suitable equipment for this method has also been developed by the Engineering Department.

Examples of this latter type of facility are isolated links between schools and training colleges or contribution links from remote sources in a schools network to a central studio for general distribution. The cost of providing channels on pair type cables, which require a separate pair of conductors for each channel, varies roughly according to the number of programmes. In the VHF system, each additional programme requires terminal equipment only and costs are therefore increased only marginally.

The Post Office has been asked to submit quotations for providing the communications links

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TELEVISION in schools is not new. For several years many local authorities, including London, have provided the means for the BBC and ITA schools programmes to be received in school classrooms by way of aerials erected at the schools or over relay company wires.

Nor is educational closed circuit television entirely new to Britain. Small-scale experiments have been carried out at Hayes, Middlesex, and Havant, Hampshire, and a few teachers' training colleges have been linked to local schools for appraisal and training purposes.

It is a big step, however, from using television to supplement the curriculum with broadcast programmes, or as a training aid, to producing programmes locally as an integral part of the timetable. This was first done in Britain by the Glasgow Education Authority which, since last August, has been distributing modern language and mathematics lessons to its schools and colleges from its own studio.

Closed circuit educational television has a number of considerable advantages. Apart from what it can offer in teacher training, it enables specialist subjects and intricate or dangerous scientific experiments to be shown to a very wide audience of pupils; gives additional impact to certain subjects; and helps to overcome the shortage of specialist teachers. A full complement of teachers will still be needed at the receiving end to supervise classes and follow up the televised lessons which will remain only a part of a class's timetable.

". . . A full complement of qualified teachers will still be needed at the receiving end . . ."

for closed circuit television education services in a number of other cities and a scheme for 100 schools in Plymouth has been approved. The University of Sussex has been considering the introduction of a similar Post Office scheme to link it with a group of schools and colleges in Brighton and the Engineering Department is studying the plans of other universities to link groups of their buildings by closed circuit television.

Other authorities are almost certain to follow London's lead. To plan the allocation of its resources as far in advance as possible, the Post Office has now written to the education authorities of all the largest boroughs in the country telling them of the facilities available.

The new transmission systems whose development has been stimulated by educational closed circuit television promise to have applications in a much wider field. Indeed, the new equipment designs have already been applied to single channel links for traffic control on sections of the M4 and M6 motorways.

THE AUTHOR

MR. P. M. NEWEY *joined the Post Office as a temporary Principal on secondment from the South Eastern Gas Board in January, 1964. Since then he has been engaged on the private services duty in the Inland Telecommunications Department's Tariffs and Legislation Branch.*

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New Post-Graduate Awards

WITH the primary aim of furthering research and development expertise of special value to the Post Office, a number of awards is to be made to selected staff each year for post-graduate courses at universities with facilities for research or advanced studies into problems of particular interest to the Post Office.

The awards—for periods of one, two or three years—will, in appropriate cases, enable the holders to qualify for a Master of Science or a Doctor of Philosophy degree. Initially, they will be granted for courses in telecommunications science and engineering. The scheme is expected to come into operation in September.

This new scheme is a further step forward in the Post Office arrangements for providing special training for its technical staff. Student apprentices, normally recruited straight from school with qualifications to take a Science or Engineering degree course, are given a year's practical training in the Post Office before being sent—at Post Office expense—to a university or college of advanced technology. In addition, an annual competition is open to Post Office staff who have obtained an Ordinary National Certificate with high marks in Engineering or an appropriate combination of GCE certificates at "O" and "A" levels, and successful candidates are sponsored for a full-time sandwich course leading to a B.Sc. degree.

The Future of Telecommunications

Outlining some of the fascinating possibilities in the years ahead, the Engineer-in-Chief warns against over-optimism and stresses the need for greater productivity in every sphere of Post Office work

Picturephones could affect the shape of the transmission networks. This experimental videophone, produced by the Plessey Electronics Group, is capable of operating over normal telephone circuits.

WHAT developments are likely to take place in telecommunications in the next 50 years? How will they affect the Post Office and its customers and how can these developments be most efficiently and economically achieved?

These were the questions which the Engineer-in-Chief of the Post Office, Mr. Donovan A. Barron, CBE, answered when presenting the inaugural lecture of the recently formed Institution of Electrical and Electronics Technician Engineers.

"The speed of technological advance is such that anybody who tries to forecast the future to any distance ahead is sticking his neck out a long way," warned Mr. Barron. "One can only hope to draw intelligent conclusions from current trends and the evidence of the latest research, coupled with experience, intuition and foresight.

"In 50 years' time the population of Britain may be 75 million and there is likely to be an ever-improving standard of living, with a maximum exploitation of scientific and technological development. It is against that background that any prophesy must rest.

"At present," he said, "there were some six million exchange lines and 10 million telephones. In 50 years' time there might be 25 million exchange lines and between 40 to 50 million telephones. Today the total number of local and trunk calls is about 16 million a day. In 50 years this figure may swell to 150 million a day.

"In these circumstances what sort of picture do we get of the national telecommunications service? Some things can be taken for granted. For example, all exchanges will be automatic; there will be STD throughout the country; greater speed of connection; new facilities; easier methods of dialling and so on, all based on the technological upsurge and the ever-increasing use of electronics and miniaturisation.

"The ordinary telephone of the future will have

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A wide range of new subscribers' apparatus is now being developed. Left: One of several experimental repertory diallers. Right: The new loud-speaking telephone No. 4A, among the most advanced of its type in the world.

novel features and be easier to use. More and more we shall tend to sell installations rather than just a line. There will be telephones upstairs and downstairs and in the bathroom rather than simply a telephone in the hall. Wall telephones will become more popular.

"With the rapid expansion of national and international dialling more digits will have to be dialled and this will increase the need for dialling to be made easier—a task on which we are already doing a lot of work. There will be push-button telephones and sending machines which can set up calls to frequently-used numbers by a simple selection operation.

"There will be lots of other aids in ever-increasing quantities. We are looking at answering machines, data sending devices, burglar and fire alarms and meter reading equipment.

"One does not yet know what demand there might be for some sort of picture-phone service. Such a requirement could make a very big difference to the future shape of our transmission networks."

Mr. Barron went on to say that private automatic branch exchanges will become more and more truly automatic so that there will be a decreasing need for switchboard operators. Increasingly, arrangements will be made for people to dial directly into the particular extensions they want. There would be all sorts of new facilities: short code dialling; transfer of calls between extensions; the ability for any extension user to be put through to a dictating machine; and data handling. "PABXs could well become part of computer software and anybody with a computer could run a PABX as a sideline."

Commenting on developments which he foresaw in connecting subscribers to local exchanges, Mr. Barron said that for a long time to come there would be a need for distribution poles because this was still the cheapest way for the Post Office to make the connections.

