POST OFFICE

telecommunications

JOURNAL

ONE SHILLING
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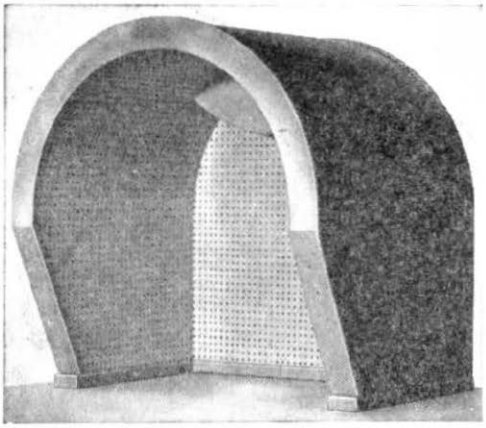
SIXPENCE

SUMMER 1966

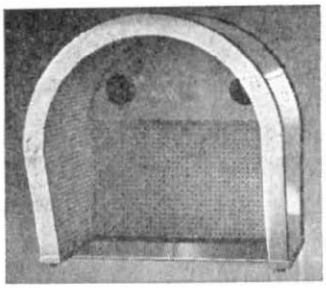
WHITELEY
for acoustic hoods

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.

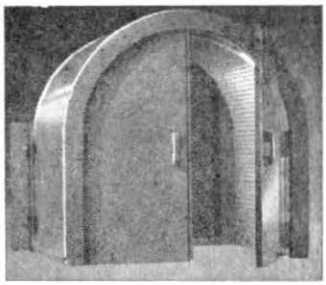
Whiteley acoustic hoods are strongly made from resin bonded ply and finished in a cellulose enamel which makes them suitable for indoor or outdoor use.



Standard Hood dimensions
25" high x 20¼" deep x 24½" wide



Fitted with loudspeakers

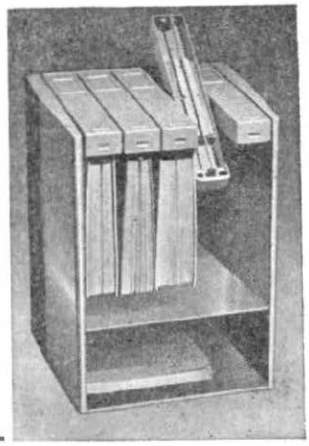


Fitted with doors for outside use

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

& directory holders

Directory Holder dimensions 17⅛" high x 13½" wide x 13⅜" deep



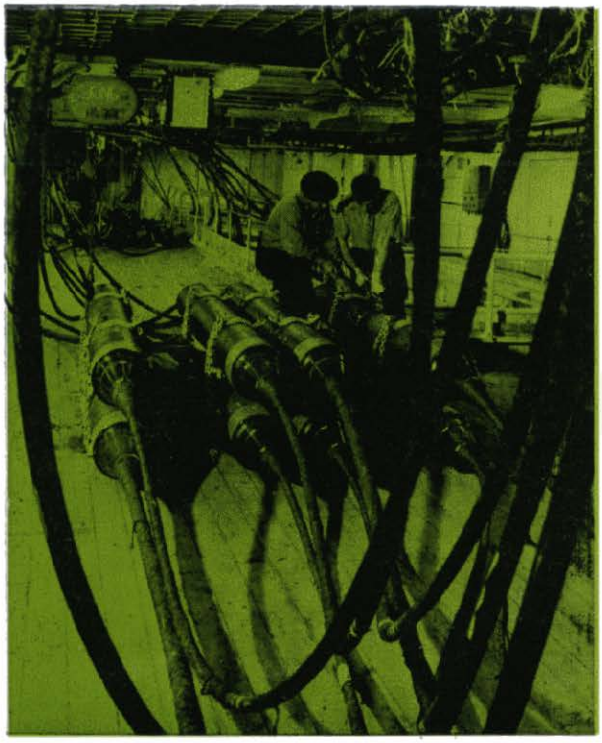
These attractive, and extremely functional, directory holders will hold five directories neatly and securely, in indivdual swivel holders permitting easy identification and reference. The lower shelf provides additional storage space. The units are of cast alloy, finished in an attractive grey epoxy 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*

STC TELECOMMUNICATIONS REVIEW

MAY 1966



Complete Submarine Cable Telephone Systems

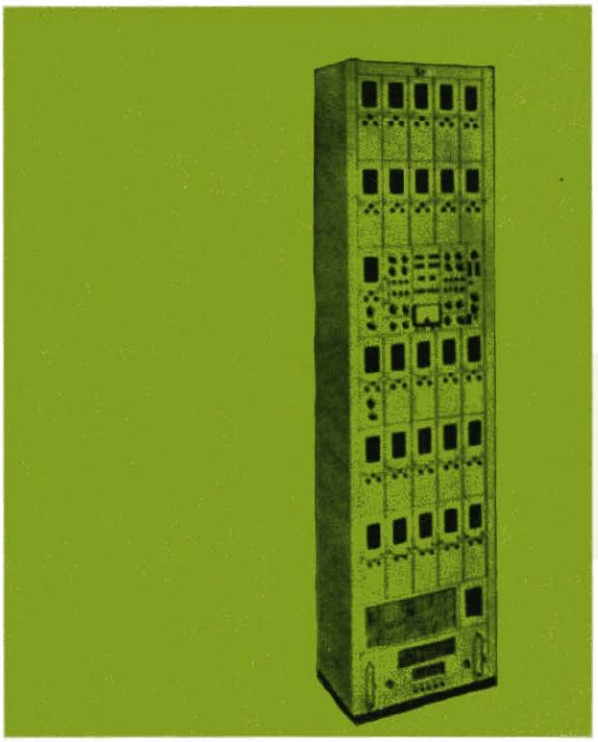
STC are fully equipped to cover every phase of submarine cabling for telephonic and telegraphic transmission. Plan, design, supply and install—a complete service from drawing-board to operation. Systems providing up to 640 high quality telephone circuits can be supplied.

STC systems include shallow or deep water submerged repeaters, land based terminal equipment and repeater power feeding equipment for long and short systems. One of the few commercial organizations in the world qualified to provide fully integrated systems tailored to any location and specification, STC have supplied equipment now in operation over a total route length of twenty thousand nautical miles.

The illustrations show STC submerged repeaters on the deck of the cable ship "Monarch" ready for laying, and a suite of terminal equipment.

Details of the complete range of systems available from: Standard Telephones and Cables Limited, Transmission Systems Group, Basildon, Essex. Telephone: Basildon 3040. Telex: 99101 (STC Basildon).

STC



ARQ

Automatic error correction equipment type TEC.1

TEC.1 is for use in conjunction with the terminal equipment of long distance international telegraph circuits over radio paths for such services as public telegrams, telex and leased channel operation in accordance with CCIR requirements.

It automatically detects and corrects telegraph code errors which may be introduced into the message by interference from static, multi-path propagation or other sources.

☐ Fully transistorized ☐ Four-channel or two-channel operation by switching or two-channel in separate cabinet ☐ Channel subdivision of all channels included on the main equipment ☐ CCITT and American speeds ☐ Tested repetition cycle ☐ Automatic and manual character-phasing ☐ Compatible with other equipments ☐ Book techniques used throughout for easy routine servicing or replacement ☐ Adequate test and monitoring points provided ☐ Small number of types of basic units reduces spares holdings to a minimum.

For further details write, 'phone or telex Standard Telephones and Cables Limited, Radio Division, Oakleigh Road, New Southgate, London, N.11. Telephone: ENTerprise 1234. Telex: 261912.

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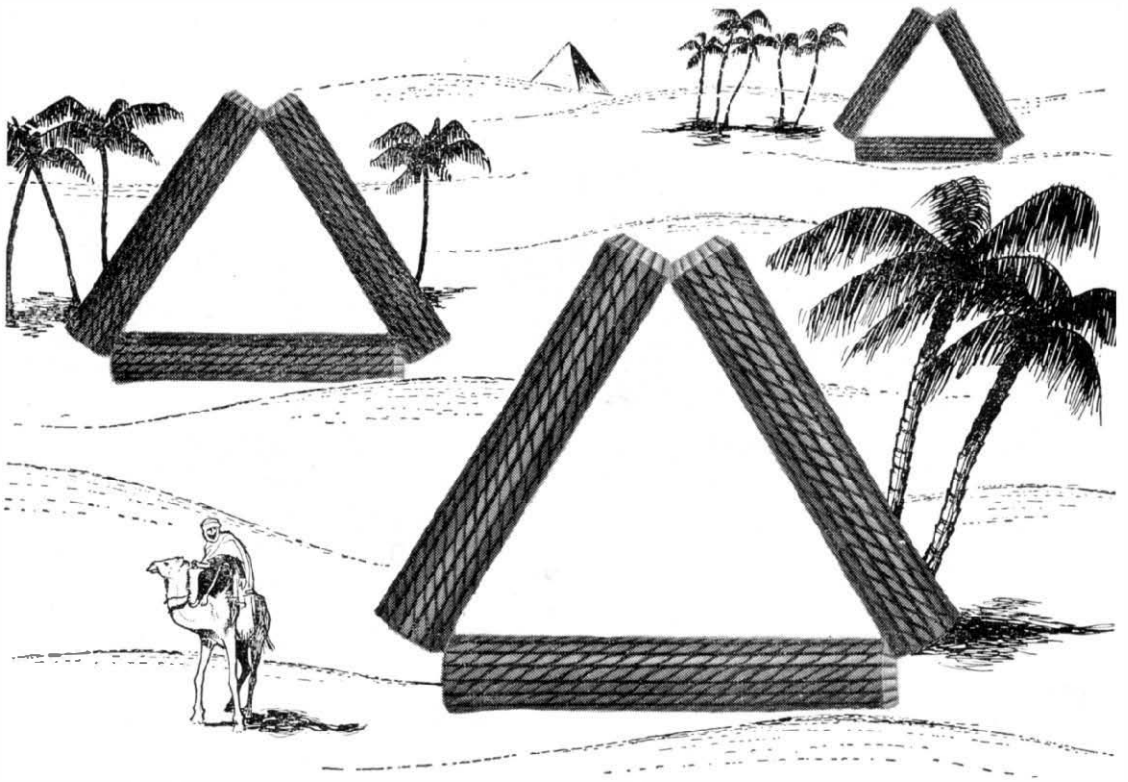
STC



Talking of permanent fixtures

We'd like to talk about Rawlplugs. It's true that the pyramids were built entirely without Rawlplugs; and it's also true that we haven't had a chance to see whether Rawlplugs will last as long as they did. But we do know that there's a Rawlplug for every screw ever made, and their fantastic, rot-proof strength would make the Sphinx grin. If you're building a modern pyramid, use Rawlplugs instead of slaves. Booklets, catalogues, samples and representatives are at your service on request.

FOR EVERY SIZE OF SCREW THERE'S A RAWLPLUG

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Post Office Telecommunications Journal

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

CONTENTS

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Vol. 18 *Summer 1966* *No. 2*

"A DAZZLING FUTURE"

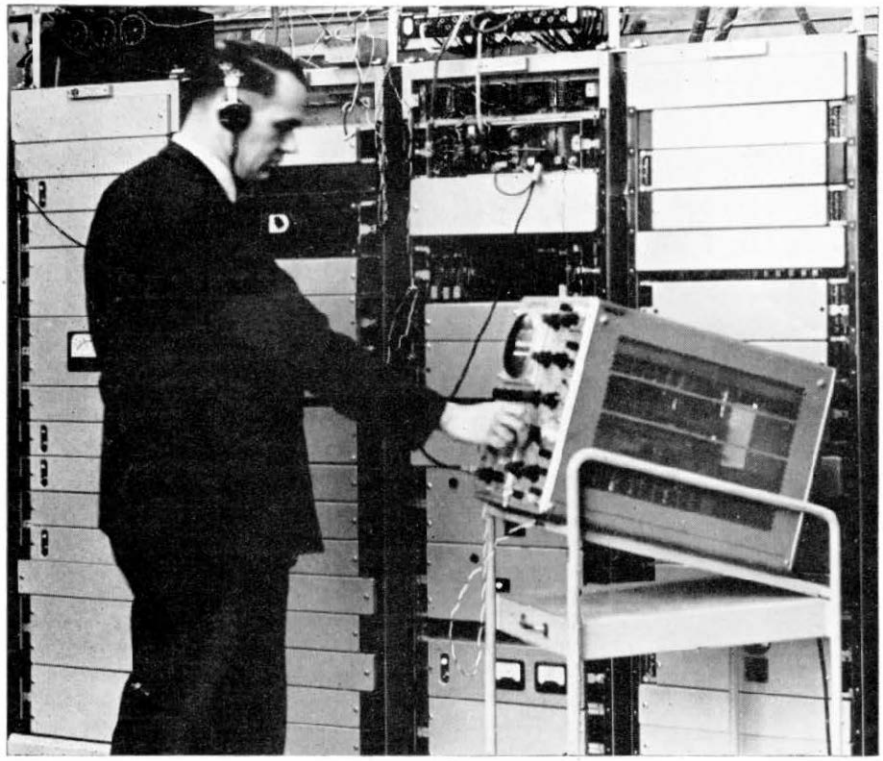
THE WHITE PAPER *Post Office Prospects, 1966-67,* **which is fully reported in this issue of the** *Journal,* **throws into new and greater relief the tremendous task which lies ahead for the telecommunications services.**

It also charts the course which will be taken to modernise the services, to introduce new services and facilities and to keep pace with the ever-increasing demands, which means doubling the telephone system within the next seven years.

It does not conceal the difficulties of the next two years—particularly the congestion and growing waiting list due to our inability to get sufficient plant quickly enough; and it emphasises the need for giving the best possible output and the best possible service in those sectors which are within our own control. Finally, it re-emphasises our enduring aim of providing the country with the most efficient communications systems at the lowest possible prices consistent with sound financial policies.

Hand in hand with the need for greater productivity goes the need for even closer collaboration between management and staff—an essential factor for progress which was recently underlined by the Postmaster General at the Association of Post Office Controlling Officers' Conference. "Management and staff will work effectively together only if they share common objectives," said the PMG. "The common objective of the Post Office is to provide good services to the public at reasonable prices while maintaining fair conditions for the staff. Our skills are only important because they help us to do this. We do not exist to provide engineering services or sales services or supervising ability for their own sake. We exist to provide first-rate services.

"The future of our industry is full of dazzling prospects. Communications is the central nervous system of a modern industrial society and the world. We shall all have to adapt to change, to re-organise and then, no doubt, to change again. But these changes are the living proof of our vitality. They will test us to the utmost—but, whatever challenges they bring, I have not a single shadow of doubt that together we shall be more than equal to them all."



Pulse code modulation enables much greater use to be made of many telephone cables, says the White Paper. In this picture an ST and C engineer tests some PCM equipment.

The urgent need to expand and modernise the telephone service is highlighted in this year's White Paper on Post Office Prospects which discusses the problems, takes a look at the future and points . . . .

THE WAY AHEAD

"THE telecommunications services are facing unprecedented demands and growing more quickly than ever before," says the White Paper "Post Office Prospects, 1966-67" which the Postmaster General recently presented to Parliament.

"The system has to be modernised and new services and facilities have to be provided. All these things have to be done if a complete and efficient communications system for voice and data is to be provided as cheaply as possible. And they have to be done at a time when the pace of change is being quickened by the rapidity of technological developments."

The White Paper warns that although a greatly-expanded investment programme has been launched there is a limit to the rate at which expansion can be accelerated, new buildings and equipment can be brought into use and new ideas and techniques can be exploited. Even the ambitious and wide-ranging plans now under way will take time to produce results. Meanwhile the telecommunications services face many challenging problems, largely due to under-capitalisation in the past, and are likely to continue to do so.

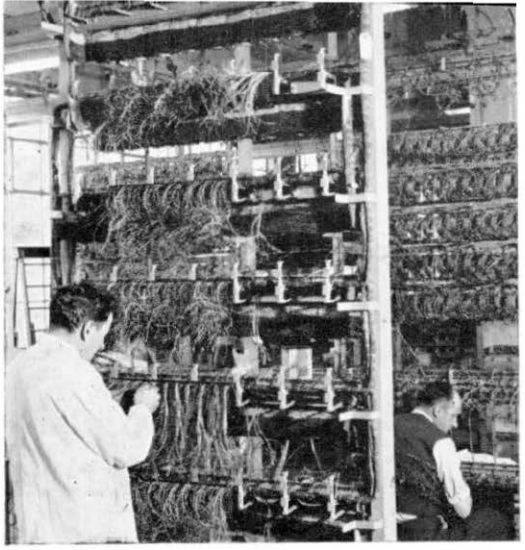
Present expectations are that the number of telephones will grow at an average rate of 7 per cent. each year during the 1960s compared with 4.2 per cent. in the 1950s and that the number of calls will increase annually by some 9.5 per cent. compared with 3.1 per cent. This means, in effect,

that the telephone system—the third largest in the world—will be doubled over the next seven years. "This," says the White Paper, "is a formidable undertaking and is the maximum expansion in that time that at present seems practicable. Even so, it may not be enough."

A great deal has already been achieved, especially in the past three years. In 1963, when the White Paper "The Inland Telephone Service in an Expanding Economy" was published, it was expected that by 1967-68 the number of telephones would have risen to 11.5 million—an increase of about 29 per cent. Now, it is anticipated that there will be nearly 13 million telephones by 1967-68, an increase of 45 per cent.

Similarly, the growth in the number of calls will be much higher than had been expected. The increase over the five-year period ending in 1967-68 would now probably be 3,000 million instead of the 2,000 million originally forecast. Much more had been done than was promised in the 1963 White Paper, but it had not been possible everywhere to clear the waiting list by the end of March, 1966, as was then hoped, although about three-quarters of all the exchanges were without waiting lists.

The quality of service was not as good as it should be in all parts of the country, notably in London and the South-East, and the improvement of this situation must have the first priority in Post Office planning, the White Paper emphasises. A new system of management statistics had been introduced to help keep the situation under review.



The British telecommunications equipment manufacturers are expected to double their output in the next three years. Here, contractor's engineers wire group selector and relay set racks.

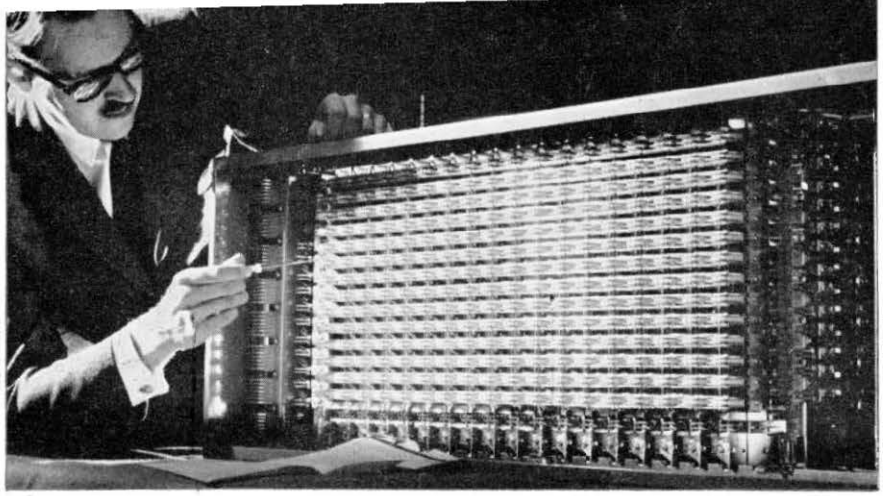
"The scale of what has to be done to put matters right and the time needed for the big capital projects to be planned and implemented, means that progress will not everywhere be rapid. But there will be progress, increasingly so as the plans continue to gather momentum."

To keep pace with the ever-widening range of new facilities and service, to meet the expected rise in demand, to modernise and give the consistently high quality of service that is required, the investment programme is being expanded

OVER

An engineer at work on some of the latest trunk signalling relay equipment at the International Exchange, London. This and similar equipment is helping to cope more efficiently with the rapidly-rising number of ISD and STD calls.—

Picture: Standard Telephones and Cables Ltd.



To make the fullest possible use of available capacity, the Post Office will take some of industry's output in crossbar equipment. In this picture, a firm's engineer tests the wires at the back of a crossbar switch.

Picture: ST and C.

rapidly. Capital expenditure on telecommunications is expected to reach over £350 million in 1970-71, compared with £204 million in 1965-66 and £98 million in 1960-61. One of the most critical parts of this programme will be the provision of exchange equipment on the scale required. Expenditure in this sector, which was £49 million in 1965-66, will have to be more than doubled if requirements are to be met.

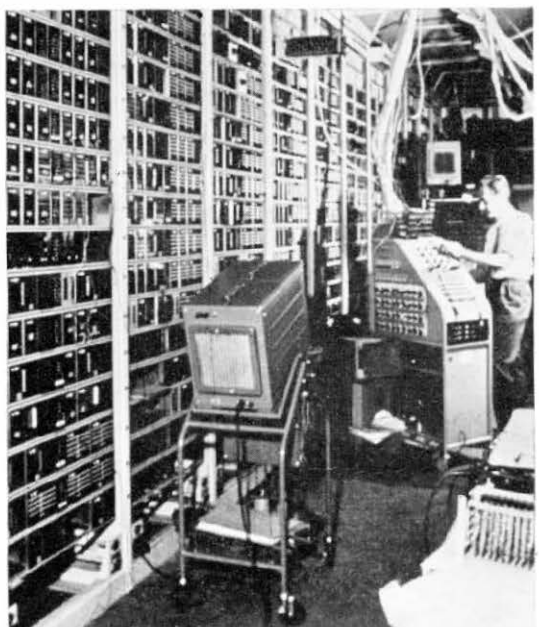
"This is an enormous challenge, not only to the Post Office but to the telecommunications industry as well . . . To make the maximum use of the available capacity, the Post Office will take part of the industry's output in crossbar equipment as well as in existing electro-mechanical and the new electronic systems."

