Post Office telecommunications journal

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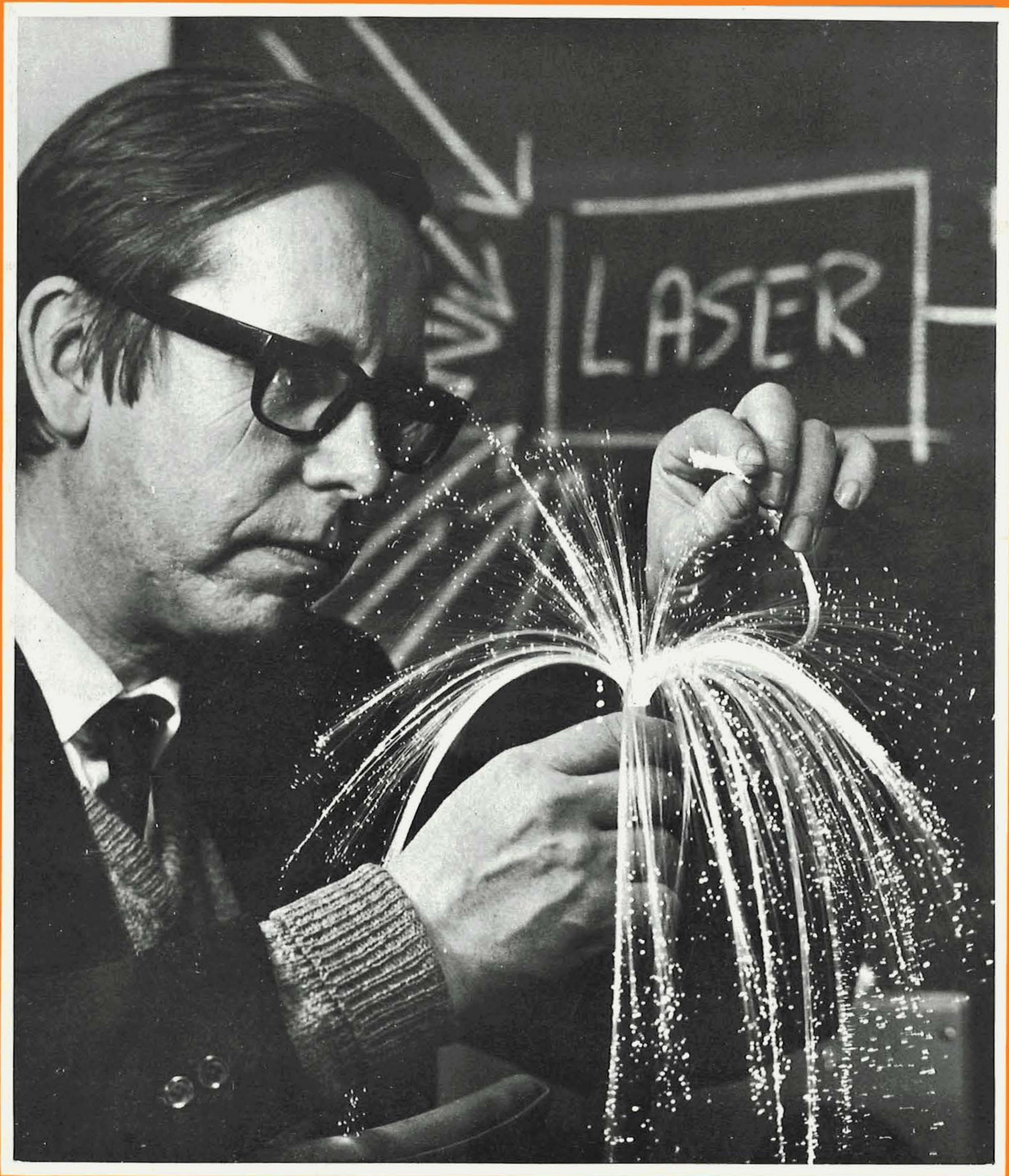
Summer 1970 Vol. 22. No. 2



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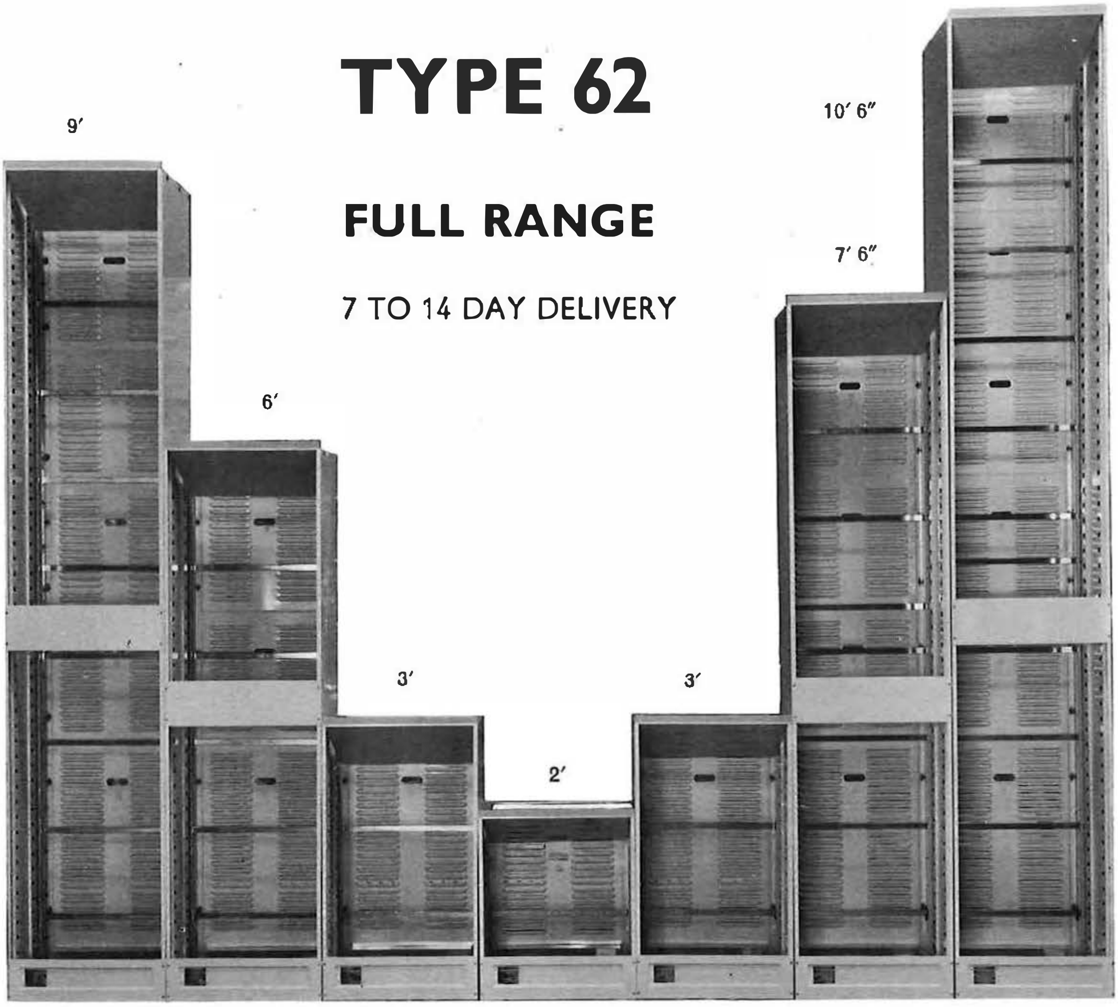

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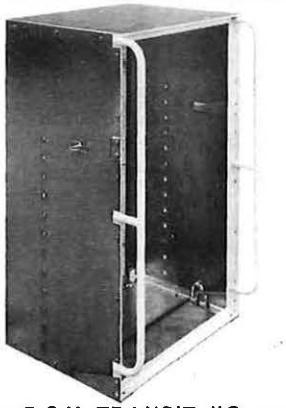

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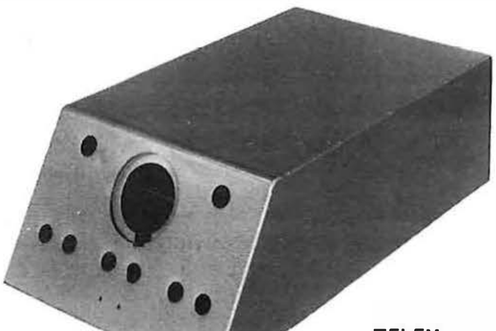

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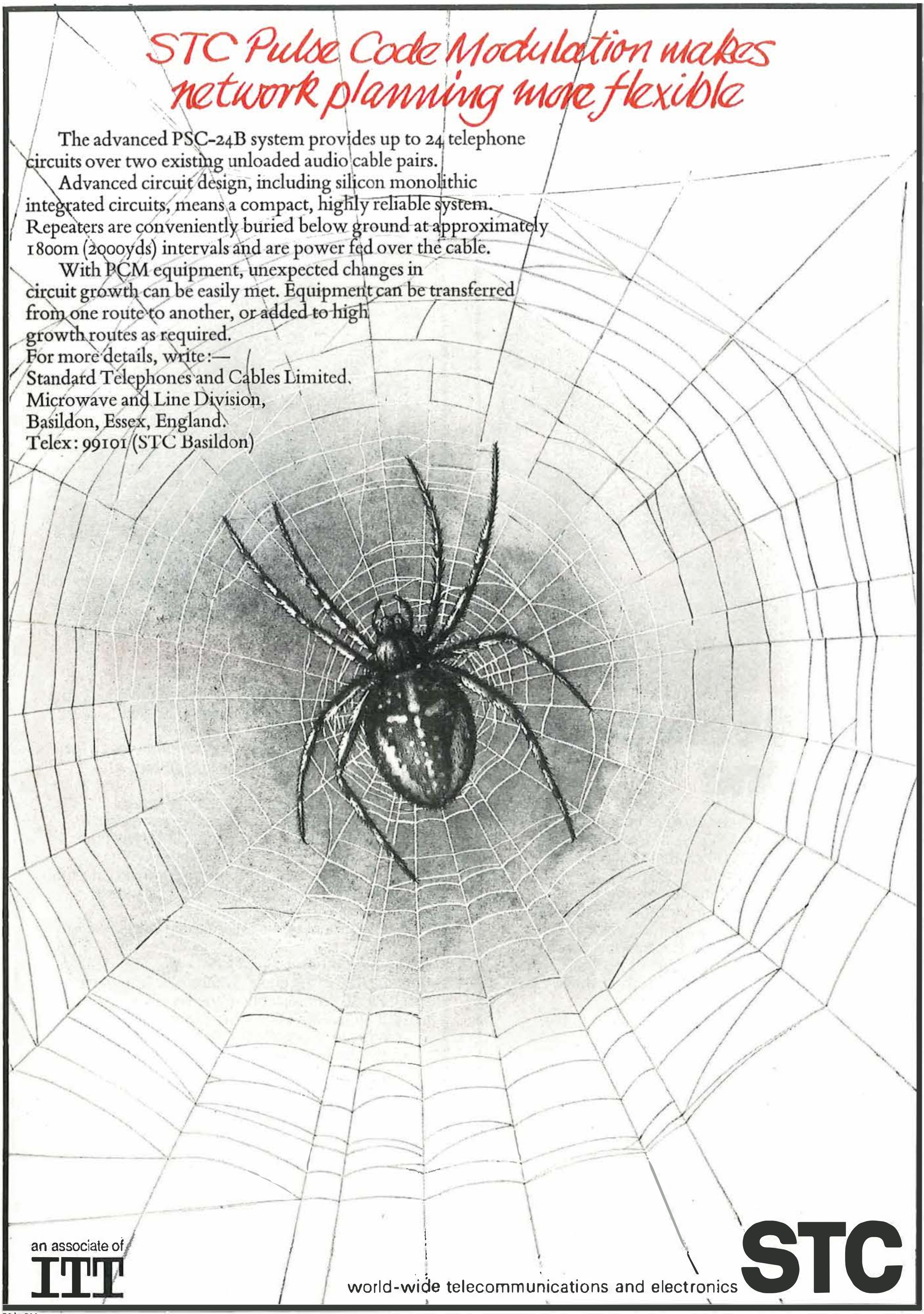
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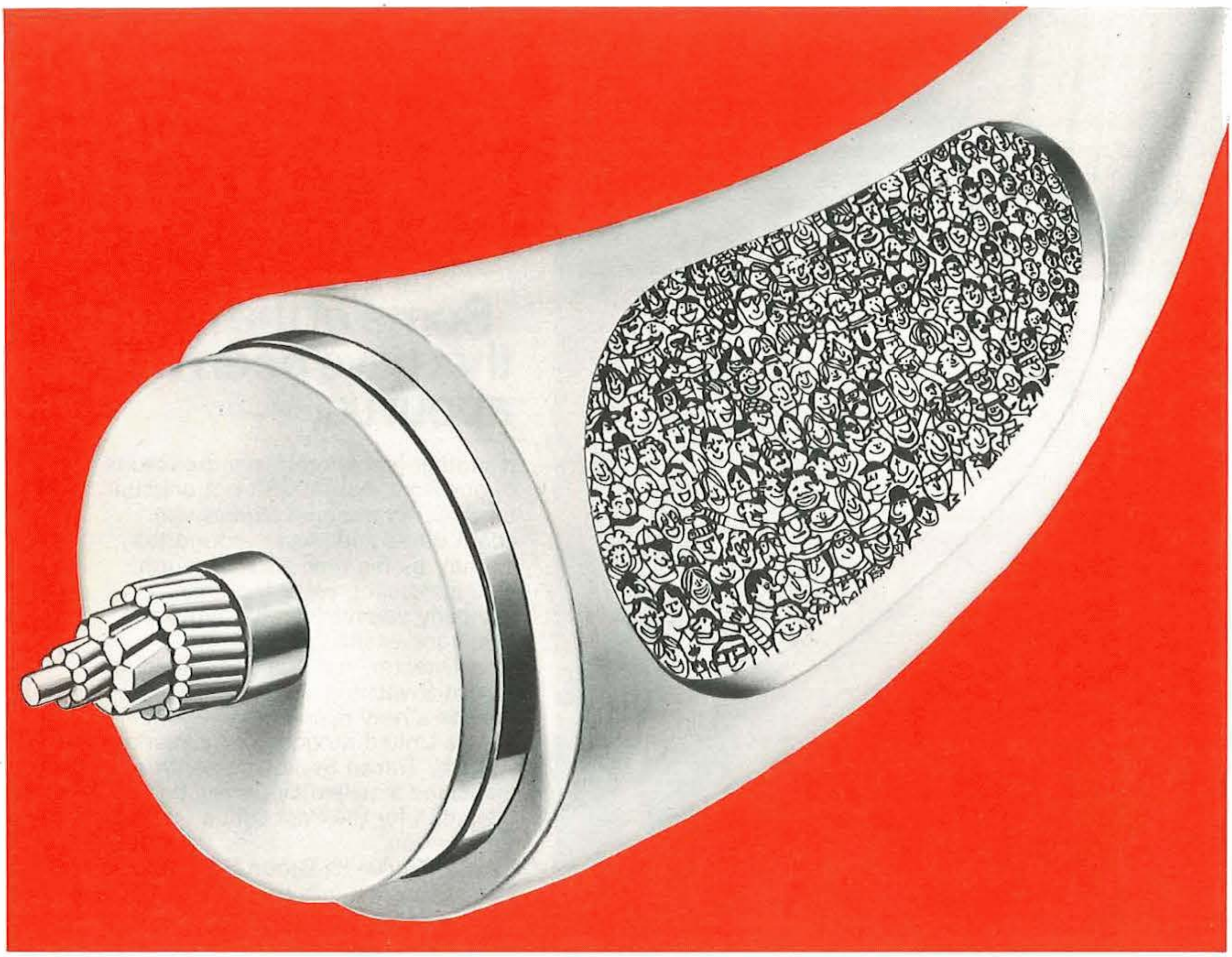

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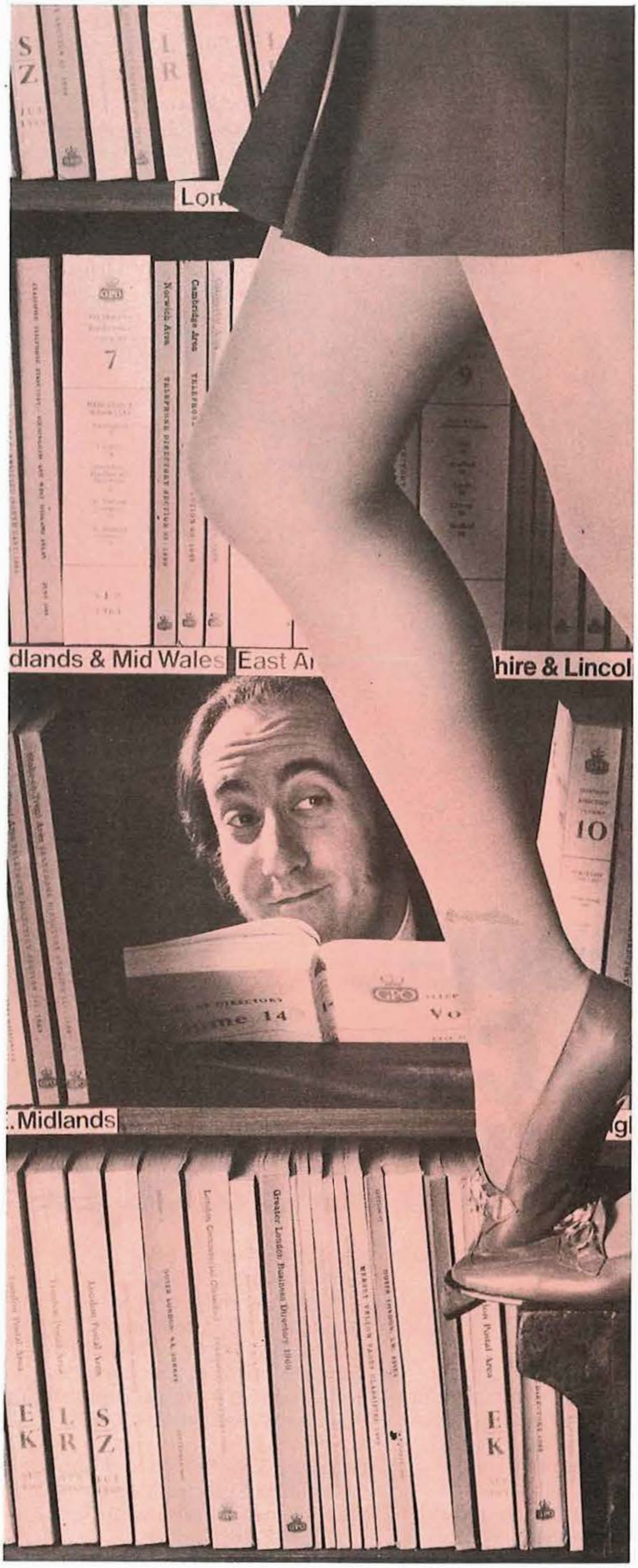

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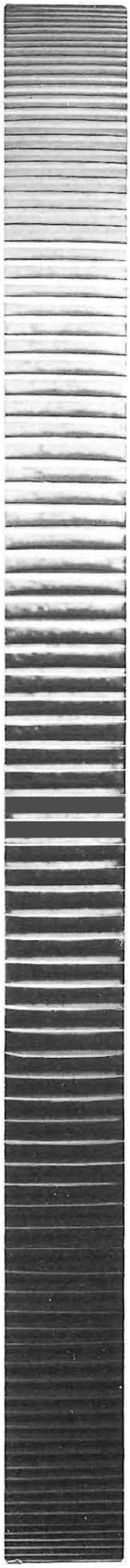

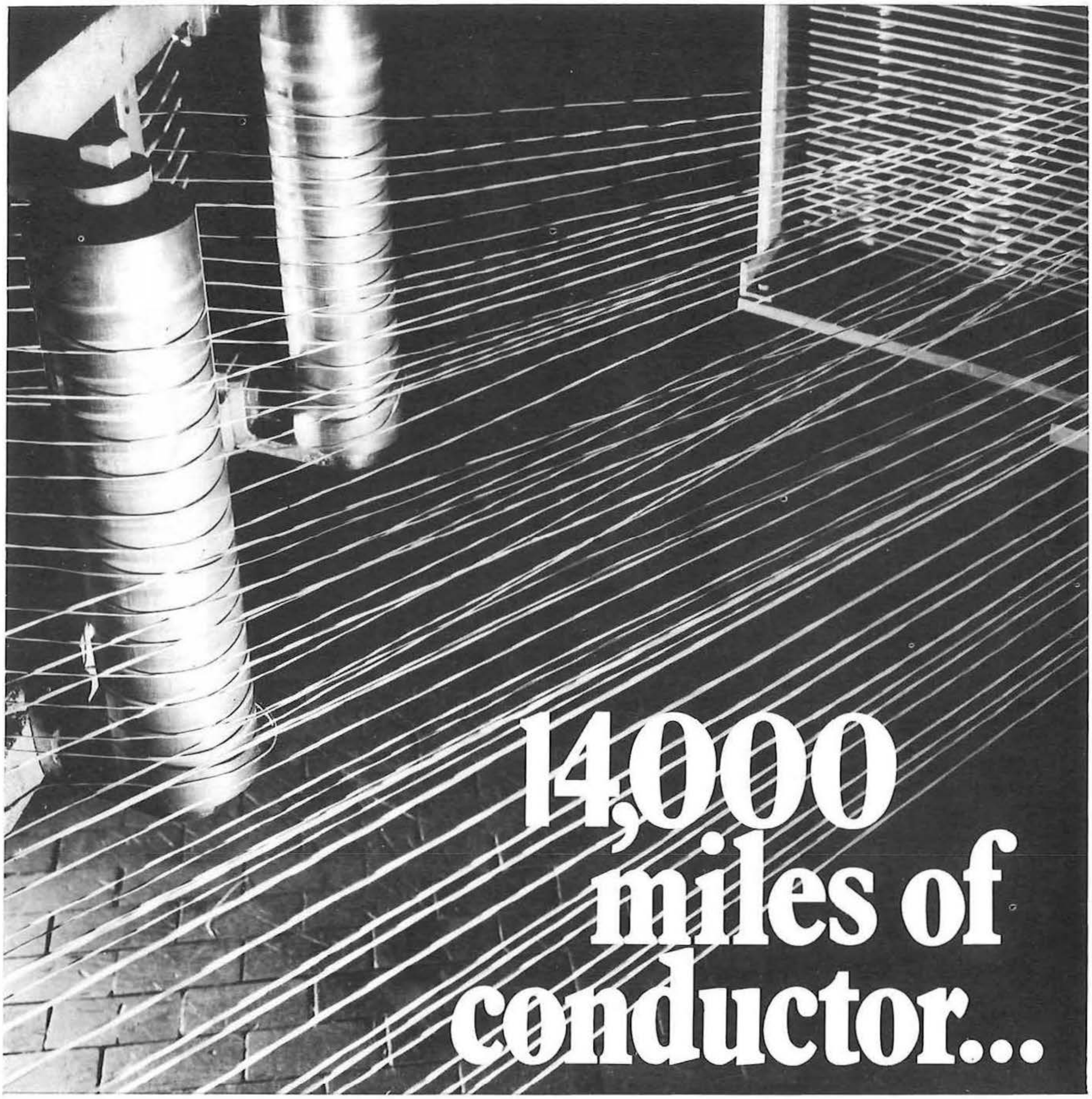
14,000
miles of
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Post Office telecommunications journal

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

Vol. 22 Summer 1970 No. 2

Assuring the future

THE NEW prices for telecommunications services have now come into effect, following consideration by the Post Office Users' National Council of the tariff proposals put forward earlier this year.