There would also be a continuing need for ducts but in future he thought many of them would

The Engineering Department is carrying out trials with this American construction vehicle which can erect aerial cables three or four times faster than any other method.

be in new materials such as P.V.C. One of the big problems was cabling these ducts but this would be overcome by using machines such as the ductmotor—a Post Office invention—which, using compressed air, passed a draw-wire through a duct at the rate of about 50 feet a minute. Another problem was jointing the conductors, but here, too, advance systems were already being used experimentally which promised to reduce the time spent on this task by some 25 per cent. Trials were also being carried out with new construction vehicles which could erect aerial cables three or four times faster than had hitherto been possible, and with another device for pulling cables more rapidly through ducts. "We do not take the line that we know it all," said Mr. Barron, "and are constantly trying to find out the best from other countries and to use it."

"It is my personal conviction," Mr. Barron went on, "that we shall inevitably come to the point when a number of services will have to be combined in the interests of national economy and efficiency. I think we are bound before long to reach the stage where the telephone service, sound radio and television are supplied over a common distribution network direct to every house just as automatically as water and electricity are laid on now. This will permit the customer to have whatever he wants and could mean some very interesting developments in our local networks. We can already see in principle how it could be done. There may, for example, be small coaxial tubes in the local network which would give the appropriate bandwidth, and through which all telecommunications services could be supplied."

Speaking of possible developments in telephone exchanges, the Engineer-in-Chief said that at the moment this country was on a knife-edge. At present we had the basic Strowger switching system which was very effective but not very fast. There were faster systems, such as crossbar, which was also electro-mechanical. This system was in essence an arrangement of relays in a cross-formation that operated the necessary contacts. It was more expensive in capital outlay but it was certainly cheaper to maintain.

"We took a decision some time ago to try and jump a stage and to go right into electronic exchanges, thereby putting us and our manufacturers a stage ahead of everyone else. I think we

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Above: A Canadian construction vehicle which pulls cable through ducts very rapidly. Below: The Pentex electronic exchange recently introduced at Peterborough.

A close-up of a microwave horn aerial at the Post Office Tower in London, focal point of the nation-wide radio relay system which is being extended throughout the country.

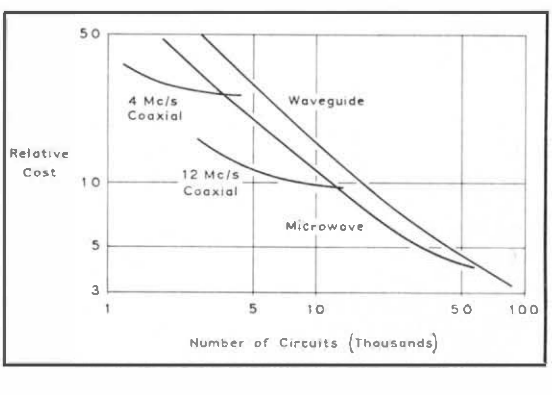
are in sight of doing that, certainly for exchanges of up to 2,000 lines. You can put two of these together to make an exchange of 4,000 lines. Exchanges of up to 4,000 lines form a very large part of the total exchanges in any country. In fact, more than half the exchanges in Britain have only a few hundreds of lines and a very large part of the export business of our manufacturers is concerned with exchanges of this order of size. In these electronic exchanges we have got a winner and in a few years I think we shall be buying as much electronic exchange equipment as our suppliers can produce. We are in sight of getting a European lead, at least, and possibly a world lead, in this field.

"Signalling between exchanges has obviously got to be carried out with the greatest possible speed," continued Mr. Barron, "because one can not have expensive international links held up while some slow national system is taking a long time to establish a call." Future signalling would be in the form of coded digital information rather than trains of impulses as at present. There were also interesting possibilities in the development of pulse code modulation which could enable data and speech to be sent more easily over the same network, and open the door to integrated transmission and switching developments.

The trunk network in Britain was at present provided mainly over coaxial cables, but was now being supplemented with a microwave radio system which had important advantages. The microwave system could provide a very large number of circuits and, because it was radio, roads did not have to be dug up, ducts laid and cables put in between the transmitting and receiving stations.

"But telephony traffic is growing very rapidly and this, with the need for more television channels, broadcasting, closed-circuit programmes, high-speed data services and possibly the picturephone, may combine to use up radio bandwidth at an embarrassing rate. The number of systems that can be put in the microwave bands is limited and it may be that the capacity of links of current types will be exhausted on the heavy traffic routes in about 10 years. We can probably go 15 years because we are now developing systems in the 11,000 megacycles-a-second band which could be used to supplement the present 2,000, 4,000 and 6,000 megacycle band systems.

"All over the world, people have been wondering for a long time if there are other ways of getting broadband communications systems of high traffic capacity. One of these is the waveguide, which is a hollow pipe through which signal energy is guided. Current thinking is in terms of a pipe about two inches in diameter, which, with signal transmission in the H_{01} mode—



Left: The 0.375-inch coaxial cable is at present limited to eight tubes. Fully-equipped with 4 Mc/s systems, the maximum circuit capacity is 3,840 circuits; with 12 Mc/s systems, 10,800 circuits. The theoretical waveguide curve suggests that this medium would be less costly than microwave radio for capacities in excess of some 60,000 circuits.

that is, one in which there is no longitudinal component of electric field—would provide up to, say, 50,000 Mc/s worth of useable bandwidth. Repeater spacing would be at about 20 miles.

"A system using the H_{01} mode would provide a uni-directional capacity of something like 250,000 speech circuits, or 100 or more television channels. The capacity needed would alter appreciably if a large-scale demand arose for picturephone facilities because of the greatly increased bandwidth that each circuit would then require.

"However," Mr. Barron warned, "there are serious considerations of economics and practicability. Such a system would cost a great deal: there is the guide itself, laying it, the intermediate repeaters, housings, and so on. There are also the practical problems of installing the system. For capacities smaller than 50,000 circuits, conventional wideband media—for example, multi-tube coaxial cables—will probably be cheaper.

"At present consideration is being given to the development of a 60 Mc/s coaxial cable system giving 10,000 four kc/s speech circuits per pair of three-eighths-of-an-inch tubes. With a smaller tube, one-sixth-of-an-inch in diameter, it is now possible to have a system which would give 2,700 circuits for a pair of tubes and since 20 such tubes could go into a cable, 27,000 circuits could be provided. The use of optical pipes and lasers, which might give 10^8 Mc/s bandwidth, were other possibilities."

An operator sets up a call on a data installation. Data systems are being rapidly developed.

On data transmission and the future uses of computers in telecommunications, Mr. Barron said, there was a growing interest in obtaining a wider range of printed characters and functions on teleprinters, for example capital and small letters and mathematical symbols. For this reason, an international standard seven-unit code was being negotiated.