While the exchange equipment part of the programme will be critical, adds the White Paper, other parts will not be without difficulty. Over the next five years some 70,000 more trunk circuits—more than exist at present—will be added to the system, together with over 400,000 of the shorter-distance junction circuits. About five million more local lines between subscribers' premises and exchanges will be added and about 11.5 million telephones will be installed. Notwithstanding a determined drive to improve productivity, in which the unions are co-operating, the engineering force will have to be increased by about 15 per cent. by the end of 1970-71.

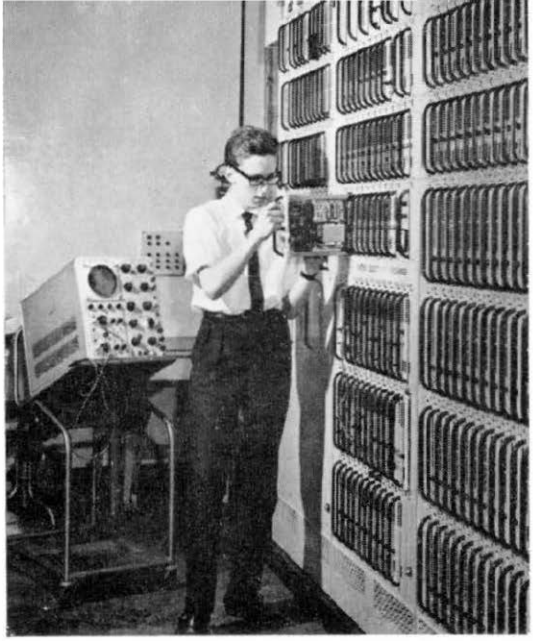
On modernisation and change, the White Paper says that automation, Subscriber Trunk Dialling and International Subscriber Dialling require the customer to do more for himself to obtain his calls, but they give him the benefit of speed and cheapness. This trend of greater customer participation in the operation of the service will continue.

Business customers were being offered new services, such as data transmission and closed-circuit television. Almost the whole range of apparatus installed in customers' premises had been modernised, several new devices had been introduced and more were on the way—for example, press-button telephone, the Trimphone and the repertory dialler.

Research and development into electronic exchange systems had been increasingly successful. All small and medium-sized exchanges were being ordered in electronic form from now on and by the early 1970s virtually all new exchange equipment was expected to be ordered in this form. Satellite communications were becoming an accepted part of the international telecommunications network.



A view of the new electronic exchange at Leighton Buzzard. The Post Office has already placed orders for production electronic exchanges in the smaller and medium-size ranges and will step up orders as manufacturing capacity grows.



A Post Office engineer tests a supervisory relay set in the prototype small reed (200-line version) electronic exchange now in use at Peterborough.

Millions of telephone bills are now being produced by computer at the London Computer Centre. Here, a 40-column card-reader for MATS cards is being used.

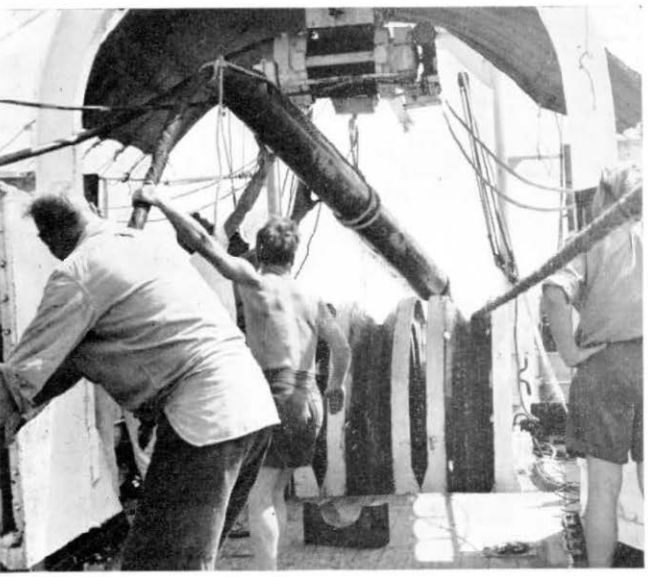
The White Paper goes on to stress the need for greater productivity. Much of the planned expansion will itself generate improvements and some benefits will accrue simply from the bigger scale of operations. Other benefits, for example, automation, reduce the need for staff such as operators. Technological change also makes a contribution: electronic exchanges, for example, reduce maintenance costs and pulse code modulation enables much greater use to be made of many telephone cables. The intensive application of computers to a large part of telecommunications clerical and allied processes had begun and there is a continuing and vigorous drive to improve working practices, particularly on the engineering side. The telecommunications services expect to raise productivity (as measured by the ratio of income at constant tariffs to cost at constant pay and prices) by about six per cent. a year in the next five years.

✱

In a section dealing with the prospects for the year 1966-67, the White Paper says that:

- *Local telephone calls are expected to maintain their annual growth rate of eight per cent; inland trunk calls to increase by about 16 per cent; inland telex calls by some 20 per cent; overseas telephone calls by 15 per cent and overseas telex traffic by some 30 per cent.*
- *About 10,000 trunk circuits and a further 58,000 shorter-distance junction circuits will be added to the system.*
- *It is planned to start work on some 170 new telephone exchanges and 20 new engineering centres and workshops. Standard building techniques will play a big part in speeding the building programme.*
- *Contractors will begin installing equipment for about 140 new exchanges and for extending about 510 existing exchanges. Equipment installation is expected to be completed at 130 new exchanges and 315 extensions. Many smaller jobs will be done by Post Office staff.*
- *It is planned to add 775,000 lines to the local cable network connecting subscribers' premises with telephone exchanges—nearly 30 per cent more than have been added in any previous year.*
- *It is expected that orders for about 1,255,000 connections will be met—885,000 by new provision and 370,000 by the "take-over" of existing installations.*
- *The number of telephone connections on 31 March, 1967, is expected to be 6,977,000 (compared with 6,397,000 on 1 April, 1966).*
- *The corresponding number of telephones.*

OVER



The first repeater in the Hong Kong to Guam section of the SEACOM cable is launched over the bows of the Post Office cable ship HMTS Monarch.

including extension instruments, will be about 11.5 million by the end of the year.

● *The waiting list rose by about 25,000 over the past 12 months and on 31 December, 1965 totalled 71,000. A further 126,000 applications for service were in process of being negotiated or met. A reduction in the number of applications awaiting lines to the exchange was offset by a big increase in those awaiting exchange equipment. "This," says the White Paper, "underlines the seriousness and urgency of the exchange equipment problem . . . it will take time for this problem to be solved and it will probably get worse before it gets better. There is a determination in the telecommunications services to solve it with all possible speed . . . but, meantime, the problem should be seen in perspective." About three-quarters of all exchanges had no waiting list by March, 1966. Elsewhere, waiting lists due to scarcity of lines to the exchange should become of decreasing significance. At approximately one per cent of the total size of the system, the present list was noticeably less than in many other European countries, both absolutely and relatively.*

● *The telex service was expected to have more than 17,000 lines at the beginning of 1966-67 and about 3,500 more will be added during the year.*

Outlining development plans for 1966-67, the White Paper says:

★ *Manual exchanges are being converted to automatic working at the rate of two a week and by March, 1967, there will be only 230 manual exchanges in the country. Automatic service will then be available to 96 per cent of subscribers and trunk dialling facilities to about 70 per cent.*

★ *The first effects of the introduction of All-Figure Numbering will be felt in the large cities in 1966. The change to all-figure numbering is essential if the service is to expand at the required rate.*

★ *The first orders for production electronic exchanges in the smaller and medium-size range have been placed and will increase in number as manufacturing capacity is built up. Production versions of electronic equipment for the largest exchanges and for use in extending existing conventional exchanges will be ready for trial in public service in the next year or two.*

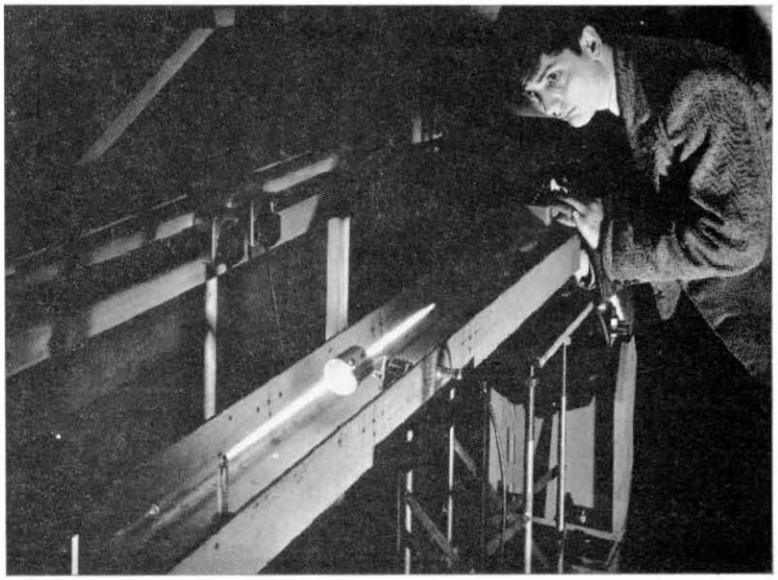
★ *Datel services will continue to be developed and expanded to meet customers' needs. The Datel 600 Service, already available to the United States, France, Austria and Denmark, will be extended in 1966 to Australia, Canada, West Germany, New Zealand, Norway and Switzerland.*

★ *A new Telexogram service will be introduced, first to Belgium, the Netherlands and West Germany. This service will enable telegrams addressed to telex users to be transmitted direct from the telegraph office in the country of origin.*

★ *The Hong-Kong to Guam section of the South-East Asia cable (SEACOM)—which will link Singapore and Australia by way of Sabah, Hong-Kong, Guam and New Guinea — is expected to open for public service in mid-1966.*

★ *Two more synchronous satellites will be launched in the second half of 1966—one over the Atlantic and one over the Pacific. They will provide commercial communications in addition to backing-up communications for the United States Man-in-Space project. The Post Office is giving technical help to Cable and Wireless Ltd. which will own and operate a satellite earth station on Ascension Island working with the Atlantic satellite.*

How The Challenge Will Be Met



An experimental gas laser undergoes tests at ST and C's Harlow laboratories. The use of lasers for telecommunications purposes is a real possibility in the not-far-off future.

IT was no discredit to the Post Office that it had not fully met the aim laid down in 1963 of abolishing the waiting list for telephones by March, 1966, said the Director of Inland Telecommunications, Mr. K. H. Cadbury, MC, in an informal talk at Headquarters after the publication of the White Paper on Post Office Prospects.

"We have, in fact, supplied 17 per cent. more exchange connections than we had expected to do", he added, "and the only reason we still have a waiting list is that demand has risen by 24 per cent. above our expectations."

There were three main reasons for the rapid growth in demand. First, basic telephone prices had not been changed since 1961 (apart from a small change in 1963 to call charges) so that the telephone was becoming cheaper in relation to other things that people want. Second, there was clearly a change in the public attitude towards the telephone. People were marrying younger and putting a telephone higher on their list of priorities, and the rate of increase in the penetration in the "lower" occupational groups was growing faster than in the traditional telephone market. Third, demand for telephones appeared to be affected by economic circumstances in a more complex way than had hitherto been assumed. In 1965-66, for example, the overall effect had been less than expected and demand had reached an all-time high despite various Government deflationary measures, some of which had probably even encouraged demand for telephone service.

Traffic, too, had risen rapidly—at a faster rate, in fact, than in the United States or in other parts of Europe. Nationally, the British had not made as much use of telephones as people had in other countries and were probably now catching up so that the trend could be expected to continue.

"Thus, the most important underlying factor which we are faced with in achieving our long-term purpose is the explosion in demand for our services. To meet it we have got to double the size of the telephone system over the next seven years or so and to provide telephones in the 1960s

OVER

The young lady with the Trimphone typifies two important developments — the growing demand for a telephone as an essential and the introduction of more aids for subscribers.

at nearly twice the rate we were doing in the 1950s. With traffic, the task is even harder. Calls in the 1960s are growing at more than three times the rate of the 1950s."

There were two other important underlying factors: the need to modernise our system and the fact that its technology was changing. The automatisation programme and the extension of STD were of long standing, but International Subscriber Dialling was expanding rapidly and with All-Figure Numbering we were not only asking the customer to participate, but were also seeking to get him to change his habits. Similarly, we had to modernise our services to business, thus emphasising the importance of such things as the extension of data services and telex. Finally, we could not satisfy our customers without offering them a wide range of modern facilities, so we were developing such devices as press button telephones, Trimphones and repertory diallers.

Technology was constantly changing. The Post Office was moving from Strowger equipment to electronic and picking up crossbar on the way. Micro-wave developments were symbolised by the opening of the Post Office Tower and newer developments, such as pulse code modulation and lasers, were already in sight.

A recent aid to productivity: the Simon hydraulic platform being used to erect an aerial cable.

"All these factors contribute to an increasing demand for investment," Mr. Cadbury continued. "The current five-year programme for the telephone service alone is in excess of £1,200 million. We are now the fastest growing of the major nationalised industries . . . It is very satisfactory that a programme expanding as fast as ours has been accepted in the National Plan."

Unfortunately, there was a considerable threat to our ability to earn the average return of 8 per cent. on our net assets which had been set in 1963. We were very near that margin now, on assumptions in line with those in the National Plan, such as that wages would increase by only 3½ per cent. a year. Clearly, from the expenditure side the 8 per cent. return was at risk. On the income side, as well, the programme was based on assumptions about continually-rising traffic and supply and if those assumptions should be falsified there could be a marked drop in earnings. For example, a one per cent. fall in trunk traffic would mean a drop of £1 million in revenue.

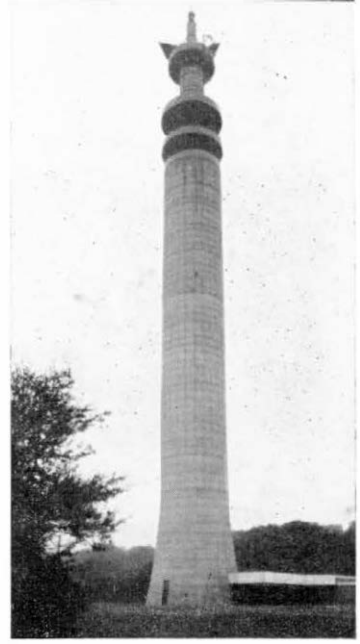
Significantly, too, the need for capital did not grow in proportion to the addition of new connections because of the growing complexity of the system. The value of the assets per working telephone five years ago was £160. Today it was £200 and in five years' time it was expected to be

£240. The 8 per cent. return on which the whole investment and tariff policy depended could, therefore, be achieved only by sustained effort. That was why the need for greater productivity was of paramount importance.

"One way in which we are getting the benefits of productivity is by the automation of our service," continued Mr. Cadbury. "First, the closing of manual exchanges and the expansion of STD should, depending on the rate of traffic growth, at least prevent any substantial increase in operators. If we had not embarked upon this course, it is extremely unlikely that we should have been able to recruit enough to keep the operator service going and we should have had to spend tremendous sums on extending switchboards and enlarging buildings.

"Second, there is an extensive programme of computerisation planned in Telephone Managers' offices which is expected to result in a reduction of about 4,000 clerical staff within the next five years. Telephone billing is the first stage of this, but ultimately an integrated system covering most of the routine operations in Telephone Areas will produce even larger savings. At the same time, more conventional improvements in office methods are being pressed forward. For example, the revised provision of service procedure will save some 30 million clerical operations.

"Third, a tremendous effort is being made on the engineering side to increase output, both by



A mini-Post Office Tower: one of the many microwave radio stations which will eventually form a chain throughout the country to carry thousands of telephone circuits and television channels.

improving equipment and mechanical aids (for example, new exchange maintenance techniques, gas pressurisation and new types of cable) and by reorganising methods of work—for example, divorcing jointers from their mates and reducing the size of gangs. All this demands—and is getting—constant management attention and Staff Side co-operation.

"Every man and woman in the service must pay his and her way if we are to safeguard our future as an expanding industry . . . But increasing productivity is not just a matter of greater

OVER

New Apparatus for Subscribers

Among *the wide range of new and modernised telephone apparatus now under development three items began to become available as the* Journal *went to press.*

They are the new Speakerset No. 1, *a larger version of the* Keymaster *inter-communication system, and the Private Automatic Branch Exchange No. 6.*

The Speakerset No. 1 *amplifies incoming speech and is the modern counterpart of the now outmoded Amplifier and Loudspeaker which was provided in two versions for AC and DC operation. The new amplifier, loudspeaker, volume control and on/off switch are all housed in an attractively-designed grey plastic case and the instrument is particularly useful for broadcasting information or commentaries to a group of people in a large room — for example, a bookmakers' premises or in a news agency. Extension speakers will become available later.*

The Keymaster, *which provides capacity for two exchange lines and ten extensions, is being made in light ivory, two-tone-grey or black. It is a modernised version of the House Exchange System* (2+10) *and is styled on the lines of the modern telephone, with the press-button calling unit fitted above the dial but in front of the handset. This system is particularly useful in offices and large houses. Initially it will be on market trial in London, but will be made available in other areas as supplies increase.*

The PABX 6 (see the Winter, 1965, issue of the Journal) *is the standard improved version of the interim PABX* 5 *which has proved very popular.*

The new luxury telephone — Trimphone — *which went on market trial in London North-West Area in November,* 1965, *is now being made available additionally in London North Area, Northern Ireland and Wales and Border Counties. The instrument is now also available in three two-tone colours: light and dark blue, grey-green and the original grey-white. As deliveries increase, the areas in which* Trimphone *will be marketed will be extended to cover the entire country.*

Two more examples of how the Engineering Department is speeding work and saving manpower. Left: An electronic concreting machine and (right) a mechanical concrete vibrator. Both machines are in wide use.

output, since all the standards and targets which are now set are related to the long-term aims of the telephone service. For example, speeding the despatch of bills or the provision of service have revenue implications which are just as relevant as greater engineering or traffic outputs to our ability to earn 8 per cent. and thus to the justification for growing investment."

Despite rising investment and the encouraging growth of productivity there were serious physical problems in achieving the required expansion, added Mr. Cadbury. The buildings and sites programme was being greatly expanded and here the effort both in the Post Office and in the Ministry of Public Building and Works would need to be maintained. So far, Regions had responded very well to the increased burden of work and although some individual cases were proving very difficult a general threat to expansion was not anticipated.

The trunk system was at present suffering seriously from congestion, although we were adding long-distance circuits faster than ever before. There would be a deficit of about 3,000 circuits at the end of March, 1966, and although 10,000 circuits would be added during 1966/7 about the same deficiency was expected to remain in March, 1967. Thereafter, it was hoped that the industry would be able to catch up arrears and meet our needs. The junction situation was less acute, although requirements had substantially increased. Unfortunately, therefore, it would be unrealistic to expect the congestion problem to be significantly eased within the next year or so.

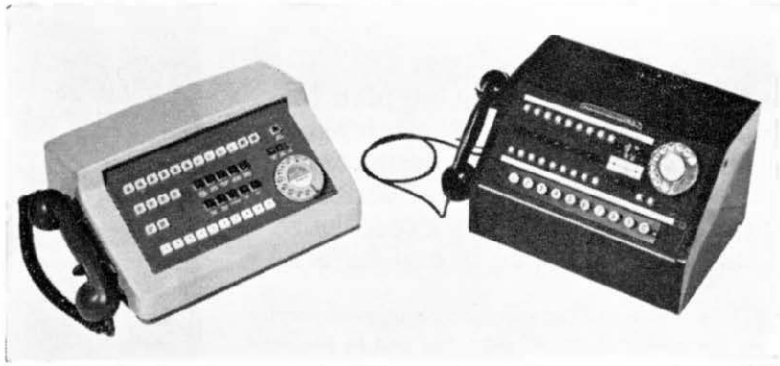
The main bottleneck was in the exchange equipment programme. Manufacturers had doubled their output of Strowger equipment in the last three years and expected to redouble it in the next three. At the same time they were setting up capacity for electronic exchanges and all new orders for exchanges of less than 2,000 lines would be in electronic form. There was some additional crossbar capacity on which the Post Office could draw and about 5 per cent of our total requirements would be taken in this form until the large electronic exchange came forward in two or three years' time.

The manufacturers had given assurances at the highest level that this tremendous expansion and change would go forward as planned, but they themselves were faced with serious problems of factory construction and recruitment and even this programme was inadequate for our needs. We were attempting to spread our inadequate resources more widely by shortening provisioning

periods and to improve our speed of response by taking more frequent records of traffic and reviewing the equipment programme quarterly instead of once a year. But the waiting list due to equipment shortages grew by 33,000 in 1965 and, inevitably, if demand maintained the forecast levels, the numbers awaiting exchange equipment would grow in the next two or three years to five or six times that figure before it began to diminish.

"We are faced with a tremendous task both in maintaining our rate of return and in overcoming physical shortages," concluded Mr. Cadbury. "Despite the difficulties, we must maintain the quality of service we give to the public, which in this context covers the whole range of facilities we offer, including the provision of new service. But, if there is a conflict between the maintenance of efficient services for existing customers and the provision of service for new customers, the former takes precedence. This emphasis is reflected in the current priorities for inclusion of cases in the exchange provision programme, where the shortages are most acutely felt."

FACELIFT FOR THE SMALL PABXs



The new small cordless PAB switchboard (left) and the old (right). The new switchboard has a better keyset and is much easier to maintain.

The smaller cordless switchboards—those of fewer than 50 extensions and known as the PABX No. 1—have been re-designed for the first time since they were introduced 16 years ago.

The new switchboard, which is cheaper to produce, easier to maintain and more attractive in appearance than its predecessor, provides the same facilities and no changes to the PABX equipment are required to accommodate it in its moulded case. It has illuminated press-button keys which combine calling and supervisory signals with circuit designation or key function. The keyset has also been improved in appearance and now has micro switches which give a light touch.

PLANNING FOR THE FUTURE

A new organisation has been set up in the Engineering Department whose task will be to identify potentially important long-term technical developments, analyse their worth and, without risk of incompatibility, suggest an overall, strategic framework within which detailed development work can be carried out.