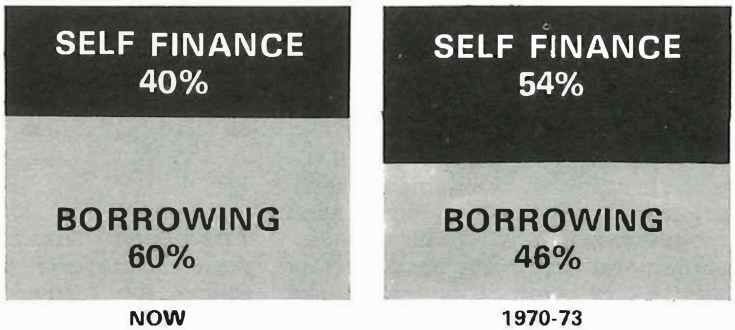
For the customer the new prices mean an unwelcome increase in his expenditure.

For the Post Office the additional revenue provides assurance for the vital investment programme of the 1970s—a programme that will ultimately be of benefit to the customer and the whole nation.

Many of the present deficiencies in the telephone service stem from under-investment in the past when the supply of capital was strictly limited by the Government. The result was that the telecommunications business entered the 1960s with a heavy backlog and insufficient capacity to meet the heavy growth demands of the decade.

The Post Office has stated on many occasions that it cannot allow this to happen again. Despite the impressive range of achievements in the 1960s, the correction of deficiencies due to under-capitalisation has still to be completed. At the same time, the Post Office must be prepared for a period of unparalleled growth and change in the '70s. To meet this challenge a £2,700 million, five-year capital investment programme is now under way.

The present ratio of borrowing to self-financing will be reversed in 1970-73.



Some of the money to pay for capital investment comes from Post Office earnings; the rest has to be borrowed. For 1969-70 barely half the capital requirements were financed from telecommunications internal financial resources. If the tariffs had not been changed, this proportion would have declined steadily to less than a third in five years time.

Borrowing would have risen from £190 million a year to £400 million a year in the same period, and the Government was concerned about the magnitude of these demands on its resources. They could be reduced only by cutting investment, or by financing more of it from Post Office income. The Post Office was determined to do all it could to ensure that the investment programme, and its services to the public, would not be cut back.

It was with this background that the Government announced, in consultation with the Post Office, its intention to increase the financial target for the telecommunications business from $8\frac{1}{2}$ per cent return on net assets to 10 per cent from 1 July. The new target period is to run until 31 March, 1973.

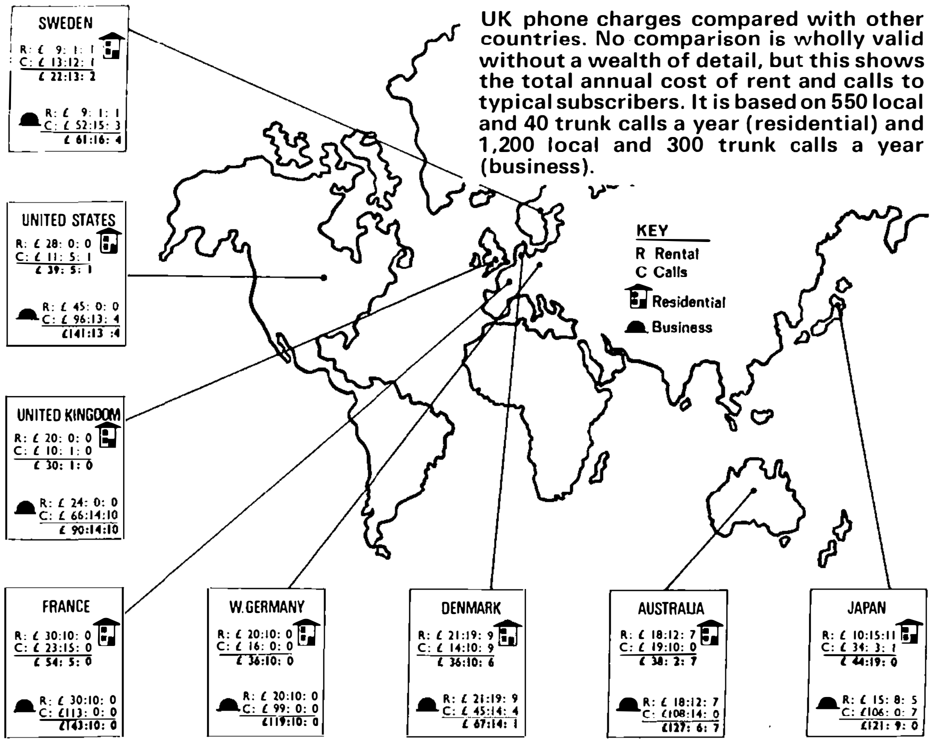
Although Post Office telecommunications has done much to absorb rising costs—its productivity record is one of the best in the country—prices had to be increased to meet the new financial target and to achieve the objective of maintaining Britain's place as a world leader in telecommunications.

The new tariffs will produce additional revenue of about £65 million in a full year, equivalent to an increase of about 8 per cent on revenue.

The new target requires the Post Office to finance more of its capital investment programme from internal sources and less from costly borrowing. In the $2\frac{3}{4}$ years from 1 July, 1970, capital spending will amount to £1,400 million. If there had been no changes the old tariffs would have brought in just over £550 million (40 per cent of requirements) in self-financed capital, leaving almost £850 million (60 per cent) to be borrowed.

IN THIS ISSUE

COVER PICTURE: A Post Office scientist demonstrates a possible high capacity cable system of the future in which laser beams would be used to transmit telephone calls along strands of glass no thicker than a human hair. Each pinpoint of light in this simulated effect indicates a single strand of glass, and each minute strand might carry up to 2,000 telephone conversations. The effect was obtained by passing ordinary light along a bunch of glass strands. The scientist is Mr. R. B. Dyott of Dollis Hill.



UK phone charges compared with other countries. No comparison is wholly valid without a wealth of detail, but this shows the total annual cost of rent and calls to typical subscribers. It is based on 550 local and 40 trunk calls a year (residential) and 1,200 local and 300 trunk calls a year (business).

The new charges provide £750 million (54 per cent), reducing the amount to be borrowed to £650 million (46 per cent), thus significantly reducing future interest payments.

However, the price increases form only a part of the plan to meet the higher target. The telecommunications business is to add to its formidable record in productivity improvements to help hold costs. One outstanding example of productivity can be seen in the vast telephone sector. Although the number of telephone connexions has grown by more than 40 per cent in the past five years, the number of hours worked by engineering staff has remained virtually constant. In the period 1965-71 output per head will have improved each year by more than 8 per cent, compared with the national average of 2.5 per cent. Further improvements will ensure that staffing remains at the present level for the next 2½ years while the number of telephone connexions increases by 25 per cent.

While every opportunity will be taken to stimulate profitable business, priority in the capital investment programme will be given to maintaining and improving the quality of service for both commercial and private customers.

Statistics which trace the growth of telecommunications in Britain fully support the need for a massive investment programme. In the 1960s the number of telephone lines grew by nearly four million to eight million; in the 1970s it will grow by at least another eight million. Today one home in three has a telephone; by the end of the present decade two homes in three will have one. The number of calls will be double the present 27 million a day.

At the same time, the Post Office must be prepared to cater for a fivefold growth in Telex, and, as the country moves further into the computer age, the number of data transmission terminals can be expected to increase 50 times or more, calling for further refinement and expansion of the Post Office's telecommunications facilities.

To handle the greater variety of services which society demands, it is necessary to operate an expanding and more flexible system of telecommunications. More modern equipment must be introduced as quickly as is practicable to widen the range of services.

The programme is vast and challenging. It is vital if the country is to have modern telecommunications services on the scale needed to meet customer demand. But it has to be paid for. Part of the cost must be met by raising prices, but even the new tariffs are inexpensive by international standards (see map above).

Post Office telecommunications has four main objectives. These are to:

- Maintain and improve its services.
- Put its business on a sound commercial footing.
- Meet its social responsibilities.
- Meet the financial target set by the Government.

Some of the decisions needed to reach these objectives are bound to be unpopular. The Post Office regrets this, but believes that the alternative—a restriction and deterioration of services—is not acceptable.

The new tariffs mean that the contribution by the telecommunications business to the investment programme has been increased by more than a third. The Post Office has sought to secure assurance of its vital investment programme and a greater control over its own destiny.

DETAILS OF THE MAIN CHANGES

QUARTERLY TELEPHONE RENTALS—Because of the very low use of the telephone in Britain compared with most other countries, over a quarter of residential customers were paying less for rent and calls combined than it cost to give them service.

Exclusive business rental is increased to £6 from £4, exclusive residential rental to £5 from £4; shared business rental rises from £3 10s. to £5 and shared residential rental from £3 10s. to £4.

MAXIMUM CONNEXION CHARGE for a new line within three miles of an exchange is raised from £20 to £25. This is reduced when certain components of a new line are not provided and in other special circumstances, such as when an existing customer moves house.

These changes, with increases in connexion charges and rents for some items of subscriber's apparatus which have nearly all remained unchanged since 1961, will raise about 80 per cent of the extra revenue the Post Office is seeking.

LOCAL TELEPHONE CALLS made a loss of more than £25 million in 1968-69. The new charges will increase income by about £6 million. The main change is an increase in the unit charge for calls from STD exchanges from 2d. to 2½d.: this is partially offset by an increase in the time allowed in the standard rate period from four to six minutes. For local calls from exchanges without STD the charges of 2½d. for calls from residential lines and 3d. for calls from business lines both go up to 3½d. but continue to be untimed.

The time allowed for 6d. on local calls from STD coinboxes is reduced from six to four minutes in the standard rate, and from 12 to eight minutes in the cheap rate.

TRUNK CALLS are a profitable sector of the business, but they present a problem —a great concentration of traffic in a limited period of the day. This peak traffic dictates the amount of plant and equipment that the Post Office has to provide, and the cost of this is reflected in the charges to the customer. By offering tariff incentives for off-peak use the Post Office has encouraged greater use of the system after 6 p.m. and at weekends and now, for subscriber-dialled trunk calls, the intermediate Saturday rate will be replaced by the cheap rate.

Nevertheless, there is still great pressure on the system during the Monday-to-Friday morning peaks and the Post Office has taken further tariff action to lower and flatten these peaks. This includes a new increased peak-rate tariff for trunk calls from 9 a.m. to noon Monday to Friday.

Outside the peak period the unit charge for calls from STD exchanges is increased from 2d. to 2½d., but more time is allowed so that the price of dialled trunk calls is broadly unchanged.

The Post Office Think Tank

By Lord Snow

Lord Snow writes for Telecommunications Journal about the Post Office Think Tank—the small group of distinguished thinkers, unconnected with the Post Office, who will suggest ideas that may help the Corporation and its customers. Lord Snow was asked to form the Think Tank by Lord Hall, Chairman of the Post Office.

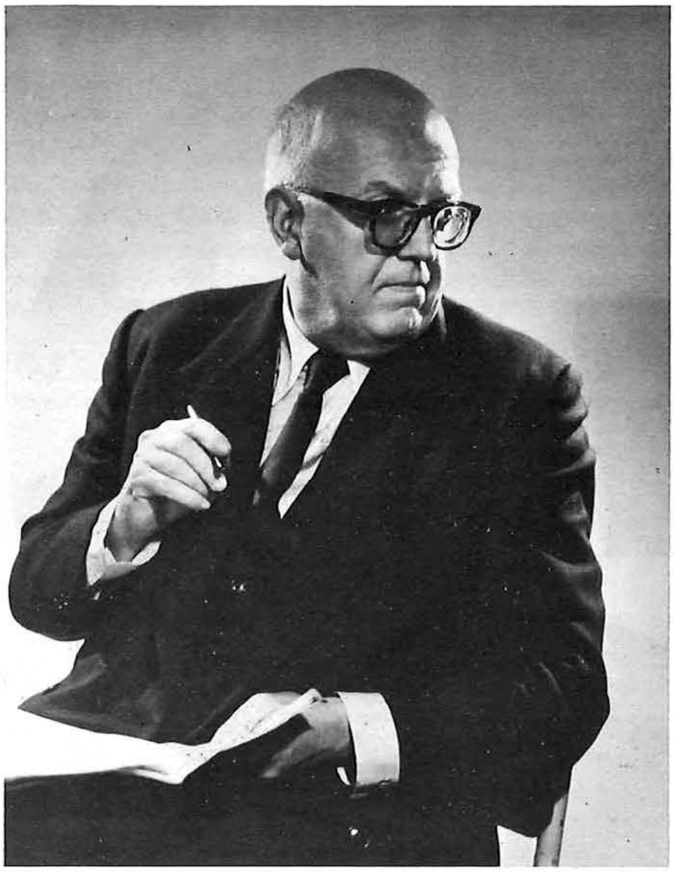
THE announcement of a Post Office Think Tank caused a good deal of flurry, and incidentally involved me in a remarkable amount of correspondence. I was reduced to thinking that whatever tiny sense of proportion my fellow countrymen had ever possessed they had now entirely lost. Come wars, riots, revolutions, epidemics, mass murders: none of that would matter, so long as someone was left to ask the essential question—now what about the Think Tank?

The name is American. Not a very suitable name, but it is difficult to find a good one. Just as it is difficult to define what a Think Tank is or ought to do. Perhaps the best way to start is to begin with some negative definitions. A Think Tank is not a complaints or suggestions department (though the general public does not realise that: letters pour into the Post Office, also to my house which seems a bit cool: also telephone calls to my house, which seems a bit cooler. I have even been interrogated in the street. In the past weeks we have realised that, to some people, nothing the Post Office can do is ever right. Alternatively, that nearly everyone outside knows precisely what is necessary). A Think Tank is not a Royal Commission nor an investigating service. It is not an executive committee. It is not a clearing house for bright ideas. In the present instance, it is not an ad hoc panel for running the Post Office or telling it how to do its work.

There are over four hundred thousand men and women in the Post Office. The amount of ability is very large. It would clearly be absurd (except, apparently, to some millions of citizens) to think that any outsiders, clever as you like, are going to dream up thoughts which have not already been dreamed up inside the corporation. Everyone has his pet ideas. Ideas, you soon discover if you listen to our well wishers, are two a penny: it is many thousands to one that any idea, even from inventive and experienced men, won't be unique. Among four hundred thousand people it would have bobbed up somewhere.

The same is true of projections into the future. What ought communications to be looking like in 1990? Or 2010? The Post Office, like any big organisation, has its own future-looking groups. There are plenty of others inside who like imagining the future. These informed guesses are likely to be at least as good as anyone else's guesses.

So where does the Think Tank come in? Various methods of application are being tried in the U.S. Most of these are connected with very long-distance projects, like the improvement of the ecological environment in the year 2000: and often, though the members of the tanks are of the highest class, the exercise can have a flavour of the academic. Ours is bound to be, and must be, different. There is nothing academic about the functions of the Post Office. Any Think Tank here is under an obligation, on a fairly short time scale, to earn its keep. I do not mean that this is an obligation laid on us by the Chairman, but it is one that all responsible men would for themselves immediately accept. We are attempting a rather different job from the



Lord Penney, a member of the Think Tank team. The distinguished atomic scientist is now Rector of the Imperial College of Science and Technology.

Lord Snow heads the Think Tank. During the last war, when he was in charge of scientific personnel, he was involved in a number of similar groups whose ideas helped the war effort.

more contemplative Tanks of the U.S.: though, like them, we have to find our own methods and our own goals.

We have, at the time of writing this, been going only four months or so. I can't say yet whether we shall have success or how much. But I can indicate our first approach. We assumed that thinkers in the Post Office were at least as competent as any of us: and so we decided, at least in the first instance, to work in parallel, having no connection with the corporation other than published information and the day by day experience that is open to any citizen. This sounds perhaps a little odd: it is not the final answer, but it seemed a reasonable sighting shot. Left to themselves, what would a few comparatively sensible people, drawn from different disciplines and different experiences, think about the administration and planning of communications in this country now and for, say, the next 10 years?

That happens to be a very interesting problem, but not at all an easy one. Some of us have learned, from wartime experience and later, that almost all decisions of this type turn into a matter of priorities. That is, there are a hundred choices the Post Office might make tomorrow with fairly good reasons for any one of them. The art of the whole process is to get the priorities right—or more exactly, for there is usually no answer which is 100 per cent right, get the priorities as little wrong and as workable as possible. In the last war we got the priorities right about radar and wrong about tank manufacture: the Germans did exactly the reverse. It was obviously desirable to collect one or two eminent persons who had been close to such decisions.

Don't think our priorities are likely to be better judged than those the corporation is working on. But an independent set arrived at externally, with no mutual influence, may be a support or a check. If we come up with precisely the present scenario, well, that does no harm but a great deal of good. If there are points of difference, they are worth looking into.

In that case, though, they would be worth looking into only if the Tank, collectively or individually, has something not quite commonplace to contribute. We have not yet settled on the optimum number. There has had to be a certain amount of trial and error before we reached the membership for the second half of 1970. I can say, however, that the optimum number looks to be quite small. Two members have been announced—Lord Penney and Dr. R. D. Thornton—and those names do reveal some of the principles behind the selection. Lord Penney as well as possessing great insight and wisdom has also had precisely the experience I have just mentioned, both in the war and afterwards with the Atomic Energy Authority. Dr. Thornton is a research worker aged 25, one of two of the group under 31. It seemed a good idea not only to have a weight of experience, but also some of the acute young minds. Forming new kinds of conceptions can be a young man's game. So I deliberately set out to collect a varied age range, from the twenties up to that of the older statesmen.

Not all of them are or will be scientists. It is desirable to have some who have lived with large-scale production or who have, either born with or acquired, inspired commonsense. It will be a little time before we have settled on the proper mix. In a small group, there is an interaction of personalities to experiment with. People can stimulate each other or the reverse and it is sometimes hard to predict which: so that kind of balance has to be thought of, as well as more formal questions, such as, could we make good use of a sociologist?

Our methods of work have been kept elastic. We meet together every fortnight or three weeks, and we consider how immediate day by day problems can be linked to our guesses about the future. The major work, however, is done in private: members send their conceptions and views to me on paper, and these are circulated and replied to. There is, as one would imagine, a good deal of telephonic communication.

It is all a vital, interesting, and promising programme. I am not proposing that this is the only way the Think Tank can operate, or even the best way. We shall not rest content until we have found what seems the best and most efficient technique.

In 12 months' time, we shall be able to estimate to what extent the enterprise has been worthwhile. And that has a significance which goes further than the immediate job with the Post Office. If this Think Tank justifies itself, then others will be tried. Is there a place, outside big organisations, but connected with them, for detached and independent thinking? A lot of people would like to know the answer. Only a fool would be positive at this moment, but I have hopes that we shall provide some answers.

● *An article describing Post Office long-range studies of the social and economic environment begins on page 10.*

Teaching by television for London schools

By A. J. BURT

LEFT: Teacher and pupil help to get a programme "in the can" at the London Schools' television centre, Battersea.

BELOW: Eyes glued to the classroom receiver, youngsters await the start of another lesson by television.

FOR 800,000 pupils and students in London the classroom will never be quite the same again. Teaching by television is now a regular event in 1,200 schools and colleges which are receiving the special programmes put out by the Inner London Education Authority's television service. The Post Office provided the closed-circuit TV network of specially designed cables and amplifiers which was handed over to the Greater London Council for service in March of this year.

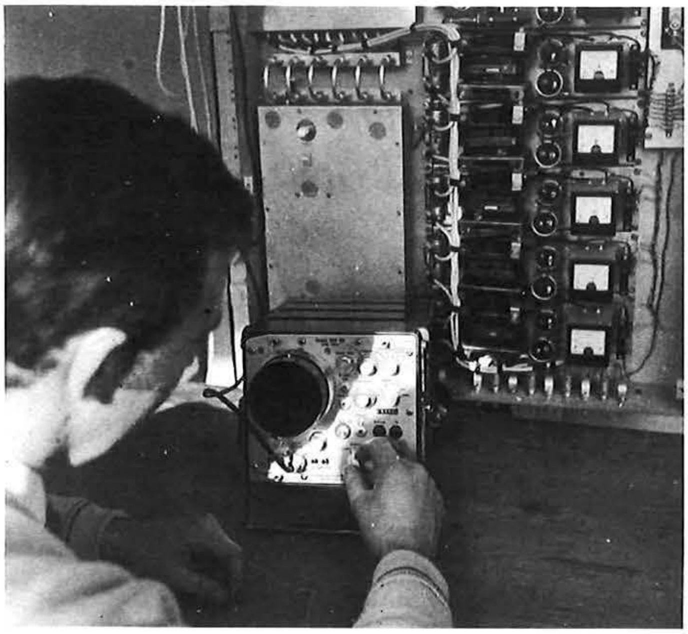
Ninety teachers, all trained in the use of television as a teaching method, are working full-time as directors, presenters and scriptwriters. In the current educational year 400 new programmes will be produced each of which will be transmitted three or four times a week on two of the network's seven channels—the others are allocated for BBC and ITV broadcasts and for university and higher education use.

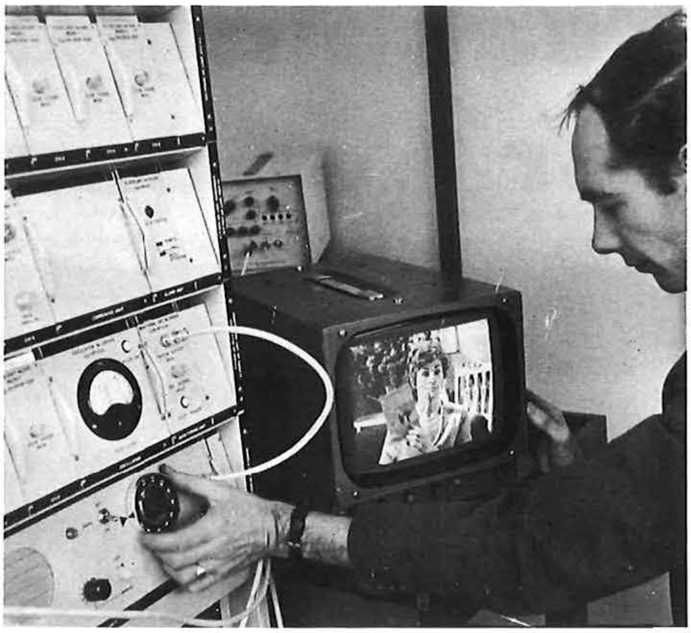
For London Telecommunications Region, which carried out the work, the job has been a three-year marathon involving the laying of 500 miles of external cable in which are jointed about 700 buried amplifiers, installing another 1,300 amplifiers in schools and telephone exchanges and 4,000 television receivers in the classrooms. A special Progress Committee was set up to control the operation and the Region's Critical Path Methods group undertook a feasibility study.