The main requirements for data transmission arose from the exploitation of computers and could, therefore, be expected to increase in scale and speed as the business activity of companies was progressively integrated into computer-based data processing systems. There would be networks of lines and computers which would enable customers to transmit and receive data from one or more centralised computer installations. There would also be a need for computers to communicate with other computers. Similar demands would grow for scientific and engineering applications, particularly with the emergence of on-line computer systems in which it was possible for a large number of requirements from various data sources to be handled by a computer simultaneously. The Post Office was at present considering the possibility of using wideband 48 kc/s data circuits for speeds of up to about 40,000 bits a second. Using wider bandwidths—say, 240 kc/s—it might be possible to achieve speeds of up to 150,000 bits a second. The application of pulse code modulation techniques might even provide data speeds of between 60,000 to 1,500,000 bits a second over two-wire unloaded circuits, such speeds readily catering for computer-to-computer communication.

Computers would also be used, Mr. Barron believed, to control the operation of the international telephone network. Located in each international centre, they would talk to each other over a signalling grid and pass information in the form of high-speed data to enable routings to be decided. One problem which remained to be overcome was metering charges for international calls but he was confident that an acceptable and economic method would be found.

In spite of the tremendous advances which had been made in satellite communications, said Mr. Barron, and the obviously important part they would play in world-wide telecommunications systems, submarine cables were not yet dead and they could still provide an energetic competitor

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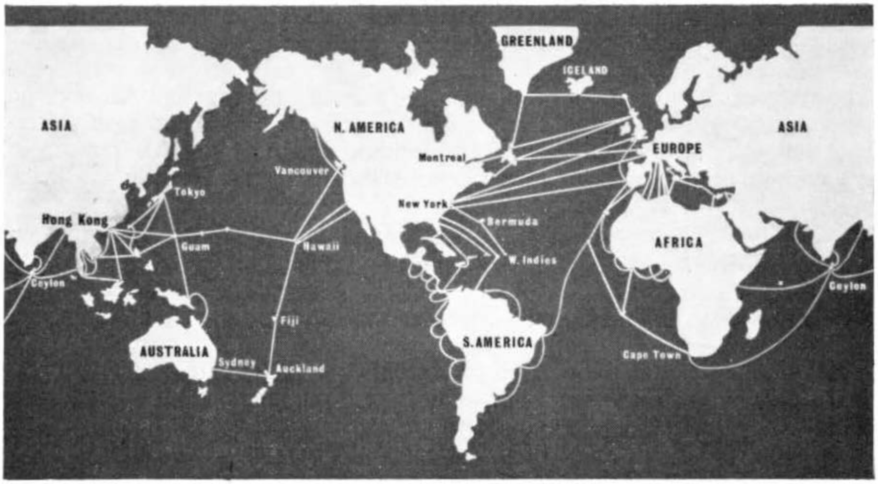

This map shows how the world might be linked by submarine cables 20 years from now.

for satellites. We were developing an ocean submarine cable system with a bandwidth extending up to about 10 Mc/s and which would be capable of providing on a single cable 1,200 three kc/s spaced circuits on routes up to 3,000 or 4,000 nautical miles. Submerged transistor repeaters would be used, spaced at intervals of about seven nautical miles, in lightweight-type cable of about one-and-a-half inches in diameter. It was expected to cost little more than twice as much as the present 80-circuit CANTAT and COMPAC type of system while giving 15 times the number of circuits. This submarine cable system could, if needed, be operational by 1970.

"I have outlined some of the fascinating possibilities in the future of telecommunications," said Mr. Barron, "but it is no good forecasting them unless one takes care to ensure that they are realisable, not so much scientifically and technically but in terms of the research, development, manufacture, installation and maintenance effort required for their achievement.

"So far as the Post Office is concerned it would be quite impossible to carry out these projects, and on the scale which I have outlined, unless either we obtain more than our share of the available national manpower—which would be wrong and unfair to other equally necessary projects—or unless we achieve such success in improving our productivity that our manpower requirements are reasonable in relation to other national needs.

"I have shown you some of the ways in which we are trying to increase our productivity. Our constant aim must be to make it possible for more construction work and more maintenance work to be done by the same number of men—not by expecting them to work unreasonably hard, but by constructive management, planning, design and the use of new tools, machines, and appliances. If we do that, the sort of things I have been forecasting will come true, with, no doubt, many others which we cannot yet foresee."

"Rapid and efficient communications are essential if the country is to make the maximum use of all its resources," said the Postmaster-General, the Rt. Hon. Anthony Wedgwood Benn, when he introduced Mr. Barron to his audience.

"Communications are vitally necessary in the drive for increased productivity and the expansion of exports.

"If we are to make the fullest use of our resources, scientists and engineers must be given the opportunity to play their full part—working closely together to ensure that new ideas are turned into plant and machinery and that the technicians are available to operate it.

"The technician engineer is of the greatest importance to the electrical engineering profession and to industry and anything which can be done to improve his status, increase his knowledge and raise his efficiency is vital."

ATME GOES ON TRIAL

By J. C. BILLEN, AMIEE

A new automatic equipment is being tried out in eleven countries, including Britain, which is designed to improve the quality of international telephone circuits and at the same time save manpower and maintenance costs

AEE A. R. Lawrence, of the Main Lines Development and Maintenance Branch, operates the main control board of the new ATME equipment. Note the tape-reader (right).

A BIG step towards further co-ordination in the field of international telecommunications is the introduction of Automatic Transmission Measuring Equipment—an automatic system for testing the transmission quality of international circuits—which went on trial recently at the International Centre in Faraday Building.

This is no isolated experiment by the Post Office but part of an extended trial taking place simultaneously in 11 European countries to improve the quality of service on international telephone lines.

The new equipment, which is designed to International Telegraph and Telephone Consultative Committee (CCITT) specifications, will, it is hoped, bring about a considerable reduction in man-power needed for testing and maintenance work. It is also expected to allow circuits to be checked more frequently than in the past. With the demand for international circuits growing at the rate of between 15 to 20 per cent a year, this automatic system of checking circuits is essential if a good transmission quality is to be maintained on international calls.