The new unit—called the Long-Range Systems Planning Unit—will consist of about six people, led by Mr. J. W. Freebody, who has been appointed an Assistant Engineer-in-Chief.

The subjects which the new unit will study include the possible technical developments in the next ten to 15 years, for example, computers talking to computers over a digital communications network, the reading of gas, electricity and other meters over telecommunications systems, and people consulting their bank statements by making a telephone data call to a computer.

Mr. Freebody, who joined the Post Office in 1933, spent 20 years in the Telegraph Branch and in 1958 was appointed head of the Technical Support Unit which is operated by the Post Office on behalf of the Ministry of Technology and carries out investigations into automatic data processing systems.

A SCHEME FOR REDUCING CALL FAILURES

H. BANHAM,
BSc(Eng). C Eng. AMIEE

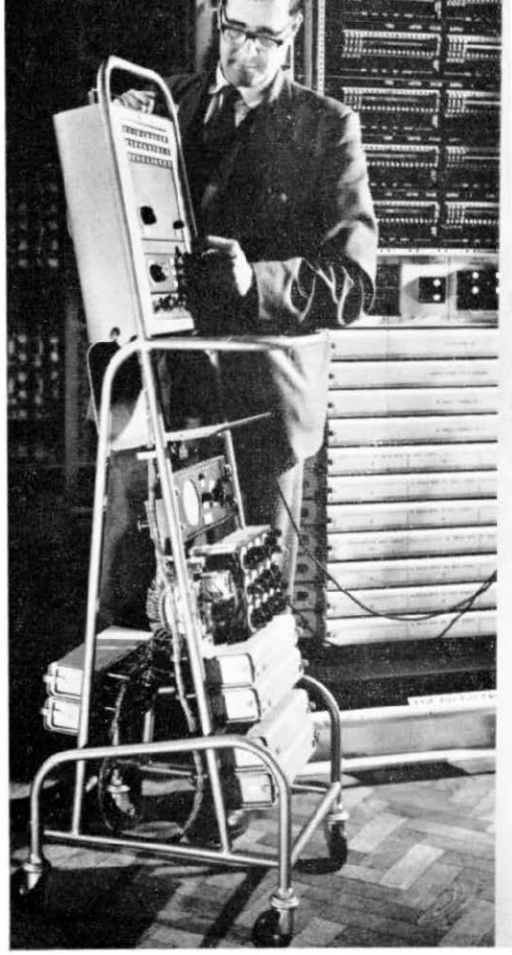
In the search for a master plan to improve the quality of the telephone service, a Headquarters team has toured the country and produced an outline scheme which is expected to result in a reduction in call failures

THE quality of the automatic telephone service has always been of deep concern to the Post Office administration and continuous efforts to effect improvements have been made for many years. A comparison between the present service and that experienced, say, 15 years ago, shows that those efforts have met with considerable success. Nevertheless, the telephone service is still a long way from what it should be and public dissatifaction is being expressed in some places, particularly in large cities.

It is obvious that many of the difficulties arise from the shortage of lines and switching equipment caused partly by restrictions on capital expenditure after World War Two and partly by an exceptionally high rate of growth in recent years. But the present accelerated programme of provision should give considerable relief in due course. Reduction of call failures due to congestion is likely, however, to highlight a residual percentage of call failures due either to plant faults or even to organisational defects, and intensified efforts are now being made to eradicate the weak spots.

In the past, many schemes have been sponsored to improve individual aspects of the service but there is now a need for a "master plan", the objective of which should be to raise the performance of the whole system to a higher standard. Before such a standard can be set, or even discussed, it is necessary to study such questions as: are the published statistics reliable and meaningful; is there an irreducible lower limit to call failures due to plant faults, or is there an optimum value consistent with reasonable expenditure? Still wider issues, not yet determined, include the desires of the public and the limit of its willingness to pay for better performance.

Following consideration of these problems, the Engineering Department has prepared the outlines of a maintenance plan for steady improvement of the service until by 1975 the results should be at



This is the transportable artificial traffic generator which is now being used in Group Switching Centres to send calls into the STD network and check their correct completion.

least twice as good as in 1965. Details of the plan were completed in collaboration with all Regional and Area Managements during a tour of the country by a Headquarters team.

One of the first conclusions reached was that the quality of the automatic exchange service and its maintenance could be measured by the following factors:—

1. Percentage of total calls ineffective due to plant defects, divided into local and STD calls from director and non-director exchanges.

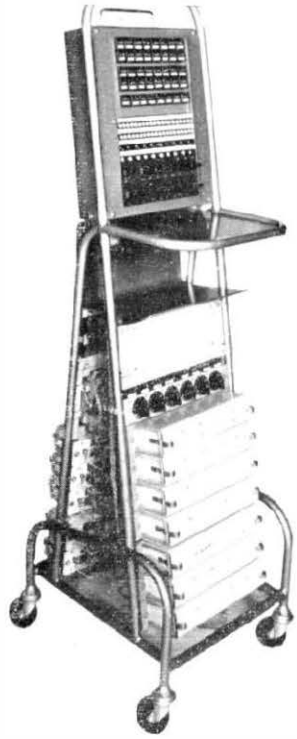
2. Complaints per station per annum. Call offices were excluded since deliberate damage is the major cause of defects in this category and swamps all other considerations.

3. Maintenance costs in manhours per station per annum. These were desirable to ensure that the productivity improvement would accord with the National Plan and that minor changes to the service were not being obtained at too great an expense.

Once the categories had been selected, it was possible to set targets for the next few years, based upon previous performances and a reasoned estimate of the quantitative effect of existing and proposed improvements. The targets were produced, first on a local, then Regional and finally a national basis, due regard being paid to the relative influence on the larger network of each component. As expected, the results for each Region occupied a wide band of values, but it was also observed that the presence of a few poor results depressed the Regional average.

It was apparent that maximum value would be obtained if these 'tail-end' exchanges received prior attention and so a lower control limit was set for each category. The lower control limit is defined as the value of the particular statistic which contains the performances of 80 per cent. of the exchanges in the Region, rounded up as necessary, and is recalculated annually, based on the previous year's results. All exchanges which exceed the limit in the following year will receive special attention.

Discussions about the methods of reducing call failures revealed some new ideas, but generally the emphasis was on the speedy detection and clearance of faults, the eradication of known weaknesses and the shortage of apparatus, including spare parts. It is hoped to remedy the latter by an intensive manufacturing programme: all existing factories are now in full production and new factories are being set up. Installation periods for new exchanges and extensions to existing exchanges will be shortened by reducing acceptance testing time, made possible by more rigid quality control of manufacture, and by improving installation methods.



This transportable device for recording the quality of service at any switching stage in the telephone network was designed and built by Post Office Headquarters Scotland. It can be connected by means of plugs and cords to 24 circuits at a time.

Maintaining equipment once it is in use will be made more effective by relating the effort employed more closely to the actual need of the apparatus. At present, apparatus is tested and inspected, often manually, at fixed intervals according to the incidence of faults previously found.

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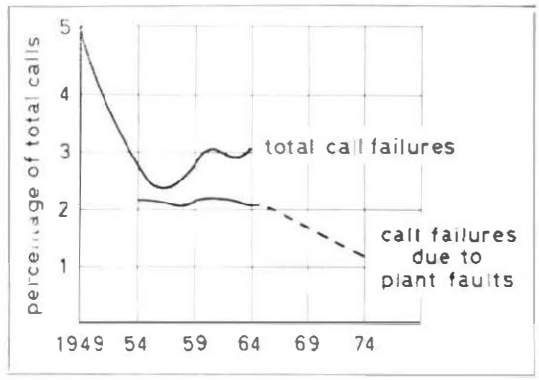
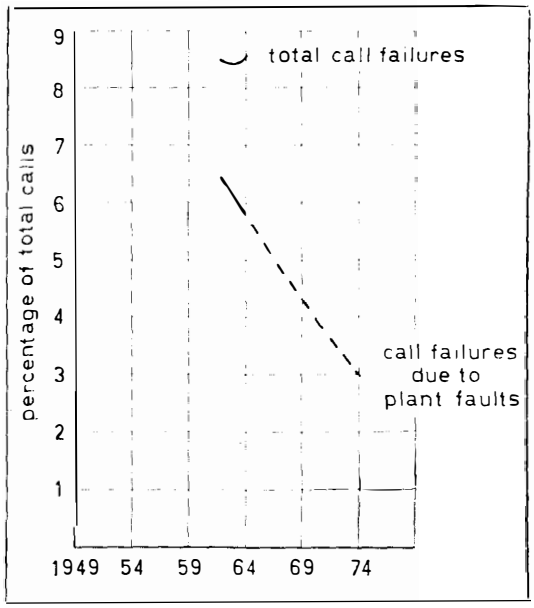
This graph shows the local call failure rate since 1949 and the likely trend for the future.





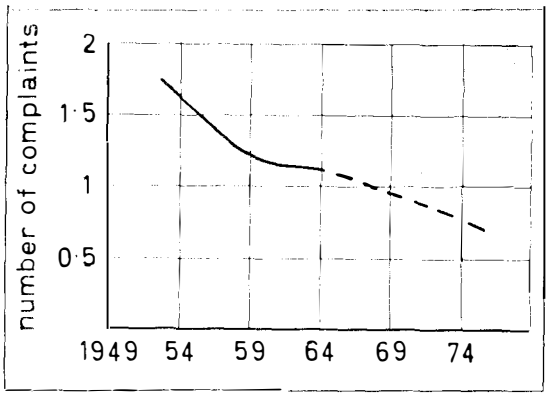
A graph illustrating STD call failures due to plant defects, the total of actual failures, and the future targets up to the year 1974.

and is overhauled when necessary. In future, as soon as the necessary plant is available, all operations which can economically be carried out in this way, will be mechanised so that men will be used only for tasks which demand their training and talent. With mechanisation, some important tasks can be done more frequently, for example, all the vital common apparatus in an exchange can be operationally tested each morning before the start of the main rush of traffic while, at night, the same routiners can carry out a programme of the marginal tests essential to locate incipient faults but often now neglected because of the long time required for each test. Other machines will take over the boring but necessary physical work such as bank cleaning. The success of these measures depends to a great extent on the willingness of the staff to adopt more modern methods and one of the heartening features is that talks which have already begun indicate that this co-operation will be forthcoming.

The quality of the STD service presents many novel problems, apart from the basic question of how to measure it. The linking of many different types, ages, and conditions of exchanges throughout the country, and eventually throughout the world, means that some very complex equipment has to be used to control calls and to provide correct interworking. While this equipment, much of it electronic, has been carefully designed for maximum reliability, mishaps can still happen which although in themselves minor, may react throughout the network. For example (and a very common example, too), a road contractor's workman on the M6 motorway extension could damage one of the cables between Stoke-on-Trent and Manchester and immediately interrupt 600 calls. Some of these calls could be from, say, Penzance to Glasgow, or between any one of the vast combination of exchanges in Great Britain and the Continent; yet when the call failure is reported locally, the organisation must be such that the necessary action is taken immediately at all terminal exchanges. Such an organisation is being set up as the STD network develops, using the existing arrangements as much as possible but with modern automatic devices to detect failures, to identify their cause, to signal their existence to the affected parts of the network, to divert calls round the fault and to alert the maintenance staff so that repair work can be put in hand. Many minor faults are difficult or uneconomic to detect directly so they will be located by statistical methods. All reported STD call failures in a region will be recorded as they occur on a chart or in a simple computer until a pattern emerges, revealing the possible whereabouts of the fault, final detection being verified by the use of statistics from other regions or from locally made tests.

The local network of subscribers' lines and telephones has not been forgotten since many of the call failures occur here. The latest telephones have about half the fault rate of their immediate predecessors; replacement of bare overhead wires by insulated wires has greatly reduced faults between distribution poles and the subscribers' premises; and the main cables in the local exchange network are being pressurised to keep out water. To ensure that faults are cleared as soon as possible, the system for reporting and handling them is being streamlined and once the new procedure is established it should be possible not only to remedy defects quickly but also to mechanise the consequent statistics so that weaknesses in design or installation practice become evident at an early stage.

Since 1952 the number of complaints per telephone each year has decreased and will go on decreasing as illustrated by this graph.



The measurement of quality of service is an art in itself, leaning heavily on sampling theory because it is clearly impossible to check all the 19 million local and two million trunk calls made each day. At the moment the progress of about one in every 3,800 local calls and one in every 700 trunk calls is noted to see whether they are successful, and if not, how they failed. The resultant analyses are circulated within the telephone service, both round the various headquarters for management use and round the exchanges for any necessary action to be taken. The targets set for the future will be checked in the same way. The normal methods of compilation at present in use will be supplemented by devices in automatic exchanges and trunk centres which can automatically take much larger samples and be instructed to hold the circuits involved in particular call failures. Wherever the real traffic is insufficient to indicate the true quality of a particular link in the network, artificial traffic generators can be used to set up calls and to indicate the results.

It is possible, though not yet proved, that with the present type of network there is an irreducible minimum below which it is uneconomic or impracticable to reduce call failures. But, although theoretical studies continue, this is not allowed to restrict Post Office efforts. Apart from major steps described in this article and the many technical improvements in detail always being developed, future expectations are that call failures due to exchange faults will be practically eliminated by the advent of electronic exchanges which are not only intrinsically more reliable but which will also have built-in devices to route calls past any faults which do occur.

THE AUTHOR

MR. H. BANHAM *is an Assistant Staff Engineer in the Telephone Exchange Standards and Maintenance Branch of the Engineering Department concerned with the maintenance of the Subscriber Trunk Dialling network and electronic exchanges. He joined the Post Office in 1937 in the Manchester Telephone Area. After service with the Royal Signals during World War Two he was promoted Assistant Engineer and in 1947 transfered to Engineering Department Headquarters where he was promoted to Executive Engineer in 1951 and to Senior Executive Engineer in 1959 before taking up his present appointment.*

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HEARTBEATS BY TELEPHONE

Post Office telephone lines were put to a new use recently when the heartbeats of a patient undergoing a bladder operation at St. Paul's Hospital, Covent Garden, were transmitted to the Director of the Research Department of Anaesthetics, Royal College of Surgeons, during a lecture he was giving to the Bio-Chemical Exhibition at the New Horticultural Hall, in Westminster.

The experiment—designed to illustrate how it may soon be possible for doctors anywhere in the country to obtain the opinion of a heart specialist on the condition of a patient's heart by playing the beats down the telephone—was highly successful. For the demonstration the Post Office modified existing data transmission equipment to carry the heartbeats to Westminster where they were recorded on special modem equipment which has been developed by the Post Office.

DIALLING TO WARSAW

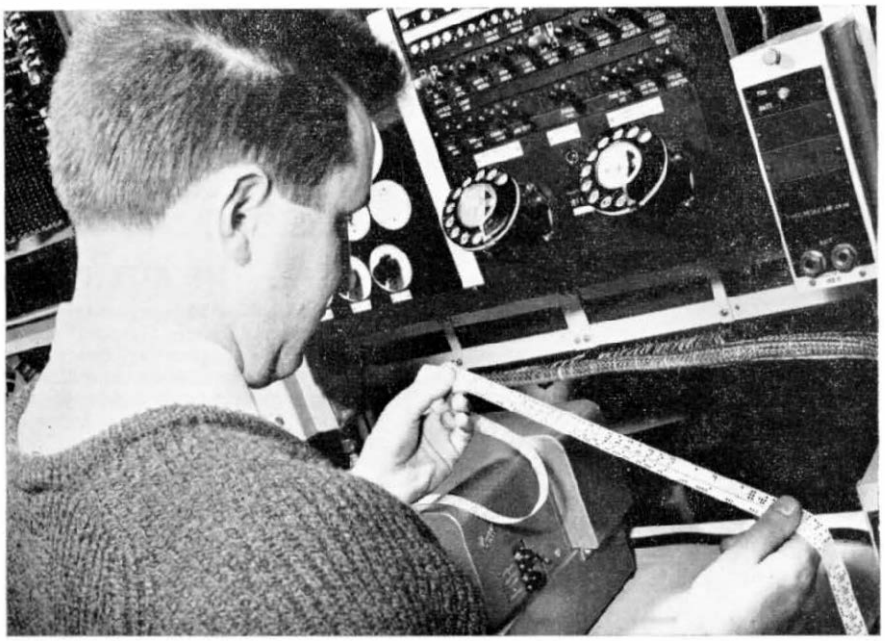
Operators at the Continental Exchange in London can now dial direct to subscribers in Warsaw and Warsaw operators can now dial direct to British subscribers without help from a British operator. This is the first time the direct operator dialling system has been brought into service between Britain and an East European country.

In anticipation of an expected increase in calls, the number of lines to Warsaw have been doubled.

THE SILENT REVOLUTION

A statistician discusses some of the problems and practical snags of scientific sampling—a technique which is being increasingly used to gather quick and accurate information about Post Office services and their marketing possibilities

By J. F. WOODS, BA, BSc(Econ), AIS



Technical Officer K. J. Northover inspects a punched tape representing a sampled STD call from the Trunk Traffic Analysis equipment at Fortress Trunk Exchange.

AT a time of spectacular advance in the Post Office—in satellite communications, microwave radio relay systems, electronic switching, Subscriber Trunk Dialling and so on—a silent revolution is going on in the background: the spread of more scientific methods for gathering information about Post Office operations and the market for its services.

As the Post Office becomes a modern Ministry of Communications, the sheer scale of its operations brings ever-increasing communications problems for the organisation itself. Among them are those involving the flow of information from the customer and from the operational units to the centre of the administration.

It is impossible to analyse the details of every envelope, the statistics of every parcel, the cost of every telephone circuit, the characteristics of every telephone conversation, the opinion and likely future behaviour of every potential user

AEE B. E. R. Briggs carefully winds a reel of sampled STD calls. Reels similar to this and containing hundreds of sampled calls will be sent to a computer centre for data processing from the 140 or so Trunk Traffic Analysis equipments now being supplied.

of Post Office services. The answer in such instances, where a complete count is too costly or too time-consuming or just impossible, lies in scientific sampling.

In the Post Office, much of the information needed for costing, for forecasting, for controlling operations, for maintaining standards of service and for forming policy depends upon sampling. And where so much depends upon them, these samples have to be scientifically designed if they are to be reliable.

Scientific sampling has gained considerable ground in the Post Office in recent years, particularly since the beginnings in 1950 of what has now become the Statistics and Business Research Department.

For some time, continuous samples of telephone tickets have been taken at manual exchanges and these have provided a wealth of information, mainly for revenue studies. Now work is going on to develop continuous sampling of trunk traffic under Subscriber Trunk Dialling conditions and so provide a variety of details for costing and engineering purposes.

Sampling is also being increasingly used for public opinion and market research studies. Annually, over the past few years, surveys of public opinion of the telephone service have been carried out among residential subscribers and a panel of residential subscribers is being set up to provide background information for forecasting purposes. Also, starting this year, a survey of opinion on the telephone service is being conducted among business subscribers.

Anyone studying the details of these schemes would conclude that sampling is an extremely practical subject and it is true that while a fair amount of theory is involved, it is a question also of enlightened common sense and experience. One may play for hours producing a technically very satisfying scheme, but the results will not be much good if the instructions are too involved for the people who have to collect the figures. Again, people have an uncanny knack of making like homing pigeons for the slightest ambiguity in a questionnaire and with unfailing precision interpreting it in a way the designer never thought of. Or, if there is the smallest loophole in a procedure, people will rush in, trying to be helpful, and the resulting bias makes even W. S. Gilbert's elliptical billiard balls look spherical by comparison. Post Office statisticians concentrate more on an objective selection of sample items and careful control of procedure than on very elaborate design.

Even with simple designs, however, there are differences between a properly designed sample and a subjectively chosen one. The design will be aimed at an objective selection, free from any serious bias. The difficulties here are not always appreciated. Often people will think they are eliminating any personal choice and taking an objective sample when they are merely being haphazard. Bias, too, is in practice very difficult to avoid since it can be quite unconscious.

For policy decisions one often needs not only the results of a sample but also some idea of how reliable these results are. A scientific scheme is so designed that by bringing in probability theory

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Left: Mrs. R. Willett, a telephonist at Brighton Telephone Exchange, holds the 1,000th ticket selected for her by the card counter. These machines are now being supplied to the largest switchboards to speed ticket counting and Trunk Call Analysis sampling.

Mrs. Willett reloads the counter machine with another batch of trunk tickets. The machine can count tickets at the rate of 600 a minute.

one can estimate the reliability of the sample. But one cannot apply probability theory where subjective choice is exercised. Say, for example, that someone sits down with a list of towns and chooses a sample of them that he thinks is representative. Since there is no way of working out the probability of our sample-taker selecting by personal choice, say, Oswaldtwistle rather than Toller Porcorum or Moggerhanger, it is quite impossible to work out how reliable the sample may be. Of course, subjective selection may be justifiably used in certain circumstances—for example, in the Post Office a complete count of some item may be taken, for reasons of administrative convenience, during the same week in each year. But, in such cases, one cannot assess reliability.

In actually applying a sample design, much of the work will be in overcoming practical snags, such as finding a suitable list from which to sample. A great deal of care may be needed to find a list or "sampling frame" which is suitable for a particular problem. Say a list of adults is required. Electoral registers give such a list, but even this will exclude younger persons and people who have recently moved into the district. It is a matter of practical judgment whether the resulting bias may safely be ignored or whether special efforts must be made to supplement the frame.

An example of a centrally-maintained frame in the Post Office is the Exchange Connection Sampling Frame (ECSF) which gives the numbering range of each exchange in each Area and is kept on punched cards. Because omissions in sampling frames tend to bias results, considerable trouble is taken to keep the ECSF as complete and up-to-date as possible.

After the most suitable list has been obtained there are further snags in giving each item the right chance of being selected. Say, for example, that a sample of households is needed for a public opinion survey. Taking the individuals from an electoral register will give the bigger families a greater chance of being chosen. Something therefore must be done to even up the chances—for example, by accepting a name only if it is the first on the list for that household. Again, on

the ECSF special coding is necessary for eleven and over PBX units to equalise the chances of selection.