At the hub of the network is an extensively equipped television centre at Battersea. (It is the second centre to be used in the scheme. The first, at Highbury, is to be demolished because it is on the line of a projected roadway). The TV Centre has two production studios, a training studio and all the ancillary facilities for programme production.

The service has been provided in three stages. The first connected 300 schools in north and east London to the network and these received the first transmissions in September of 1968. Stage two consisted of connecting up another 650 schools by September, 1969, and because of the problems with the Highbury TV Centre, also involved the equipping of the new Battersea Centre and the "turn round" of part of the stage one network. Because this was in service the work had to be done during three weeks of the schools summer holidays, but was completed on time. Stage three involved connecting the remaining 250 schools by March of this year.

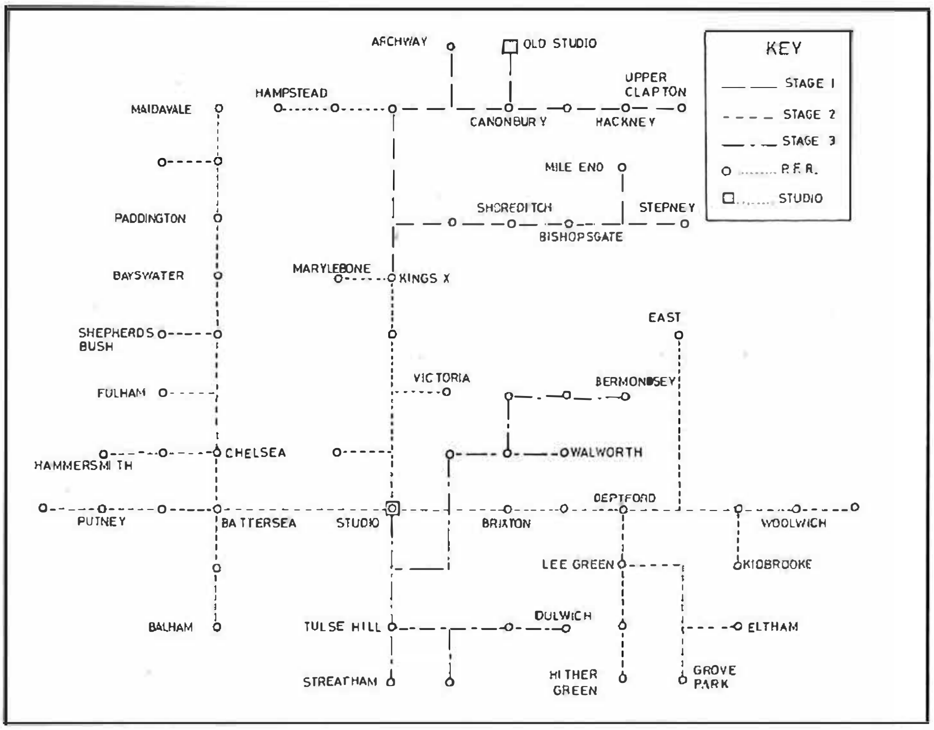
Seven 625-line monochrome or colour programmes can be relayed simultaneously and selected by a special tuner fitted to Decca receivers in the classrooms. The television and sound signals from the TV Centre are translated into the 40-140 MHz VHF band by the Post Office send terminal at the Centre and then transmitted over the network, the backbone of which is a web of mainline feeders which cover the whole of the Inner London Education Authority's area. From amplifiers and branching units in these feeders spur cables branch out to feed the programmes to individual schools. The amplifiers are supplied with power from power feeding amplifiers in the telephone exchanges en route





ABOVE: A technician uses a portable pulse tester to locate disconnexions and short circuits quickly. The tester transmits a series of pulses and when they encounter a fault reflected energy is returned to the transmitter. The time this takes pinpoints the distance to the fault. The pulses are displayed on the small radar-type screen and the distance can be read off from a calibrated scale.

ABOVE RIGHT: A technician checks the quality of transmitted pictures during installation.



The main feed network for the schools television service.

and compensate for the losses of the cables at these frequencies.

Provision work consisted of five main activities—planning, cabling and jointing, centralised amplifier production at the Regional Line Up Centre, internal wiring of schools and commissioning of the system.

The effort of external staff has been considerable. In addition to a demanding programme they had to cope with many technical problems. For example, the cable (in two sizes 0·62 and 0·345 inches) has solid polythene dielectric and cannot be bent to a small radius. As a result large sweeping bends had to be used and in manholes in the congested streets of London this posed problems. Jointing these cables involves injection moulding of the dielectric—a new technique for area staff—and even with specially designed equipment it takes four hours to make each joint.

The work of the Regional Line Up Centre required close co-operation with Regional Headquarters and area external staff. As each section of the cable was laid an amplifier that matched the preceding cable section was constructed at the Line Up Centre. The cable length and the characteristics of the particular drum had to be known precisely.

A small Regional group was set up to plan, co-ordinate and test the wiring of schools which had been carried out by the area concerned. Some comprehensive schools had very large installations, and a total of 69 auxiliary amplifiers were fitted in the bigger schools to compensate for losses in wiring. During wiring tests within the school buildings staff used "Walkie Talkie" radio sets to keep in touch with each other.

Commissioning a cable network of this kind had not been attempted before. For the stage one programme 100 miles of cable, 159 buried amplifiers, 292 schools amplifiers all had to be proved through and commissioned in 13 weeks and all with a staff inexperienced in television work. Engineers, both for the Line Up Centre and for commissioning the system, were recruited from the areas. Few had any previous training in this specialised work and it was necessary to train the staff on the job with a team, as soon as its training was complete, splitting into two sections, each training new entrants until the required number of teams was built up.

Commissioning work also necessitated a good speaker system over which engineers carrying out tests could keep in touch with local exchanges and with one another. Originally it was planned to use telephone sets working in the normal speech frequency range but due to the high noise levels encountered LTR Works Group had to design and develop Carrier Telephone Sets using frequencies of 280 and 380 kHz which could be operated over the coaxial cable used to provide the TV network. They have proved to be very effective in use and are capable of working over a line loss of 90 dB.

There was a need for a quick

Wiring a school in Bermondsey.

means of locating simple continuity faults—disconnexions and short circuits—and a portable pulse tester proved to be the answer. Transmitting a series of pulses any impedance irregularity encountered causes reflected energy to be returned to the transmitter. The time taken for this to occur is a direct indication of the distance of the fault. This is displayed on a cathode ray tube, rather like a radar screen, and the distance to the fault can be read off direct from a calibrated scale. Amplifier positions are also shown.

Once a section was proved clear of faults, power was applied and high frequency signals passed over the network to the schools to check that the level and frequency response was satisfactory. The main lines feeding the network had to be set up to very close limits and special "mop up" equalisers were inserted at all exchange amplifiers to ensure this. The process was simplified by displaying the frequency response on a cathode ray oscilloscope and the effect of adjustment could be immediately seen. The network has also been tested and found satisfactory for colour transmission although at the present time only black and white receivers have been installed.

Despite the many problems posed by any new system of this kind all the original target dates were met by the Post Office. This was achieved with a system that involves what is probably the largest closed-circuit television network of its kind in the world.

THE AUTHOR

Mr. A. J. Burt is an Executive Engineer and has been with the LTR Television Commissioning Group since 1968. He has also worked on the Region's Critical Path Methods Group, on Auto Exchange and Long Distance transmission duties. Earlier, he was involved with the TAS1 and TAT undersea cables.

Gateway to the world's phones

A NEW international switching centre—the largest "gateway" exchange of its kind in Europe and possibly the world—is to be built in the City of London to cope with the continuing rapid growth of international telephone traffic. The building will cost about £7 million to construct, and will be equipped and in service within four or five years.

The switching centre will connect United Kingdom telephone subscribers to numbers in all parts of the world—with the great majority of calls dialled direct by customers. It will also route calls between countries in Europe and the rest of the world.

The initial equipment will cost about £10 million and more will be added as traffic grows. Ultimately the exchange will be able to connect up to 200,000 calls an hour using more than 20,000 international lines via cables and satellites.

The name chosen for the new building is Mondial House—the word mondial emphasising the world-wide function and the use of the telephone dial. It is due to be completed in 1972, when the installation of telephone equipment will begin.

A design feature of the building, which will overlook the River Thames, is that the six floors above ground level will be stepped and set back, mainly to ensure that views of St. Paul's Cathedral from London Bridge are preserved.

Equipment will be installed in stages, with the exchange coming into operation in 1974 at about one-quarter of its eventual capacity.

There will be a large degree of automatic testing and fault location built into the equipment. Cordless switchboards will be used to connect calls which customers cannot dial themselves. Diesel generators will provide the eight million watts of electricity required to keep the exchange working in the event of electricity failure.

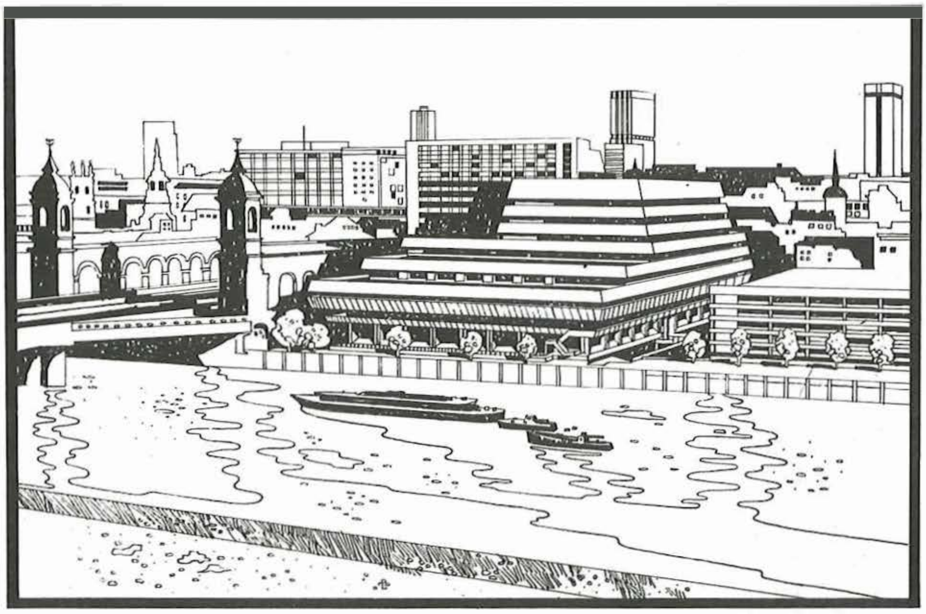
By 1975 Mondial House will be connecting some 23 million calls a year. This will be about one-third of all international calls, a proportion that will steadily increase as additional equipment is installed to meet the expected rise in traffic. Mondial House will eventually be the main international switching centre in the United Kingdom, and have a staff totalling about 2,000.

It is to be the Post Office's third international automatic telephone exchange. The other two are the existing main exchange in Faraday Building and a new exchange now approaching completion in Wood Street. These three exchanges will be inter-linked and will work together as a total system. By 1975 over 60 per cent (currently over 70 per cent) of international telephone calls will still be starting or finishing in London, most of them in the City, and so the "gateway" exchanges which form exit and entry points in the international network must be located there.

Some 30 million international calls a year are now made from and to the United Kingdom and by 1975 this figure is expected to increase to about 70 million. The UK has direct circuits to about 75 countries and other countries can be connected through intermediate points.

At present about half the international calls made are dialled by customers and are connected through the existing exchange in Faraday Building. (By the time the Mondial House exchange is in service the proportion of dialled calls is expected to have risen to 70 per cent). International calls that are not dialled by customers are connected by operators either in the Faraday or Wood Street buildings or at smaller manual exchanges in other parts of London. All these operators have access to the automatic equipment in Faraday Building and Wood Street.

A drawing of Mondial House as it will appear alongside the River Thames.



A leap ahead in cable capacity

The Post Office is to introduce a 60 MHz coaxial cable system with the largest capacity in the world. It is a bold extension of the existing coaxial system, stretching the technology to its limits.

By K. G. T. BISHOP

This cylindrical tank will be used in a field trial as a manhole to house the repeaters for the new cable system. Based on the concept of the agricultural silo, it is constructed of steel plate, is 1.8 m. in diameter, 2.4 m. deep and can be sunk in the ground. The coaxial pairs are laid out around the circumference, each being connected to its individual repeater case on the wall. The cable leaves the silo on the same tangent as it enters avoiding sharp bends. The cables are plumbed into entry seals to ensure the installation is watertight.

THE SIZE of the trunk telephone system has been increasing in recent years at an annual rate of approximately 15 per cent and substantial numbers of additional public trunk circuits are required each year. To help cope with this demand the Post Office is introducing a 60 MHz coaxial cable system with a capacity far greater than any at present available anywhere else in the world. The fully equipped 18-tube cable will have a capacity of 97,200 circuits compared with the 16,200 circuits available on the 12-tube, 12 MHz coaxial cables currently being installed, or the 18,000 circuits using the frequencies reserved for telephony broadbands on microwave radio systems.

Two other systems which could help to meet the increase in traffic economically—digital systems to work on coaxial cables and circular waveguides—are at an earlier stage of progress. A considerable amount of research and development has still to be done on both, and still more time will be needed to test and evaluate the prototype installations.

Network planners must always be certain that systems will be available on time. For the routes they are planning from 1975 onwards they envisage the use of 60 MHz systems and consequently work on this is being pushed ahead.

The cable for the first 60 MHz coaxial system will be laid from London to Birmingham during 1973 and will be quickly followed by a Birmingham to Manchester cable. The north-south route is the one with the highest circuit growth, approximately 12,000 circuits per annum, and conforms to a pattern in national communications that has existed since the Industrial Revolution. In making surveys for the more important routes, the possibility of the later addition of a circular waveguide along the same route as the cable will be borne in mind.

The 60 MHz line system, using frequency division multiplex principles, is a bold extension of the 12 MHz coaxial system to the limits of current technology, and many problems have yet to be resolved. Each of the nine pairs of coaxial tubes will utilise the frequency spectrum from 4 MHz to 60 MHz in which 12 900-circuit broadbands can be assembled to give a capacity of 10,800 telephone channels—four times the number provided by each of the six pairs of tubes in the 12 MHz system. The attenuation of coaxial cables at 60 MHz is higher than at 12 MHz which necessitates placing the repeaters at closer intervals. Dependant repeaters will be installed underground every 1,500 metres and will be energised by power fed over the cable from power feeding stations. The increase in the number of repeaters per system arising from the closer spacing, each loaded with four times as many circuits, makes it more difficult to meet the required linearity performance.

The uniformity of the cable characteristics is of importance and from exhaustive tests that have been made on 375 E (i.e. 0.375 inch) coaxial cables of British manufacture, it is evident that they will be suitable for the 60 MHz system with little or no modification to the method of construction.

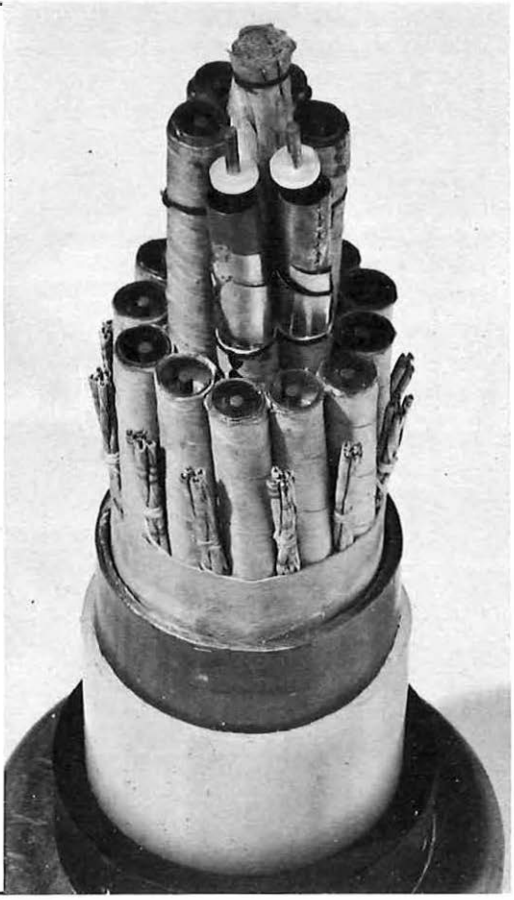
The cable, as designed, will consist of 18 such coaxial pairs over which it will be possible to operate nine both-way 60 MHz line systems suitable for telephony, data, television or a combination of all three. Eighteen is the maximum number of coaxial pairs which can be drawn into a single bore of a standard Post Office duct. An eight-pair cable is under consideration for routes with lower ultimate capacity.

An important feature will be the reservation of one of the nine systems for protection purposes. If a fault occurs on one of the working systems, it will automatically be switched out of service and the "protection" system will carry its traffic. As the fully equipped cable has a capacity of 97,200 telephone circuits, steps must be taken to lessen the likelihood of damage to the cable as simultaneous failure of all the circuits would have a serious effect upon the trunk service.

The route will be chosen so that, as far as possible, a secure environment is provided for the cable. A method of "hard" (i.e. specially secured) route construction is being developed which entails laying cables deeper than before, segregating the duct and manholes from existing underground plant and dedicating its initial use to 60 MHz systems exclusively. On the grounds of security, the hard route will be restricted to two cables which will be laid at a depth of 1.2 metres. In built-up areas ducts will be laid for the cables, but in open country sections the cables may be armoured. Modern brazing techniques will be used to make the coaxial joints and they will be of the highest integrity.

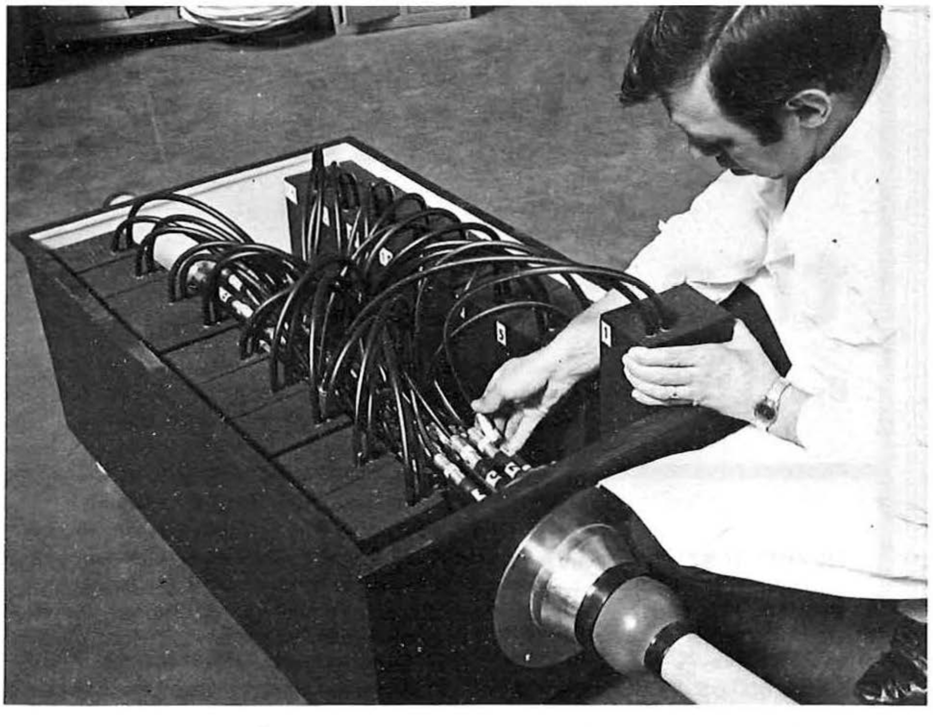
To house the repeaters, manholes of various design are under consideration. One design is a pre-cast manhole of conventional shape; another is a "silo", a cylindrical tank based on the concept of an agricultural container; and a third a silicon-aluminium alloy box of conventional design. The more favoured at the moment, however, is the alloy box, which can be accommodated in a standard manhole. It is likely to prove the cheapest method.

A section of the new 60 MHz coaxial cable. It adopts a design based on the 375 E coaxial pair cable. It is possible to pack 10,800 circuits on two 375 coaxial tubes and 18 of these tubes can be accommodated in the new cable made to present diameter limits. The 18 coaxial tubes are contained within a lead sheath with a polythene protection overall. The cable is made up in two layers. The first is of six coaxial tubes and the second of 12 tubes. A 10 lb. paper-insulated copper quad is laid in each of the outer interstices. Jointing presented a problem. If the pairs are jointed in normal fashion and access is required to the inner tubes the joint has to be eight inches diameter, necessitating the use of brass for the sleeve with separate end cones. As a result of development work on the joint, however, it has been found possible to bring the inner layer up to the outer layer round special formers and joint all the pairs in one layer. This overcomes the access problem and reduces the overall diameter to five inches. The closure can therefore be completed using a standard six-inch lead sleeve and no special piece parts will be required.



Work has already started on a trial route for the new cable which will run from Marlborough Repeater Station towards Hungerford. The duct has been laid to hard route requirements. Soon the manholes will be put down—a number of each of the large pre-cast design and silos plus a few of the more conventional shapes—after which drawing in of the cable will start, followed by installation of the line system amplifiers. The field trial will continue until April, 1973, around which time work should be starting on the laying of the first cable between London and Birmingham. But enough should have been learned sometime before that date to allow the drawing up of specifications and the letting of orders for the manufacture of the cable.