Today there are nearly 2,000 international circuits between Britain and other countries. By 1970 this number will have increased to about 3,500 and by 1980 probably to 9,000. The present manual system of checking circuits is a time-consuming business involving the withdrawal of circuits from service, sometimes for unduly long periods. Long and complicated circuits are tested once a week; shorter circuits at monthly or two-monthly intervals. With the introduction of

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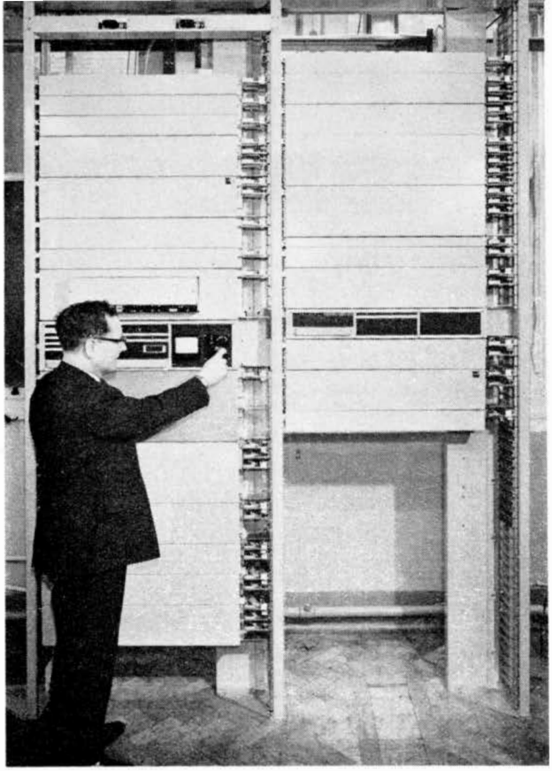


EE J. T. Gosby carries out an electrical adjustment to the measurement and control equipment during installation tests.

International Subscriber Dialling and the use of automatic methods for setting up connections, it became more difficult to identify circuits of poor transmission quality, hence the need for devising an automatic checking system.

The transmission parameters which have the greatest impact on service given to subscribers are the circuit loss and the noise on circuits which must not be so great as to impair unduly the transmission quality of the telephone connection between subscribers.

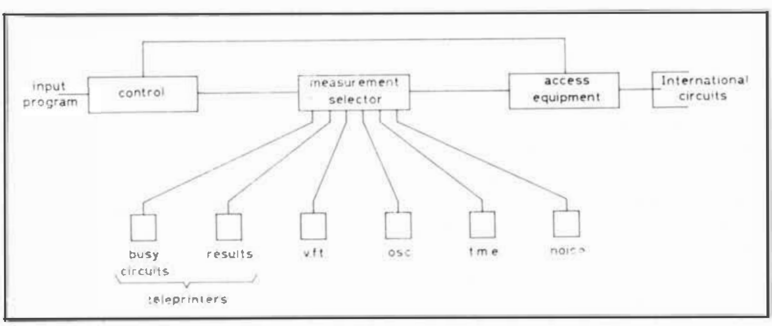
Under normal conditions, circuit loss can vary because of temperature effects on cables and equipment, power variations, and so on. Under fault conditions the circuit loss can be abnormally high or the transmission path can fail completely. Excessive transmission loss and noise deficiencies can also seriously affect the operation of automatic signalling arrangements.

The new automatic equipment will carry out transmission and noise measurements automatically and the results, printed out in an internationally-agreed format on page printing teleprinters, will appear at both ends of the circuit under test. To ensure that the equipment will operate satisfactorily with similar equipments in other countries, the CCITT specification defines all the essential technical features but leaves as much freedom as possible in those features which are local and peculiar to the international centres of each Administration.

The main elements of the Automatic Transmission Measuring Equipment are the Control Unit: a Measurement Selector; Access Equipment; a Transmission Measuring Equipment Unit; a Noise Measurement Unit; a Test Oscillator; a Voice Frequency Telegraph Equipment and a Teleprinter.

The Control Unit is itself controlled by instructions fed into the input programme terminals by punched tape or cards. Initially, punched tape will be used. The input programme indicates which circuits are to be tested and what test cycles are to be carried out for a particular sequence of tests.

The Measurement Selector calls into operation the appropriate item of measuring equipment to perform a particular measurement and thereafter the elements required to print out the results. The Access Equipment connects the ATME to the particular circuit to be tested. The Transmission Measuring Equipment Unit measures the actual level of the test signal received over the circuit under test from the distant end.



This diagram illustrates the main parts of the new automatic transmission measuring equipment.

The Noise Measuring Unit observes the amount of noise on a circuit for a period of five seconds and compares the average level with a pre-determined fixed level. The Test Oscillator, which supplies the test signal, incorporates three generators with frequencies of 400, 800 and 2,800 cycles a second, any one of which can be applied to the circuit under test. The Voice Frequency Telegraph Equipment generates the voice frequency telegraph signals which are used to transmit the results of the measurements over the tested circuit. The teleprinters are page printing machines similar to those used for international telegraphy but which print only figures.

The time required to carry out the tests on a circuit, including the setting up of the call, varies from about 16 seconds on an 800-cycles-a-second transmission measurement in both directions to about 37 seconds for a full cycle of tests, including noise and transmission loss measurements at 400, 800 and 2,800 cycles-a-second in both directions. Thus, the new automatic equipment can fully test some 100 circuits an hour. This is much faster than manual testing and means that circuits need to be withdrawn from service for a much shorter time.

The first trial equipment is now operating at the International Maintenance Centre in Faraday Building, where all international circuits between Britain and the rest of Europe are tested. A second trial equipment has been installed in Dial House, Manchester, to test circuits in the Post Office national network.

There is no doubt that future automatic testing techniques will be needed for all international circuits, including the longer ones between continents which are fast becoming the backbone of the world telephone network. Equally, it is clear that future equipment should include facilities for testing overall signalling as well as transmission quality and that it should be universally compatible. It may well be, too, that future automatic devices will be able not only to detect faulty circuits but also take corrective action and ultimately, maybe, locate and remove faults at source.

THE AUTHOR

MR. J. C. BILLEN, AMIEE, *is an Assistant Staff Engineer in the Submarine Cable Section of the Engineering Department Main Lines and Development Branch. After 10 years' Area and Regional Service he came to Main Lines Branch in 1940, and has been concerned with the development of the international telephone service and submarine cable systems. He is a regular UK representative at CCITT meetings and is chairman of a CCITT Working Party dealing with the problems of intercontinental circuit maintenance.*

★

Mr. S. J. Edwards

A New Director for the South-West

Mr. S. Scott

THE new Director of South-Western Region is Mr. S. J. Edwards, MIEE, who took over his duties from Mr. Stanley Scott, OBE, MC, on 19 February.