Telephone connections can be listed beforehand so that the sample can be made quite specific. But this does not apply to telephone conversations. Here, the great practical difficulty is to make sure that instructions are followed and subjective choice is not allowed to intrude. Exchanges are instructed to sample every thousandth ticket and a good deal of attention is devoted to finding a procedure which will ensure that objective sampling is achieved.

In considering the practical points, little has been said about design except that it should give objective selection. On occasions the Post Office uses elaborate designs but emphasis is usually on the simpler design with careful control of procedure. Perhaps, as mechanisation progresses, less time will be spent chasing the thousandth ticket and more time on elaboration of design. One suspects, however, that the great law of the General Cussedness of Things will continue to operate and that practical snags, since electronic equipment can be temperamental too, will accumulate even more rapidly than before.

THE AUTHOR

MR. J. F. WOODS *is at present responsible for telecommunications and motor transport questions in the Statistics Branch of the Statistics and Business Research Department, GPO Headquarters. Before taking up his present appointment in 1965, his experience has included the conduct of large-scale sample surveys with Television Audience Measurement Limited and economic forecasting as a statistician/economist in the Commercial Planning Department of the British Iron and Steel Federation, where he was latterly head of the Computer Applications Section.*

THREE NEW SUBMARINE CABLES

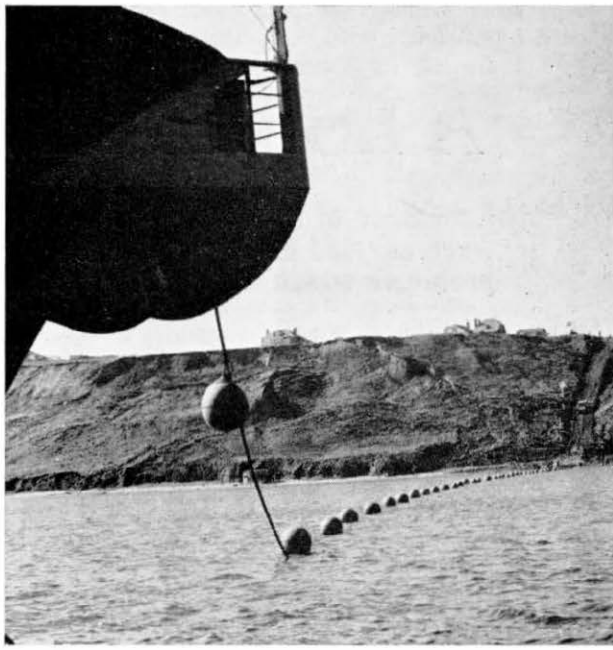
THREE new submarine telephone cables which will have the biggest capacity of any in the world are to be laid in 1966 and 1967. Each will carry 480 circuits and be laid from Hampshire to St. Helier, Jersey; Yorkshire to Norway; and from East Anglia to the Netherlands.

Manufacture of the cable and equipment has begun and the shore end of the first to be laid—from Cayton Bay, near Scarborough, to Kristiansand, in Norway—was completed by the Danish cable ship "Peter Faber" at the end of April.

The U.K.-Norway cable will be 386 nautical miles long and will have repeaters spaced along it every eight-and-a-half miles. The repeaters will use transistors in place of valves, making the cable the first to contain transistorised repeaters on a large scale (the only other international submarine cable known to have transistorised repeaters is the one between Britain and Belgium). The main cable to Norway will be laid in 1967, probably by the Post Office cableship HMTS "Monarch".

The shore ends of the cable to Jersey will be laid in October this year and of the Covehithe (near Lowestoft) to Katwik (Netherlands) cable in April, 1967. HMTS "Monarch" will also probably lay these two cables.

The overall cost of the three projects is expected to be about £3 million, borne pro-rata by the British, Norwegian and Dutch administrations.



The shore-end link of the new cable from Britain to Norway is floated ashore at Cayton Bay, Scarborough, from the Danish cable ship Peter Faber, moored 300 yards offshore. The shore-end cable, attached to buoys to keep it steady, was hauled to the beach by two local fishing boats.

Senior members of London's Task Force get down to business. They are (from left to right): Mr. E. Davis, Mr. D. Breary, Mr. W. E. Thomson, Mr. S. R. Valentine, and Mr. H. E. Francis, the Task Force Leader.

A London Plan for 2000 AD

A member of a special Task Force set up in 1963 describes how studies were carried out and plans drawn up to deal with many problems which unprecedented demand for telephone service is creating

By S. R. VALENTINE

LONDON telephone subscribers account for a third of all telephone calls made in the United Kingdom so that planning for the future switching of this traffic is of immense importance in relation to the whole telephone service. The recent upsurge of traffic, particularly of trunk traffic, further highlights the need for a long term plan for London if future shortages of equipment or expensive expedients are to be avoided.

For these reasons, in August, 1963, a number of officers were formed into a team—known as The London Trunk and Junction Network Task Force—to prepare an outline long term plan for routing and switching London's telephone traffic. The team consisted of engineering, scientific and telecommunications staff who brought their separate disciplines together to deal with the problems involved in such a study.

The Task Force issued its final report in August, 1965. Its principal recommendations were that there should be a measure of decentralisation of trunk and tandem switching units, the existing central London units being retained, with some change of function, but supplemented and relieved by seven switching centres located in the London suburbs. These recommendations were accepted by the Post Office Administration.

Taking for its study the period 1970 to 2000, the Task Force concentrated on traffic originating and terminating in the London director area. In 1963, when the study began, there were in

this area just over 1.3 million working exchange connections served from 224 exchanges, and the total traffic originated in the busy hour was 54,000 erlangs.

By 1970, the beginning of the review period, the number of exchanges will have increased to about 330, be housed in 173 buildings and serve some two million exchange connections. Calls between these exchanges will be routed either over direct junctions or by way of a junction tandem exchange. There will be two main tandems and five sub-tandems, all situated in central London, and together they will switch about one third of the traffic circulating within the director area.

Apart from some traffic carried on direct routes, calls between director exchanges and exchanges in charging groups adjacent to the director area will be routed by way of toll units, all located in central London. One unit will cater for outgoing traffic from the director area, subscribers dialling special local codes for these calls, and two units will cater for incoming traffic which will be completed by national number dialling.

For calls between the director area and the remainder of the country there will be ten trunk switching units in central London—five for outgoing and five for incoming traffic. In addition, there will be a unit carrying both outgoing and incoming traffic.

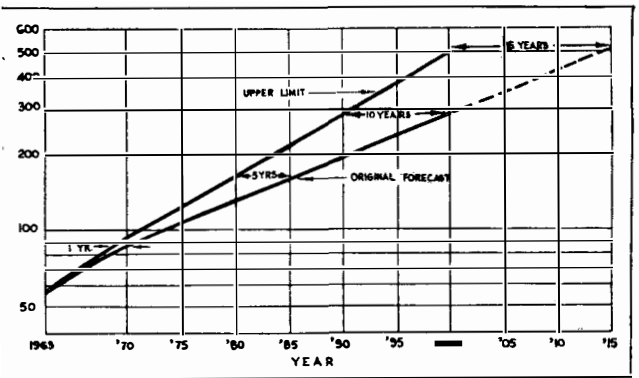
Before considering possible plans for 1970 onwards, the Task Force had to determine the likely development in exchange connections and traffic during the review period; the costs to be used in comparing any alternative schemes; and the technical developments likely to influence such schemes. It forecast that by the year 2000 the director area exchange connections would grow to 4.3 million of which about one million would be business lines and the rest residential. This meant that by the year 2000 virtually every household would have telephone service. It was also assumed that the average number of calls in the busy hour from a business line would double over the review period and those from a residential line would almost treble. In arriving at these forecasts previous long term trends and the calling rates of comparable cities in other countries were taken into account.

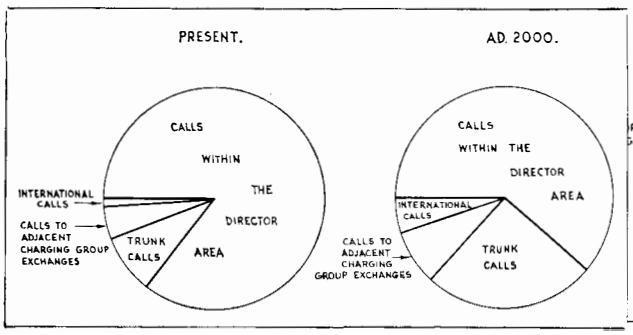
The resultant forecast of originating busy hour traffic in the year 2000 was 280,000 erlangs, compared with 54,000 erlangs in 1963, and within this overall total particular classes of traffic—such as within-director-area traffic, traffic to adjacent charging groups, and trunk traffic—were assessed separately.

It is, of course, difficult to forecast so far ahead and the degree of error must inevitably be large. However, because the traffic quantities were to be used for comparing alternative schemes and not for actual plant provision, it was not essential for them to relate to precise dates. They were looked upon rather as levels of traffic which might be reached at any time over a span of years. Nevertheless, because of the recent up-

OVER

Below (left): The original "upper-limit" forecasts of busy-hour traffic originated in the director area. The possible coverage of the original forecast is also shown. Below (Right): Illustrating the proportions of the various types of calls expected to be made by London subscribers in the year 2000, compared with the present proportions.





Two members of the Task Force working out some of the problems with the Dollis Hill computer. The Force also used computers at Bristol University and at the Elliott Brothers Ltd. Service Centre.

surge in traffic and the speculative nature of the forecasts, it was decided to test any favoured scheme against an upper limit of 500,000 erlangs of originated busy hour traffic and to use this upper limit also to assess the possible span of years applicable to the original forecasts.

Detailed current costs were assembled for all appropriate types of local, tandem and trunk exchange equipment and for junction and trunk line plant. For costing purposes the director area was divided into a small central area and three concentric rings, and the cost of accommodation, exchange equipment and line plant in each such area were considered separately. Using these current costs as a basis, forecasts were made of future costs in terms of annual charges, particular attention being paid to the relative cost of switching equipment and line plant.

On technical developments, an increasing use of Pulse Code Modulation (PCM) junction systems and electronic switching equipment probably using reed relays was envisaged and, as a separate exercise, the possible use of an integrated PCM switching and transmission system in the local tandem network was considered.

A number of possible alternative switching schemes were prepared and within each scheme various ways of routing traffic were postulated. Initially, separate consideration was given to traffic circulating within the director area, traffic between the director area and its adjacent charging groups and to trunk traffic, but it was realised that there would be a need ultimately to amalgamate the most promising schemes into a single composite plan which could be achieved in practice by a smooth progression from the existing arrangements. The schemes for each class of traffic varied from those which largely perpetuated the existing centralised arrangements to others which decentralised the switching of varying proportions of traffic on to different numbers and locations of switching centres.

Studies were carried out to compare the cost in terms of annual charges between the various schemes. For this purpose, extensive use was made of computers, first for preparing detailed traffic data from the overall forecasts and then for routing the traffic and calculating the appropriate equipment and line plant costs.

The somewhat unexpected result of these cost studies was that the annual charges of the alterna-

This diagram shows the future division of the director area for routing and switching purposes. The approximate locations of the proposed sector switching centres are also shown here.

tive schemes differed from one another only marginally, particularly on within-director-area and trunk schemes. It would, of course, have been wrong to assume from this that it did not matter how traffic was routed or where switching units were situated. What the results showed was that provided a scheme was devised on sound principles a worth-while degree of decentralisation could be achieved without increasing the theoretical long-term costs. They also threw into greater relief other factors which ought to be taken into account, along with costs, in determining any final plan.

The extent to which individual schemes reduced the need for switching equipment in central London was, of course, important; any decentralisation would relieve to some extent the difficulty and cost of providing buildings in the centre. Again, management and service advantages could result from an alignment between the boundaries of Telephone Areas and those of the areas served by particular switching units because Telephone Managers would then be more directly responsible for the handling of traffic peculiar to their own subscribers. In addition, an early study had shown that for economic reasons there should be a greater use of 10 lb/mile instead of 20 lb/mile cable, within the director area and it would be well, therefore, for the siting of switching centres to facilitate this feature.

The overall plan which the Task Force has recommended is based on the division of the director area for traffic routing and switching into a central circle of four miles radius and seven outer sectors. The outer sector boundaries largely coincide, so far as the director area is concerned, with those of the proposed outer-London Telephone Areas (including the recently established South Area) and in time they can be made conterminous.

Within the four-mile circle the existing trunk and tandem switching units will be retained and augmented over the years as necessary. In addition, there will be one, or possibly two, 4-wire-switched central units. In each outer sector a Sector Switching Centre (SSC) will be established some eight or nine miles from the centre of London. Each SSC will contain an incoming and an outgoing trunk switching unit and a junction tandem. Furthermore, each will be an auto-manual centre dealing with a considerable portion of the operator-handled traffic originated within the sector. The central trunk units and the SSCs will be connected to international exchange for overseas traffic.

The present main tandems will switch cross-London traffic and the present sub-tandems will be used to switch traffic between central exchanges and those suburban director exchanges close to the centre. Other tandem traffic, including traffic between the remaining suburban director exchanges and the centre, traffic within a sector and traffic between adjacent sectors, will generally be switched by way of the SSCs.

For traffic to charging groups adjacent to the director area and for outgoing trunk traffic the function of the existing toll and trunk units will be restricted to serving those exchanges within the four-mile circle. The SSCs will serve the exchanges within their respective sectors for these same purposes. Direct routes from central units and SSCs to distant group switching centres will be provided where justified. Otherwise, traffic will be routed by way of the special 4-wire-switched central unit either over direct routes from this unit to group switching centres or onward by way of the national transit network. On calls to the adjacent charging groups it is suggested that local code dialling should in due course be changed to national number dialling.

OVER

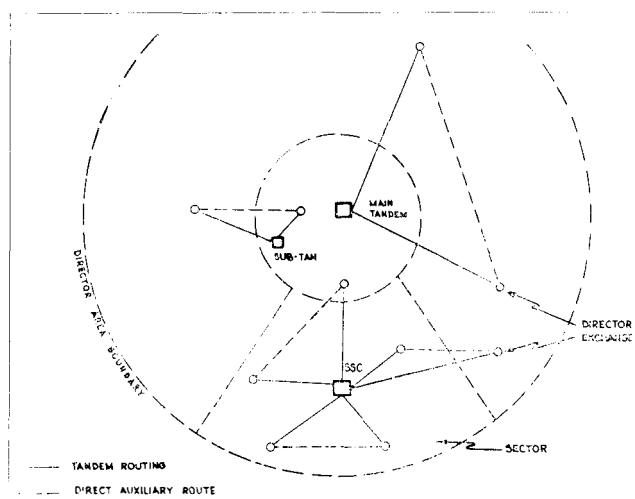
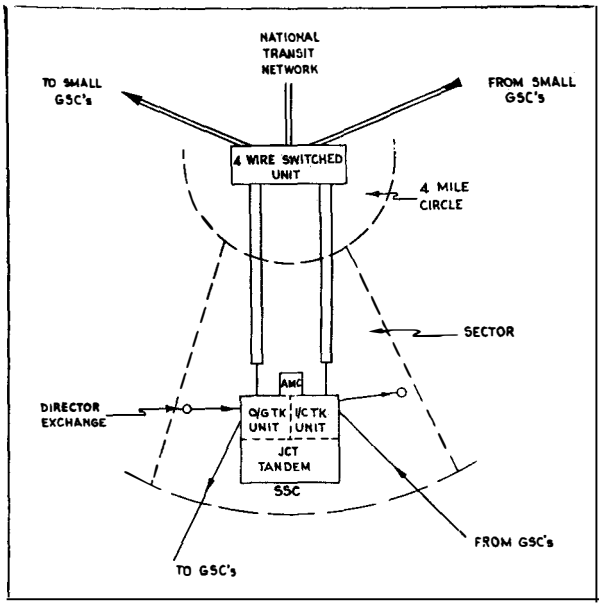


Diagram of the plan for routing and switching the within-director-area traffic.



This diagram shows the make-up of a Sector Switching Centre and the main routings of trunk and adjacent-charging-group traffic.

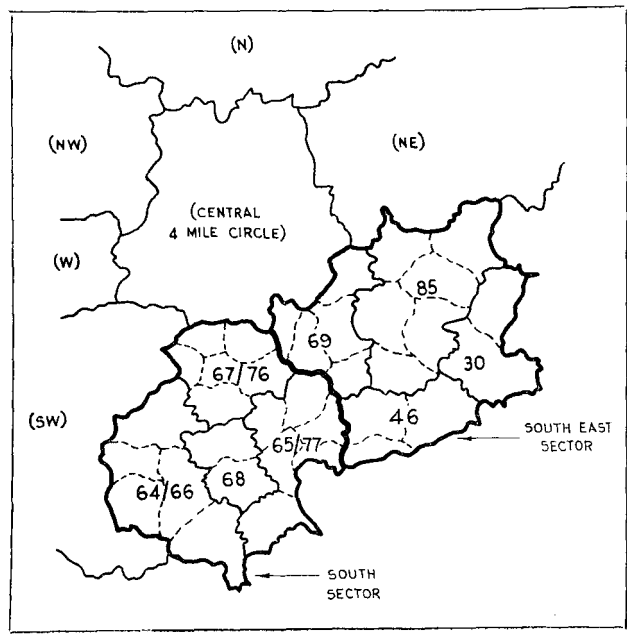
This should be easier for subscribers and will also enable London to keep within a seven-digit numbering scheme much longer than would otherwise be possible. Traffic to and from adjacent charging groups will then be handled in a similar manner to trunk traffic and the need for distinction between toll and trunk exchanges will disappear.

The routing of traffic incoming to the director area will follow a similar pattern to that for outgoing traffic. The existing central units will serve the four-mile circle, the SSCs will serve their respective sectors and the 4-wire-switched unit in the centre will also function for incoming traffic. There is, however, one major difference in the case of incoming traffic as compared with outgoing.

Decentralising the switching of traffic outgoing from the director area does not involve any novel feature. The exchanges within a sector are served by direct junctions to the SSC, where the traffic is collected and treated as a whole for onward routing purposes. For the decentralisation of incoming traffic however, the originating register-translator at the provincial centre must be able to identify each London director exchange sufficiently for calls to be routed to the appropriate SSC for the exchange concerned. This is not possible at present but with the change-over to All-Figure Numbering, the numbering scheme in London is being re-arranged so that codes which start with the same first two digits are allocated to exchanges within the same sector. In this way it will be possible for a distant register-translator, by its normal discriminating facilities, to identify the appropriate sector in London for each objective exchange.

The overall plan, therefore, fulfils to a large extent the features which the Task Force considered desirable. The SSCs between them will switch about half the within-director-area tandem traffic, one third of London's trunk traffic and up to about half of the traffic between the director area and its adjacent charging groups, thus achieving a worthwhile degree of decentralisation and relief to the centre. The plan also gives to Telephone Managers a larger measure of control over the equipment serving their own

Two sectors of the director area and the first two digits of the AFN codes allocated within each sector are shown in this diagram.



customers and, by bringing the switching units nearer to the sources of traffic, it is also easier to make greater use of lighter-gauge cable.

The plan also obviates the present need in London for a complete network of junctions to director exchanges from all incoming units and, by concentrating in the SSCs all types of traffic, it provides for further economies to be achieved by combining junction routes. Finally, speech transmission will be improved initially and further progressive improvement will be facilitated.

This article gives only a small insight into the work of the Task Force and the main features of its plan for London. Many other studies covering such matters as the size of the director area, the optimum size of director exchanges, and the numbering scheme, auto-manual position and transmission requirements were also carried out and are dealt with in the Task Force Report.

The Task Force received help from many sources, including the Inland Telecommunications Department, the Engineering Department, the External Telecommunications Executive and the London Telecommunications Region itself. Its members hope that their outline plan will become a firm framework on which to build the telephone service in London for many years to come.

THE AUTHOR

MR. S. R. VALENTINE *is a Principal Telecommunications Superintendent on the staff of the Task Force. He entered the Post Office in 1929 as a Youth-in-Training at the Research Station, Dollis Hill, and in 1932 become an Assistant Superintendent of Traffic, Class Two, in London. Following a period of Temporary Higher Executive Officer in the Establishments and Organisation Department of Post Office Headquarters he was promoted in 1952 to Chief Telecommunications Superintendent in the Manchester Area. He was appointed to PTS in the London Telecommunications Region in 1962.*

★

HELP FOR THE HOUSEBOUND

FORTY elderly and housebound people in Manchester will soon be able to speak to their nearby friends and relatives over an emergency communications system operated from the electricity mains supply in their own homes.

The scheme is an experiment designed to discover how far such a system will meet the needs of the elderly and housebound for emergency communications. It is being sponsored by the Post Office, which is providing the commercial portaphone device free, in conjunction with the Manchester Corporation Welfare Department, the North-Western Electricity Board and the Post Office Engineering Union, whose members are installing the equipment voluntarily.

Because the portaphone operates over the electricity mains supply system-it simply plugs into a convenient supply point—there are no line plant costs. The controls consist of a "press-to-talk" button and an "on-off" volume switch. The cost of the mains power for each device if left continuously running is about 4d. a week. The portaphones are supplied in pairs—one fixed in the elderly person's home and the other in the home of a nearby friend or relative on the same phase of the mains supply. Some problems in pairing have been encountered and a complete evaluation of the experiment may not be possible until the scheme has been in operation for about 12 months.