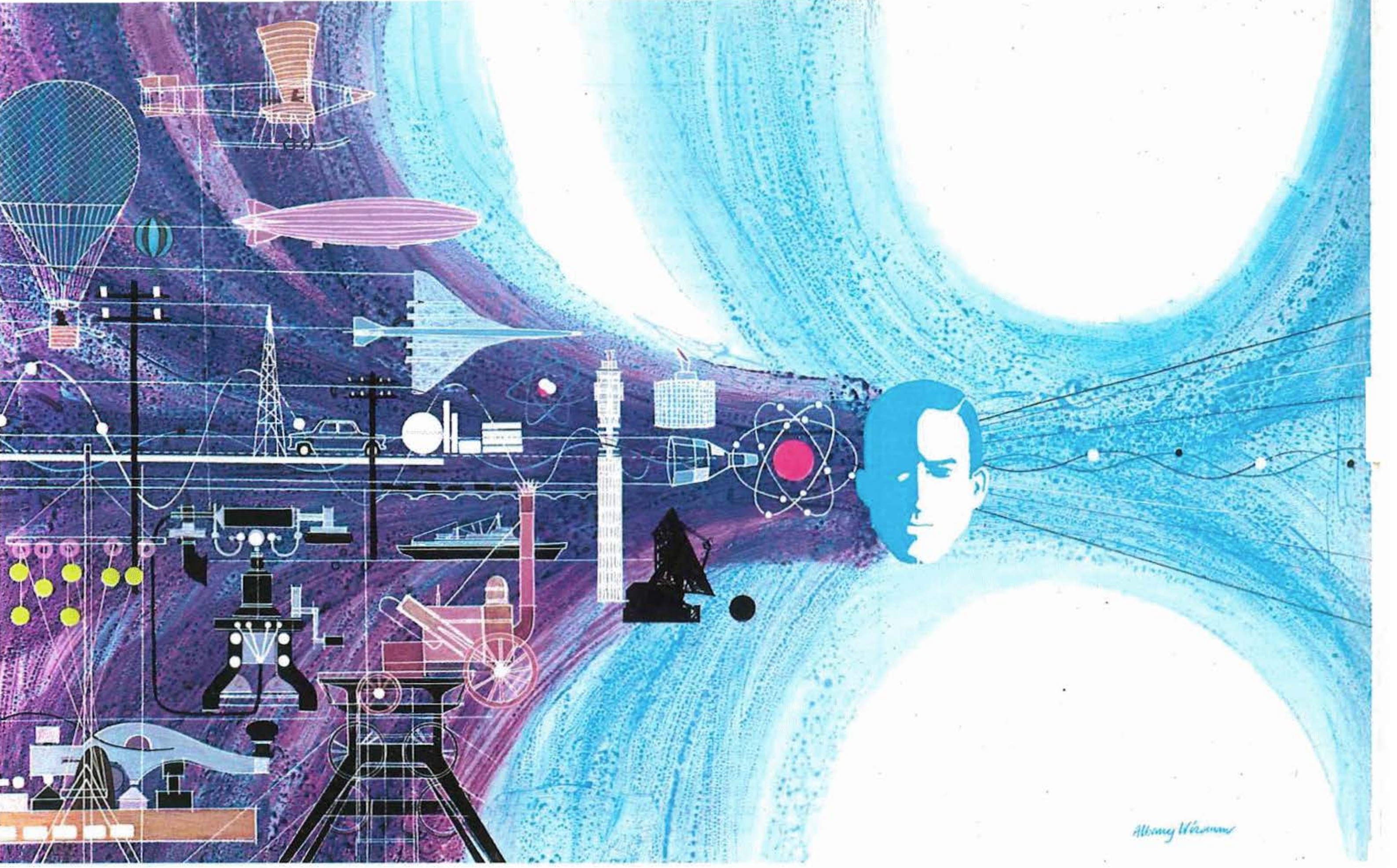
With the electrical and mechanical safeguards that are being built into the system, a higher reliability than obtained on any previous coaxial line system is confidently expected. It has been estimated that for a 160 km route cable breakdowns will not occur more than once in ten years, and any working circuit will be available for 99.99 per cent of the planned lifetime of the system.



A wooden mock-up model of the silicon-aluminium alloy box, the more favoured method for housing the repeater units. It can be laid direct in the ground or in a standard manhole.

THE AUTHOR

Mr. K. G. T. Bishop is a Senior Executive Engineer in Network Planning Department with responsibilities for the planning of high capacity inter-city trunk cables. He has also worked on the planning of closed circuit television networks.



ECOLOGY. Branch of biology dealing with living organisms' habits, modes of life, and relations to their surroundings (Oxford Concise Dictionary).

This picture of "Ecological Man" hangs in the author's office and represents the challenge set to his Branch. The history of human endeavour, particularly in communication, passes symbolically through the mind of Ecological Man as he considers the unknown, long-term future. The artist was Albany Wiseman.

Looking for signposts to the future

By L. L. GREY

In our last issue we published a panoramic view of telecommunications in the year 2000 as seen by the head of the Post Office Long Range Studies Division. In this article a member of the Division describes how they are studying possible developments in the social and economic environment during the coming decades to see what part telecommunications can and should take.

MOST people are inevitably so pre-occupied with present-day problems that they rarely, if ever, consider what may be in store for them 20 years ahead. A large business organisation cannot work that way, and Post Office research and development staff are now studying advanced systems and new switching equipment in preparation for a network in the 1990s of incomparably greater capability, potential and complexity than we have today. What will life be like in the nineties? What activities are there likely to be in the home and in business which will place new demands for service on this network of the future? The answer, of course, is that it is not possible to evaluate these activities and demands in precise terms; nor does anyone seriously believe it to be desirable that plant and investment should be committed for a period so far ahead. Our successors, who might well have different views, would not thank us. Why, then, plan for the long term at all?

The reason is simply one of necessity. Viewphone, the telephone system incorporating a video display of the user, illustrates the point. When the first telephone exchange was introduced into Britain in 1879 only nine exchange lines were connected in the first six months, and it took about 45 years before the millionth exchange line was connected. Similar problems would have to be faced with Viewphone; while it is to be hoped that its introduction would occur very much more quickly, it would nevertheless take some 10-20 years before we could have a large national network. The original identification of a market for a videophone service has already been done by Bell of America. We now have to confirm that there is a market in this country, gauge the demand and solve the technological problems involved. The last of these points is crucial because of the considerable work required to produce customer, exchange and transmission plant.

If a Viewphone service is to be introduced, the annual capital investment will be very substantial and could quickly become a significant fraction of the total capital investment in the telecommunications service. Such major expenditure requires careful examination of the market to judge its extent, principal users and their main locations.

The normal means of gauging a market is, of course, by use of market research techniques in which potential customers' views are sought on the product one is thinking of placing on offer. An appreciation of likely demand can therefore readily be formed. In the case of Viewphone, however, we are considering a period for general introduction that could be 10 or 15 years away, and few people are going to have formed views for that period of time ahead. Who is going to need Viewphone? Who is going to afford it? What benefits would its introduction bring? Would it be a substitute or a complement (or both) to transportation? These are some of the questions that need to be answered. To do this we need to look at the environmental conditions that are likely to prevail in the 1980s.

The majority of big firms in this country whose time scales for the introduction of new products are similar to our own, of which Shell, Unilever, BP and Plesseys are just a few examples, all have teams working on long-range planning. They know that this is vital if they are to introduce new, and phase out old, plant in an orderly manner. So great is the gathering momentum of information technology, and so long are our development times, that it would not be difficult to be caught on the wrong foot and be unable to satisfy our customers' legitimate needs.

In 1968 the Systems Planning Unit of the former Engineering Department was augmented and re-named the Long Range Planning Division (subsequently the Long Range Studies Division). The Division is organised into three branches: LRS3 is studying the long-term future of the trunk network, LRS2 is concerned with systems and facilities and LRS1 with ecological and economic studies (or more simply put the study of the future environment). This article is mainly concerned with the work of LRS1 which, at the time of writing, has a staff of five (including two recently appointed economic advisers).

One of the first tasks facing LRS1 is to look at the general long-term socio-economic conditions that are likely to obtain in this country towards the end of the present century. This involves initially studying the Registrar General's forecast for population, age distribution and movement, household size and size of working population to provide a basic operating framework. Then by taking various projections of Gross National Product (the value of goods and services produced plus net income from abroad) we can determine the wealth that could be available and the possible distribution of incomes. (Figs. 1 and 2).

Investigations can then be made into the general pattern of family expenditure at different income levels to give an idea of possible future leisure expenditure and ownership of consumer durables. (It is of interest that in 1968 the "average" family spent 5·7 shillings per week on postage, telephone and telegrams which was only slightly more than was spent at the hairdresser—4·29 shillings). We have to consider whether expenditure on our services will increase as a result of increased benefits that can be provided by telecommunications—services which may have to be introduced in competition with expenditure on, for example, cinemas, travel, education.

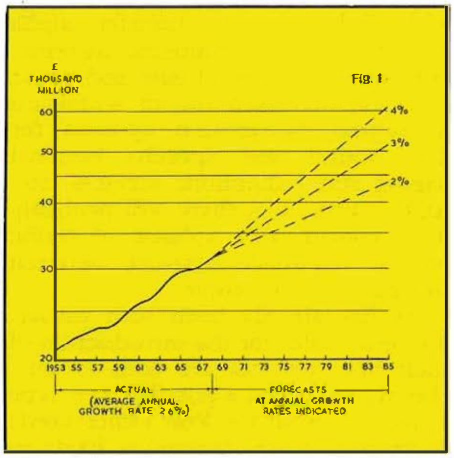
Analysis of expenditure in the business sector is not so easy to come by; such information could tell us, for instance, the proportion of operating costs spent by selected firms on telecommunications, and hence enable us to gauge the importance attached to telecommunications by the firm concerned. In addition one could see how expenditure was divided between the various services (e.g. telephone, Datel, telex, etc.) and the trends in such expenditures as time went by. We would look to see whether there was any correlation between expenditure on telecomms and the success enjoyed by the Company.

Work on the above lines is concerned with the macro-end of operations. At the micro-end we hope, in due course, to obtain data about the extent to which meetings can be satisfactorily conducted by the use of audio-visual electronic communication in place of face to face meetings, and the possible implications this may have on urban and regional planning policy.

It will be appreciated that, with much of the work described, it will be a considerable time before the impact on telecommunications in the long term can be seen. Recent work has looked at manufacturing industry and commerce in order to compare their relative performances in terms of their contribution to GNP, growth and investment rates and in export performance, and so help to decide the sequence in which industries should be studied with a view to gauging their long-term requirements for telecommunications.

At the same time the usage made of non-telephone Post Office services in 1968/69 has been analysed (in terms of facilities) to see how industrial groupings compare in their use of telecommunications. This has enabled us to see how users vary in their employment of telex, Datel, radio-phone and closed-circuit television. Such information is a valuable input when studying the long-term needs for telecommunications. Our work will not overlook the field of internal communications within firms, nor the long-term trends in overseas communication generated by transnational companies.

In the 1980s an endless stream of technological possibilities affecting the telecommunications network pre-



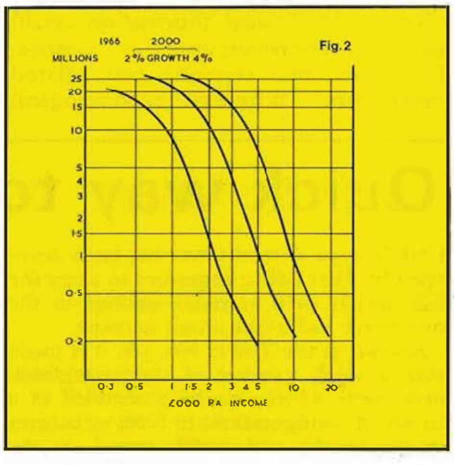


Fig. 1 shows forecasts of the Gross National Product (the total value of the country's goods and services) up to 1985, calculated at constant 1963 prices. The projections show the wealth available at different rates of growth, and from this a possible distribution of incomes can be calculated. Fig. 2 shows the actual distribution of incomes in 1966 and forecasts for the year 2000 at the annual growth in values shown. The forecasts assume no change in distribution pattern, and allows for population growth.

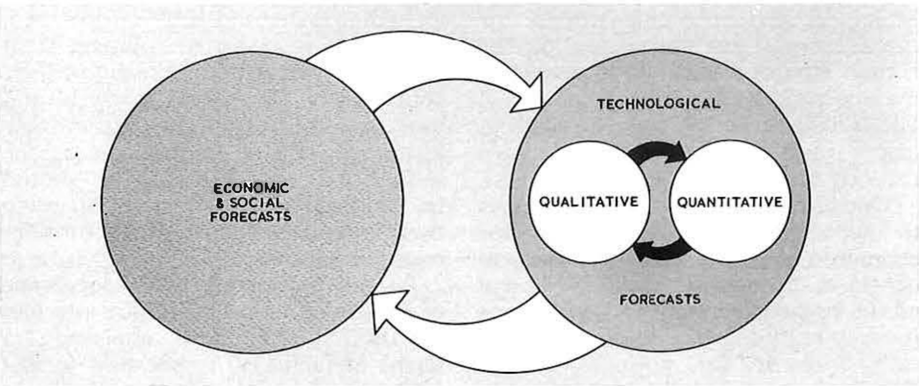


Fig. 3. Technological planning has to be harmonised with customer needs. This diagram by the Stamford Research Institute illustrates the relationship between socio-economic forecasts and technological forecasts.

sent themselves, looking, for all the world, like some electronic Pandora's box. These include Viewphone; cordless telephones; improved facsimile operating at high speed and at low cost, or perhaps with colour or with the facility for subscribers to superimpose their own "scribbles" as drawings are transmitted; stored programme controlled exchanges (with the ability to provide a wide range of new facilities); visual display units with light pen to transfer alpha numeric and diagrammatic information; a wider range of data and vision services; increased use of wideband household distribution systems for TV, sound and speech; national paging and radiophone services, etc. At this time, too, there will probably be a considerable volume of traffic on the telephone network between computers and people.

As has already been seen earlier, the time scales for the introduction of such new services are considerable. Having identified a possible new type of facility, what the Post Office needs to know is when demand is likely to justify its introduction, or alternatively when technological innovation could lead to improvements in service. These are two separate but related viewpoints. Whereas technological innovation is a service matter, forecasting demand requires careful judgement of the market. With change so often resisted by potential users we must take into account whether social attitudes can keep pace with technological advance. In one industry it has been found in practice to be unwise to introduce a new product in which the gap between technology and social attitudes formed within the prevailing economic framework exceeds 15 years.

What we must do is to harmonise technological planning with customer needs (Fig. 3). We have to decide how to maximise the benefits that telecommunications can bestow on our future society. The characteristic of telecommunications services offered by the Post Office is that they all share in their ability to save time compared with alternative means of communication. In the business field this is a matter of money. Some services, of course, are more economic to the user than others, and it is here that the problem of providing competition to other forms of communication arises (e.g. to transportation). As the long-range planner looks into the future he can see some of the new opportunities that are beckoning to the business; he knows, however, that in each instance a sound economic case has to be made out which it is hoped the passage of time will not diminish. The answers may well be elusive because one cannot methodically research the market for facilities that lie some 10-15 years away.

After Long Range Studies Division has done its homework in the technological and socio-economic field one can only put out signposts for the future and let those who are concerned with the shorter term consider the roads down which they will travel.

Going through my son's stamp collection the other day my eye caught sight of an envelope franked "first UK Aerial post Sp 9 1911 London". The letter was to an address in Notts and had travelled on the first stage of its journey from London to Windsor by air before continuing on to its destination which it reached on September 13 "early". Despite its imperfections, this service must have been regarded as a marvel in its time. Can we hope in our time to plan telecommunications that will not only arouse such interest but also effectively satisfy the demands of the next generation?

That is our challenge; it will not be met simply by thinking up new ways of using today's products, nor should we assume that the way society and business evolve will not undergo radical changes in the future, many of which may be initiated through the advent of new systems of information technology. The area of our work in long-range studies is almost limitless. We are quite sure, however, that to all worthwhile endeavours there has to be a beginning.

THE AUTHOR

Mr. L. L. Grey is Head of the LRS1 Branch of the Long Range Studies Division. He joined the Post Office in 1968 after 21 years as a telecommunications specialist in the Navy.

Quick way to build towers

A NEW type of steel tower has been developed by Post Office engineers to carry the dish aerials used at radio stations in the microwave radio-link trunk network.

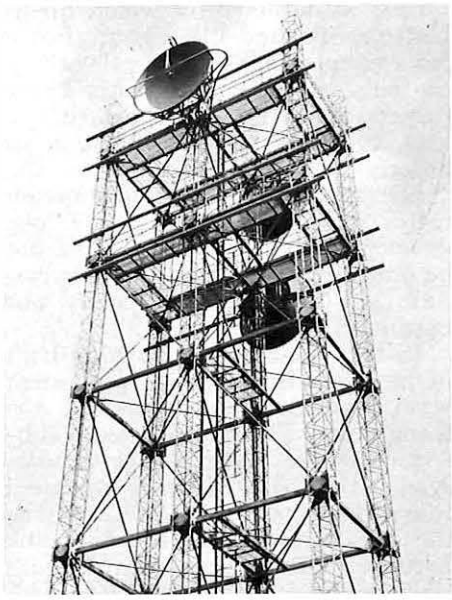
Known as the Tower No. 5A, it is made from a small number of interchangeable piece parts which can be assembled in a variety of configurations to form structures having height and width suited to the differing requirements at each station. The parts are suitable for stockpiling, enabling towers to be provided more quickly than those of conventional "Eiffel" type. These have a limited adaptability and 50 to 100 times the number of piece parts, making stockpiling uneconomic.

The new towers can support 12 ft. diameter aerial dishes at heights up to about 160 ft. and are especially suited to situations where many aerials are needed at lower heights. Where planning considerations permit, economy of capital investment is possible by providing initially only a part of the tower, adding more sections when traffic growth requires more aerials.

The first of the new towers has been built at Craiglockhart on the outskirts of Edinburgh. It is 110 ft. high and has capacity for 12 12 ft. dishes. At present only three aerials are fitted. Initially these new radio channels are required for Commonwealth Games communications.

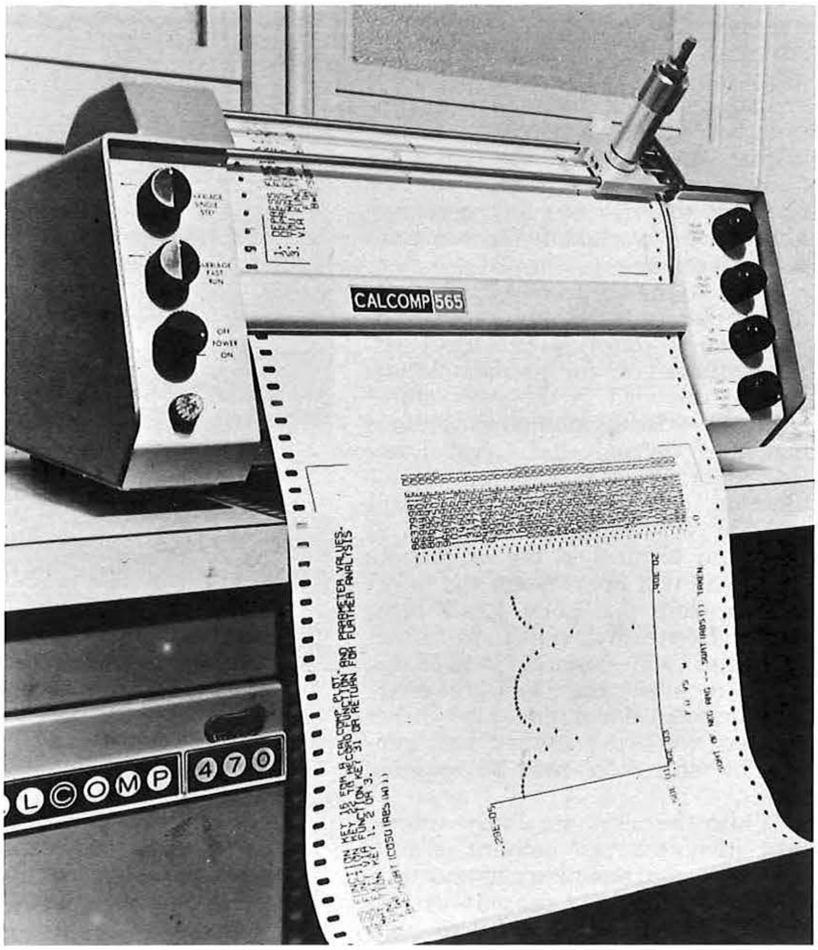
Further Towers 5A will be erected shortly at the following radio stations—Craigarrol Hill, near Dundee; Enoch Hill, near Portpatrick; Greenlowther Hill in Lanarkshire and Ballygomartin, near Belfast. A sixth has been planned for Cambret Hill in Kirkcudbrightshire.

The design has been approved by the Royal Fine Art Commission and its counterpart in Scotland.



One of the largest on-line computer systems in the country will maintain a constantly updated central record of all long-distance telecommunications plant.

3 million long-line records on demand



A graphical plotter similar to the one shown here is attached to the computer and will draw out main underground and cable junction diagrams. A complete diagram can be drawn in about 20 minutes compared with six hours by hand.

By B. CROSS

A £1 MILLION computer system is being developed by the Post Office to speed up the planning and provision of long-distance and local telecommunication services. The system is designed to maintain a central record of all inter-exchange plant in the country and, when fully developed in about three years time, it will estimate from traffic measurements the numbers of circuits required on each route. It will also design the circuits, route them, allocate the plant and print out detailed action instructions for dispatch to the offices concerned in setting up the circuits.

There will be on-line facilities—direct access to the central computer—for such purposes as updating of records and allocation of plant for new circuits. This direct link between the computer and Headquarters, Regional and Area offices will be provided through about 100 Visual Display Terminals on which the required information comes up on small television-like screens.

The most advanced of the studies leading to the implementation of the system are the Long Lines Computer Projects which involve two distinct operations—a Long Lines Utilization Project covering trunk and junction circuit planning, provision and utilization and a Long Lines Forecasting Project involving trunk and junction circuit traffic data capture and estimating. Eventually, local line planning and provision will be integrated to form an overall line plant control system.

Implementation of the Utilization Project, with which the remainder of this article deals, will bring benefits to the Telecommunications business in increased productivity and operational savings. There should be substantial savings from the ability of the computer to optimise plant utilization and plant planning, and productivity benefits when it takes over the routine tasks of record maintenance and circuit provision work.

Operational benefits arise mainly from the computer's ability to give speedy information to maintenance organisations dealing with breakdowns. Stand-by facilities or other measures can be brought into use more quickly, so improving the public service and at the same time cutting down on loss of revenue caused by the breakdowns. Calculations have been made to establish the minimum level of savings at which the project return on capital is maintained at the required Telecommunications business target of 10 per cent. It can be shown that even if all savings amount to only a tenth of those estimated it will still be profitable to continue the project.

The computer has been installed and is working. The Post Office Data Processing Service is responsible for system design and programming and overall implementation. For two years, until early 1968, most of the team was engaged on producing programs to give interim assistance to Headquarters branches and Regions in the general area of the study; there were also tests of the various procedures that would eventually be needed for the main project, for example automatic routing procedures and the plotting of cable diagrams by the computer. The full project team was not established until July 1968.

The main aim of the Utilization Project is to accept the annual schedules of circuit estimates (ASCE) together with random demands for private circuit facilities and process these to produce, as output, circuit orders for distribution to the field. In addition a complete up to date record has to be maintained within the computer, and a broad utilization pattern for several years ahead will also be produced. A large range of statistics will have to be available on demand

and special programs will be added as required. Full information on line plant usage, together with details of breakdowns and planned interruptions, will also be available for on-line display at Network Co-ordination Centres. The system will also be required to print out any necessary information in schedule form to assist these Centres.

Input to the Utilization Project will mainly be provided by the output from the Forecasting Project. Local line information for private circuits will be obtained in the Area offices either by existing manual procedures or, later, through the Local Lines Computer Project. The request for junction, and possibly trunk, plant will be forwarded to the Circuit Provision Control in the originating Area who will then obtain the information from the Long Lines computer. Eventually, the Local Lines computer will connect with Long Lines to avoid the need for intermediate manual handling. Many other projects are being studied and integration with these may be required later.

While the aims are fairly simple, they involve a vast amount of processing, record handling and updating. Also needed are procedures for changing over from manual to computer working. But staff in the Regions and Areas, although fully informed and consulted, should be only slightly involved in the early stages and left free to continue with the current heavy commitments of day to day work.