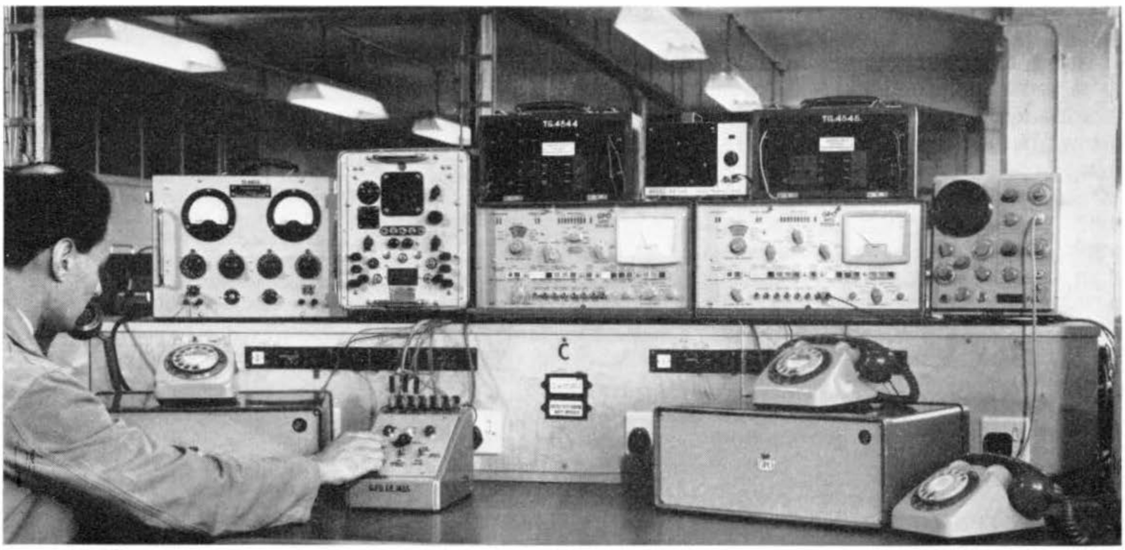
Mr. Edwards, who joined the Post Office in 1931 as a Probationary Inspector, served in South-Western Region in various posts ranging from Inspector at Bideford to Efficiency Engineer at Regional Headquarters before becoming Telephone Manager at Cambridge in 1945. He was later Telephone Manager at Brighton, an instructor at the Post Office Management Training Centre and Chief Regional Engineer in the London Telecommunications Region and in May, 1965, was appointed Deputy Regional Director of South-Western Region.

The retiring Director, Mr. Scott, joined the Post Office in 1922 as a sorting clerk and telegraphist, serving subsequently as a Clerical Officer, Assistant Surveyor 2nd Class and Assistant Postal Controller until 1940. During World War Two he served with the Royal Corps of Signals, winning the Military Cross in France in 1940. As a Lieutenant-Colonel, he later commanded various Signals units in North Africa and Italy. After returning to the Post Office in 1945 as an APC at Leeds, Mr. Scott moved to London Postal Region in 1951 and became Deputy Regional Director four years later. In August, 1955, he was appointed Chief Inspector of Postal Services at Post Office Headquarters and in 1956 Assistant Secretary in charge of the Postal Mechanisation Branch. He became Director of South-Western Region in 1962 and was appointed a member of the Government's South-West Regional Economic Planning Board when it was set up in 1965.

The Post Office plans to set up a series of centres throughout the country which will test, maintain and repair customers' Datel installations. This article describes the work which has been carried out at the first of these Centres during the past year

TEST CENTRES FOR DATEL

By N. G. SMITH and F. C. LEAVITT



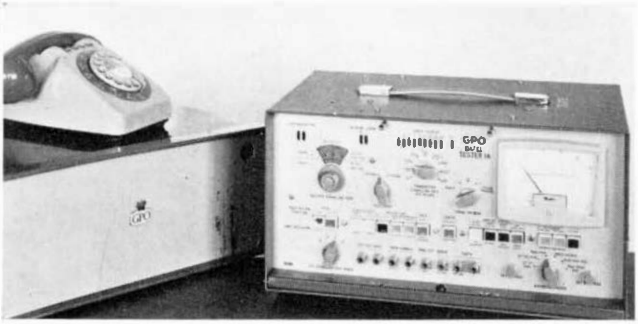
At the London Test Centre, Technical Officer A. Huggins remotely tests a customer's installation.

IN December, 1964, the Post Office set up a prototype Datel Test Centre in central London to test equipment supplied for the Datel 600 Service. This first Datel Test Centre became operational in January, 1965, when the first Datel Modem—the Post Office equipment fitted in customers' premises to provide Datel 600 Service—was installed.*

The basic function of the Datel Test Centre is to test modems as they are fitted for customers and subsequently to locate and initiate clearance of faults. The loss of a data transmission link can be both costly and embarrassing to the user. To meet the need for faults to be rapidly located, a facility has been included in those modems which can transmit in both directions simultaneously to enable them to be tested from a Datel Test Centre with the customer's assistance. This method of testing enables a quick and relatively cheap test to be made to verify whether the Post Office modem is working satisfactorily. It is then only necessary for an engineer to visit the installation when a fault exists. Service will generally be restored by replacing the faulty item which is then returned to the Datel Test Centre for repair.

When a customer's data transmission link fails, the customer is required by the service agreement to check that his own equipment, at each terminal, functions correctly. If the customer's tests indicate that his equipment is working correctly and that the failure appears to be due to a malfunction in

**The Datel Services were described briefly in the Spring, 1965 issue of the Journal, and one of the first Datel 600 Service installations in the Summer, 1965 issue.*



A Datel Tester No. 1A, being used to test a Datel modem at customer's premises.

either the Post Office modem or the telephone line, the fault is reported to the local Telephone Exchange as a normal service complaint. Here, the test clerk checks the telephone exchange line or private circuit. If this is fault-free, a preliminary test of the modem is then made by asking the customer to transmit data signals. The test clerk listens to the data signals and, where facilities exist, also measures the power level of the signals. The complaint, together with the results of the preliminary test of the modem, is then passed to the Datel Test Centre.

At the Datel Test Centre modem equipment is available which enables any customer's installation to be correctly "matched" and tested. Depending on the nature of the fault and on the result of the preliminary test, the testing engineer at the Centre decides how best to go about locating the fault so that service can be re-established as quickly as possible. Generally, he decides which terminal is most likely to cause the difficulty and initiates a remote test. A telephone call is first set up to the suspect modem and the customer disconnects his own data terminal equipment by withdrawing the rectangular "interface" plug from the back of the modem which terminates the cable from the customer's private terminal equipment. The customer then presses a push button on the modem, revealed after the plug is removed, when he hears a tone in the associated telephone. He continues pressing the button until the tone disappears. The tone which comes from the test modem at the Datel Test Centre, generally disappears a fraction of a second after the button is pressed and this indicates that the customer's modem has switched to the remote test mode. The Datel Test Centre can then test the modem since a loop will have been established through the equipment. Removal of the test modem by switching back to telephone connection at the Datel Test Centre, removes the tone, restores the customer's modem to normal operation and reconnects his telephone to the telephone line.

After this remote test, which usually takes only about 10 to 20 seconds, the customer can be told of the result and of the action which will be taken to restore service.

In addition to maintenance testing, the Datel Test Centre also directs installation tests. Under the direction of the Datel Test Centre an engineer at a new installation causes the modem to transmit signals that can be measured and analysed at the Centre. He also measures the output of the modem in the customer's premises when the modem at the Centre is transmitting signals. Some trimming adjustment is normally required during installation. The results of the installation test are recorded and filed at the Datel Test Centre for reference during subsequent maintenance testing.