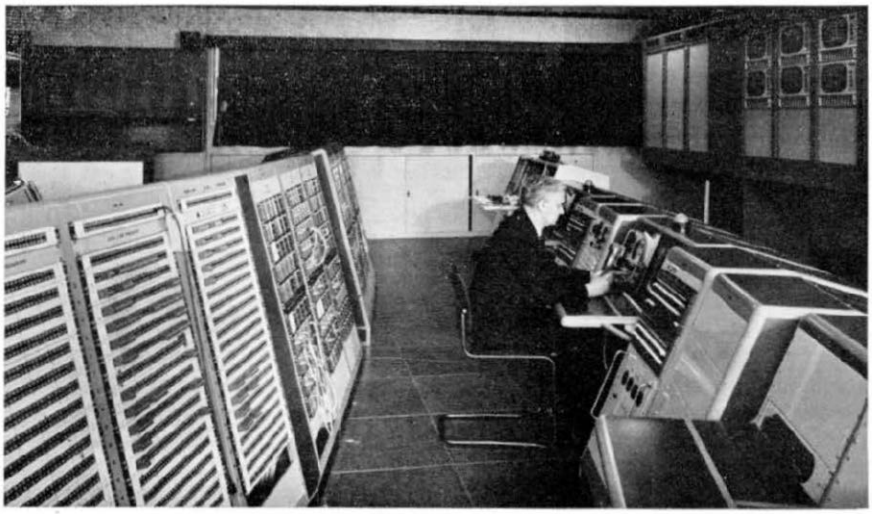
David Norbury

Technical Officers R. J. Bagguley (right) and H. Street install the new device in the home of an 80-year-old Manchester widow.

The Post Office plays a big part in the nation's television system and teams of Engineers are continuously on duty routing programmes, maintaining equipment and testing picture quality at the . . .

TV NETWORK SWITCHING CENTRES

By W. E. GERRY



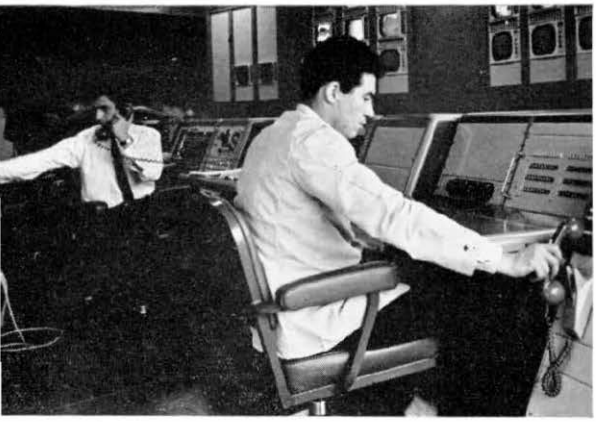
General layout of a large switching centre, showing the three-suite arrangement. The Engineer at the console is adjusting the oscilloscope on his left. Behind him are the circuit distribution racks and on his right the picture monitor suite.

THERE are two fully operational television networks in Britain, both used for broadcast entertainment: one by the British Broadcasting Corporation and the other by the Independent Television Authority. A third network, to carry the BBC Second Programme is now being provided, service so far being given to the London, Birmingham, Manchester, Cardiff and Southampton areas.

Within each network, programmes are transmitted between cities or other large population centres over main links connected by studio circuits with the broadcasting authorities' studios or programme control centres, with transmitter links completing the chain of communication from programme sources to broadcast transmitting stations. Programmes are routed to different parts of the country by suitable interconnection of the three types of circuit under the operational control of the broadcasting authority.

The Post Office provides and maintains most of the vision circuits and also undertakes the switching of Independent Television links according to a daily schedule supplied by the ITA. At the Post Office stations where television circuits are terminated and interconnected there are control points known as Television Network Switching Centres—a title which does not fully describe their function since, in addition to the switching operations on the ITA network, it is here that the major testing and maintenance work is done on all vision circuits.

When a single programme is networked over the whole country it can be transmitted over as many as six main links and a similar number of studio circuits and transmitter links. If the picture quality is to be acceptable at the remote end of the network, performance standards of individual circuits must be very high so that there is an obvious need for regular performance checks to be made of all vision links, for means to locate and clear faults without delay and for



Left (top): A close-up of the vision test console, showing an Engineer connecting a vision circuit to a picture monitor by press-button. In the foreground is the keyboard through which communication is made with other stations.

Below: Showing how connections can be set up between the distribution racks and the test console from the seated position.

facilities to observe that programmes are being correctly routed.

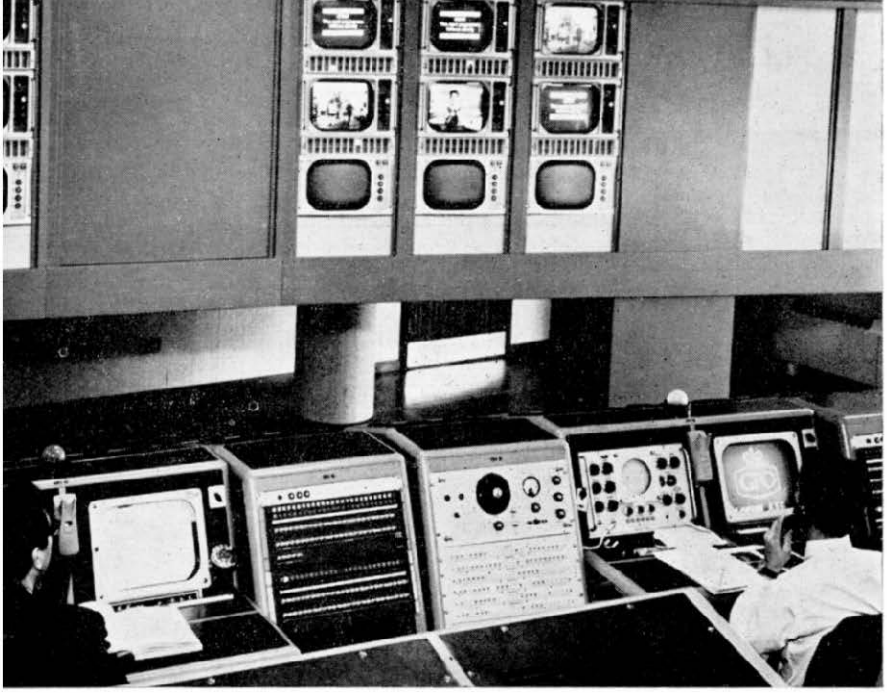
Performance is assessed on waveform response, the principal test signals being generated waveforms which simulate critical characteristics of a picture signal. At the receiving end of a circuit oscilloscopes are used to reproduce the received signal and circuit performance is rated according to the differences in shape and so on between the sent and received waveforms. More than one test signal is required to assess performance fully and some forms of distortion are more tolerable than others. A rating system has been devised which equates the subjective effects of the various forms of distortion and the test results interpreted by the system give an accepted indication of the quality of the circuit.

The comprehensive tests required involve the use of a considerable amount of test equipment, particularly since the BBC 2 network operates to 625-line definition standards as against the 405-line picture structure of the earlier networks. This, coupled with recent and anticipated future growth of television traffic has led to the setting up of a standard arrangement at network switching centres to ensure that the essential testing is carried out under conditions conducive to the best possible service.

The modern television network switching centre is essentially a control room with equipment in three suites, each having up to four parts. The first suite comprises four consoles functioning as distribution racks at which all circuit terminations are centralised. Two of the four consoles are video distribution racks, one each for 405-line and 625-line vision circuits. Circuit terminations are grouped in sections, each network having its own section and being identified by the background colour of the circuit labels. Circuits normally connected together are terminated on adjacent coaxial plugs, the interconnection being made by a U-link. At the end of the circuit termination sections there is an end unit on which special control facilities—such as switching in standby amplifiers at unattended stations on studio or transmitter circuits and extension of alarms or supervisory systems on coaxial line and radio links—may be provided.

Sound circuits associated with vision links are also provided and maintained by the Post Office. They terminate on the audio distribution rack which is the third console in this suite. The fourth console provides facilities for connecting vision and sound circuits to network switching equipment.

OVER



Monitor sets, placed at a normal viewing distance from the test console, are used to check circuit continuity and picture. More critical examination of picture quality is made on the high-grade monitor seen on the test console. This picture was taken in the television switching centre at the Post Office Tower in London.

The second suite, which is both physically and functionally central, consists of three test consoles and one switching console. The test consoles, placed opposite and facing their distribution counterparts, mount test equipment for 625-line vision, 405-line vision and sound circuits respectively. Test equipment on the vision test consoles consists of waveform generators and oscilloscopes for the waveform tests and a precision picture monitor for close examination of picture detail. There are also oscillators, level measuring sets and so on for other tests and a speaker keyboard for communication with other stations. Any vision circuit can be connected to its appropriate test console by coaxial trunks from the distribution rack. The item of test equipment applied is selected on a push-button control panel at the test console.

Similar arrangements for testing sound channels associated with vision circuits are provided on the audio test console, the third item on the test suite, which enables checks to be carried out on sound levels, and distortion and noise to be measured.

The fourth console in the suite accommodates network switching equipment varying in circuit capacity according to the foreseen switching requirements at each station. This equipment switches vision circuits and their accompanying sound channels simultaneously at precise times. A number of switching operations can be prepared in advance, the actual switch taking place under the control of an electronic clock which is synchronised with the Post Office Speaking Clock service, the agreed time standard for these operations. A warning signal is given at a predetermined time before the switch is due so that the operation may be monitored.

Beyond the test suite is the monitoring suite which houses picture monitors mounted at a height visible to testing staff seated at the test consoles. Selecting equipment in the repeater station enables any vision circuit to be connected to a picture monitor by pressing a button switch at the test console. A set of monitors is associated with each test console, the ratio of working circuits to monitors being between 5:1 and 23:1 according to the size of station. The vision circuit connected to a particular monitor is identified on an illuminated panel fitted adjacent to the monitor. These monitors are used as a continuity check rather than for close examination of picture detail and are not of the same grade as the precision instrument at the test console. Monitors opposite the network switching equipment can be connected to the vision circuits in a switching operation and "off-air" television receivers are provided to check local broadcast transmissions, thus confirming continuity of any outgoing transmitter links.

To ensure the best possible working conditions, the switching centres contain a number of special

An Engineer at work on the test console, observing a wave-form signal on the test oscilloscope.

features. For example, all cabling to the control room equipment is brought through a false floor built six to nine inches above the main floor; lighting is controlled to give the low-intensity illumination best suited to monitor viewing; noise is reduced by sound insulation; and ventilation ducts are provided to counteract the effect of heat generated by the equipment. Terminating circuits on the distribution racks and allocating picture monitors to working circuits can be effected by means of cross connections in the repeater stations so that operations in the control room are confined to the testing and controlling functions. All these arrangements will apply to the network switching centres in London, Birmingham, Manchester, Carlisle, Kirk-o'-Shotts and Bristol.

In addition to these major centres there are smaller terminal stations which, while not involved in network switching, require maintenance facilities of similar order. Control rooms at these stations are called minor network switching centres which, in view of the absence of scheduled switching commitments, may seem to be a misnomer. But outside broadcasts and other special events can call for variations from the normal interconnection of vision circuits and the maintenance facilities are modelled on those at the larger stations.

The equipment at the minor switching centres is also arranged in three suites, but each has only one console. Network switching sections are not needed and, since the sound channels are brought into the centre for association with network switching equipment, audio sections are also unnecessary. One video distribution console provides terminations for all video circuits, with an end unit for miscellaneous control requirements. The single vision test console is slightly lengthened to allow the mounting of 405-line and 625-line test equipment and the picture monitor suite consists of one framework accommodating monitors for both definition standards. The monitor selection equipment can be arranged so that circuits of either standard are connected to the appropriate type of monitor.

Future developments such as the anticipated growth in television traffic, including the provision of a fourth network, will affect these centres. There are also indications that closed circuit television for educational and other purposes will lead to a large increase in Post Office televison interests and commitments.

Network switching commitments are also expected to increase, particularly if the number of services expands. New switching equipment now on order for the London Network Switching Centre will more than double the switching capacity of the present installation and similar expansion is planned for three provincial centres.

The advent of colour television will also add to the maintenance work required on television circuits. Link tests will need to include checks of response to the colour content of the picture signal and its relation to picture brightness and, as a result, more test equipment will be needed. However, the increasing use of transistorised equipment and current design trends towards miniaturisation will lead to more compact test devices, and it is thought that the console frameworks now in use will be capable of mounting all the equipment required.

THE AUTHOR

MR. W. E. GERRY *Is an Executive Engineer in the Main Lines Planning and Provision Branch of the Engineering Department. He joined the Post Office in 1928 as a Youth-in-Training in the Central Area, LTR and later transferred to the LTR Outside Broadcast group where he was promoted Assistant Engineer in 1947. He took up his present post in 1962.*

Mr. W. Jackson (left) and Mr. W. Barnes demonstrate their invention on a Southport estate.

A TRIUMPH FOR TWO TECHNICIANS

A BRILLIANTLY simple—and highly successful—new way of detecting faults in polythene-sheathed underground cables has been discovered by two Post Office Technicians from Preston. And it has won for them a £300 award from the Post Office Suggestions Scheme.

The story of this remarkable discovery—now known as the Barnes-Jackson Test—began some months ago when Technicians William Barnes and William Jackson had the idea that a "leaking" noise could be picked up from a telephone cable in much the same way that water diviners can locate a hidden spring.

Their big chance came when they were sent out to find fault in a cable in Southport. Southport has no poles—all telephone cables there are underground—so Mr. Barnes and Mr. Jackson decided to try out their idea instead of adopting the normal method of lifting up paving stones along the route of the cable until the trouble is located.

They arranged for an oscillating tone to be put through the cable from the exchange and then one of them, with the headphones, aerial and amplifier, walked along the pavement endeavouring to pick up the noise as he went. Nothing happened so, disconnecting the aerial, Mr. Barnes and Mr. Jackson began to walk disconsolately away, the connecting wire to the amplifier trailing along the pavement.

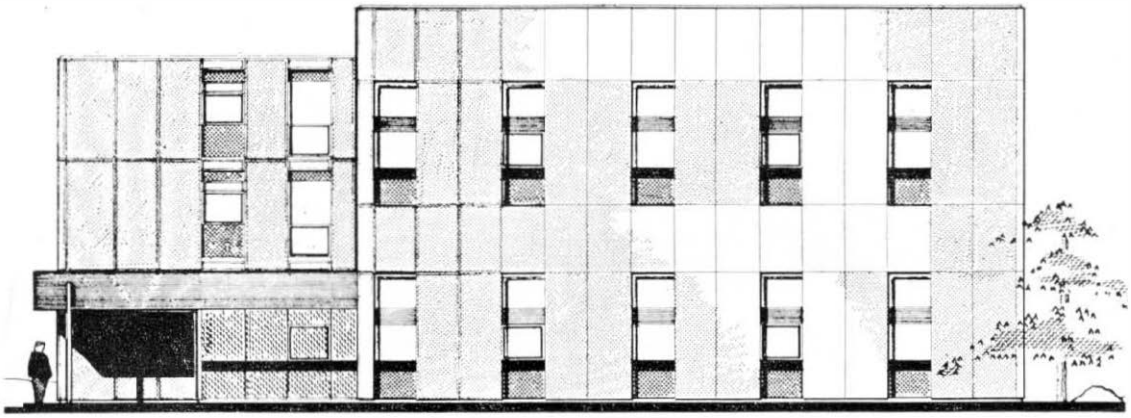
The amplifier was still switched on and suddenly through the headphones came the tone they were seeking. Trailing the wire, they discovered the fault at the point where the tone became loudest.

However, the tone was still not loud enough to detect all faults so the two technicians tried increasing the amplification but without much success. Then, once again, sheer chance took a hand. While they were trying unsuccessfully to trace another fault with their equipment they were about to give up when Technician Jackson picked up the bare end of the wire connected to the amplifier. Immediately a much louder tone came through the headphones. They realised that the current was flowing through Mr. Jackson's body. Excitedly, Mr. Jackson bent down and moved his free hand closely over the pavement and the tone increased until the fault could be detected to within an inch or two.

This new method of detecting cable faults can be used only with polythene-sheathed cables and is based on identifying the point where alternating current from an oscillator connected to the faulty wire and to an earth electrode flows through the cable sheath perforation into the surrounding soil. An amplifier-receiver can detect the point above the sheath where the tone is loudest.

The amplifier-receiver is transistorised and is carried by one man who wears a headgear receiver and keeps his finger in contact with one of the input terminals of the amplifier. A second man holds the bared end of a conductor, about two yards long, which is connected to the other input terminal. The two men then walk along the route of the cable, about two yards apart so that each acts as an electric probe. Between their feet there is a potential difference due to the leaking alternating current. When one of the men moves to where the tone becomes loudest he is standing over the cable sheath fault.

The new method is now being taught in some of the Post Office engineering schools.



Architect's drawing of the K 2.1 type telephone exchange with vertical extension as it will appear in the not-too-distant future. One of this type is now being built at Royston, in Hertfordshire, for later extension.

TELECOMMUNICATIONS BUILDINGS

By L. T. WOOD

DESIGNERS and builders are being severely tested these days. Houses, hospitals, schools, factories are required to be built quicker, to better standards, and in larger numbers than ever before, but it is vital that a share of the building industry's heavily pressed resources be allocated to providing accommodation for telecommunications. The exchange buildings are no less essential than equipment and line plant to meet the massive and growing demand for telephone service.

This demand and its distribution, the geography of the country and the way the telephone network has developed over the years are factors which, when combined, produce the major operational requirement for new buildings in the telephone exchange field. During the next ten years, it is estimated, more than 1,000 new buildings—both small and medium sized—will be needed to house new exchange equipment and the cost of constructing them will amount to about £20 million. This vast programme excludes the small buildings provided and maintained by the Post Office without the assistance of the Ministry of Public Building and Works.

Extensions to existing exchanges, new auto-manual centres and telephone engineering centres will also be needed. Indeed, these buildings will need even more capital. But the number of smaller and medium-sized exchange buildings required and the urgency of the demand provide the most profitable area for the economic deployment of modern building techniques.

Standardisation and pre-fabrication or, as it is more widely called, industrialisation, are not new to the telephone system. Standard brick and timber buildings for unit automatic exchanges have been in existence for a long time. In fact, the timber versions of these buildings have been pre-fabricated and assembled on site over the past 15 years. Three types are still in use: type A, accommodating up to 45 connections, type B with 46 to 168 connections, both costing around £600; and type B1, providing for 400 connections initially and extending to 600, and costing up to £1,200. Future provision of new unit automatic exchanges will be made in B1 buildings only, smaller buildings being discontinued.

The Post Office progressed through the alpha-

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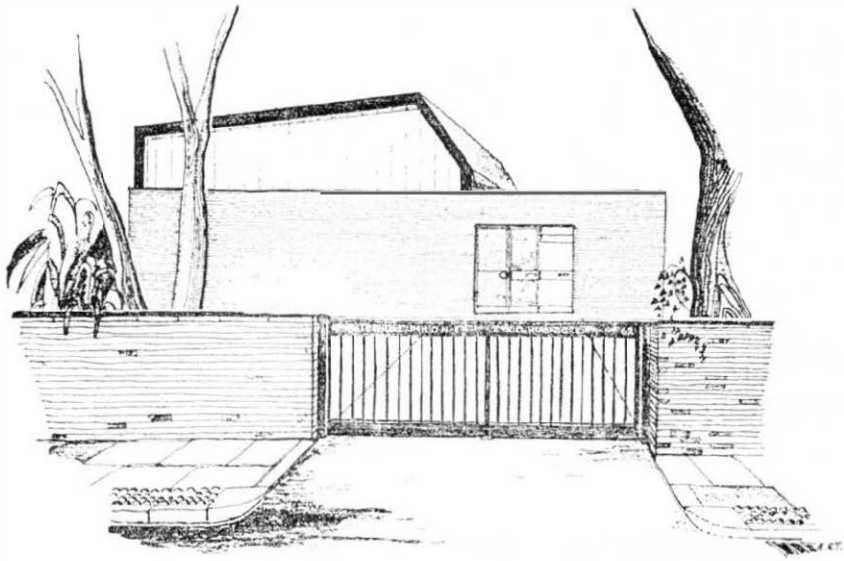


Architect's drawing of the L-type design of automatic telephone exchange.

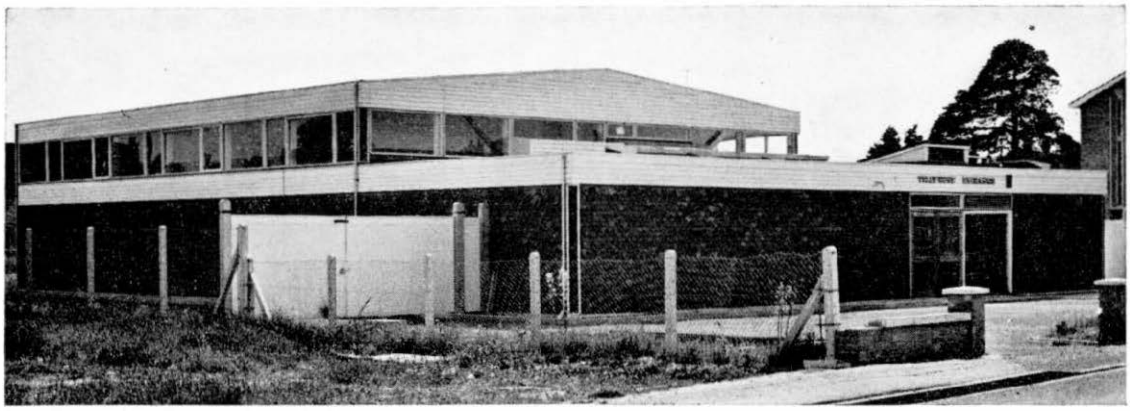
bet to the letter G in naming the various types of small standard exchange building designs up to the beginning of World War Two, and, since about that time many repeater stations have been housed in standard buildings. But it was not until 1961 that the first of the modern standard-designed exchange buildings suitable for non-rural telephone conditions was introduced. This design—the H type—with separate apparatus and battery rooms, welfare and kitchen facilities, catered for an initial 20-year capacity of between 1,600 and 2,000 connections, provided for a 100 per cent. extension of the apparatus room and cost about £10,500.