A rapid switch to computer working could cause severe problems because any project of this magnitude needs a considerable time for testing and parallel running to ensure the removal of errors. Even then there will always remain the possibility that occasional errors might cause failure. As a result it will be necessary to duplicate the computer equipment to ensure that faults do not cause lengthy breakdowns of service. Initially, of course, while the manual system is in parallel with the computer, duplication will be unnecessary.

Implementation will also have to be very carefully staged to ensure that the steps taken are not too large so that users never have to rely too heavily on the computer for their operations without adequate standby facilities whether by computer or staff.

By the end of this year, when Stage 1 of the implementation is due for completion, the following offices will be connected—National and all Regional Network Co-ordination Centres; London Telecommunications Region Circuit Provision Control (CPC); Network Programming Departments circuit provision offices and Area CPC in Cardiff, Chester, Bristol, Southampton, Belfast, Glasgow, Scotland West, Edinburgh, Manchester Central, Liverpool, Birmingham, West Midlands, Leicester, Nottingham, Colchester, Cambridge, Brighton, Reading, Leeds and Newcastle. Remaining Area CPC will be connected during Stage 2 due for completion at the end of 1971.

These units will provide Area and Regional offices with visual display access to the long lines computer.

Staff will be able to have displayed on the Visual Display Units any trunk or junction record by keying a simple request code. Amendments to these records will usually be made by keying in the basic design information for each circuit required. The computer will allocate the plant required for the circuit and update the pertinent records. This updating will, however, only be possible for Visual Display Units in the offices having control of the particular plant. By the completion of Stage 2 all records needed for the utilization and planning of trunk and junction plant will be held on the Long Lines computer and regularly updated in step with day-by-day and hour-by-hour changes in the offices concerned.

In Stage 1 programs will also be provided to enable the line plant allocation record for the whole trunk and junction network to be maintained by the computer. This record alone consists of over three million pair and channel entries, each of which has to be able to contain at least one complete circuit designation. Work on converting the record started three years ago and will not be completed for another one or two years. Other information available for computer processing during this stage will be a complete record of outstanding circuit work and a file of all circuits provided since the start of computer working. Stage 2 will extend the number of records to include all terminal exchange equipment records, transmission equipment records, circuit order records for all current circuits and a traffic and engineering route record. The total size of the records will then be over 500 million characters and will have cost nearly six years and £250,000 to collect and prepare.

Stage 3, intended for implementation in 1972–73, will cover introduction of the full facilities.

Network Programming Department, Regions and Areas will, therefore, soon have at their command the resources of one of the largest on-line computer systems in the country. As the project proceeds to full implementation considerable change will be made to the way circuit provision work is carried out. Very little manual record-keeping will be necessary and most of the staff will be concerned with the more complicated network problems; they will have little need to concern themselves with the details of plant allocation. Such changes must be introduced smoothly and to the complete satisfaction of the operational departments. This is the prime aim of the project staff.

THE AUTHOR

Mr. B. Cross joined the Post Office in 1949. Since 1960 he has been concerned with the application of computer techniques to line plant planning and provision. He was an Assistant Staff Engineer in Management Services Department until his appointment as Senior Chief Executive Officer in the recently formed Post Office Data Processing Service.

Keeping track of buried treasure

By G. R. SMITH

ABOUT £450 million of external engineering plant is used to provide Britain's local telephone network. Twelve million pairs of wires from exchanges to flexibility points and 15 million distribution pairs carrying over eight million exchange lines stretch out in a huge communications web covering just about every street in every town and village.

Keeping track of this buried treasure of Post Office assets is not only an outsize job, but a vital one if the local telephone network is to function as it should. Only by having an accurate records system available can the situation of a specific piece of plant be pin-pointed, its type and utilization identified, or possible improvements to the network recognised.

But the keeping of external plant records is now providing vexing problems. Because of the vast task involved, inaccuracies have crept into the system. Some people now believe that, on average, 20 per cent of all records held at Installation Controls are in some way incorrect. Others are more damning and put the error content even higher.

For the record, the problem is an international one. Foreign administrations have similar difficulties and many are having to face them on an even greater scale.

What is not always realised is that every single error in the records can quickly create an ever increasing vicious circle of wasted time and effort. At Installation Controls for example incorrect records can delay maintenance procedures and the provision of service. Responsibility for the errors does not necessarily lie with the officer who maintains the record, but possibly in the hands of the men who supply him with the information, such as maintenance gangs who change pairs without reference to the Routing and Records Officer or without subsequently forwarding an advice of pair diversion. Too often works construction parties fail to certify jointing schedules. Customers' telephone numbers are sometimes wrongly recorded and working circuits shown as spares. Mistakes can be expensive too if other service industries are given wrong information where roadworks are involved and, as a result, Post Office plant is damaged during excavation.

In a nutshell, what is required is the closest possible co-operation between record office staff and the men working in the field, with all following the correct procedures for the maintenance of records which are clearly set out in instructions.

In about a year's time, work will start on the switchover of the local line records to a computer system and it is now more essential than ever that these instructions are followed. A trial to determine the best methods of computer working has already started in the Cambridge Telephone Area. The computer will require much more information than exists in present day records, including a list of all addresses in the United Kingdom. There can be no question of feeding a highly expensive computer system with millions of items of information if a substantial percentage of them prove to be inaccurate. Although the field trials have already shown that many existing errors will be corrected during the manual transfer to the computer of distribution point information, and the computer itself by cross-checking will find others, a sustained effort will still be required before the new records are made sufficiently reliable for computer use.

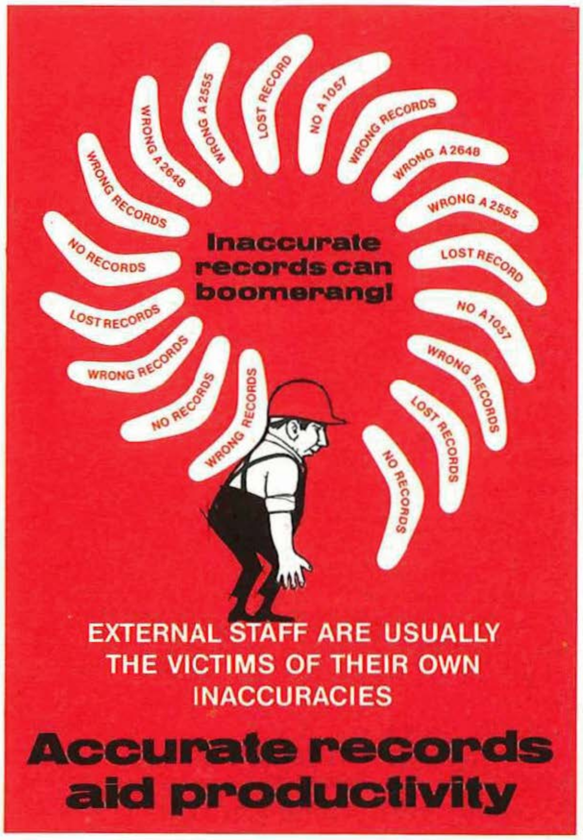
The greatest drawback to attaining the accuracy required is probably the fact that so many people are involved in the maintenance of records, increasing the risk of human error. There is also something of a psychological problem involved in getting staff to realise that the accurate recording of even the most minor of day-to-day jobs is important.

In an effort to drive home the urgency and necessity of keeping accurate records of external plant a campaign is now being launched throughout the Post Office to emphasise their importance. Special attention will be given to local line plant records at training colleges up and down the country, and it is hoped that more teaching time will be devoted to the subject. Posters and circulars will also be used to push home the message. It is a campaign which will have to succeed, and especially so if the computer system designed to speed up the processes of local line planning, control and utilization is not to be wasted.

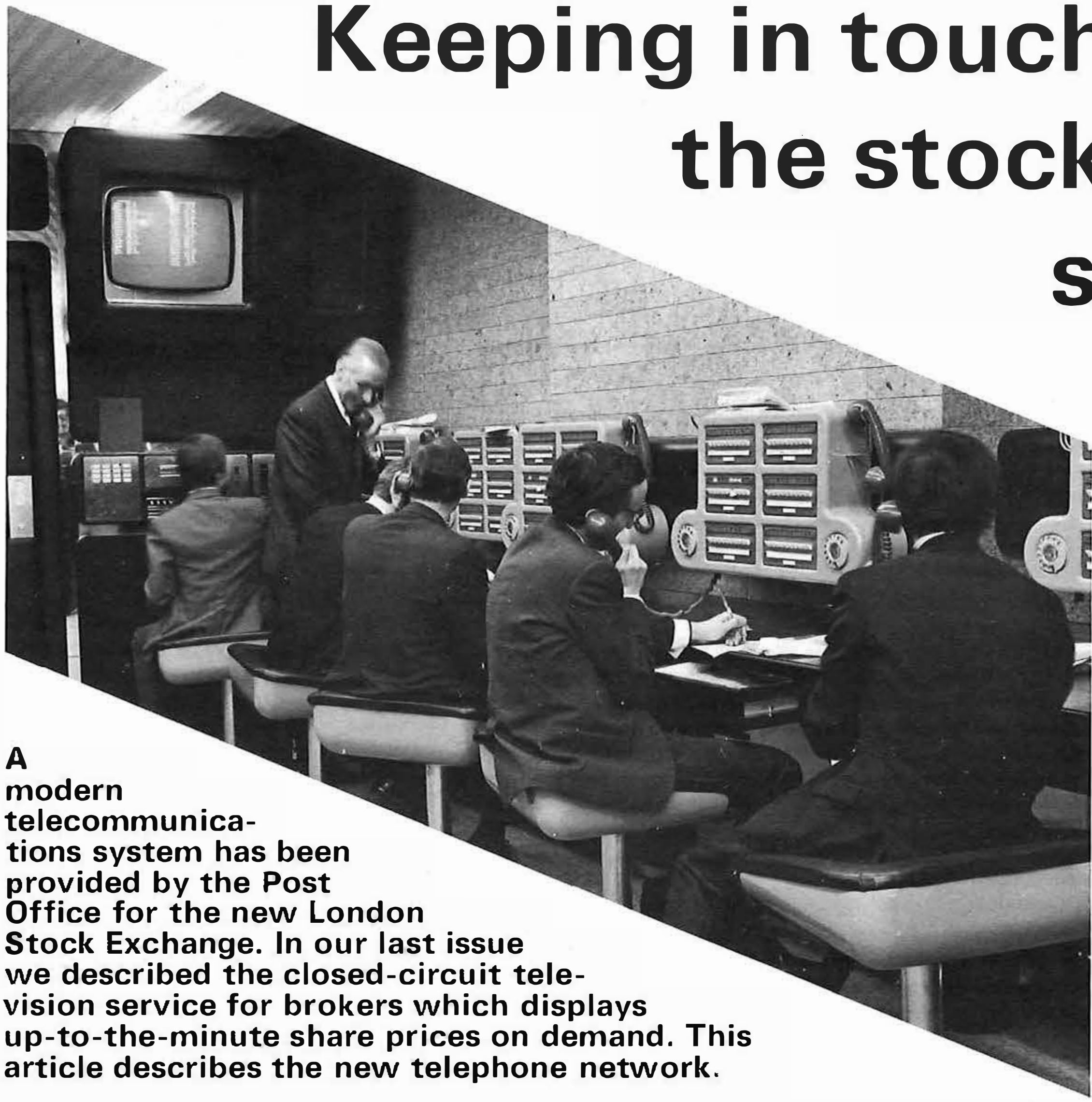
THE AUTHOR

Mr. G. R. Smith is an Executive Engineer in the Operational Programming Department of Telecommunications Headquarters engaged in the development of local line planning methods with particular regard to the recording techniques and procedures.

The poster reproduced on the right is just one of the aids being used in a campaign now being launched throughout the country to impress on staff the need for accurate external plant records. This need is now more urgent than ever with the impending switch of records for the Post Office's local lines network to a computer system.



Keeping in touch with the stocks and shares



LEFT: A broker's office in the Stock Exchange—known as a "box". The specially designed wall fitments house Post Office 10-line key and lamp units. The TV receiver links the "box" with the closed-circuit television network and displays the latest prices.

A modern telecommunications system has been provided by the Post Office for the new London Stock Exchange. In our last issue we described the closed-circuit television service for brokers which displays up-to-the-minute share prices on demand. This article describes the new telephone network.

ONE of the largest and most efficient private telecommunications systems in use anywhere in the world is now serving the London Stock Exchange. More than 6,000 telephones have been fitted and Stockbrokers' offices in the City re-equipped with modern switchboards and additional private circuits. The laying of the underground cables was the largest construction job ever carried out by the Post Office for a single customer. In the last two years alone London Telecommunications Region has spent more than a quarter of a million man hours on installation work.

Every effort was also made to "tailor" the system to the unique requirements of the Stock Exchange. For example, to cope with the extra-ordinarily high room-noise level associated with share-dealing activities, telephones on the "floor" of the Exchange have been provided with lamp signalling instead of bells and a special push-button cut-out reduces the transmission of background noise when the phones are in use.

A 600-channel "paging" system, installed for the Stock Exchange by the manufacturer, is used to get members to the telephone quickly. Each carries a multi-tone radio locater in his pocket which gives out "bleep" signals when he is wanted. The signals are set up by a colleague simply depressing a push-button on the wanted member's telephone. The signal then goes out over a wiring system installed in the Stock Exchange building and is picked up by the member's locater.

The telephone network links the offices of the 225 member firms with the main Stock Exchange building and with each other, and provides the main building with access to the public telephone network.

By J. D. HITCHCOCK

With the old system a large network of private circuits and external extensions had been built up over the years. Most of these lines were routed on tie cables radiating from a frame in Salisbury House, a building conveniently near Wood Street Telephone Exchange. A forecast of the growth likely to take place in the next 20 years in each exchange area through which these circuits passed justified laying cables directly from the new Stock Exchange to three telephone exchanges and to Salisbury House. The laying of these cables involved pulling in a 2000/4 PCUT cable to Wood Street Exchange, a 1600/4 to Moorgate Exchange, a 400/4 to Monument Exchange, a 1200/6½ to Salisbury House and a 1000/6½ to a manhole in Gresham Street to provide circuits for stockbroking firms in that area. Cables for the closed-circuit television and for the paging equipment were installed at the same time.

All external cables were brought into the Stock Exchange through a 24-way lead-in from a manhole constructed in Old Broad Street nearby. Eleven ways are already fully occupied and firm orders have been received for an additional 12 coaxial cables to be taken into the building for extensions to the closed-circuit television network. Concentration of other underground plant was so great that a tunnel had to be built leading away from the Stock Exchange manhole in both directions along Old Broad Street and Threadneedle Street. Nine-way ducts were laid in the tunnel to link up with existing routes. So that work could continue throughout the week, a shaft was sunk in the pavement outside the Royal Exchange for staff access and the removal of spoil.

At the centre of the system is a PABX 3 installed in the basement of the building with its three-position manual switchboard on the fifth floor. It gives access to the public network through 31 exchange lines and six "O" level circuits. The arrangement of extensions is not a standard one and has been designed specifically to meet stock market requirements.

The ultimate provision is for 3,100 extensions divided into two groups. The first, the "A" group, consists of 200 extensions for the use of administrative staff who have direct access to the public network from these extensions on a lamp-per-line basis. The second, the "S" group, has 2,900 extensions which are mainly external and are terminated at the switchboards of member firms who have offices in the vicinity of Throgmorton Street. While the users of these extensions may dial direct to any other extension in either group they are barred from access to the public exchange network. This barring facility is for accounting reasons and ensures that brokers and jobbers make their public network calls through the PBXs in their parent offices. The "A" group uses a conventional arrangement employing 50 point line finders together with 100 outlet group and final selectors. Equipment for "S" extensions follows public exchange practice and consists of uniselectors with access to 200 outlet first and second group selectors and 200 line finals.

A characteristic of Stock Exchange traffic is the extremely heavy calling-rate coupled with the short holding-time of the majority of calls. International crises also produce abnormal traffic surges. These have been catered for by providing a high-capacity exchange battery, float charged by means of a standard power plant. The Post Office supplied and installed all of the power equipment which is fed by two three-phase, 60 ampere electricity mains feeders.

A major part of the project was the equipping of the member-firms offices, traditionally called "boxes", on the "floor" of the Exchange. These employ "S" extensions connected to key and lamp units or single telephones. Altogether 1,900 10 and 20 line key and lamp units were installed, many fitted in furniture to members' own designs. Switching arrangements have been provided in many of the outside offices so that these extensions may be diverted through private circuits to the boxes during the day and to other premises after the Stock Exchange closes for business.

The transfer operation to the new system took place during the weekend 6 to 8 February this year. At close of business on the Friday afternoon engineers began to disconnect the power and to cut away the circuits to the old building. The operation had been prepared for by teeing existing cables at various points. A thorough testing programme covering every public and private circuit involved had also been carried out. Finally, each operation to be performed during the transfer had been scheduled together with the name of the man responsible for carrying it out. This was part of a detailed transfer plan based on public exchange transfer practice but far more complicated because of the large number of private circuits involved.

ABOVE: A few of the 6,000 telephones which have been installed being tried out by some of the LTR installation team.

RIGHT: Telephones in use during a busy day on the Stock Exchange "floor".

Throughout the Saturday and Sunday every circuit transferred was tested and the faults revealed were reported to a transfer fault control in the basement of the tower block. These were passed out to the appropriate staff to clear and then to report back. Arrangements had previously been made with many City firms to have their offices opened over the weekend for engineers to visit their switchboards to test lines. And before the transfer weekend a team of travelling supervisors had visited every member firm to explain the new system and advise on how to get the best results from it.

The objective set by the transfer team was to ensure that the stockbrokers opened for business on Monday morning in their new premises with a fault-free communications system. There were few faults not cleared by the time the market opened.

The completion on time of this huge project was, in part, due to the work of a City Area Project Team established in 1966. A Critical Path Method (CPM) network was constructed to programme both the telecommunications activities and the building work associated with them. Updated progress assessments, produced every five weeks by a computer, ensured that emphasis was placed on appropriate activities at the proper time. The final success, however, was due to the very close co-operation between the customers, the Post Office and the other contractors involved.

The provision of this huge communications network is only the first phase of the Stock Exchange project. Soon the work will start all over again. In the summer of 1972 the Exchange will make another move, this time to a permanent home to be built on the site of the original building. While the PABX will remain in its present position much of the equipment which has been installed will have to be taken out and provided all over again in the new building. Between then and now the Post Office will be hard at work, planning and installing, ready for this second move.

THE AUTHOR

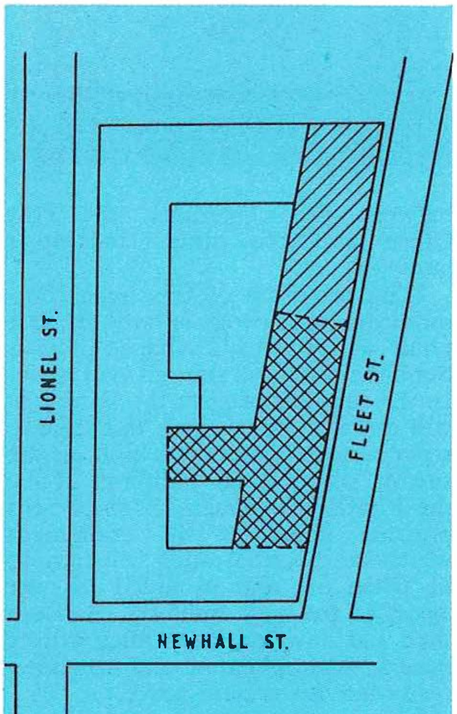
Mr. J. D. Hitchcock Deputy Telephone Manager, City Area, since August last year was primarily responsible for the transfer operation to the new Stock Exchange network and set up a special committee for this purpose. He was formerly Area Engineer, West Area, Deputy Telephone Manager, North Central Area, and also served in Telecommunications Headquarters and in Bedford.

ABOVE: Modern design and colourin

RIGHT: The 500-seat dining room dec
mural in the background adds a distin

ABOVE: Young telephonists enjoy the comfort of the powder room which has wall-to-wall carpeting and colourful furnishings.

Facelift at B



The diagram shows how the E-shape of the existing Telephone House (unshaded) was extended along Fleet Street to form a "square". The diagonally shaded section indicates the urgently needed accommodation which was built first. At the same time an extra floor was added to the whole of the existing building. The crossed shading represents the eight-storey tower block which completed the building operation.

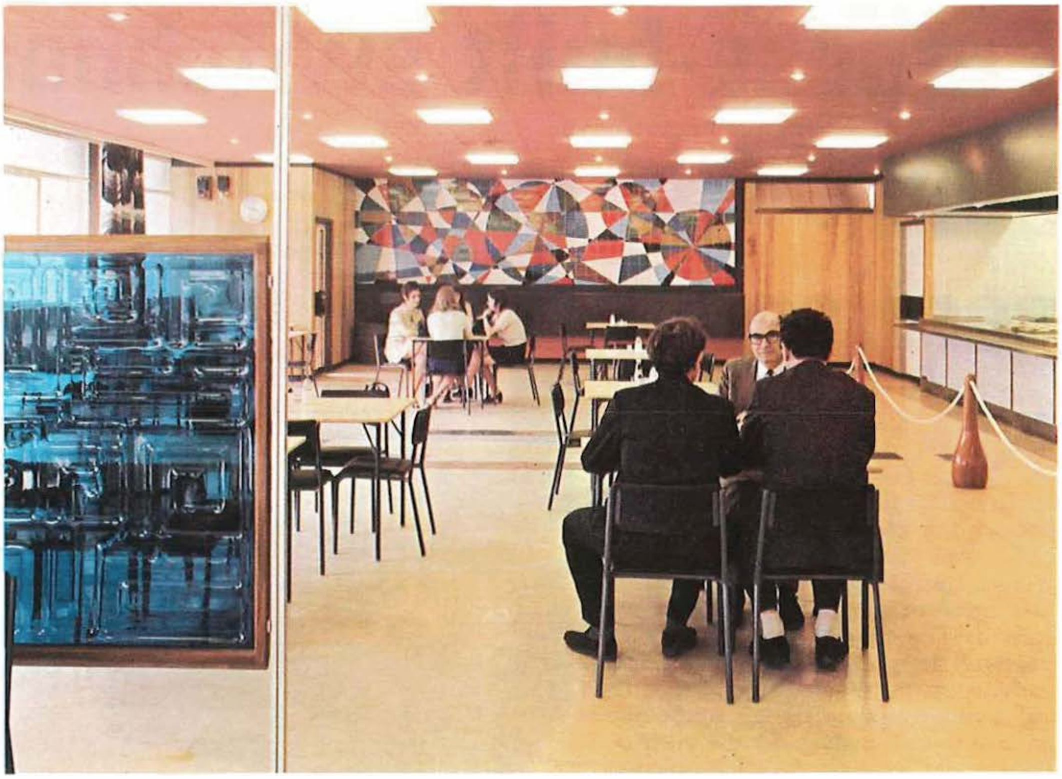
THE 33-year-old Telephone House in Birmingham has been having an extraordinary facelift. In a £1 million construction operation the roof has been ripped off, a new "floor" added to the top of the building and a major extension, including an eight-storey tower block added to the existing structure . . . all done while 1,500 staff got on with their everyday jobs.