The test equipment provided at the Datel Test Centre includes a Datel test set, a frequency counter, a transmission measuring set and test Datel modems. The heart of the test equipment is the Datel Tester 1A which, being portable, can also be used at the customer's premises. When connected to a modem by means of the "interface" plug, in place of the customer's data terminal equipment, the test set functions in the same way as the customer's equipment—exercising control of the modem through push-button switches and indicating the condition of the modem by means of lamps. It can send binary signals into the modem in the same electrical form as the customer's data transmitter to either the data or the low-speed return channel over a wide range of data signalling rates. It can also examine the binary signals from the modem and visually indicate distortion, again over a wide range of signalling rates. Before the Datel Tester 1A became available, these three tasks were performed by a specially constructed control box and a Telegraph Distortion Measuring Set. The London Datel Test Centre uses both the tester and the earlier apparatus. Two telephone exchange connections are provided, so that two Datel installations can be tested simultaneously.

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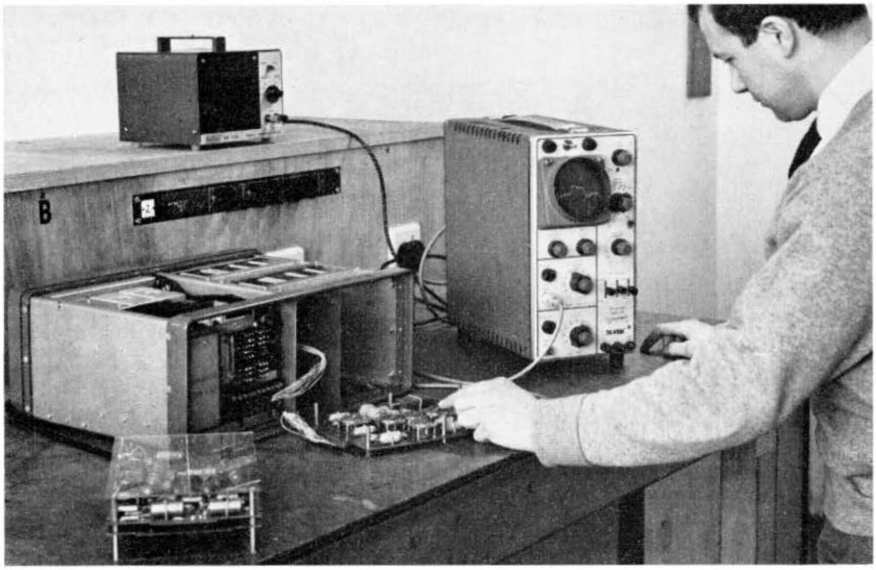

Technical Officer K. Knightson checks a Data modulator, part of a Datel modem, while carrying out repairs at the London Datel Test Centre.

The Datel Test Centre is also the Repair Centre for faulty Datel apparatus and for this work uses additional test equipment such as an oscilloscope, a variable oscillator in the audio range, and an attenuator to help locate unit faults. A routine fault-locating technique has not yet been fully developed, largely because very few faults have so far occurred in modems in service. If, as is hoped, this low fault rate continues, it may be some time before a standard technique is decided.

This first Datel Test Centre has provided valuable experience in determining the setting-up and maintenance requirements for Datel installations where the Post Office provides the modem. The rapidly growing Datel Services will clearly need a number of Datel Test Centres and it is anticipated that at least 12 will be required to satisfy the needs of customers throughout the country. Although it is planned for the centres to deal initially only with equipment associated with the Datel 600 Service, responsibility for other Datel services will be assumed as they are introduced. Additional test equipment will be provided as the need arises.

A programme of Datel Test Centre construction has begun. A centre in Birmingham is expected to be in service by the summer of this year and a second Centre in central London is expected to open shortly afterwards. As the service expands and additional Datel Test Centres come into operation, the responsibility for testing new Post-Office provided modems and existing installations will be allotted to each new Centre on a geographical basis. Testing responsibility will be transferred to each Test Centre gradually to allow engineers in the new Centres to acquire experience and confidence. This method of integrating the Centres into the national network should ensure that the quality of maintenance service does not deteriorate. Transferring responsibility for modems from one Datel Test Centre to another will not affect customer's fault-reporting arrangements since these will continue to be made to the local Telephone Exchange and not direct to a Datel Test Centre.

THE AUTHORS

Mr. N. G. SMITH *is an Executive Engineer in the Engineering Department's Telegraph and Data Systems Branch. He joined the Post Office as a Youth-in-Training in Bedford Telephone Area in 1942 and after service with the Royal Signals transferred to Long Distance Area as Technical Officer and Assistant Engineer. He was promoted to his present appointment in 1961.*

Mr. F. C. LEAVITT *joined the Post Office Engineering Department in 1948 as a Labourer-Trainee in the City Area. He was promoted from Technical Officer to Assistant Engineer in 1959 and is at present concerned with maintenance techniques for telegraph machines and Datel equipment in the Telegraph and Data Systems Branch, Engineering Department.*

A Little "Neddy" for the Post Office

The Post Office now has its own Economic Development Committee—the first State-run industry to have one.

The new Committee will have three main tasks. First, it will examine the economic performance, prospects and plans of the Post Office and assess from time to time its progress in relation to the national growth objectives. Second, it will consider ways in which the Post Office can contribute more effectively to these objectives; and third, it will provide information and forecasts to the National Economic Development Council.

The new Committee will consist of 14 members headed by the Chairman, Sir Andrew Crichton, who is Managing Director of the P and O Steam Navigation Company and Vice-Chairman of the British Transport Docks Board. Five members are from Post Office Headquarters. They are Mr. K. H. Cadbury, MC, Director of Inland Telecommunications; Mr. G. R. Downes, Director of Postal Services; Mr. J. H. Merriman, Deputy Engineer-in-Chief; Mr. E. W. Shepherd, Director of Finance and Accounts; and Mr. S. Wood, Director of Statistics and Business Research.

There are five trade union members. Mr. L. V. Andrews, Deputy General Secretary of the Union of Post Office Workers, and Mr. S. A. Seaton, General Secretary of the Association of Post Office Controlling Officers, will represent the Post Office Departmental Whitley Council Staff Side. The Post Office Engineering, Factories and Supplies Departmental Whitley Council Staff Side will be represented by Mr. T. Edis, Assistant Secretary of the Civil Service Clerical Association; Mr. J. K. Glynn, General Secretary of the Society of Telecommunications Engineers; and by Mr. Charles Smith, General Secretary of the Post Office Engineering Union. There will be four independent members: Mr. D. J. Palmar, of the Department of Economic Affairs; Professor A. W. McIntosh, of the London Graduate School of Business Studies; Dr. D. F. Jacques, of the National Economic Development Office; and another still to be appointed.