In 1962 the K range of buildings was introduced to provide up to 7,000 connections—a big jump up the scale. The K range now consists of five designs. Its nucleus comprises an apparatus and distribution frame room, units of various ancillary accommodation being associated with it. The five designs, all of which cater for a 100 per cent. extension of the apparatus room, are: K1 (2,000-5,000 connections initially; staff welfare, 7 men); K1 C (as for K1 but staff welfare, 20 men; maintenance control); K2 (5,000-7,000 connections initially; staff welfare, 20 men; Assistant Executive Engineer's Office); K2 C (as for K2 but plus maintenance control); K3 (as for K1 C but plus Assistant Executive Engineer's Office).

Of these designs the K1 was the most widely useful and in 1963 a critical examination of this design was carried out with a view to reducing its cost, which was then about £22,000. As a result, a re-design, known as the K1 Mark IV, was introduced in 1964 and the five-bay version of it is currently costing about £19,000.

About that time it was recognised that the field of standard exchange buildings was ideal for adapting and developing the use of the modern industrialised building systems available to the Post Office's building agents, the Ministry of Public Building and Works. The Ministry had become members of two buildings consortia and, in developing a system of its own, it had three systems of construction available which it could control and for which it could ensure a high degree of competition. Based on earlier development work by Hertfordshire County Council and the (then) Ministry of Education, a consortium of local authorities had instigated a special programme (CLASP) which gave the name to the building system they evolved. Accordingly, a K1 Mark IV designed building was erected in CLASP at Heath End, in Berkshire, and compared with a similar one, in traditional construction, at Wantage a few miles away. The CLASP exchange took six months less time to build at roughly the same cost as the Wantage exchange.

Meanwhile, work proceeded on new designs to accommodate equipment for 600 connections initially (the L2) and for 1,600 connections (the L3). This development was designed to take up



The Heath End Exchange — the first Post Office building to be built in the CLASP system.

Building development work for the Post Office is carried out or sponsored by the Joint Post Office Ministry of Public Building and Works Research and Development Group (RDG). RDG consists of a small number of Post Office professional and operational people (led by an Assistant Secretary) and professional and technical staff of the Ministry working together as a research team.

The Group, which is chaired by the senior Ministry member who is a Superintending Architect, was set up in 1957 with the following terms of reference: "*to develop such methods as will enable Post Office buildings — which are operationally effective — to be built at minimum cost and with maximum speed*". It works under the direction of the Joint PO/MPBW Directing Group, chaired by the Director of the Post Office's Buildings and Welfare Department and composed of Post Office operational Directors, an Assistant Engineer-in-Chief and senior Ministry officers, including the Chief Architect and the Deputy Director General of Research and Development.

Since the Ministry members of RDG are also members of the Directorate General of Research and Development, the central research organisation in MPBW, the Group has access to the results of research of a much wider nature than it would be possible to undertake itself. This Directorate General has extensive national responsibilities, including the collection and interpretation of building information, the promotion of new and faster ways of building and the improvement of building management techniques.

The main field of RDG's operations is in standardisation of design, adaptation of suitable industrialised building systems for Post Office buildings, inspections of selected projects and completed buildings, cost control and giving guidance in planning to MPBW architects and Post Office planning officers.

the demand at the lower end of the K1 Mark IV capacity and to replace the UAX type B1. A prototype L3 building in traditional construction at North Weald will be completed this year. The costs of the L design buildings are expected to be between £8,000-£10,000.

As a result of the CLASP experiment, it was decided that both the K1 Mark IV and L designs should be adapted for building in this system. During the course of the conversion work, it became clear that CLASP would give considerable flexibility for combining the various functional units throughout the complete range of sizes covered by the two traditional designs. This range of designs has now been designated the M range.

Another recent development from the K range is the K1.1 and K2.1 series which provides for erection on a narrow site and the vertical extension of the apparatus room at the end of the initial equipment period. A prototype building from this series is being constructed at Royston, Hertfordshire. This new series comprises two design features and two size ranges. In the K1.1 and K1.2 buildings the foundations and columns of the frame are designed for eventual vertical extension, a lightweight roof being erected initially. In the K2.1 and K2.2 designs the foundations and columns are also designed for eventual vertical extension but the floor for the upper apparatus room (to take 180 lbs. per square foot loading) is incorporated in the initial roof. The K1.1 and K2.1 designs will provide up to 5,000 connections initially and the K1.2 and K2.2

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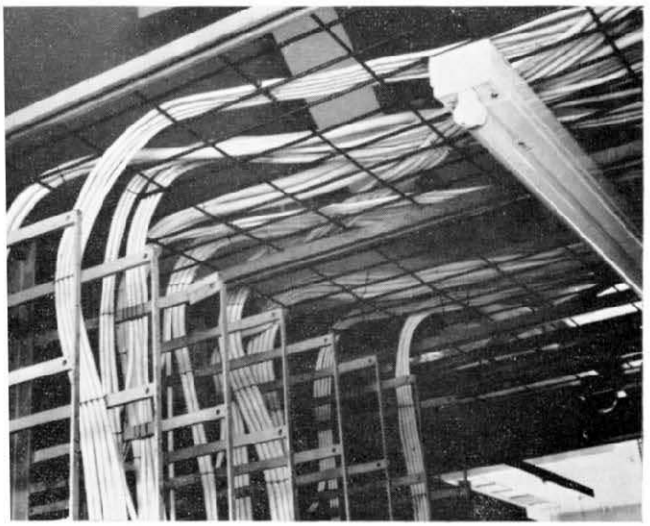

Above (left): Wantage automatic telephone exchange, built in 1964, is an example of the K1, Mark IV design using traditional building methods. Right: The H-type now replaced by the L and K designs.

Trials are now taking place with a system of running cables to distribution frames over welded mesh to provide a better cabling arrangement.

designs from 5,000 to 7,000 connections initially. The Royston prototype building is of K2.1 design.

This development is a practical recognition that suitable sites for telephone exchanges are becoming increasingly difficult to find. Reviews of future requirements over the next five years show that, if the sites were available, the complete range of standard designs would satisfy more than 80 per cent. of the new exchange buildings needed. But, because of the awkward sites that will inevitably have to be used, this degree of penetration in standardisation will not materialise unless the standard designs can be made more flexible. With this object in view, a method of building is being developed, in collaboration with private consultant architects, which is intended to embrace the use of components from systems available to the Ministry and which should give the flexibility required for building on almost any shape or size of site. This development, started fairly recently, has not yet progressed to the stage when recommendations can be made, but the logical outcome, if successful, would be an industrialised system for automatic telephone exchange buildings.

Small and medium-sized automatic telephone exchanges—which comprise relatively simple functional accommodation units put together in the same way for each project—are ideal for standardisation. This does not apply, however, to the other large operational building requirement—telephone engineering centres. Although the main purpose of a telephone engineering centre is to group engineering staff on external and internal construction and maintenance work with the stores and vehicles they use, site and operational problems often make such grouping impracticable. For example, in many areas, the Motor Transport Workshop is most conveniently associated with a postal building or on a separate site. The approach to standardisation of telephone engineering centres, therefore, might well follow the Uniform Planning Approach to sorting office design being tried out with small postal buildings.

The Uniform Planning Approach development shows that the operational requirements of sorting can be met in any sorting hall of between 1,500 and 8,000 square feet by one of four

standard span-designed buildings, so long as a suitable site is available. An immediate comparison which springs to mind is the Section Stock and Works Order Store accommodation at a telephone engineering centre. Apart from the obvious difference in operations, the two buildings —or at least their shells—should not differ very much.

Meanwhile, private consultants have been commissioned to carry out a user requirement study and to advise on a suitable method for building telephone engineering centres. These consultants are working in close collaboration with the Joint Post Office/Ministry of Public Building and Works Research and Development Group and the Engineering Department which is concerned with the wider policy issues involved in providing accommodation for engineering field work. One of the major problems being tackled is how to plan the building complex to give the most effective use of site space for vehicle circulation.

A number of telephone engineering centres are also being designed in the SEAC (South Eastern Architects' Collaboration) system. It is expected that the practical experience of building centres in this system will contribute to a solution to the general problem.

No certain outcome of these developments, which got off to a later start and present more complicated problems than the small and medium sized automatic telephone exchanges, can be foreseen at present. What is certain however, is that the most modern building techniques will be exploited to the full in improving the design solutions to the building of telephone engineering centres.

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DUST, DAMP and RUST PROOF

This is not a puzzle picture. Nor are those things on the plastic tray mince pies or Yorkshire puddings. They are telephone switching components about to go into a welding machine.

This picture—taken at S.T.C.'s North London factory—shows part of a new packaging technique. The components are automatically fed and welded into their "blisters" with a cover of plastic sheeting and sent on their way—dust, damp and corrosion proof. No labelling is necessary, since the code numbers on the components can be clearly seen, and the containers are self-extinguishing. Storage problems are also reduced.

This new packaging technique was devised by S.T.C.'s Telephone Switching Division in close liaison with the Post Office Supplies Department.

A New International Telephone Centre

Work has begun on a new building at London Wall, in the heart of the City of London, to house the first comprehensive International Telephone Services Centre to be planned as such from the outset.

The north block of Faraday Building is at present the main centre of all Britain's international telephone services but accommodation there is limited and already the growth of traffic has made it necessary to provide both continental and inter-continental manual switchrooms in other buildings: Wren House, Monarch Telephone Exchange and Kelvin House. Switchroom space has also been vacated in Faraday's north block to enable additional automatic switching equipment for the overseas services to be installed there.

The new building is an extension of the existing Wood Street Telephone Exchange and although it will provide only 80,000 square feet of floor space this will be sufficient to meet the needs of the international telephone services up to 1975. It will be fully operational by September, 1969.

A fuller report describing the facilities which the new International Telephone Services Centre will provide will appear in a future issue of the *Journal*.

While the world waits for reports of the World Cup soccer matches, the Post Office is on the ball, preparing the links and setting up special facilities for an army of commentators

SETTING UP THE LINKS FOR THE WORLD CUP

THE Post Office is putting the finishing touches to the planning for one of the biggest—if not the biggest—special events it has ever tackled: providing the vast and complicated network of telecommunications for the Press and broadcasting authorities covering the World Cup Football Association Competition to be held in Britain in July.

To meet the needs of some 16,000 representatives of the world's Press and a small army of sound and television organisations, the Post Office is setting up special telephone, telegraph and broadcasting facilities at each of the eight match grounds so that sports reporters can send "on-the-spot" commentaries all over the world. More than 40 countries, including 25 in Europe, will be relaying matches live, or showing film recordings, to a world television audience of some 400 million soccer fans.

The Post Office is also equipping Press centres in each of the seven cities where the matches will be played—London, Birmingham, Manchester, Liverpool, Sheffield, Sunderland and Middlesbrough—from where reporters will be able to send background reports and forecasts between games.

The entire operation has involved laying many miles of telephone cable, installing scores of

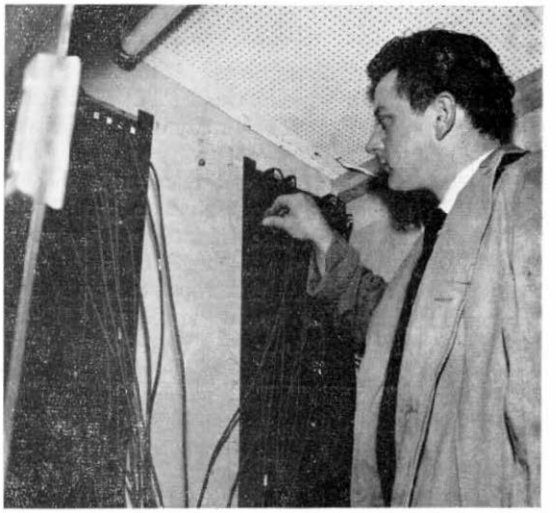
GPO Technician Albert Roper sets up and tests some of the 240 telephones which have been installed in the Press Box at Wembley Stadium.

Above: Most of the World Cup traffic will pass through three switching racks at the International Programme Switching Centre at Faraday Building, London. Here, Mr. William Syms solders some of the 48,000 connections.

Right: Technician George Andrews tests the switching unit in the Press Box at Wembley.

PLANNING the telecommunications services for the World Cup began three years ago and was carried out in consultation with the Competition organisers by the Inland Telecommunications Department in Headquarters, London Telecommunications Region Headquarters and Telephone Managers in the Midland, North Eastern, North Western and London Telecommunications regions.

Details of the services available to the Press have been published in a Press Guide to be issued by the World Cup Organisation and the Post Office itself is issuing a World Cup Telephone Directory and a brochure giving general information about Post Office services for distribution to the world's Press and overseas visitors.



additional broadcast circuits, more than 1,500 telephones and about 100 teleprinters. In all, nearly 2,500 cable pairs are being provided at the soccer grounds to carry reports by way of telephone, telegraph and radio and television broadcasts.

At each match ground the Post Office will be providing five main communications facilities for the Press: telephones at Press seats; communal telephones for general use; telex call offices; overseas telegraph offices; and terminations for picture transmission.

The number of exchange lines connected to telephones at Press seats will vary from up to 68 at the White City in London (where only one match is being played) to up to 240 at Wembley (where nine matches, including the final, will be held). Since no reporter can be sure of having the same seat for all the matches he attends at any one ground, Telephone Managers are installing a simple patching system between the exchange line terminations at the grounds and the telephones at the Press seats so that a reporter can be given the same number no matter where he sits at each match. This will benefit both the Press and the Post Office and enable the exchange lines to

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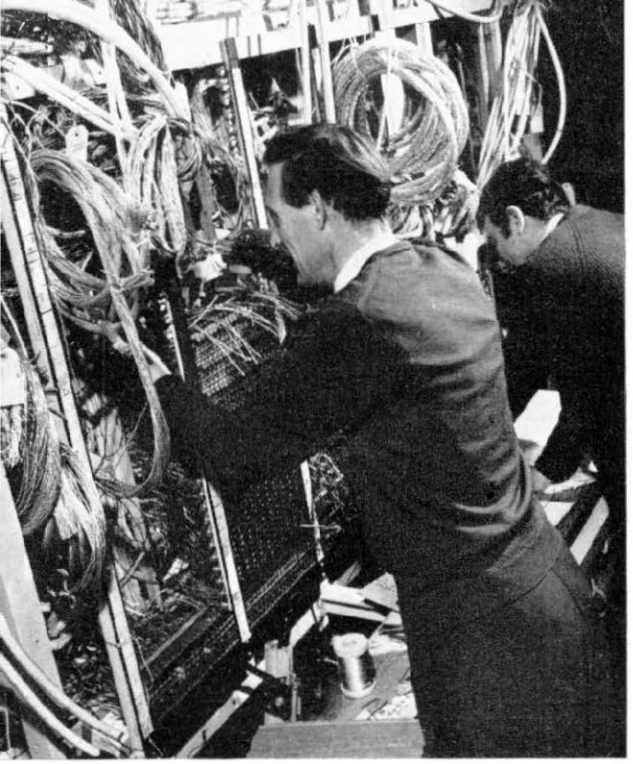


Two men and a tangle of wires. Technicians Tony Tutin and John Ryan at work on one of the racks at the International Programme Switching Centre.

be connected and disconnected at a convenient point before and after each game. All Press seat telephones will be rented by the appropriate newspapers or agencies.

Suites of Post Office-manned telephones will be installed in the Press Room at each ground to enable Pressmen to make inland and overseas calls. These telephones will be fitted with coin boxes, but it is expected that most calls will use transferred charge or credit services and will require operator assistance.

All Press Rooms will also be equipped with Telex call offices containing three or four teleprinters with automatic transmitters and facilities for off-line tape preparation. To minimise the risk of possible congestion, callers will not be granted the usual facility of operating the machines themselves. Instead, all tape preparation and sending will be carried out by Post Office telegraphists.

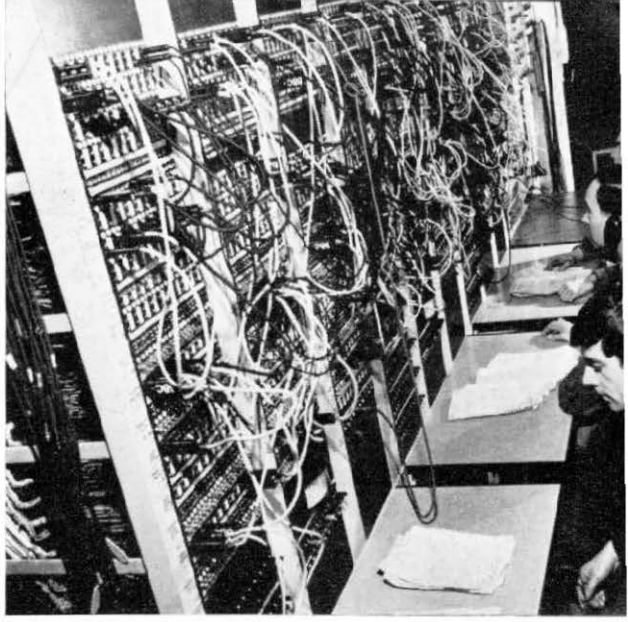
Each Press Room will also have an Overseas Telegraph Office from where cables will be sent by Telex to Electra House, London, for onward transmission to any part of the world. Four-wire terminations are being provided at each ground to which Press photographers can connect their own mobile picture transmission equipment.

To cater for Press requirements between the matches, Press Centres will be set up in the seven towns and equipped with suites of telephones, telex call offices, Overseas Telegraph facilities and, possibly, private wire services for the larger Press agencies. These Press Centres will probably be opened for 12 hours a day.

The British Broadcasting Corporation will be handling the distribution of all inland and overseas programmes and a BBC/ITV consortium has been set up to deal with all television requirements.

To meet the demand for overseas radio and television commentaries, a number of television

To help foreign visitors with their language problems, these linguist operators from the Birmingham area have volunteered to man the local exchanges on a rota system between 8 a.m. and midnight on days when matches are played at Villa Park.



The three switching racks at Faraday which will handle incoming radio, television sound and still picture transmission during the World Cup games.

sound and radio commentary positions for home and overseas programmes will be provided at each ground.

The Post Office will provide a considerable amount of cabling inside each ground for the outside broadcast circuits and is planning to make available nearly 500 music and control circuits between the six provincial grounds and London.

All the inland trunk and international broadcasting links will be rented by the overseas broadcasting authorities. Because of the exceptionally heavy demand for music circuits between the grounds and London, only five circuits from each ground will be of full music quality; the rest will be normal speech circuits.

The Post Office expects to have little difficulty in meeting broadcasting demands from existing resources but if requests for extra-European circuits become excessive alternative routes might be brought into service.

Broadcasting bureaux are being set up at all the World Cup centres to act as administrative headquarters and provide working accommodation for television and radio commentators and officials. In the provincial bureaux the Post Office will be providing two local ends for connection to music circuits, one local end for connection to a control circuit, two exchange lines for non-auxiliary working, a Telex installation and up to six exchange lines with renters' coin boxes. The London bureau will be set up at the TV Centre and served by the temporary installation of about 100 telephones, telex and cable facilities.

The task of handling the many inland and overseas calls which will be made by the Press and broadcasting representatives during each game will be considerable. However, since the times at which the matches will be played do not coincide with the normal busy hours, the Telephone Managers in each area are providing adequate traffic carrying capacity by connecting all exchange lines at the grounds to suitable central exchanges serving a predominance of business connections. In London, exchange lines from the White City and Wembley will be dispersed between several London exchanges to provide optimum access into the city exchanges.

All overseas calls and an estimated 90 per cent. of all inland trunk calls will be routed via the centre of London. The remaining 10 per cent of inland trunk calls will be to provincial newspaper centres—mainly Manchester and Glasgow.

It is expected that traffic to and from the Press Centres and the Broadcasting bureaux will be presented as a steady flow throughout the competition and that it will be satisfactorily dealt with by existing resources.

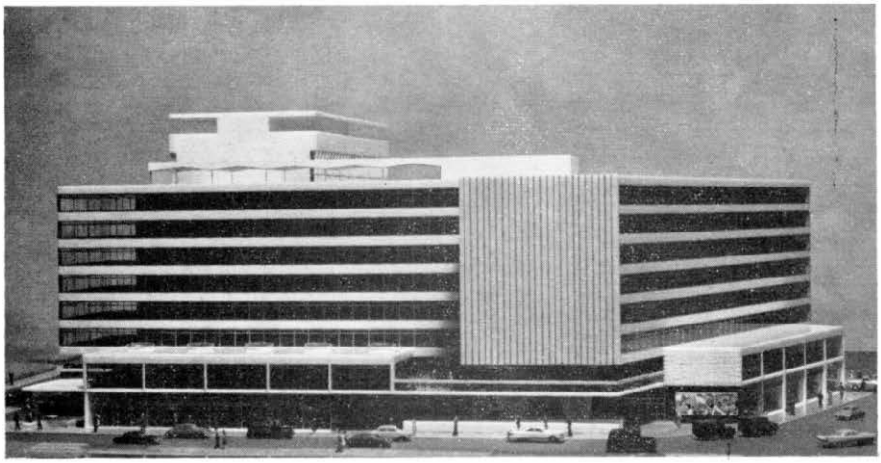
A GREAT deal of the contribution which the Post Office is making to ensure the success of the World Cup Competition will be of lasting benefit to the inland telephone service. Most of the additional cables that are being installed will remain in use after the Competition is over to augment the local telephone networks.

SOCCER STAMPS

Here are two of the three special stamps issued by the British Post Office to commemorate the 1965-66 World Cup Competition. They are the first British stamps to feature sportsmen and were issued on 1 June.

A New Telecommunications Centre . . .

By C. W. A. MITCHELL



A model of the new building in Hounsditch which will house the combined telegraph and telex offices. The first equipment will come into service in 1968.

A NEW telecommunications building to be known as St. Botolph's House, is now under construction in Hounsditch, London, to house a telegraph transmission terminal for overseas and provincial telegraph trunk routes, a large Overseas Telegraph Area Office and a second combined international and local telex exchange to supplement the existing exchange in Fleet Building.