The plan to construct new units and weld them to an operational building was imaginative but necessary. There was no suitable space in Birmingham's city centre to erect a new building to provide the additional space urgently needed to cope with the growth of the trunk units at Telephone House. In fact the extensions have almost doubled the floor space and will be sufficient to meet the expanding requirements of three trunk units, a Transit Switching Centre, two local exchanges, a telex exchange, HF and VF terminals, TV Switching Centre, a Directory Enquiry Bureau and an automanual switchboard as well as all ancillary equipment.

The task has presented many problems for staff. For four years they have had to put up with the clatter of hammers and drills, flooding on occasions, ventilation troubles when windows were boarded up and when outside walls were demolished masses of hardboard had to be erected to screen both staff and equipment from debris and dust. A variety of mishaps included the collapse of roof scaffolding which dropped tons of rubble down the main stairwell to the basement. But because of the safety precautions that have been taken no one has been injured. While, despite mishaps to equipment, there has been no serious breakdowns, there have been some minor impairments to service and the dust may bring problems in the future.

Staff, however, are having their reward with improved welfare facilities. A powder room has an attractive wallpaper, and liberal use is made of mirrors. There is wall-to-wall carpeting, stools in cream and brown and easy chairs in tangerine. A 500-seat staff restaurant is decorated in bold, fashionable colours and is served by a kitchen fitted with the latest equipment. There is a large carpeted lounge and a games room and drying room. A special-purposes room has been designed for the reception of visitors and for official functions.

Planning the job was complex. Telephone House had to be taken as a whole and the needs of all the units considered so that the best possible use could be made of the new building. The job has been done in two phases —first the building of a small block to meet urgent accommodation needs, and the second the building of the tower block and the additional floor.



ꞡ extends to the washrooms.

orated in a bold fashion. The
ctive touch.

Birmingham

The completion of some lower floors had to have priority so that urgently required exchange equipment could be moved in. To ensure that priorities were adhered to a Critical Path Analysis exercise was mounted.

Work began in July, 1966, with few problems for about 12 months. Noise from drills and excavating machines did create difficulty in the DQ Bureau but this was overcome by double-glazing the windows. By the middle of 1967 the major problems began to emerge mainly caused by night work—as much as possible was done after normal business hours—and the infiltration of water.

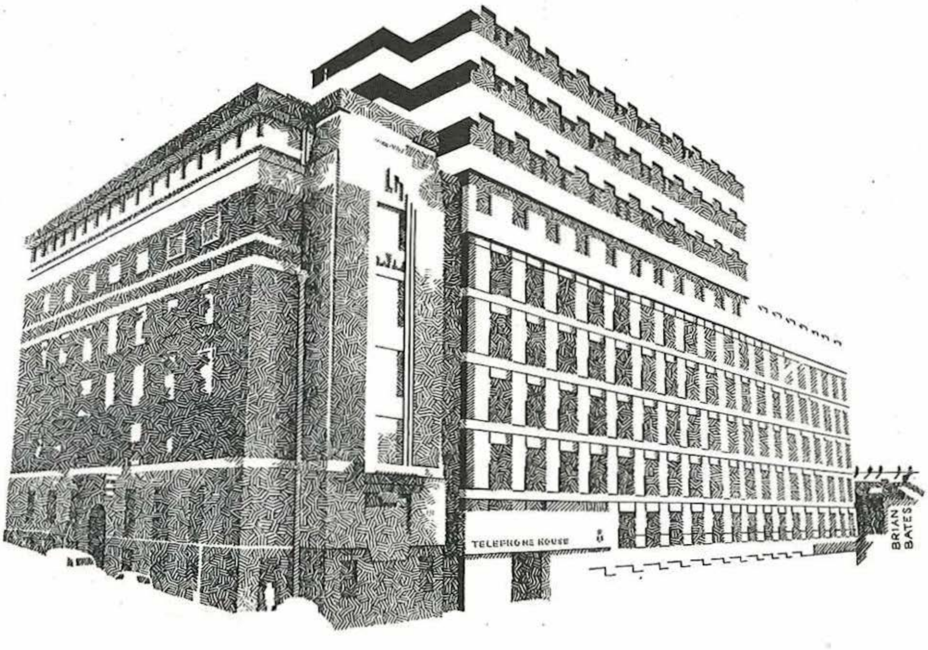
Construction of the new floor over the entire building needed a great deal of heavy demolition work above the switchroom which is normally operational 24 hours a day. Arrangements had therefore to be made to switch calls to Hill Street exchange about a mile away between midnight and 7 a.m.

After clearing the roof area, steel framework for the new floor had to be erected during the day. To protect staff, polythene sheeting was put up. Rainwater did leak into the building but arrangements made with the builders and Post Office cleaners avoided serious damage to equipment, furniture and fabrics.

Because the site was little larger than was required for the new buildings rubble had to be stored on the adjacent staff car park to allow scaffolding to be erected. Some of the scaffolding blocked the only approach to the apparatus doors and hoist and had to be specially adapted to allow access for vehicles.

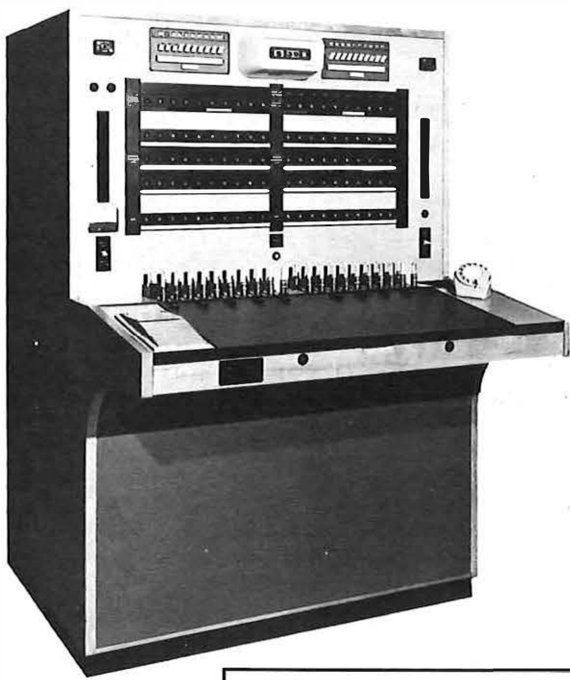
Most of the major work has now been done although modernisation of the old switchroom is still going on. Switchboards have already been lowered and a specially designed acoustic ceiling with built in ventilation facilities is being installed. A new colour scheme, modern lighting and fully carpeted floor will complete the "facelift" which will give telephonists exceptionally good working conditions. A new entrance and foyer has still to be designed.

The job has taken longer than planned. But that it has been achieved at all is perhaps remarkable . . . not least for the co-operation and goodwill of the entire staff who for so long have had to work in the most trying conditions.



An artist's impression of Telephone House, Birmingham, showing how the old and the new buildings are joined. On the left is part of the old block with an extra storey built on top. On the right is the new section, including the tower block.

Purpose-built switchboards for new data service



The Post Office's new high-speed data transmission service–Datel 48K–was described in our last issue. This article deals with the specially developed manual switchboard, pictured here, and the operating procedures used in the manually switched trial network.

By R. C. ADCOCK and M. J. BURGESS

NEW manual switchboards have been produced entirely by Post Office staff to interconnect at London, Birmingham and Manchester the group links of the Datel 48K trial network. Data will be transmitted between these city centres at a speed of 48,000 binary digits per second. The switchboards have been purpose designed and built because early estimates showed that to modify an existing standard design would not have reduced costs, and the restrictions could have produced problems.

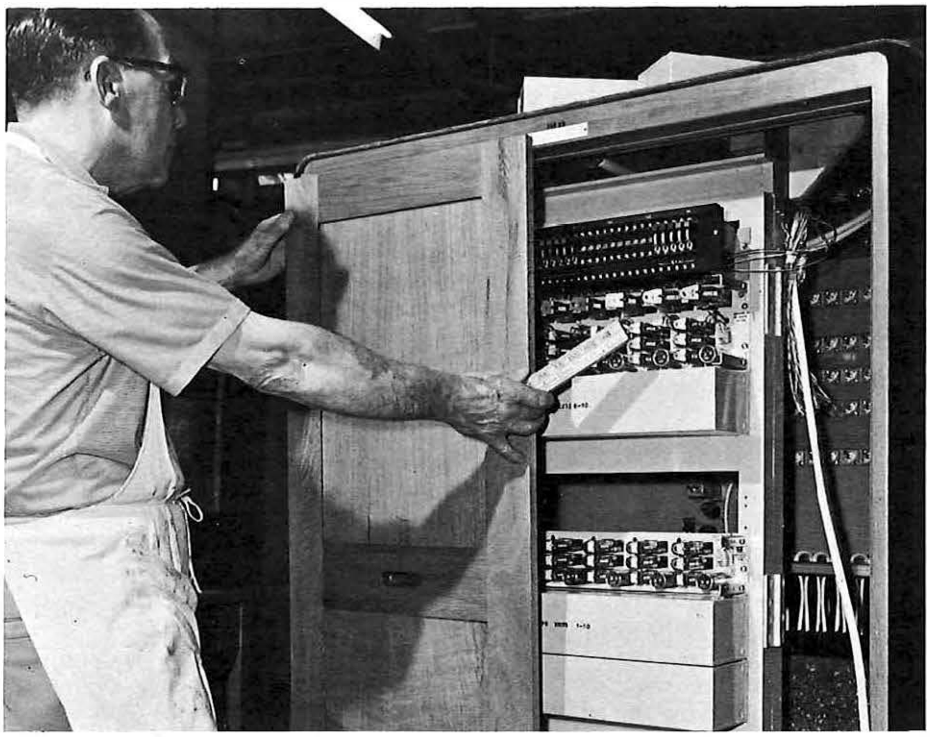
Involved in the work were Telecommunications Development Department, who specified the facilities required in consultation with Network Planning and Service Departments, and staff at the Post Office factory at Enfield who undertook functional design and manufacture. Inevitably, unforeseen problems cropped up, but they were overcome without delay to the target completion date. Full testing of the switchboards was carried out by the Factories Department inspection test team and delivery made to the three Regions by the beginning of August last year.

Intended for installation in manual switchrooms, the new switchboards conform as far as possible to agreed design standards. Differences are the use of coaxial cable for the switchboard cords—this was in fact the major hurdle—and the width. Because each circuit requires two appearances for four-wire operation the new switchboard is nearly half as wide again as standard designs. This was worrying from the point of view of ease of operation, but after experimenting with a mock-up model the extra width was found to be satisfactory. Other minor difficulties such as the best positioning of the clocks and the minimum spacing required between the "plugs" and "jacks" were also solved by the use of the mock-up.

The new switchboards have a capacity for termination of up to 10 trunk (inter-switchboard group links) and 30 customer circuits (connexion between customers' premises and switchboard). Because of the facility requirement for simultaneous both-way data transmission a four-wire system is used as against the two-wire circuit which is sufficient for speech transmission and employed on conventional boards. As a result separate connexion of the two directions of transmission is necessary. For this reason the new switchboard is divided vertically into two halves—incoming customer local circuits are associated with outgoing group links on one side and out-going customer local circuits with incoming group links on the other.

The necessity to use coaxial cable cords created a problem because normally cords are of a flexible braided construction with a tension member to take the strain when they return under force from weights. Similar construction is not available in coaxial cable and a degree of compromise was necessary. Operationally, it is important that the cords can be used as far as possible in the same way as on a conventional switchboard. To allow this, a cord

The new switchboard being constructed at the Post Office factory, Enfield.



weight system had to be devised which did not apply dynamic stress to the coaxial cable termination—a factor which could have resulted in their early failure.

The mock-up model helped to solve this problem too. The double-ended cords necessary for the four-wire circuit are securely fixed at their centres with one weight running on each half of a cord. The important feature of the design is that when cords return under force from the weights, the weights reach the bottom of the cord weight chamber before the termination protecting sleeves bottom in the recessed desk apertures. To achieve this, rubber shims are placed under the cord weights to give a half-inch free play at both ends of the cord.

Various coaxial connectors were considered, but a PO coaxial socket No. 1 with special protecting sleeve provided the best answer. This resembles a conventional switchboard plug and is straightforward to use. Terminology presents a problem here. Normally sockets are mounted on the switchboard and plugs terminate the cords, whereas the converse applies to the 48 kbit/s switchboard and sockets terminate the cords. For operational purposes it has been decided to refer to the coaxial sockets as "plugs" and the coaxial plugs as "jacks".

A cord tester is provided on the switchboard for engineers' use. Short circuits, disconnexions and intermittent high resistance terminations can be detected. Although supervisory circuitry has not been developed for the 48 kHz group circuits, provision is made to light a red alarm lamp for each incoming group link on failure of its group reference pilot (GRP). This facility will not operate initially and awaits the availability of equipment for 104.08 kHz group reference pilot. The present national standard GRP of 84.08 kHz cannot be used on a 48 kHz data group on account of mid band interference and 104.08 kHz falls outside the band used for data.

For call timing purposes a mains frequency synchronous clock with digital display is provided, from which the operator will record the time at the start and finish of a call. Back up comes from a pulse driven PO clock No. 72A which will be used in the event of a main clock failure.

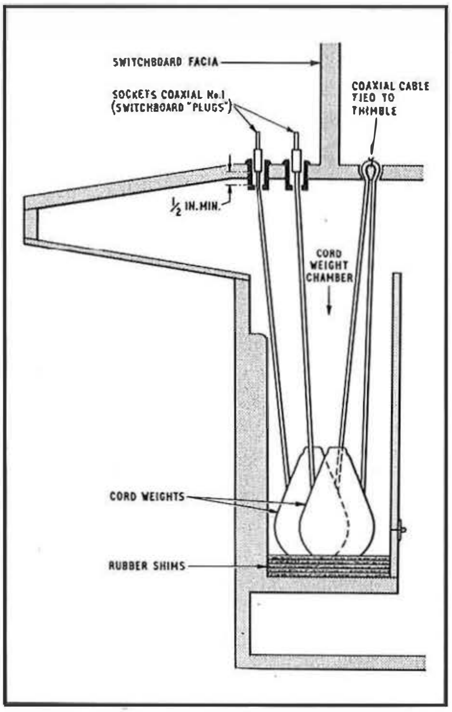
For operation of the switchboards, call control speech facilities are necessary both between operators and from operator to customer. These are provided by key and lamp units No. 2A with associated equipment—some design modification was necessary—initially to terminate on each switchboard six direct exchange lines, one private wire to the local Datel Test Centre, and one private wire to each of the other two switching centres.

The switchboards will be staffed by telephonists and are located in telephone switchrooms in the London Howland Street, Birmingham Telephone House and Manchester Cathedral Exchange buildings. Service will be offered on a 24-hour basis with all calls being booked in advance for a stated duration. Initially, only one operational group link will be provided between each of the switchboards and a comprehensive booking procedure has been devised to prevent "double booking" the trunk circuits from both ends for the same period whilst also ensuring optimum utilisation of the circuit. Calls will be booked with the "local" operator (who will thereafter control the call) via the public telephone network circuits terminated on the switchboard. Communication between operators in connection with bookings, setting up and clearance of calls will be via inter-switchboard speech circuits.

Shortly before the call commencement time the controlling operator will set up the connexion between the customers circuit and the appropriate trunk circuit using two double-ended cords and four jacks—the transmit and receive channels for each circuit require a separate jack. She will then ask the distant operator to connect the other end of the trunk circuit to the called customer's circuit using a similar connecting procedure. At this stage the controlling operator will contact the calling customer, using the public telephone network, to advise that the connexion has been set up; the customer will be asked to confirm that the transmission is satisfactory so that the call can be timed ON. Towards the end of the booked period the controlling operator will contact the calling customer via the public telephone network and advise that she will shortly be clearing the call. If the customer requests extra time this may be allowed subject to the trunk circuit availability, otherwise the call will be cleared on time and the distant operator asked to clear her connexion.

Since there are no supervisory or monitor facilities available on the data circuits the operator must rely implicitly upon the customer's confirmation of satisfactory transmission before timing the call ON and similarly must not automatically clear the connexion without first having warned the customer that cleardown is imminent.

Although the switchboard has been primarily designed for connexion of trunk calls, local call facilities between two customers served by the same switchboard will be offered. Provision has also been made to interconnect any two switchboards via the third one in the event of a trunk route failure between two of the switchboards. Initially the service will open with about six customer terminals in London, three in Birmingham and five in Manchester.



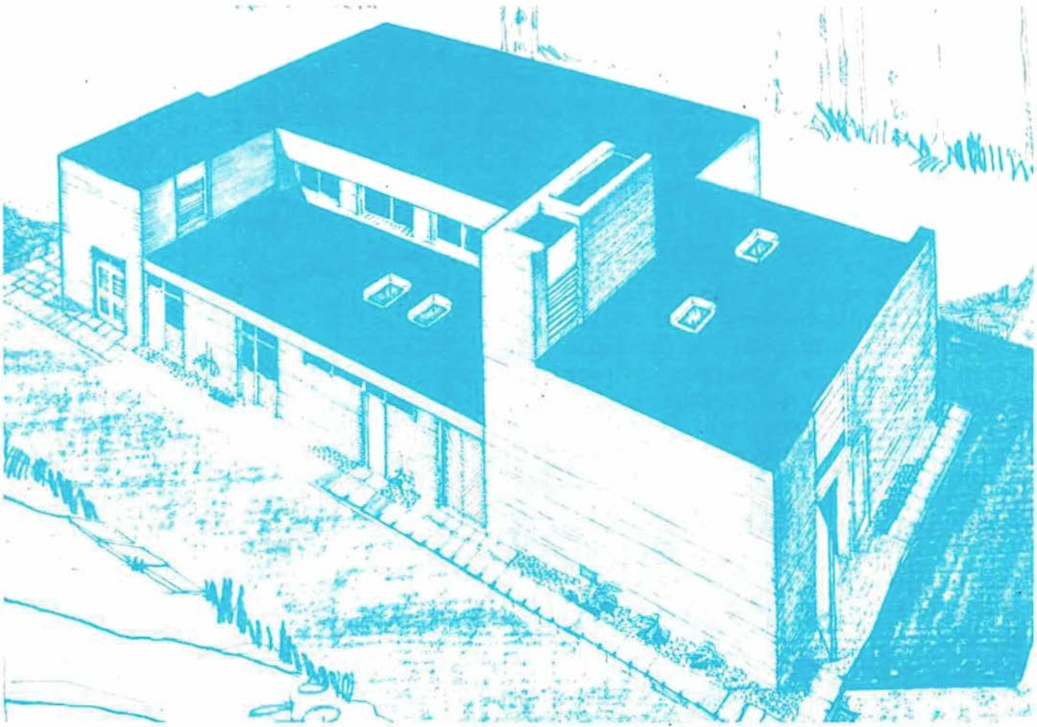
A diagram of the cord weighting system.

A technician tests the switchboard at the Enfield factory.

THE AUTHORS

Mr. R. C. Adcock is an Assistant Executive Engineer in Line and Radio branch of Telecommunications Development Department. Since 1965 he has been concerned with circuit transmission standards for data transmission and was responsible for the technical development of the switchboard while acting as Executive Engineer. He is now working on the development of television equipment.

Mr. M. J. Burgess is a Senior Telecommunications Superintendent in the Data Communications Division of Marketing Department and was previously with Service Department. He was responsible for the operational design aspects of the switchboard and development of the operating procedures.



This is an artist's impression of the new standard design for single-storey telephone exchange buildings—the M range—which will shortly be seen in many parts of the country. The design can be adapted for varying widths in the apparatus room.

New design for telephone exchanges

By
C. P. HIGGINS
and
E. W. F. SPRATLEY

IN recent years a major effort has been directed towards achieving speed in the planning and construction of a large number of small and medium-size telephone exchange buildings. It has been found that the use of a standard design for a number of buildings has the advantage of reducing the time and effort spent on individual projects and provides an opportunity for bulk buying with more direct cost control.

Standard designs have been used for very small exchanges (unit automatic exchanges) since the early 1930s, but it was not until 1961 that one was introduced for non-director equipment. The design became known as the H-type and it accommodated up to 2,000 lines in the initial building. Since then a variety of standard ATEs have been designed to meet various operational requirements and site conditions. Development, however, is a continuous process in both telecommunications equipment and building technology, and it became apparent in 1965 that there were a number of improvements required to the design of the existing single-storey standard buildings which could not be met simply by their amendment. These requirements, which are examined in the following paragraphs, formed the basis for the new approach necessary to meet the needs of telecommunications in the early '70s and to provide the most economic types of buildings to meet them.

The present single-storey standard building comprises three main compartments: a room to house the equipment, one for the power to operate the equipment and the remainder for staff welfare. The Power and Battery room is quite adequate for Strowger and Crossbar equipment, but is not large enough for electronic equipment if the full potential of the exchange is to be realised.

The cable lead-in arrangement has also been identified as in need of further development. The cable trench is initially expensive, often requires deep excavation under adverse weather conditions and is time-consuming in its construction.

Analysis of the activities carried out in the apparatus room shows advantages in separating the main distribution frame and test desk from the apparatus room. Under normal operational conditions the number of staff who would need to enter the apparatus room would be greatly reduced and consequently there would be less dust intrusion. The test desk operator also benefits by being outside the apparatus room in a much quieter environment.

The need for a building design to fit into its surrounding environment has to be considered in the light of new circumstances. Because of the need to accommodate equipment racks and cabling, the height of apparatus rooms is greater than that of rooms in many other buildings, and the overall height of a small telephone exchange has always been a contentious issue with County Planning Authorities as the buildings are often out of scale with adjacent properties in rural areas. The Post Office as a Government department was exempt from the mandatory planning requirements, but the Ministry of Public Building and Works consulted the Planning Authority and general agreement was usually arrived at. However, with corporation status, the Post Office is no longer exempt from the Town and Country Planning Acts.

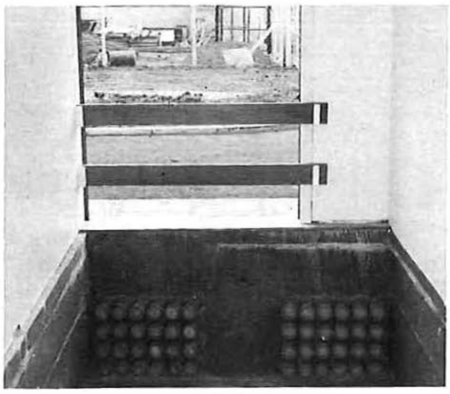
The use of industrialised building techniques, in which the major components are prefabricated, is desirable to ensure quality control of components and reduced construction time. However, to fully realise the economic potential of industrialised building, the whole operation of building construction and the provision of its equipment has to be considered as one continuous process.

All these revised user requirements were considered when a new design for single-storey ATEs was prepared and the result was a prototype exchange at Toddington near Luton. The new range is known as the M type and construction of the production buildings has started. The prototype developments are being included in the standard with additions where further development has occurred since the prototype was built.