The setting up of the new Economic Development Committee—already christened "Little Neddy"—coincides with the planned increase in Post Office capital investment from the present £220 million a year to about £330 million in 1970. This rate of expansion is greater than that planned for any major nationalised industry. During the next five years the efficiency of the nation's business will be influenced very greatly by the efficiency and expansion of Post Office services, particularly in the telecommunications field. The increased efficiency of the Post Office will, in turn, depend largely on the success of management and staff in increasing productivity by pushing ahead as rapidly as possible with automation, streamlining procedures and making the best possible use of manpower.

TELEPHONISTS GET A NEW CHAIR

The new chair—with telephonist

A more comfortable and up-to-date chair for telephonists is undergoing extensive trials.

The new chair, for use by operators at cord-type controlling positions, has a new arrangement for quickly adjusting the seat to any height between 22 and 28 inches from floor level and incorporates a screw-controlled mechanism for adjusting the height of the back-rest. Other improvements include a built-in ticket holder on the back of the chair, a wider footrest, a new base and an improved type of upholstery. The seat has a foam foundation covered by vynair.

The new chair is being issued initially to new exchanges and to replace chairs beyond local repair in existing exchanges.

Telecommunications Statistics

	Quarter ended 30 Sept., 1965	*Quarter ended* 30 *June*, 1965	*Quarter ended* 30 *Sept.*, 1964
Telegraph Service			
Inland telegrams (including Press, Railway Pass, Service and Irish Republic)	**3,009,000**	2,747,000	3,522,000
Greetings telegrams	**732,000**	619,000	754,000
Overseas telegrams:			
Originating U.K. messages	**1,886,000**	1,724,000	1,915,000
Terminating U.K. messages	**1,900,000**	1,679,000	1,871,000
Transit messages...	**1,483,000**	1,343,000	1,264,000
Telephone Service			
Inland			
Net demand	**193,000**	186,000	165,000
Connections supplied	**185,000**	185,000	159,000
Total orders in hand	**184,000**	176,000	173,000
Total working connections	**6,244,000**	6,138,000	5,797,000
Shared service connections (Bus./Res.) ...	**1,219,000**	1,197,000	1,135,000
Effective inland trunk calls	**209,361,000**	198,540,000	186,934,000
Effective cheap rate trunk calls...	**49,679,000**	45,036,000	44,943,000
Overseas			
European: Outward	**1,739,000**	1,611,000	1,496,000
Inward	*	1,387,000	1,206,000
Transit	**†14,000**	14,000	12,000
Extra European: Outward	**†154,000**	151,000	129,000
Inward	**†193,000**	189,000	165,000
Transit	**†26,000**	25,000	19,000
Telex Service			
Inland			
Total working lines	**16,000**	15,000	14,000
Metered units (including Service)	**42,153,000**	41,828,000	39,421,000
Manual calls (including Service and Irish Republic)	**17,000**	18,000	48,000
Overseas			
Originating (U.K. and Irish Republic) ...	**†2,703,000**	2,499,000	2,205,000

Figures rounded to nearest thousand.

*Figures no longer available.
†Includes estimated figures.

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GPO

TELECOMMUNICATIONS CABLES

Pirelli General are in a position to advise on complete Telecommunications schemes and are organised to manufacture and install cables for distribution and trunk services; also carrier and all types of coaxial cables.

Pirelli General also manufacture cables to meet special requirements of Public Utilities or of industry.

PIRELLI GENERAL CABLE WORKS LTD. SOUTHAMPTON TEL: SOUTHAMPTON 20381

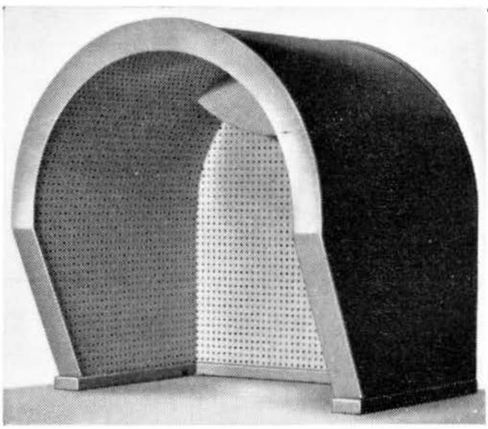
P9315

WHITELEY

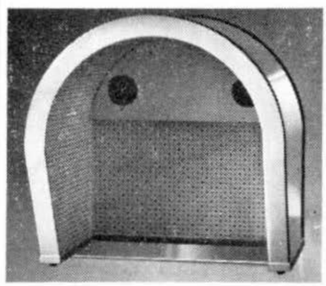
for acoustic hoods

All noisy environments such as factories, workshops, department stores and hotels require the facility of an acoustic hood which permits telephone conversations to be held without the interference of annoying background noises.

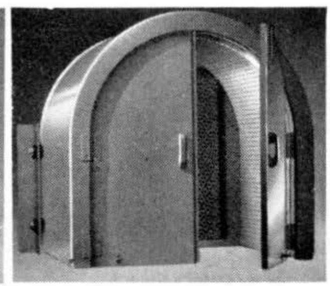
Whiteley acoustic hoods are strongly made from resin bonded ply and finished in a cellulose enamel which makes them suitable for indoor or outdoor use.



Standard Hood Dimensions
25″ high × $20\frac{1}{4}$″ deep × $24\frac{1}{2}$″ wide



Fitted with loudspeakers

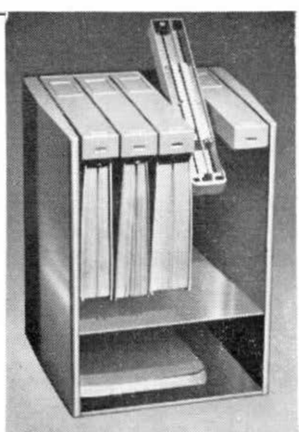


Fitted with doors for outside use

Also available with internal light and/or a storage shelf below hood.

& directory holders

Directory Holder dimensions
$17\frac{1}{4}$″ high ×
$13\frac{1}{2}$″ wide ×
$13\frac{5}{8}$″ deep



These attractive, and extremely functional, directory holders will hold five directories neatly and securely, in individual swivel holders permitting easy identification and reference. The lower shelf provides additional storage space. The units are of cast alloy, finished in an attractive grey epoxy resin enamel and constructed to strict G.P.O. design specifications.