The building, which will be administered by the External Telecommunications Executive, has been planned to meet the joint needs of ETE and London Telecommunications Region for these essential services. Unusually, it is being leased on a long-term basis from a private development company which has constructed the building to meet Post Office requirements specified by the ETE Engineering Branch.

The first equipment to be in service will be the transmission terminal providing VF telegraph trunks to overseas, continental and provincial centres as well as second generation error correcting radio telegraph terminals to replace the first generation equipment at Electra House, which is nearing the end of its useful life. The first stage of this equipment will be installed in 1967 and will come into service in 1968. The terminal will be used principally to provide the large numbers of telex trunk circuits to provincial and overseas centres which the rapidly-growing telex service requires. It will also provide circuits for inland and overseas private wires and leased radio services as well as for the Gentex service and overseas public telegraph services.

The Overseas Telegraph Area Office, which will be the fourth largest in London, will serve the EC3 Area and be installed during 1967 so that it will come into service after the new telegraph message relay unit in Cardinal House, London, is working. A new system of telegram conveyors with push-button controlled message distribution is planned for this office.

The major installation will, of course, be the telex exchanges occupying three floors or 45,000 square feet of apparatus room space and, later, a 50-position cordless switchboard. The planned capacity is for 10,000 London subscribers and a large trunk and international exchange which will augment the service now provided in Fleet building and enable international subscriber dialling of telex calls to be further extended.

Manufacture of the equipment is expected to start this year and the new exchanges are planned to be in service by the autumn of 1969.

The growth of the telex service is very rapid with subscribers increasing at a rate of 16 per cent. a year while international traffic is growing at the rate of 30 per cent. a year so that the

new exchanges will be fully exploited by 1977. Although by this time another major unit, now in the early planning stages, will be ready, St. Botolph's will remain a major pillar of the telex service for many years to come.

The main problems of building design and construction have now been solved, the building work is well advanced and contracts are being placed for the considerable variety of communications and power plant which has to be installed there.

The new relay unit will be installed in Cardinal House, Farringdon Road, the tall building in the background which is partly covered by Caxton House. The unit will be ready for service in 1967.

. . . and a new Relay Unit

THE tape relay unit which was put into service at Electra House, London, in January, 1962, is now loaded to capacity and work has started on the construction of a new and larger message relay unit which will replace the tape relay unit.

The new unit is being installed in Cardinal House, Farringdon Road, and the contract for the supply and installation of the main equipment has been placed with the MEL Equipment Company of Crawley, Sussex.

The initial installation, which will be ready for service in the autumn of 1967, will provide capacity for 50 overseas telegraph circuits. It can be extended, if necessary, to 100 overseas circuits and this would enable it to take care of all foreseeable needs.

Important planning objectives for the new centre have been the reduction of manual processes and the elimination of perforated paper tape as a message storage and relaying medium. These will be met by the use of magnetic storage for messages awaiting routing and by substituting automatic checking processes for the manual ones now used. Although the routing of messages will at first be performed by a small team of operators seated at special push-button routing consoles, the equipment will be able automatically to route messages which are prepared in accordance with the standards defined in CCITT Recommendation F31.

The growing use of these standards for transmitting international telegrams will, it is hoped, enable automatic routing to be used eventually for the majority of traffic. Messages passing through the centre will be protected by a system of serial numbers on each telegraph channel into or out of the centre, as is the present practice with the torn tape unit. In addition to the automatic insertion on forwarded messages of a new channel serial number (which is already done in the tape relay unit), the new centre will be equipped to check automatically the serial numbers of messages arriving at the centre as they are taken into storage. This, coupled with built-in checks of message re-transmission in the relay centre, will provide more accurate safeguards against message loss than the cumbersome and costly manual processes they will replace.

The new apparatus embodies electro-mechanical switching equipment to set up the required connections within the centre and two stages of magnetic storage. The first, a 2,000-character ferrite matrix, accepts the incoming message from line and presents it, either before an operator or to an automatic register, for routing. The second, which is used only when the required outgoing channel is occupied, takes the message from incoming storage (after routing has been determined), thus releasing it for any other incoming message, and accumulates the messages for each outgoing route in chronological order on magnetic tape. Sufficient tape

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units are provided to serve all outgoing routes which may be simultaneously engaged and to hold traffic which accumulates during periodic stoppages on radio circuits. One tape unit can hold about 80 messages and arrangements are made to enable higher priority messages to have precedence.

In addition to the main equipment, supporting power plant, air conditioning plant and standby diesel-alternator sets to cover failure of the mains supply are now being ordered for installation to a phased programme during 1966 and early 1967.

To meet international obligations and the requirements of the present message accounting system, a monitor copy of each message leaving the relay centre will be kept. So long as they remain necessary, advantage can be taken of these copies in dealing with service queries. The system is adaptable, however, to provide an abridged form of message monitor and it is hoped that, in time, this can be adopted with a further reduction in manual effort.

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Briefly . . .

EXPANDING THE NEWCASTLE EXCHANGE

An order worth more than £850,000 has been placed for the supply and installation of a large extension to the central automatic telephone exchange at Newcastle-upon-Tyne.

The extension will include about 70 additional switchboard positions for operators, automatic switching equipment for 900 lines, STD and trunk circuits.

The Newcastle Telephone Area was converted from manual to automatic working in 1930 with the installation of a 9,000-line central exchange and eleven outlying satellite exchanges. To meet the increasing demand, further exchanges were provided in the area between 1936 and 1954.

The equipment for the latest extension to the Newcastle central exchange will be made by Standard Telephones and Cables Ltd.

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TELECOMMUNICATIONS PRINCIPLES

A third edition of "Telecommunications Principles", by R. N. Renton, C.G.I.A., M.I.E.E., (*Sir Isaac Pitman and Sons Ltd.*, 50s.) has now been published which covers the latest syllabuses of Telecommunications Principles grades A, B and C — not Grades I, II and III as stated on the jacket.

Since the last edition, a chapter has been added on transistor electronics so that the book now has to cover the whole subject from the most elementary to electromagnetic radiation and transistor amplifiers and oscillators.

Mr. Renton covers the subject in masterly fashion. We could, perhaps, do without water analogies and 40 pages on cells seems to be a luxury. It is always difficult to interpret syllabuses but one gets the impression that the book goes well beyond the simple treatments mentioned.

But the book has a great deal to commend it. It is well written, clear, concise and accurate. It has many worked examples, diagrams and photographs. At the end of each chapter is a bibliography. These consist very largely of IPOEE Journal articles and IPOEE printed papers, and it is to be hoped that the latter are freely available for students to follow up the subjects more fully. MKS units are used throughout. There are also a number of very useful appendices, including one on Units, which students will find particularly interesting.

There is a continuing and growing need for British books on telecommunications; this one will be very popular, and deservedly so.

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IPOE ESSAY CONTEST RESULTS

Mr. A. Richmond, a Technical Officer from Oban, won the Institution of Post Office Electrical Engineers 1965-66 Essay competition with his entry entitled *Pulse Code Modulation — with some American Features.* Mr. Richmond receives a prize of £6 6s. and an Institution certificate.

Prizes of £3 3s. each and Institution certificates were awarded to the following: Technical Officers G. W. E. Gay, from Salisbury; J. Gilliland, from Glasgow; and C. R. Hill, from Lancaster. Certificates of merit were gained by Technical Officers R. J. Waterhouse (Central Training School); A. G. Hickson (Northampton); W. Findlay (Glasgow); P. J. Froude (LPR/EB); and E. Doylerush (Conway).

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An experimental Summer Road Conditions Service giving reports prepared by the local police on traffic conditions within 50 miles of Cardiff, was introduced on 1 May. The service can be obtained by telephoning Cardiff 8021. If the service is successful it may be extended to other parts of the country.

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The need for inland exchange operators in 1966-67 is likely to remain more or less constant, but wastage continues at a high rate and there are serious recruitment difficulties in some parts of the country, says the White Paper, Post Office Prospects, 1966-67.

The engineering force, which increased by 5,000 in 1965-66, is expected to increase by a further 4,000 in 1966-67.

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Because of the success of the nine television detector cars which have been tracking down licence evaders since 1963, the size of the fleet is to be doubled. In 1965 some 22,000 people were successfully prosecuted for using unlicensed sets. Many thousands more took out licences when it became known that a detector car was to operate in their districts.

THE QUEEN AT THE TOWER

When the Queen visited the Post Office Tower in London on 17 May —two days before it was opened to the public—she inspected the television control room, surveyed London through binoculars on the 580 ft.-high observation platform and took tea with the Postmaster General in the revolving restaurant. In the top picture, Her Majesty is seen admiring the gold replica of the model of the Tower presented to her by the Postmaster General. During the Queen's visit, a number of Post Office people were presented to her. In the second picture down Her Majesty shakes hands with the Assistant Postmaster General, Mr. J. Slater, BEM, MP, and (below) the Engineer-in-Chief, Mr. D. A. Barron, CBE, is presented. In the four pictures at the bottom of the page (left to right) the Queen receives Mr. A. B. Harnden, Director, London Telecommunications Region; Mr. W. L. Newman, Engineer-in-charge of the Tower; Mr. G. Burrows, Officer-in-charge of the Trunk Test Room; and Mrs. D. F. Westmacott, Chief Supervisor at Museum Telephone Exchange.

The microwave station on Pyramid Mountain (9,000 ft), near Jaspar, Alta., through which pass circuits linking CANTAT and COMPAC, is the highest in the Canadian National-Canadian Pacific Telecommunications' network. The sides of the mountain are so sheer that maintenance crews have to be sent by cable car.

2,200 TELEPHONE SYSTEMS— AND THEY ALL HAVE ONE AIM

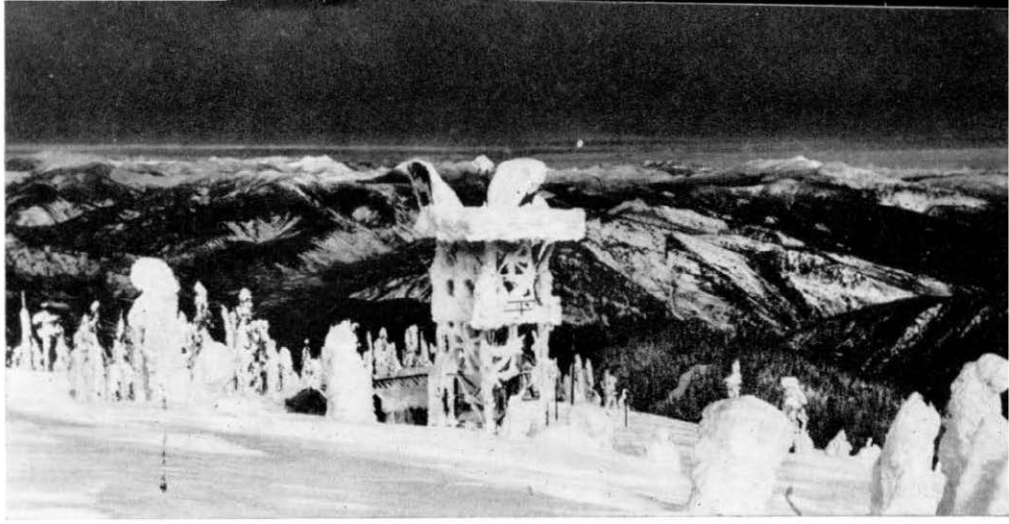
P. T. F. KELLY, BSc(Eng). C Eng. AMIEE

This review of Canada's long-distance telecommunications is based on information obtained by the author during a recent study visit to that country under the auspicies of a Nuffield Travelling Fellowship

IN CANADA the telecommunications and postal services, unlike those in Britain, are entirely separated.

There are at present some 2,200 separate telephone systems and companies, ranging in size from the Bell Telephone Company of Canada which serves more than four-and-a-half million of the country's seven-and-a-half million telephones, to those serving a handful of subscribers. Between these the systems range in size from municipally-owned companies to large Provincial Government-owned and privately-owned companies. In addition, some telephones and the overseas service are operated by Federal Government-controlled Crown corporations.

Irrespective of the size and scope of operations



One of the Trans-Canada Telephone Systems microwave stations high above the snowline in the Rockies of British Columbia.

of these various companies and corporations, they all have the same main interest: to provide good quality service at reasonable cost within the areas they serve and to provide means of connection with telephones elsewhere within Canada, on the North American continent and overseas.

With such a wide variation in the size of the systems and in the type of ownership, long-distance service—whether it is nation-wide, continent-wide or world-wide—demands close co-operation between all the telephone systems whose facilities are interconnected. It has been agreed by all concerned that, no matter how many companies may be involved, every call shall be handled as speedily and as efficiently as if there were only one telephone organisation. In a country with so many separate systems this calls for co-operation of a high order.

From this basic requirement for co-operation has stemmed the formation of organisations whose purpose is to link the various telephone systems and companies. The best known of these organisations is the Trans-Canada Telephone System which was formed in 1931 with the aim of developing and maintaining an all-Canadian coast-to-coast long-distance network. At present there are eight full members of the system and one associate member: the Avalon Telephone Co. Ltd., Maritime Telegraph and Telephone Co. Ltd., the New Brunswick Telephone Co. Ltd., the Bell Telephone Co. of Canada, Manitoba Telephone System, Saskatchewan Government Telephones, Alberta Government Telephones, British Columbia Telephone Co. and Canadian Overseas Telecommunication Corporation (associate member).

These members own and operate the principal systems in each of the provinces they serve. As partners in the Trans-Canada Telephone System they work together in a nation-wide business, providing a complete network capable of carrying a diversity of communications—television and radio programmes, data and defence communications, as well as regular telephone traffic—between the Atlantic and the Pacific.

Following common agreed plans, each member builds and owns the telephone plant within its own territory and each shares in the revenues from communications carried into, out of or across its territory. The Trans-Canada Telephone System is unique in that it has no pay-roll or staff and it cannot enter into contracts with any other concern. When it is necessary to provide a nation-wide leased circuit for, say, television, one of the major company members will negotiate the contract and sub-contract to the other members the portion in their territory.

An organisation of somewhat different character is the Telephone Association of Canada, formed in 1921 to promote the interchange of technical and operating information between member companies. In addition to the eight full members of the Trans-Canada Telephone System, four other companies belong to the association: the Island Telephone Co. (PEI), the Okanagan Telephone Co. (BC), Ontario Northland Communications and Quebec-Telephone.

Through the auspices of the Telephone Association of Canada, the experience of any member is made available to any other member and the sometimes painful process of adjusting to new techniques and new developments is often greatly eased. Many of the smaller telephone companies

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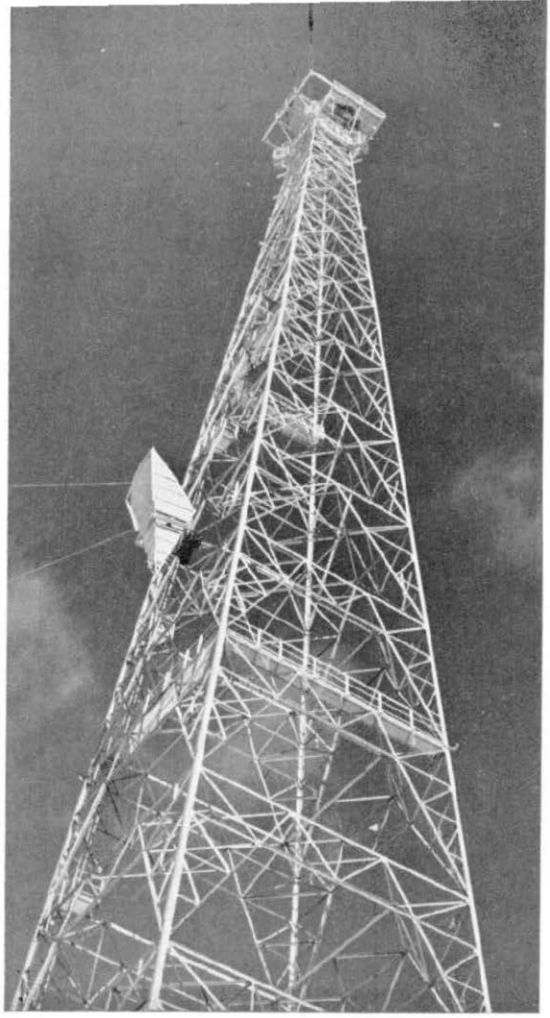


An antenna is hoisted to the top of its tower at one of the 139 stations on the Trans-Canada Telephone System's microwave route built between 1952 and 1958.

have also joined similar co-operative groups such as the Canadian Independent Telephone Association, the Quebec Independent Telephone Association and the Saskatchewan Association of Rural Telephone Companies, all of which have aims basically similar to those of the Telephone Association.

Co-operation between the companies often extends further—for example, nine companies have separate contracts with the Bell Telephone Company of Canada, through which they can obtain a variety of advice and assistance of both a technical and an operating nature in return for an annual fee. The Bell Telephone Company itself has a similar agreement with the American Telephone and Telegraph Company in the United States which gives it the benefit of latest information from below the border. The British Columbia Telephone Company has a similar agreement with the General Telephone and Electronics Corporation.

Canada's telephone companies have agreed that, because telephone service in a given area can be provided most efficiently by a single company, they do not compete with each other in providing this essential service. To compensate for the natural regulation of prices that would otherwise take place through competition, and to fix telephone rates at a level which is fair to both customers and owners, most telephone systems are subject to government regulation. Whether they are federally, provincially or municipally regulated depends on their particular charters or circumstances.

The very first coast-to-coast telephone circuit in Canada was set up by the telephone companies in the 1920s leasing from the Canadian Pacific Railway Company, who were at that time operating a nation-wide telegraph service, facilities over part of the distance to augment their own plant. In 1958 the Trans-Canada Telephone System completed a 3,900-mile microwave system spanning the continent. The other major railway company in Canada—the Canadian National—also established a nation-wide telegraph business and the two companies are still in competition today in this field.

In 1942 the two railway companies decided to pool their resources in those areas in which they had primarily been competitive in the private wire field. Under this arrangement both companies contribute equal circuit mileage and equipment to the "pool" and divide the revenues. This pooling of resources was extended in 1962 when the two companies joined forces to provide a high-grade coast-to-coast microwave radio system. This system was used not only to carry the companies' own extensive communications and telegraph business but also to provide high-grade communication channels which could be leased to private renters, such as television companies and so on.

The railway companies are thus in a position to compete with the Trans-Canada Telephone System in the private wire, data transmission and television fields and it was as a result of a successful tender that they obtained a contract from the Canadian Overseas Telecommunication Cor-

poration (COTC), for the circuits linking the CANTAT and COMPAC Submarine Cable systems between Montreal and Vancouver. There still exist areas in which the railway companies operate an exclusive service The Canadian National Telecommunication Company also provides some telephone service in parts of Newfoundland, the Yukon and the North West Territories interconnecting with the Trans-Canada Telephone System at appropriate points.

The Federal Government, through the Department of Transport, is concerned with the problems of frequency allocation and with the granting of rights for overseas cable and radio systems and experiments in the communications satellite field and, as such, attends, with the Telephone Association of Canada, the COTC and the railway companies, the relevant international bodies such as the CCITT and CCIR. However, it has few, if any, responsibilities for the inland telecommunications facilities in Canada.

The telecommunications system in Canada is thus somewhat complex. Inland message telegraph service is provided by the two railway companies in strict competition. Telex service is provided jointly by the Railway companies and a competitive TWX (switched teletypewriter) service by the telephone companies. Telephone service is given by the 2,200 separate telephone companies working to common operating standards and techniques. Long-distance inland telephone service is provided almost entirely by the major telephone companies working in partnership with some facilities leased from the railway companies in certain areas. Leased circuits for television, private and Government users, data transmission and programme transmission are supplied on a strictly competitive basis between the telephone companies acting jointly and the two railway companies—the latter working together in designated areas or separately in agreed exclusive areas. And finally, all external communications other than those to the mainland of the United States to Alaska and Mexico, are provided by the Canadian Overseas Telecommunication Corporation, with the exception of some telegraph traffic routed by way of the United States.

Since all but one of the major telephone com-

OVER

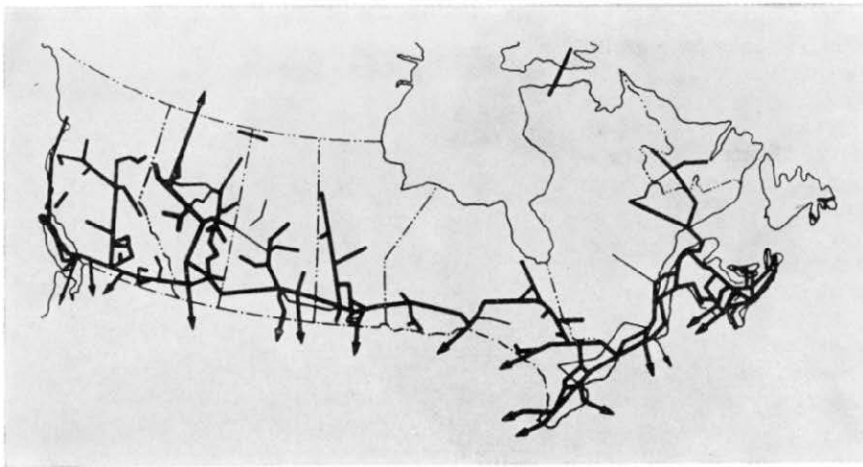
There are ten telephone systems in Canada which have more than 50,000 telephones.

Six are privately owned. They are: The Avalon Telephone Co. (Newfoundland, 66,900 telephones); Maritime Telephone and Telegraph Co. (Novia Scotia, 218,533); New Brunswick Telephone Co. (New Brunswick, 172,800); Quebec-Telephone (Quebec, 90,000); Bell Telephone Co. of Canada (Quebec and Ontario, 4,571,400); and the British Columbia Telephone Co. (Br. Columbia, 709,600).

Three are owned by the respective provincial Governments: the Manitoba Telephone System (350,000 telephones); Saskatchewan Government Telephones (247,900); and the Alberta Government Telephones (333,300).

The tenth is the Edmonton Telephone System, owned by the Edmonton Municipal Government, which has 180,000 telephones.