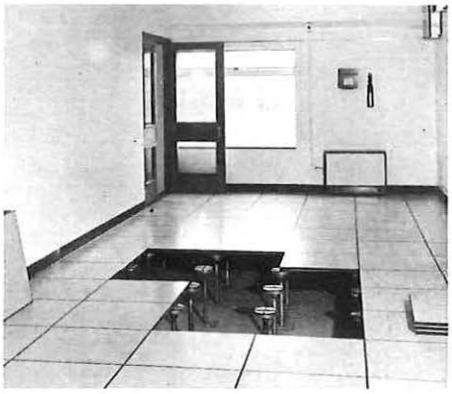
The industrial building system adopted for the prototype was the CLASP (Consortium of Local Authorities Special Programme) which uses a steel frame and concrete external cladding panels. However, the standard buildings have been designed in the SEAC (South Eastern Architects Collaboration) system which has a wider field of application to telecommunications building and uses load-bearing brick construction to make the buildings more acceptable to local planning authorities and within the capability of the small builder.

The brief for the M type range of standard designs required three widths of apparatus room to allow a greater freedom of site choice. The clear widths of apparatus room are 26 ft., 36 ft. and 44 ft. which were chosen to accommodate equipment suite lengths of 18 ft., 27 ft. and 36 ft. For easy reference these three variations of design are known as the M26, M36 and M44. The two larger variants also have larger power and battery rooms, and the main distribution frame room reflects the width of the apparatus room. The length of apparatus room is divided into 12 ft. bays and may be from four to seven bays. There are separate construction room and contractors' room enclosures in the M36 and M44. The remaining accommodation for welfare, normal stock, fan room and cable turning chamber is identical in all three design variants.

A novel feature is the development for the lead-in and cable distribution in the main distribution frame room which reduces the volume of excavation to a minimum. The excavation has a maximum depth of 4 ft. 6 in. which will accommodate a 48-way lead-in, and the cable turning chamber has been designed to allow the lead-in either from the front of the building, with the duct way under the power room, or from the side of the building. The main distribution frame is carried on a false floor, 18 in. above the normal ground floor, and the cables are provided with gas seals and broken down for connection to the main distribution frame in the void beneath. The false floor consists of a number of interchangeable 2 ft. square pvc-faced plywood panels, supported at their corners on steel pedestals. The panels under the main distribution frame are provided with holes for the cable to pass through. The cable turning chamber in the standard building is covered at the same level as the false floor of the main distribution frame room, and again covers and supports can easily be removed to give unimpeded space for cabling.



The 48-way lead-in at the prototype building at Toddington. This method reduces the excavation to a maximum depth of 4ft. 6in.



The raised false floor in the main distribution frame room at Toddington with some of the covers removed to show the void in which cables are connected.

To cater for those buildings which will be equipped with electronic apparatus a ducted ventilation system will be incorporated in place of the small ventilating units used in the earlier standard buildings. This will give complete flexibility so that any type of apparatus may be used when equipping the buildings in the range. The heating and ventilation of the apparatus room will be combined into one system by a distribution of ducts at ceiling level allowing filtered air to be passed at a controlled temperature. Window sizes have been designed to give adequate light to the main and secondary gangways, but not too large so that summer solar heat gains are a nuisance.

Most of these buildings will need to be increased in size during their life, and an interesting feature of the apparatus room and power and battery room which was not in the prototype is the introduction of double skins to temporary end walls. This has been designed to allow the inner skin to remain in position as a dust and thermal barrier while the outer skin is removed, allowing the extension to be made without disturbing the operational efficiency of the exchange. The inner skin can also easily be dismantled on completion and is so constructed that it will not create dust while being dismantled.

Work is now going ahead on the

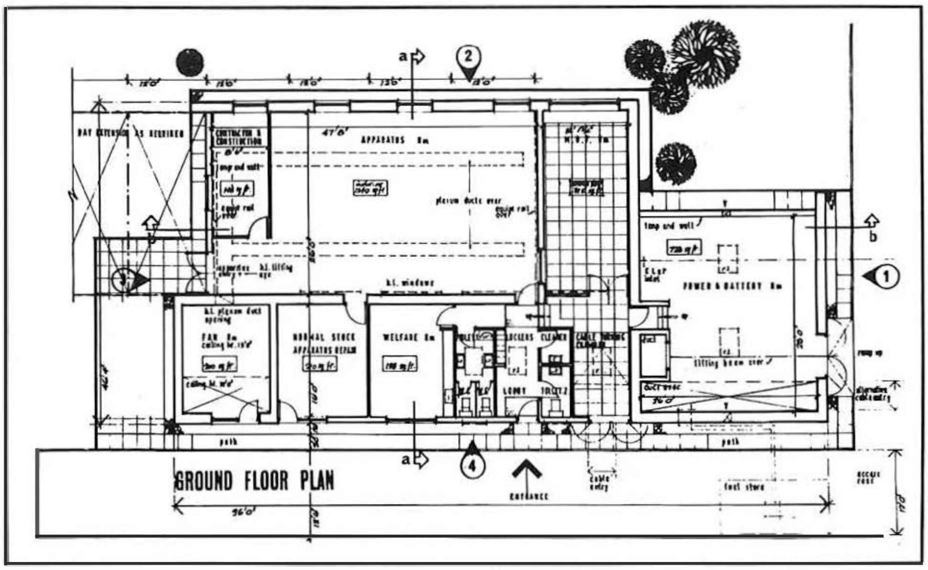
THE Post Office is spending about £50 million on more than 300 telecommunications building projects each year. The majority of these are new telephone exchange buildings, but the work also includes extensions to existing exchanges, new telephone engineering centres, motor transport workshops and miscellaneous buildings. It is clearly important that the buildings should be operationally efficient, economical in cost and ready when required, and to help achieve these aims the Joint Post Office/Ministry of Public Building and Works Research and Development Group was set up in 1957. The Group consists of a small number of Post Office professional and operational officers and MPBW professional and technical staff working together as teams.

Until August last year the Post Office staff of the Group was part of the Buildings and Welfare Department of Central Headquarters, but responsibility for work in connection with postal buildings is now vested in PHQ and that for telecommunications buildings with THQ, in close association with the sections responsible for Accommodation Standards and Services. The group dealing with telecommunications buildings is now known as the Joint PO/MPBW Telecommunications Accommodation Research and Development Group (TARDG).

The programme of work for telecommunications buildings is controlled by a joint directing group composed of THQ Directors, the MPBW Director of Building Development, Managers for Post Office services and other senior officers and is chaired by the Director of Operational Programming.

MPBW staff in TARDG are members of the Ministry's central research and development organisation which serves Central Government clients as well as extensive national interests, including the collection and interpretation of building information, the promotion of new and faster ways of building and improvements in building management technique.

TARDG activities cover a wide field, including investigating the suitability of industrialised building systems for telecommunications projects to increase the speed of building, and providing cost control information and guidance on efficient planning of accommodation to achieve economical and efficient buildings.



The ground floor plan of the M26 building

design of new telephone exchange buildings to meet the building industry's change to metric and new Post Office requirements; it is hoped to introduce them as standard buildings during 1972.

The development of the single-storey M range has paved the way for the new two-storey standard buildings, in metric, to replace the existing K.2.1, K.2.2 and K.1.1 range. These new standard designs will be known as the N range and will be particularly suitable where narrow fronted sites have been bought. They will incorporate maximum flexibility for apparatus room and power room extendability. The design is only in its early stages of development, but the general arrangement of rooms is beginning to crystallise. The proposals are for the power and battery room and the main distribution frame with its cable turning chamber to be parallel with each other on the ground floor, and both capable of being extended towards the rear boundary of the site. The upper floor will contain the welfare facilities to the front of the building, and the apparatus room at the rear will also have extension facilities. This extension, however, can be at first floor or first and ground floor if no or only limited extension is required to the power and battery room and M.D.F. room.

A single-storey standard to be known as the P range will be based quite closely on the M design, but with modifications to cater for changes in policy for packaged engine sets and modular power plant.

This has been a brief account of the work of the Telecommunications Accommodation Research and Development Group on standard telephone exchanges. Although these buildings never make the headlines as prestige projects, they do form an important part of the telecommunications network, with an annual programme approaching a hundred such buildings representing an expenditure in excess of £2 million.

THE AUTHORS

Mr. E. W. F. Spratley is an Assistant Staff Engineer in the Post Office element of the Telecommunications Accommodation Research and Development Group (TARDG). He joined the Post Office in 1926 and has worked in telecommunications training schools and in Canterbury and Norwich telephone areas.

Mr. C. P. Higgins is a Senior Architect for the Ministry of Public Building and Works and was until recently a member of TARDG. He spent three years working on telecommunications building projects.

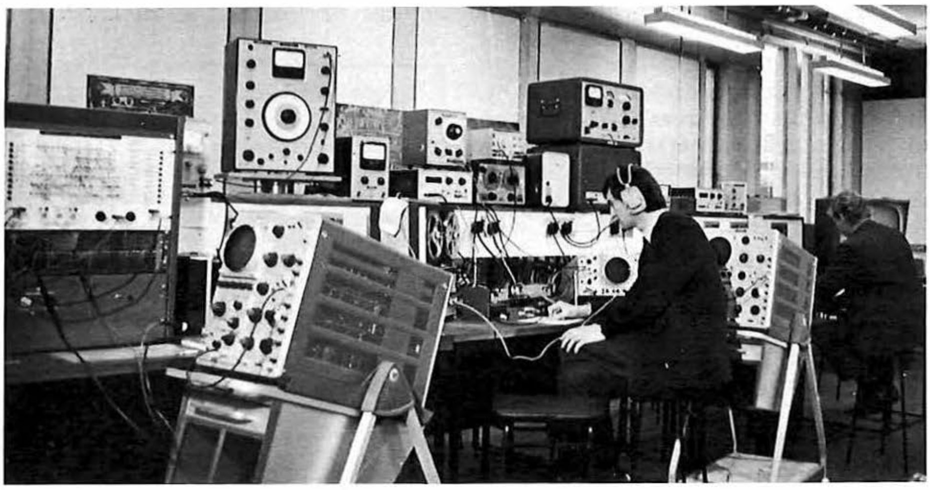
Telecommunications research at Essex University

MORE than 100 visitors, a large proportion of them from the Post Office, attended the first Telecommunications Open Day to be held by the University of Essex. The University is one of the few to make a feature of telecommunications engineering. Its work has considerable support from the Post Office which has endowed a Chair in Telecommunications Systems for 10 years at a cost of more than £100,000.

Essex offers a postgraduate course in telecommunications systems and its major research activity is in switching systems.

The first research project of the Telecommunications Systems Group of the University was set up in 1967 and concerned stored program control of exchanges —the control of switching systems by a computer with an explicitly stored program of instructions. The initial task was the development of a high-level, telecommunications-oriented programming language (TPL) which would simplify programming, but utilise storage space and processor time with reasonable efficiency. The Post Office has made a research grant for this work.

The present phase is the evaluation of TPL under realistic conditions, using as a test vehicle a small program-controlled crossbar exchange now under construction



The telecommunications laboratory at Essex.

in the University laboratory. Associated projects cover the comparative evaluation of different approaches to the control of switched networks, and the design of scheduling systems for stored program control exchanges.

Other research projects are, so far, on a smaller scale, but the University hopes to build up several now in an exploratory stage. These include optical telecommunications (in which the aim is to prove the feasibility of a large switching/multiplexing centre for wideband signals such as Viewphone); propagation aspects of satellite and radio communications (using 2 GHz radio link equipment provided by the Post Office); digital transmission on cable; and Viewphone (under the direction of a member of staff who has worked on the development of similar equipment in the United States).

Powerful computing facilities back up this research. Standard Telephones and Cables Ltd. has donated an ADX8300 computer installation and the Telecommunications System Group has bought a Honeywell 316 computer which will be dedicated to real-time usage. The Group also has access to the PDP9 computer owned by the Department of Electrical Engineering Science of which it forms a part.

Equipment undergoing field trials at Truro in Cornwall and at Carlisle will, if successful, enable Post Office engineers to find the cause of faults in customers' lines earlier than before, and so put them right more quickly.

Testing lines by remote control

By A. G. PRESTON

TO give a prompt and efficient repair service the Post Office employs a comprehensive system of testing customers' lines and apparatus from Repair Service Controls (RSC) of which there are about 400 situated in the larger towns in the United Kingdom. Although the test system is simple and effective there have always been restrictions on the distance over which tests could be conducted.

Generally, because tests are conducted over physical pairs of wires, only remote exchanges up to 15 miles away can be tested from RSC test desks. Some new equipment being tested at Truro and Carlisle can reach out beyond this limit to remote exchanges within an RSC area.

The new equipment consists of a central control console and a lamp display unit at a RSC and a test unit situated in a remote exchange. Remotely controlled by an engineer at a RSC, the equipment makes the same tests as are normally carried out from RSC test desks, but uses the public trunk and junction network, avoiding the cost of line plant reserved exclusively for test purposes. From the control console it is possible therefore to gain access to the test unit in a remote exchange simply by giving the unit a number in the numbering scheme of the exchange.

The tests are carried out at the remote exchange and the results come back in binary data form over a return signalling path and are indicated on lamps on the control console. Although loop disconnect pulsing is used to set up the connexion to the remote test unit, further commands to it and the transmission of test results back to the control console use Datel 200 transmission.

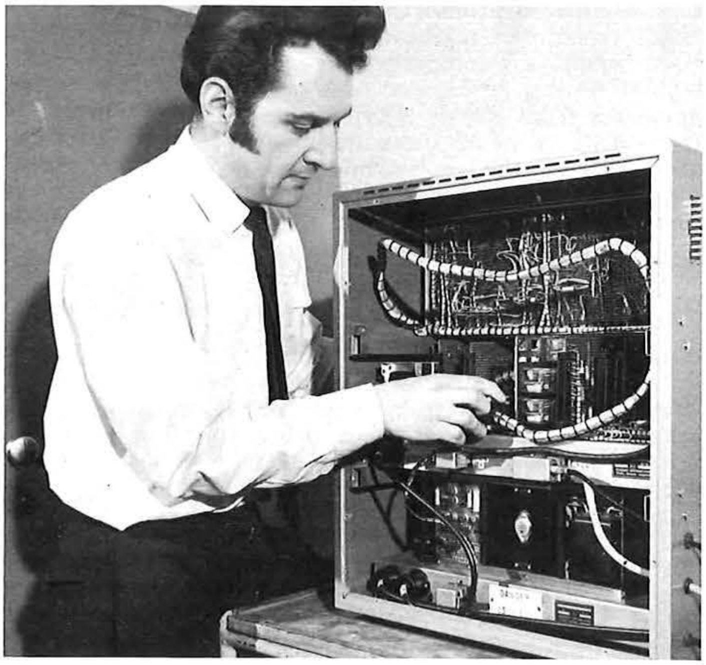
Once connexion to the remote unit is established a datel modem at the controlling end is switched into circuit and is detected by the test unit which switches its own modem into circuit. The dial pulses corresponding to the subscriber's multiple number are now transmitted as datel signals. These are converted back into loop-disconnect pulses by the remote test unit to step the test selector. The remote test unit will now be connected to the customer's line and the line condition (free, engaged, etc.) will be detected and transmitted back to the control console. If the line is free the tests can be carried out, but if engaged it is usually necessary to monitor on the line. The modems at each end are disconnected for this purpose for 10 seconds during which time the engineer may listen or speak to the customer.

The tests fall into two groups, depending upon whether or not customer co-operation is required. The tests made without his co-operation are—insulation to earth and between the wires of his pair, contact with "foreign" potential (battery contact), disconnexion test and calling equipment test. Customer co-operation is required for calling loop resistance (exclusive line and shared service line), rectifier reverse resistance on shared service, dial speed and pulse ratio test.

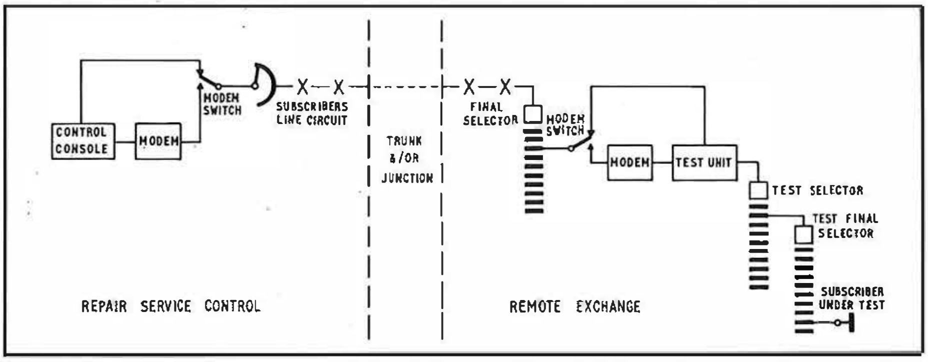
A prototype of the control console in use at Truro. The results of the tests are indicated on the lamp display unit.

Insulation is measured by supplying a constant voltage to the insulation resistance via a reference resistor. The voltage developed across this resistor is used to control the frequency of a multi-vibrator, pulses from which are counted over a fixed-time interval. The results are sent back to the control console on which lamp signals show whether the insulation is less or greater than preset limits.

The disconnexion test is made by detecting whether the comparatively large capacitor in the telephone instrument is in circuit. This is done by charging the line and instrument capacitor from a constant voltage source. A known capacitor is then switched into circuit after the voltage source has been removed. Redistribution of the original charge then



RIGHT: **Mr. Alan Jackson, Assistant Executive Engineer at Telecommunications Headquarters, makes a final check on a test unit before it is dispatched to Carlisle for field trials.**



BELOW: **A schematic diagram of remote testing equipment.**

takes place and the result is indicated by the voltage developed across the known capacitor. This voltage is then compared to a reference voltage chosen so that the absence of the telephone capacitor can be detected. This test system is independent of the resistance in the circuit and can therefore be used on both direct exchange connexions and shared service connexions.

Contact with foreign potential is detected by examining the current from the foreign voltage in the circuit across a known resistor. Comparison of the voltage developed with a reference voltage indicates whether the limits are exceeded.

Calling equipment is tested by using a tuned circuit to detect dial tone harmonics. Harmonic detection is preferred to a check on the 50 Hertz frequency of dialling tone to avoid interference problems from the public 50 Hertz supply.

The remaining tests require speech transmission and customer co-operation. The results of each are stored until the data transmission is reconnected at the end of conversation with the customer. This is achieved by the test unit detecting the replacement of the customer's receiver and then automatically changing the transmission path back from speech to data. The results of the tests are then transmitted and displayed on the control console.

The resistance of the calling loop is tested while the engineer is talking to the customer and uses the same method as that for insulation resistance. Backward resistance of the rectifier and the calling earth condition on shared service lines is tested in the same way.

While the customer dials the digit 0 dial speed is measured by a counter circuit which checks the number of pulses received within a specific time. Pulse ratio is measured by charging a capacitor at a constant rate during the make period of the dial and discharging the capacitor at half this rate during the break period. The charge remaining at the end of pulsing indicates the ratio between the make and break periods. This is indicated by comparing the residual voltage on the capacitor against a reference voltage.

If a wanted line is engaged and, after monitoring, it is apparent that it is not carrying traffic it is possibly held by a fault condition which simulates a telephone loop—known as a PG condition. Under this condition it is normally impossible to measure insulation because of the exchange equipment held by the "loop". But the new test unit has a facility which will force the release of the equipment held by most PG loops and permit some testing to be carried out. This facility is achieved by sensing the polarity and voltage across the customer's line at the test selector and applying a nominally equal voltage so reducing the magnetic flux in the relay held by the PG condition to zero. When this relay releases the circuit is seized by the test unit and insulation tests may be carried out. If these indicate that the loop is probably due to the receiver being left off-hook the engineer can connect the howler to the circuit.

A short engineering trial of prototype equipment connected between Covent Garden exchange in London and Plesseys Automation Ltd., Poole, Dorset, who have developed the system, was carried out successfully in January of last year. Initial tests followed between Bournemouth Repair Service Control and Swanage automatic telephone exchange which resulted in modifications being made to the equipment.

The field trial at Truro started in April and at Carlisle the following month. These are being used to assess the cost and service benefits before any decision is made to proceed with full scale use.

THE AUTHOR

Mr. A. G. Preston is a Senior Executive Engineer in Service Department with responsibilities for organising and operating customers repair services. He joined the Test Section in 1935 and after working on the production and maintenance of line plant transferred to Service Department in 1968.

NEW ROUTE FOR ATLANTIC CALLS

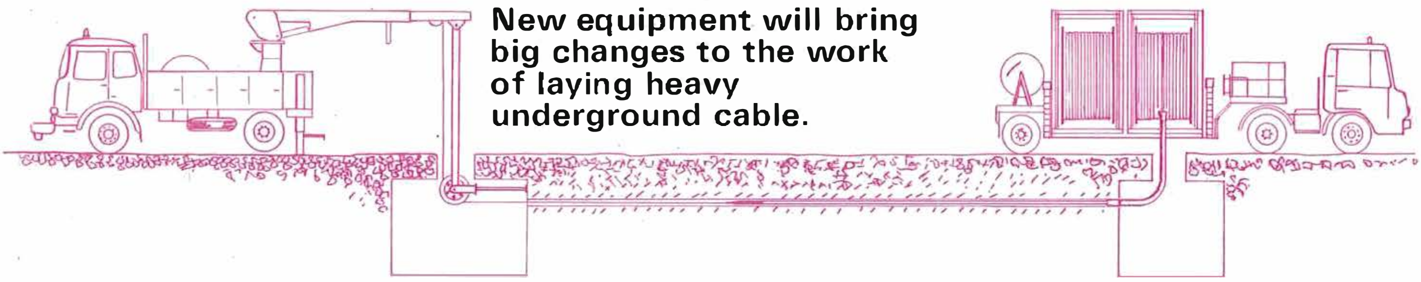
AN ALTERNATIVE route for telephone calls across the Atlantic Ocean is now available to the Post Office. It is through a submarine cable between Spain and the U.S.A. which has a direct connexion with the cable constructed for the Post Office between Britain and Portugal last year.

Several northern European countries will be making use of the service through London.

Named TAT 5, it is the sixth submarine telephone cable to be laid across the Atlantic. Part of it was manufactured in Britain.

Transatlantic telephone cables already carrying calls between this country and North America are Cantat (Britain—Canada), TAT 1 and TAT 3 (UK—USA). Cables TAT 2 and TAT 4 run between France and the U.S.A.

Communications satellites are carrying an increasing number of telephone calls between Britain and the U.S.A. and elsewhere in North and South America, but the Post Office believes that use of both cable and satellite will continue to be valuable in providing complementary transatlantic communications.