For further details please write or telephone:—

WHITELEY ELECTRICAL RADIO CO LTD
MANSFIELD · NOTTS *Tel: Mansfield 1762/5*

Marconi self-tuning H.F system—
the first in the world to be station
planned from input to output.

breakthrough

MST 30kW transmitter type H1200

An h.f linear amplifier transmitter for high-grade telecommunications.
Frequency range: 4-27.5 Mc/s.
Output power: 30 kW p.e.p, 20 kW c.w.
Meets all CCIR Recommendations.

saves 80% floor space

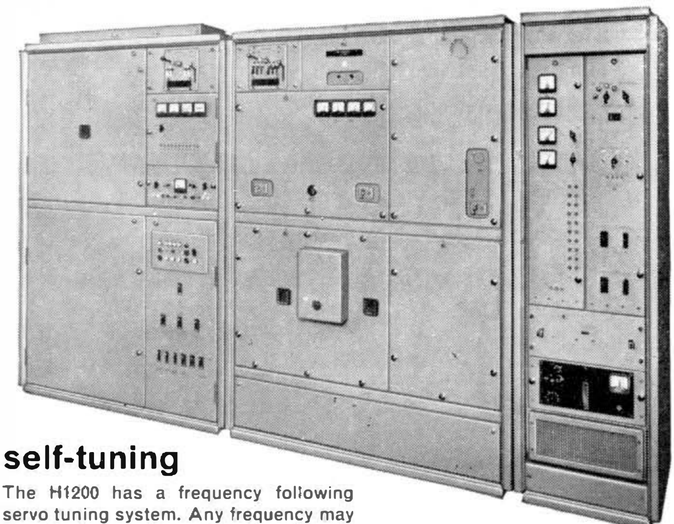
Transmitters can be mounted side by side and back to back or against a wall. Floor-ducts are eliminated and all power supply components are built-in. These features lead to smaller, simpler, cheaper buildings or more services in existing buildings.

rugged reliability

R.F circuits have been simplified and the number of mechanical parts reduced to a minimum. Highest engineering standards are applied to the design of these parts: stainless steel shafts in ball-bearings in heavy, rigid, machined castings; stainless steel spur gears meshing with silicon bronze; heavy r.f coil contacts with high contact pressure. Specified performance is maintained with ample margins.

simplicity

MST reliability allows continuous unattended operation with extended or remote control, saving maintenance and operating staff. Any fault in the servo control circuits can quickly be located with simple test routines. Transistors and printed wiring gives these circuits maximum reliability.



self-tuning

The H1200 has a frequency following servo tuning system. Any frequency may be selected on the synthesizer decade dials in the associated MST drive equipment; the unattended transmitter automatically tunes itself in an average time of twenty seconds. Final stage tuning and loading servos continuously ensure automatic compensation for changes in aerial feeder impedance caused by weather conditions. Self-tuning gives *one-man* control of an entire transmitting station.

Marconi telecommunications systems

The Marconi Company Limited, Radio Communications Division, Chelmsford, Essex, England

LTD/HS1

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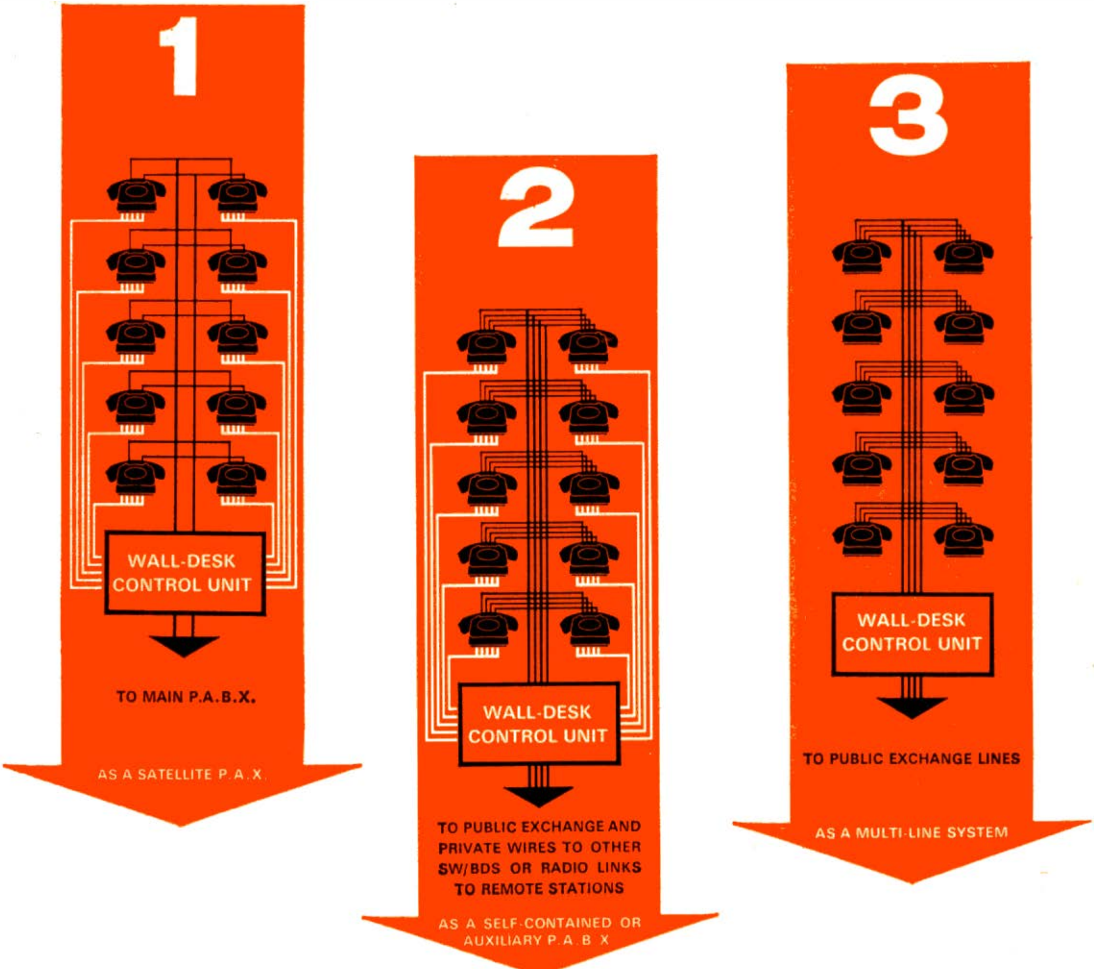

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Makes a triple attack on telecommunications problems

'Multiphone', as its name suggests, is capable of a multiplicity of applications. Serving up to 10 telephones of Plan-Etelphone type, it can be conveniently arranged by adjustment in a number of circuit modules to function as a 4-line PABX, PAX or multi-line system. Its value to all overseas administrations is increased further by its ability to work over a diversity of external circuits, so permitting a preferred arrangement to be connected as requirements demand.

Main Operational Features: Single-digit dialling of internal calls. Lamp signalling and supervision of all calls signalled, held or in progress. Internal calls made secret or non-secret by simple strap adjustment. Exchange-line exclusion feature for selected stations. Power unit operation and continuing exchange-line service during mains failure.

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