The research and development laboratories of the Northern Electric Company are on a campus in Ottawa.



This map shows the routes of the Trans-Canada microwave system. The existing routes are indicated by heavy black lines and planned routes in thinner lines.

panies have service agreements with the Bell Telephone Company of Canada, their organisations are generally based on that of the latter. While certain companies are privately-owned, the Prairie telephone systems are publicly owned. The staff of these systems, which are organised as Crown corporations, are not Civil Servants, but administration is carried out under the general jurisdiction of the Provincial Government concerned.

Basically, each telephone company is organised on a "staff" and "line" basis, "staff" being those who plan and advise and "line" those who do the job. Functionally, most of the companies are organised into divisions such as Engineering, Finance, Operations, Personnel and Public Relations, and Legal, each with its own "staff" and "line" organisations. The Operations Division, as its name implies, is concerned with the day-to-day operation of the network and is sub-divided into traffic, commercial and plant (equipment) sections. Where the size of the company warrants it, the Operations Division is further sub-divided on an area basis. In these circumstances it is usual to assign an engineering section to work alongside the traffic, plant and commercial sections to avoid continual reference back to Headquarters on engineering matters.

Where areas are set up there is still at Headquarters an element of traffic, engineering, commercial and plant activities but these are all of a "staff" nature.

The plant and engineering functions are virtually grouped together within the British organisation under engineering. But in the Canadian companies the engineering section is in general concerned only with design planning, standardisation of equipment and materials, methods and acceptance of new equipment. Once the equipment, or plant, as it is generally known, is brought into operation, thus causing money to be spent on maintaining it, it becomes the responsibility of the plant section. Thus most engineering jobs are of a "staff" type and most plant jobs are of the "line" type. However, it is not uncommon to find "staff" and 'line" functions in both sections.

This is a TWX dial teletypewriter which enables typewritten messages to be transmitted over the telephone network at 100 words a minute.

In Canada a person cannot practice as an engineer unless he or she is a professional engineer. To practice as an engineer in Quebec, for example, one must belong to the Corporation of Engineers of Quebec. Qualifications for entry are similar to those of the corporate membership of the several English engineering institutes. Within the engineering and plant sections there will thus be found graduates and non-graduates who would be called engineers or supervisors depending on their qualifications. In practice, most posts in the engineering section are held by graduate engineers.

In nearly every company long-distance service is separated from local service. Each company has recognised the need to satisfy customer complaints by making adequately-qualified staff available at suitable locations. Local Managers deal entirely with the problems of the local network, problems associated with the long-distance network being referred direct to specialists in that field. By bringing together staff engaged solely in providing long-distance service under control of a specialist in that field, economies and improvements in service have been achieved.

In the Bell Telephone Company of Canada full segregation of the local and long-distance service has been achieved. Five local telephone areas—equivalent to our regions in Britain—and a company-wide long-distance area (region) have been established. Each area is sub-divided into districts equivalent to our own areas. The long-distance, or toll area as it is known, has a completely different organisation from the local areas. Under the Vice-President and General Manager-Toll there are four sections: an engineering section dealing with planning and provision; a plant section dealing with maintenance; a marketing section dealing with sales aspects; and a traffic section. There are no public relations or accounting sections since these functions are carried out by the relevant local area staff. The engineering section is mainly concerned with long-term aspects, whereas the plant section is concerned with the day-to-day running of the long-distance network.

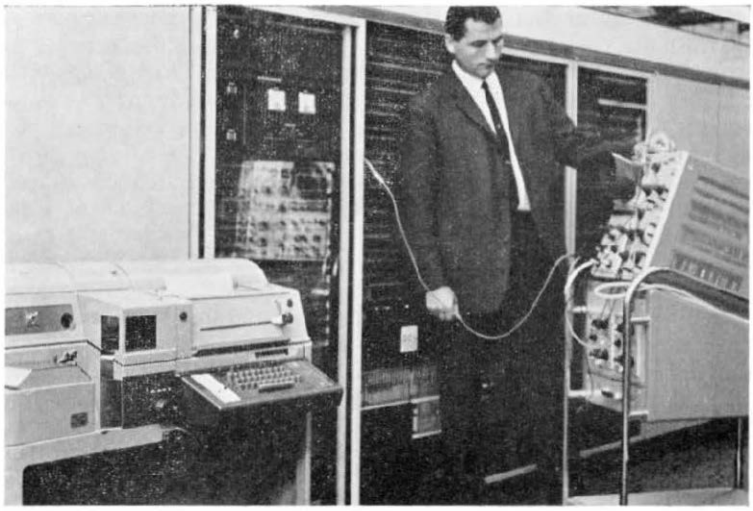
The marketing section in the toll area is important since it deals directly with the customers who make the greatest use of the long-distance facilities, that is, television companies and big business firms. The toll area is unique in that it owns no equipment cables or vehicles or buildings, these being charged to the local areas. It does, however, carry its own maintenance costs and can sub-contract to local areas maintenance of certain long-distance items if they are too small to warrant the full-time employment of a first-level supervisor.

Most of the plant used in the Canadian long-distance network is microwave radio links. There are also some 24-channel carrier systems in Eastern Canada and a considerable amount of 12- and 24-channel carrier systems working on special pairs and on deloaded audio cables. Twenty-four-channel pulse code modulation systems are gradually being introduced in the more densely populated areas. It is significant that there is as yet no coaxial cable system in Canada, although one is being introduced experimentally near Winnipeg by the Manitoba Telephone System.

Day-to-day maintenance of the overall system is carried out by the plant departments of the

OVER

The Phone-Fax, a new device which allows businessmen to transmit and receive charts, drawings and printed messages over the normal telephone system.



A view of the dual data and message switching computer system at the Canadian National's Data Centre in Toronto.

various telephone companies linked together under the auspices of the Trans-Canada Telephone System. To maintain such a complex system the various companies have adopted common maintenance standards, generally based on those initiated by the AT and T Co. of the United States. Indices are produced for nearly all kinds of circuits from telephone circuits to television links to privately leased circuits.

In all instances the indices are service orientated. Thus, instead of referring to "out of service" times, they refer to "in service" time or "serviceability". Objectives are set by the "staff" plant units and for privately leased commercial telephone circuits the current objectives are a 99.9 per cent. serviceability. This corresponds to an average outage of not more than 45 minutes-a-circuit-a-month for any reason with not more than one outage a month. Individual outage must not exceed two a month.

High service priority leases are assigned a serviceability objective of 99.99 per cent., that is 4.3 minutes outage/month. At each exchange or repeater station concerned with the long-distance network large boards show the various targets and objectives together with the actual performance. Statistics are issued showing the relative company performance in the form of league tables and comparison is also made with companies in the United States.

The Canadian Telephone Companies' management are very aware of the need to maintain a high degree of serviceability on all their circuits. To ensure this, they have found it necessary to establish certain management centres, such as Status centres, DDD (STD) Service bureaux, Network Management centres and Broadband Restoration centres. Each of the centres has a specific part to play in maintaining a high degree of serviceability and utilisation of plant and they are thus generally kept separate. Status centres provide top management with immediate information of the state of the long-distance network and daily reports and statistics. All faults are notified by telephone or teleprinter to the centre, together with possible threatening conditions, for example, loss of mains power—and a Status centre can ascertain at any time whether the overall system is in trouble.

The DDD Service bureaux were established with the prime objective of reducing the number of customer reports of faults on long-distance calls. Each bureau has its own automatic data processing equipment and faults reported either by customers, service observations or by maintenance staff themselves, are quickly converted into punched cards and immediately analysed for patterns. The plant supervisor in charge of a bureau is thus able quickly to spot fault patterns and locate them in particular trunk exchanges or line routes. Since the Service bureau concept was adopted, service to the customer has been considerably improved and a very high percentage of all DDD calls in Canada are now completed and are satisfactory transmission-wise at the first attempt.

Broadband Restoration centres control re-routes of large blocks of channels. Plans have been prepared to cover nearly every eventuality involving a microwave radio or carrier link breakdown. In the event of a breakdown the centres are staffed and control the restoration which is usually achieved by appropriating protection channels in other radio systems.

The Network Management centres control long-distance public telephone traffic only and are staffed by traffic personnel. At such centres the occupancy of all outgoing circuits is monitored and, by telemetry, the occupancy of circuits outgoing from other local trunk centres can also be monitored. Overflow routes are indicated for each direct route. When a route suffers a breakdown which causes severe overloading, a Network Management centre is able to control alternative routing and to insert verbal announcements. Master keys connected directly to the trunk switching centres control re-routing of traffic. Ultimately, the centre will be responsible for the remote switching of groups of circuits to meet changes in traffic patterns in any given 24-hour period. In a country as large as Canada, encompassing seven time zones, such switching is desirable since different areas of the country can have cheap call rates and peak traffic at different basic times.

A significant difference between the telephone organisation in Canada and that in the United Kingdom is that the big private telephone companies in the former country are generally associated with a single manufacturer. The Bell Telephone Company of Canada, for instance, owns 100 per cent. of the Northern Electric Co., the virtual sole supplier of equipment to Bell. Similarly, the British Columbia Telephone Company and the Lenkurt Company of Canada work closely together. Because of this close relationship, equipment delivery delays are rare. The manufacturer is kept fully in the picture about new systems and equipment required so that by the time an order is received much of the equipment is already made or is in the manufacturing pipeline. Equipment quality and prices are kept competitive by continuous reviews of available products from other manufacturers. If the main supplier cannot meet the performance and price standards of a competing company's product within a reasonable period, the item will be purchased from the outside supplier.

The long-distance telephone system in Canada is no doubt very efficient and provides a good service to the customer. This has been achieved by the companies recognising that long-distance service and operation raise different problems from those associated with local service; by the setting up of an organisation designed to cope with the specific problems of such a complex network; and by efficient management at all levels. Competition in the long-distance field, other than for public telephone traffic between the railway companies and the telephone companies, ensures that every company operates at maximum efficiency and this must ultimately react on the overall service given to the customer.

THE AUTHOR

MR. P. T. F. KELLY *joined the Post Office in 1944 as a Youth-in-Training in the London Telecommunications Region, South West Area. After a short period at the Central Engineering Training School he was promoted to Executive Engineer and subsequently to Senior Executive Engineer in the Main Lines Development and Maintenance Branch where he was a member of the project teams planning the various Trans-Atlantic Telephone Cable Systems.*

In 1964 Mr. Kelly was awarded a Nuffield Travelling Fellowship and spent some nine months in Sweden and Canada studying the Organisation of the Long-Distance Telephone Services in those countries. On returning to the Post Office in December, 1964, he was promoted to Assistant Staff Engineer in the Organisation and Efficiency (Maintenance and Computers) Branch of the Engineering Department where he is now concerned with the application of computers to line plant planning and control and to maintenance fault recording.

★

A SELF-CHARGING POWER PACK

A new type of fuel cell developed by Melbourne scientists for use in the outback, may be of great value in other parts of the world.

The cell was designed to supply electricity for Post Office telecommunications and repeater stations. It can run for a year without maintenance and refuelling and is expected to replace many conventional power-producing plants.

The fuel cell, the result of four years' work by scientists of the mineral chemistry division of the Commonwealth Scientific and Industrial Research Organisation . . . is virtually an electric battery capable of continually recharging itself. The main discovery was a new type of platinum catalyst with an activity 100 times greater than normal.

An official of the CSIRO said: "Theoretically, the long-range possibilities are exciting. They could increasingly take over the power generation of isolated settlements." — *From "News From Melbourne".*

RED FOR SAFETY!

THE Post Office has placed an order with a Cheshire firm for 30,000 new safety helmets which will be issued to all Engineering staff throughout the country who face the risk of head injury while at work.

The new helmets—in red moulded plastic and bearing the G.P.O. crest—are being issued in three stages: first, to those engaged on building work (for example, radio riggers), overhead construction men working in gangs, staff using the new pole erection units and those working with explosives; second, to other overhead users, including installation staff; and third, to all others engaged in work involving the risk of head injury. Wearing the helmets will be voluntary, except during high-risk operations when staff will have to put them on.

Mr. E. T. Spillet and Mr. R. Ward, from the Canterbury Telephone Area, are suitably and safely protected if the ladder should fall.

The new red safety helmet as worn by Mr. H. Setterfield, of the Engineering Department's Construction Branch.

This new move is a further step towards improving safety consciousness in the Post Office and is expected to reduce the number of injuries sustained each year. In 1964-65 almost 1,000 staff suffered head injury while engaged on engineering work. Many of these injuries would have been avoided had the men been wearing safety helmets.

The new helmet is a heavy duty headgear weighing 17 ounces, which has a peak, but no brim, and a chin strap. Wearing one of these helmets, a rigger recently escaped injury when a heavy wrench dropped on to his head from the top of a tower 110 ft. high. Another man, similarly protected, fell 30 ft. from a scaffolding and landed on his head on a pile of bricks. He too, was unhurt.

★

SLACK ROPES

"On page 2 of your Spring, 1966, issue is a picture of a man on a pair of steps. Both ropes of the steps are slack and, with the weight of the man working on the steps, the legs could slip apart to the limit of the rope, causing the man to fall. I hope the man on the steps is not a Post Office employee."—**V. E. Bagwell, Telephone Manager's Office, Taunton.**

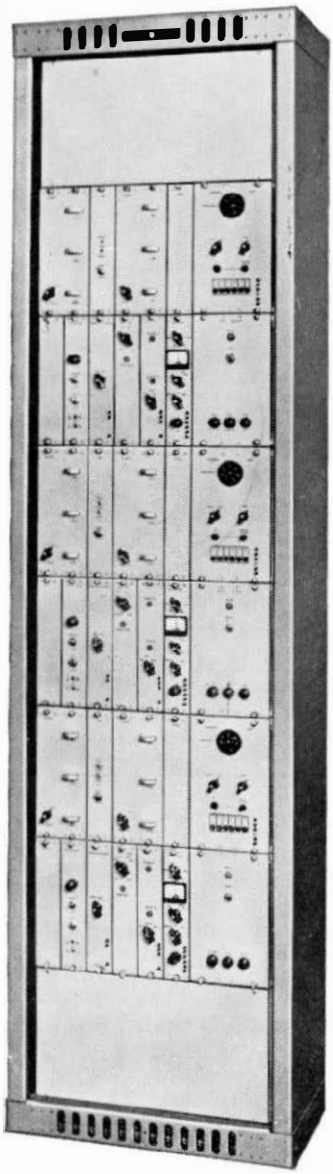
★ *We agree. The man on the steps should be more careful. He is not, however, a Post Office employee but an engineer from a manufacturing firm installing equipment.*

Telecommunications Statistics

	Quarter ended 30 Dec., 1965	Quarter ended 30 Sept., 1965	Quarter ended 30 Dec., 1964
Telegraph Service			
Inland telegrams (including Press, Railway Pass, Service and Irish Republic)	**2,706,000**	3,009,000	2,818,000
Greetings telegrams	**627,000**	732,000	611,000
Overseas telegrams:			
Originating U.K. messages	**1,834,000**	1,885,000	1,724,000
Terminating U.K. messages	**1,837,000**	1,900,000	1,697,000
Transit messages	**1,401,000**	1,483,000	1,432,000
Telephone Service			
Inland			
Net demand	**218,000**	193,000	264,000
Connections supplied	**205,000**	185,000	180,000
Total orders in hand	**197,000**	184,000	165,000
Total working connections	**6,377,000**	6,244,000	5,904,000
Shared service connections (Bus./Res.)	**1,252,000**	1,219,000	1,151,000
Effective inland trunk calls	**212,598,000**	208,356,000	184,783,000
Effective cheap rate trunk calls	**45,518,000**	49,679,000	39,171,000
Overseas			
European: Outward	**†1,814,000**	1,739,000	1,559,000
Inward	*not available	*not available	1,258,000
Transit	**†16,000**	14,000	12,000
Extra European: Outward	**†162,000**	154,000	141,000
Inward	**†219,000**	193,000	193,000
Transit	**†29,000**	26,000	26,000
Telex Service			
Inland			
Total working lines	**17,000**	16,000	14,000
Metered units (including Service)	**41,276,000**	42,153,000	41,359,000
Manual calls (including Service and Irish Republic)	**20,000**	17,000	16,000
Overseas			
Originating (U.K. and Irish Republic)	**†2,729,000**	2,703,000	2,316,000

Figures rounded to nearest thousand.

*Figures no longer available.
†Includes estimated element.



Three double diversity H2002 receivers

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The H2002 series of MST receivers for high grade point-to-point h.f. communication services.

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H2112 single path i.s.b. or s.s.b.

NO OSCILLATORS
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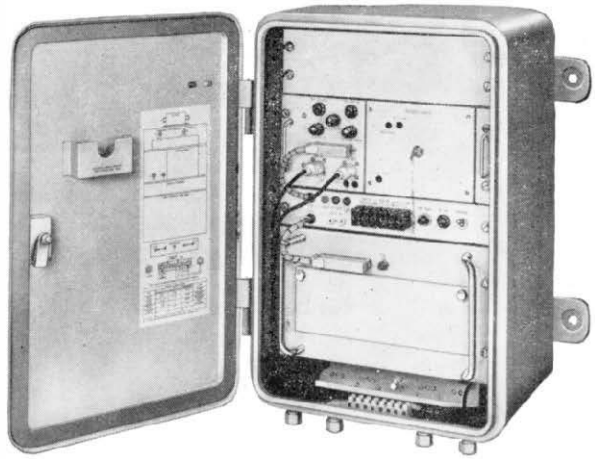

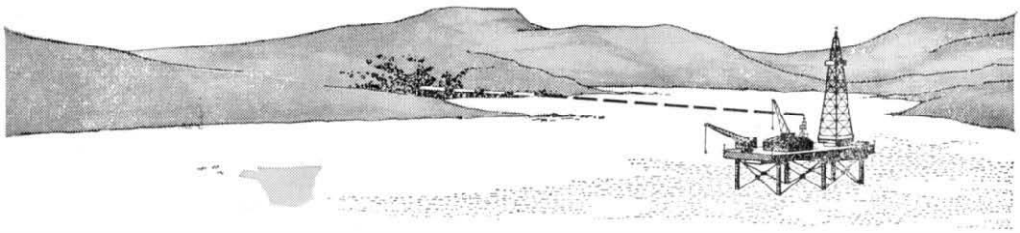

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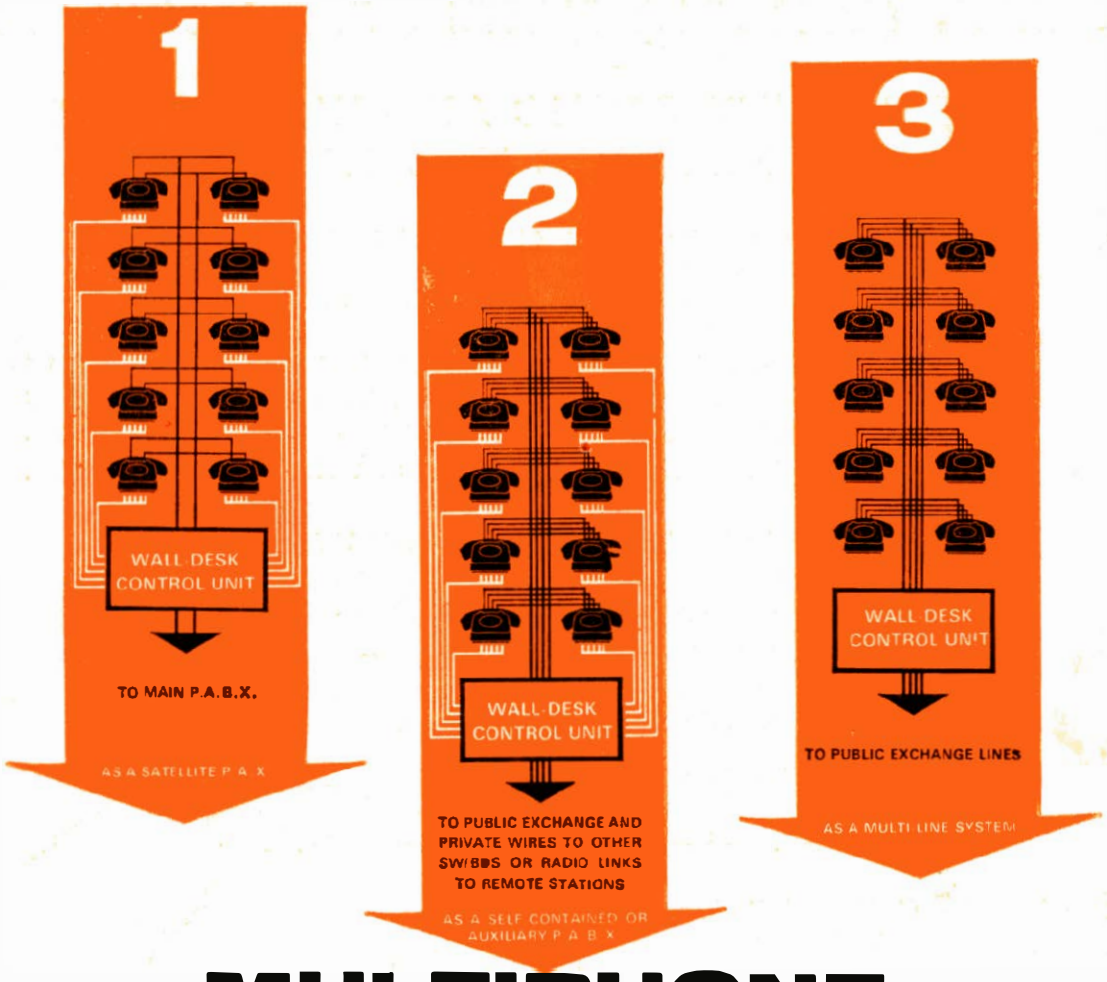

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Main Operational Features: Single-digit dialling of internal calls. Lamp signalling and supervision of all calls signalled, held or in progress. Internal calls made secret or non-secret by simple strap adjustment. Exchange-line exclusion feature for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

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