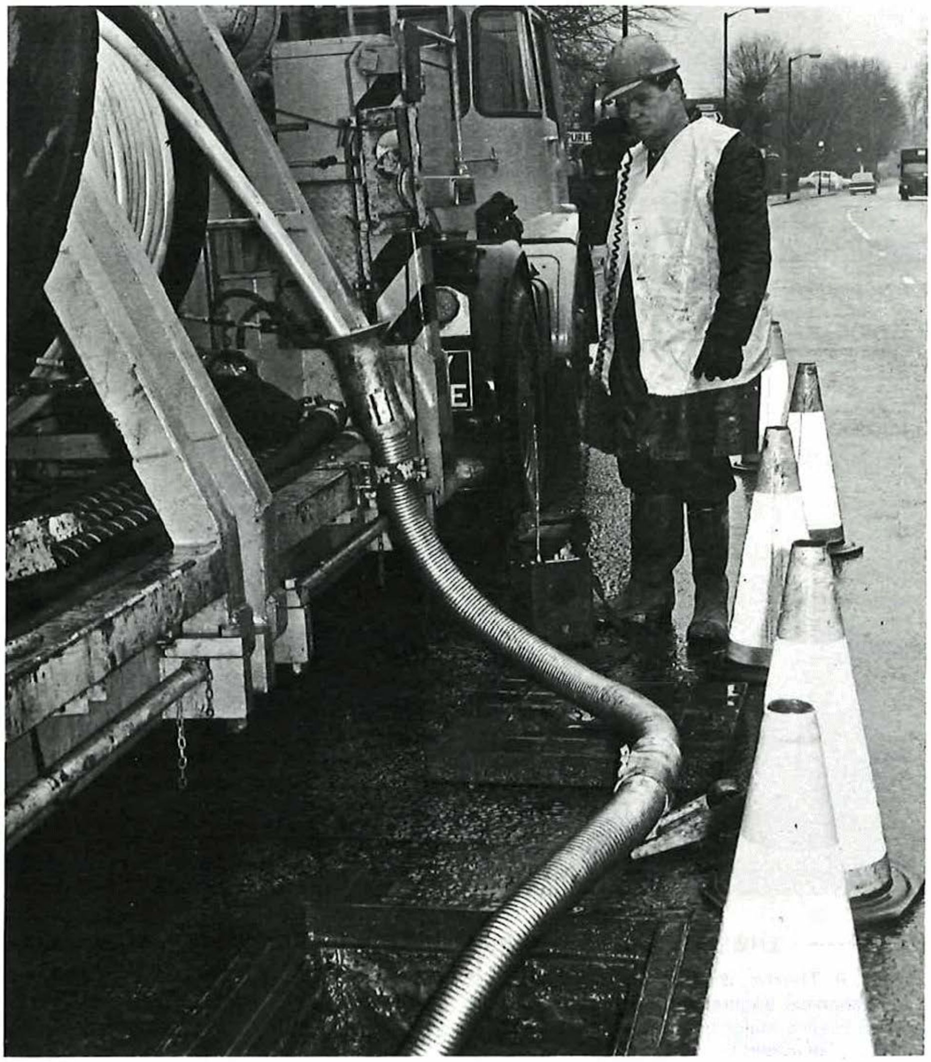
New equipment will bring big changes to the work of laying heavy underground cable.

Heavy cabling made easier

By R. THARBY

ONE of the most laborious jobs in Post Office engineering is the laying of large telephone cables in underground ducts. Cable carrying trailers and winches have to be man-handled into position, cable drums assisted to turn by hand and a work force of five men—more if a support party is required—has been necessary. Now this arduous task is about to undergo spectacular changes with new heavy cabling equipment being developed by the Civil and Mechanical Engineering branch of Telecommunications Development Department. The equipment consists of two machines, an articulated Cable Carrier and a Pulling-in Unit.

A field trial and feasibility test of the equipment which started in the Birmingham area in 1968 has already shown that actual cabling time can be cut by more than half—drawing-in speeds of up to 110 feet per minute can be achieved; that no more than three men are normally required for its operation and that all the heavier manual tasks of the old method can be eliminated.



Cable being drawn from the drum on the cable carrier through the cable guide and into the duct. The crews of the carrier and pulling unit keep in contact by radio.

The cable carrier brings cable from stores to one end of a route and the unit draws in the cable through the duct to the other end. They are simple to operate and each requires only one man at the controls with the third member of the team helping out as required. Another advantage is that they can operate without leaving the highway, each being equipped to reach out to manholes or joint boxes.

The cable carrier can take two four-ton drums of cable and two smaller drums and has a fully laden weight of 22 tons. The large drums are carried in frames which, using hydraulic rams powered by an auxiliary engine, can reach out and lift the drums aboard at the stores. The smaller drums, carried in rigid frames at the rear of the vehicle, are loaded by fork-lift truck.

The pulling unit is a short-wheelbase vehicle which carries stores and tools for the party and incorporates an 8,000 lbf (pounds force) winch with 750 yards of steel wire rope. This power and rope length enables the winch to draw in the largest cables used by the Post Office and to handle the longest lengths in which these cables occur. It can reach out in any direction to manhole entrances with a tower-mounted telescopic boom, power operated like the winch from the vehicle engine and hydraulic system. A telescopic drop-arm pivots at the end of the boom and carries a large cable sheave which is lowered into a manhole shaft by the boom until the sheave is in line with a duct to be cabled. The boom reaches out to manholes up to 24 feet away and the drop-arm extends down to 15 feet in a manhole shaft. A series of rope sheaves inside the tower and along the boom and drop-arm acts as a guide for the steel winch rope between the vehicle and the duct. The cable sheave is constrained in position by adjustable props between the drop-arm and the walls and shaft of the manhole.

In operation the cable carrier would be loading at the stores while the pulling unit, already at the site, would have set up its boom and drop-arm and attached its winch rope to the drawline left in the duct by a previous rodding party. Loaded, the cable carrier draws up on the highway as near to the other manhole as possible and the other end of the drawline led to its 1,000 lbf hydraulic winch. The crews of both machines set up contact by portable radios and, by combined operation of the two vehicles, the steel rope is pulled into the duct from the unit by the small winch on the cable carrier as it winds in and stores the drawline.

Lengths of 3½-inch diameter flexible metal cable guide are now assembled at the carrier to lead the cable from the drum on the vehicle to the duct. One end of the guide has a bellmouth and is attached to the appropriate drum-carrying frame, and the other is secured to a split branch fitting in the ductmouth. The steel rope is detached from the drawline, threaded through the flexible guide and attached to the grip on the end of the cable. The drum is raised in its carrying frame by the hydraulic rams so that it is free to rotate.

Again, with combined operation of the two vehicles, the cable is drawn off the drum, through the guide and along the duct by the winch on the unit. The operation is kept under close control at all stages by the crews in radio contact. When the cable reaches the pulling unit it is drawn out of the duct, around the cable sheave and up the drop-arm until the length needed to make a joint in the manhole has been obtained.

Although high cabling speeds of up to 110 feet per minute can be achieved, the fine control provided by the hydraulic system allows a close control over any speed selected, regardless of the variations in cabling tension that may arise. The maximum force applied by the pulling unit may be pre-set to various lower values to avoid damage to the cable and the force being applied at any time is observed on a gauge at the side of the winch operator. Stabilising jacks are extended to support the vehicle when the boom is in use and both it and the cable carrier have very high capacity water pumps to empty water-filled manholes with a minimum of delay.

The early trials have proved that this new and highly mechanised approach to cabling is not only viable but, with the large amount of cable that can be carried, the short time needed to set vehicles up ready for use and the high cabling speed, will in fact have spectacular effect on cable laying operations. In an attempt to refine and further improve the new equipment a Work Study operation is being carried out on a pre-production model recently put into service in London Telecommunications Region. This may lead to even more favourable results when the machines are released for general introduction in 1971.

Searching tests at Army centre

Spectacular development tests were made on the new heavy cabling equipment. In one, a Dynamometer Car, a heavy six-wheeled vehicle, was used to test the strength, speed and overload mechanisms of the pulling unit winch and a military armoured personnel carrier acted as an anchor and a protector for the men operating the winch in case the cabling rope broke.

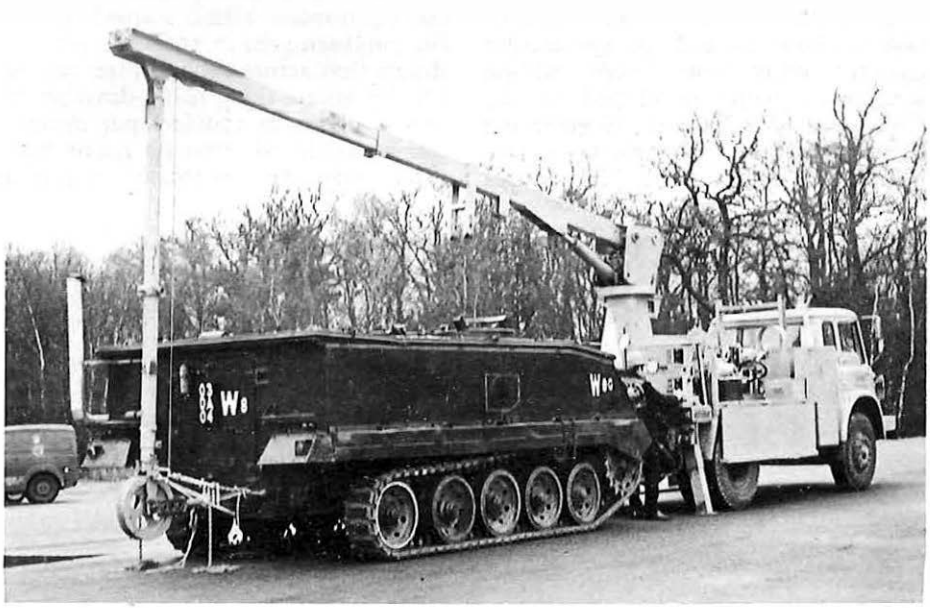
In a stability test both pulling unit and cable carrier were tilted on one side by a special hydraulic platform to discover the angle at which they would topple over.

The tests were carried out at the Military Engineering Experimental Establishment at Christchurch, Hampshire. Although normally used tor testing military vehicles, it is the United Kingdom's testing authority for civil engineering construction equipment.

For the winch tests, several hundred yards of cabling rope were run out and the free end attached to a load cell on the front of the Dynamometer Car. Instruments connected to this cell measured the load pulled by the cabling rope. Other instruments recorded the speed at which the cabling rope was hauled in.

The lower end of the drop-arm suspended from the tower-mounted telescopic boom of the pulling unit was fastened to the armoured personnel carrier. By varying the load applied by the load cell the winch pulls and speed were varied. The winch overload mechanism operated satisfactorily at its designed load of 8,000 lbs and the winch withstood other searching tests.

Transverse stability tests on the pulling unit, with stabilisers down and its retractable arm horizontal and fully extended, showed that it did not become unstable until the vehicle was tilted to 15½ degrees (steeper than a gradient of 1:4). The tests proved that the vehicles will be stable at all road gradients and cambers likely to be encountered under working conditions, and loading operations will not be over-dependent on level sites.



THE AUTHOR

Mr. R. Tharby, is a SEE in the Civil and Mechanical Engineering branch of THQ and leads a major projects development team. He joined the Post Office in 1941 at Peterborough and has been in London since 1951.

TOP: The drop arm of the telescopic boom is lashed to the armoured personnel carrier which acts as an anchor for the pulling unit during tests on its winch.

BOTTOM: The cable carrier being tilted 15 degrees by the hydraulic platform during stability tests.

An oil tanker of the Shell fleet. Shell are just one of the large companies interested in Selective Calling.

Better radio for shipping

By W. M. DAVIES

CONSIDERABLE improvement in high-frequency radio telegraphy and telephony communications with ships will almost certainly result if full advantage is taken of three new systems approved by the International Radio Consultative Committee (CCIR) at its plenary assembly in New Delhi earlier this year.

Approved for use on the world's shipping routes were: a method for the Selective Calling of ships at sea which will allow a shore station to contact a selected ship on demand in much the same way as a telephone number is dialled; a maritime version of Lincompex, the Post Office development which greatly reduces the effects of poor radio conditions on high-frequency radio telephony circuits; and Direct Printing which applies a new error-correcting system to the Ships' Teleprinter Service. The three systems are described below:

Selective Calling will replace the present method of advising ships that a shore station has a telegraph message or wants a telephone call. This has meant broadcasting a list of "wanted" ships call signs at fixed times of the day using Morse Code. Ships' operators have to listen in at these times and if they hear their call sign they contact the shore station. The message is then passed over the telegraphy (Morse) radio circuit or, if a telephone call is wanted, a time is "booked" for a radio-telephone channel. If a ship's operator is not listening the shore station cannot make contact.

Selective Calling has been designed to relieve the ship's operator of the tedious task of listening to the long lists of wanted ships and at the same time allow the shore station to contact the ship on demand.

This is achieved by giving each ship participating in the new scheme a five-figure identification number in an international numbering scheme, each country being given a block of numbers. In addition, each shore station will be given its own three-figure identification code so that a call will comprise the ship's five-figure number followed by the shore-station code. The ship's decoder will respond to its own individual number, ringing a bell or other warning device. Other equipment on the ship will indicate the shore-station code so that the operator will know who is calling. The ship's equipment can be unattended.

The codes are transmitted as a series of tone pulses, each of the digits 0 to 9 being represented by a 100 millisecond pulse of audio tone. The encoder (sender) automatically repeats the ship's code after an interval of 900 milliseconds.

The Selective Calling system was tested by the British Post Office. An encoder was fitted at North Foreland Coast Station and two decoders in the Dover-Zeebrugge ferry "Free Enterprise IV", with good results. Nearly 700 test calls were made using the medium frequency band (1·6-3·8 MHz). Failures could only be provoked by considerably reducing the transmitter power. Successful calls were also made on VHF when the ship was lying in Zeebrugge harbour, nearly 100 miles from North Foreland. The Post Office has installed UK-manufactured selective calling encoders at the Burnham/Portishead Radio Station and at one coast station. The remaining 11 coast stations will be equipped as encoders become available.

In the **Lincompex** system, the efficiency of radio circuits is raised to cable or satellite standards. This is achieved by controlling the gain factor introduced by the constant volume amplifiers at the transmit and receive ends. Previously the gain factor was uncontrolled, allowing noise and interference to degrade the circuit. With Lincompex a speech volume range of 40 db is reduced to zero. The degree to which the volume has been compressed from moment to moment is conveyed to complementary expanders at the receiving terminal by means of a frequency-modulated control-tone contained in the upper 200 Hz of the speech channel. For example, if the transmitted speech has been compressed by a gain factor of 10 db, the expander will introduce a loss factor of the same quantity so that the end to end gain is zero and the circuit will never "sing" or become unstable. It gives an advantage over the conventional system equivalent to an increase in transmitter power of about 40 times. The effect so far as the user is concerned is that any radio noise, which would be obtrusive in the gaps in the speech, is effectively suppressed and conversation made much easier. Recent tests, made in conjunction with the P & O Line, have shown that an increase in effective range of around 50 per cent can be achieved using normal transmitter power.

There are two main differences between the point-to-point and maritime versions of Lincompex. Firstly, because the maritime radio channels are of narrower bandwidth (top frequency 2,700 Hz instead of 3,000 Hz) the speechband is restricted to about 2,400 Hz and the control tone centred on 2,580 Hz instead of 2,900 Hz. The loss in intelligibility resulting from cutting the higher voice frequencies is almost negligible. Secondly, the speech-path time-delay units, which are necessary to equalise the transmission times of the speech and control paths are concentrated at the shore end, so considerably reducing the cost of the ship equipment.

The Post Office has already installed the maritime version of Lincompex at its Burnham/Portishead long-range maritime station and will later equip its other coast stations.

In providing a **Direct Teleprinter Service** to ships using the medium frequency (1·6 to 3·8 Hz) and high frequency (3 to 27·5 MHz) radio bands it is difficult to reduce to a low level the occurrence of errors caused by interference, radio noise and fading.

The inland telex system, which adopts the well-known five-unit start-stop telegraph code, is impractical for a ships' service because under radio conditions such a code is liable to produce errors—any interference or noise may produce a false start condition. In addition, the code has no redundancy, by which we mean that the mutilation of any of the information elements will inevitably produce a wrong character instead of indicating an error as such.

Consequently, several code systems which attempt to overcome the maritime problem have been produced by different countries over the years and are currently in use. Common to all the systems is the elimination of the start and stop elements and synchronisation of the sending and receiving equipments. This in itself gives a very considerable reduction in errors, but in addition practically all modern radio telegraph systems employ an error-correcting code of one kind or another.

This latter requirement has now been provided in the system recommended by the CCIR—an Automatic Request for Repeat (ARQ) type of system. Such systems are extensively used on the high-frequency radio point-to-point circuits. They operate at a telegraph speed of approximately 100 bauds and employ a seven-element synchronous error-detecting code having a three-to-four ratio of mark and space elements in each character.

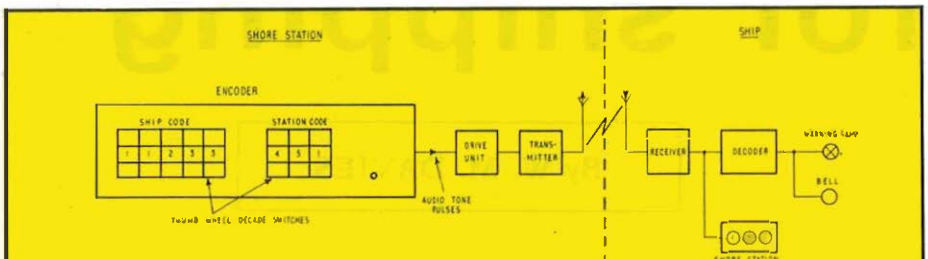
If this three-to-four relationship is not present in the received character an error is assumed, the receive terminal sends back an "RQ" (Request for Repeat) signal, and the transmit terminal then repeats the previous three characters. This process is repeated each time an error is detected so that under bad propagation conditions the system can go into the RQ cycle mode for quite long periods. The system is generally known as TOR (Teleprinter Over Radio).

The system recommended by CCIR is a development of TOR and also operates at 100 bauds, but instead of characters being transmitted in a continuous stream, interrupted only when an error is detected, the maritime system, known as SITOR (Simplex Tor) employs acknowledgement signals.

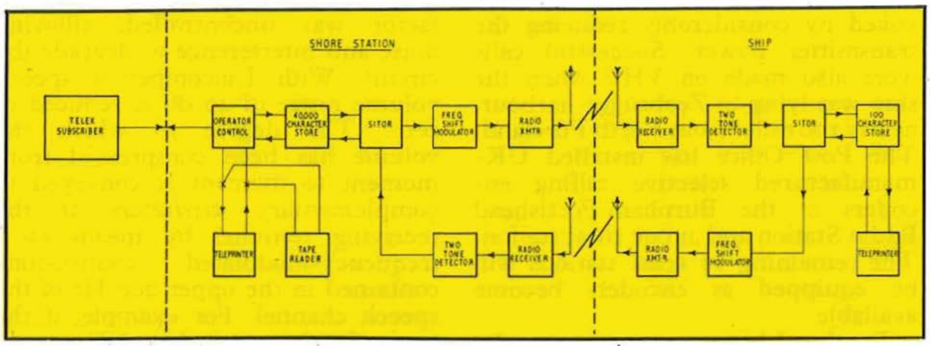
In this system the message is sent in six-character groups, each group being sub-divided into two blocks of three characters. At the end of the first block the receive terminal examines the characters for errors and if none is detected (i.e. the three-to-four ratio is present in all three characters) then a "block 2" signal is sent back to initiate the transmission of the second block of three characters. If, however, an error is detected the receive terminal sends back a "block 1" signal and the first block is retransmitted. When the second block has been successfully received a "block 1" signal is sent back and this initiates the transmission of the first block of the next group of six characters.

This feature of block by block acknowledgement implies that a return radio path must also be available. The system, however, is adaptable for unidirectional transmission (broadcast mode) where there is no return path. This will allow the transmission of weather bulletins or news reports by teleprinter to numerous ships while avoiding the possibility of numerous requests for repeats which might jam the network. With unidirectional transmission, however, errors detected by the receiving equipment are indicated in the message by the printing of an asterisk or other symbol.

The system uses a ship's call-sign to set up a call. The call-sign is detected by a ship's equipment which automatically sets up the ship's teleprinter to receive a message. With existing systems a morse message has to be sent to a ship's operator who has then to prepare his teleprinter to receive messages.



These diagrams show the Lincompex maritime system (above) and the Direct Teleprinter system for ships (below).



THE AUTHOR

Mr. W. M. Davies is an Assistant Staff Engineer in Radio Engineering section, External Telecommunications Services. He is responsible for systems evaluation, prototype testing of HF radio equipment, aerial construction for Post Office Radio Stations and CCIR support studies.

Miscellany

GREEN PAGES

BRITAIN'S TELEPHONE directories are to have a new 16-page section giving customers instant information about the wide range of services available to them. Coloured green for ready reference, the new pages were first seen in the London A-D directory which appeared in March.

All new alphabetical and combined alphabetical-and-classified directories will start with this section, and by March next year there will be Green Pages in the 20 million copies of directories in current use.

Brightly designed and illustrated, the new supplement contains advice on various telephones and aids such as extensions, intercom. systems, answering machines, credit cards, Freefone, and the telephone information services.

If customers want special directory entries—additional words, bold type, etc. —the Green Pages tell them how to apply. There is an order form for extra directories, and a price list. There is also a tear-off form for customers who need further details of the services described.

BOARD MEMBERS

CLOSE AND warm identification with local commercial and social communities is the key to the Post Office's success said Lord Hall, Chairman of the Post Office Board, in a speech to the English Speaking Union in London in April.

"Industrial Manchester is different in character from holiday Torquay. The Post Office and the services it provides must be geared to varying local needs," he stressed. Readiness to innovate and develop existing and new services was behind the new Post Office decision to set up two experimental Regional Boards—in the North-West for Posts and in Wales and the Marches for Telecommunications—including part-time members from outside the Post Office.

"A new competitive attitude is beginning to permeate the entire operation with our 400,000 staff ceasing to be civil servants and emerging as businessmen with a very real role in the community to which they belong," he said.

● Members of the new Regional Board for Wales and the Marches are: Chairman, Mr. T. H. Davies, Director (Telecommunications); Mr. S. D. Mellor, Controller Planning; Mr. G. Dawson, Controller Personnel and Industrial Relations; Mr. D. M. Rogers, Controller Marketing and Service; Mr. R. Chivers, Controller Finance and Management Services; Mr. Julian S. Hodge, businessman and merchant banker; Mr. M. W. Rosser, partner in Deloitte, Plender, Griffiths and Co.; Mr. D. Morley-Smith, managing director Rogers and Jackson (Holdings) Ltd; Professor T. Ellis Evans, Professor of International Politics at Aberystwyth.

TIMELY CALLS

CALLS for the time to the Speaking Clock telephone service totalled 261,625,000 in the year ending 31 March. This was an increase of 8·6 per cent on the previous 12 months.

New look for mobile telegraph unit

JOURNALISTS reporting major sporting and political events in this country for overseas press, radio and television are familiar with the Post Office's mobile telegraph unit. But this summer they are seeing a change in its appearance.

The unit has had a complete refit and a new paint finish. Outside, its colour has been changed from Post Office red to yellow. Inside, it has been re-equipped and has new fabric lining, working surfaces and lighting.

Operated by the Post Office International Telegraph Service to serve the press, the unit is equipped with three telex machines, two telephones and picture transmission facilities.

Travelling technicians keep the unit in good working order, and local operators at each venue spend long hours despatching telex and telegram press messages to countries in many parts of the world. They send about two million words a year—mainly about cricket, rugby, golf and the major political party conferences.

In service since 1956, the mobile telegraph unit—which is very much like an ordinary motor coach to look at—travels 7,000 miles each year to about 50 different events.

The coach which houses the telegraph equipment. Below: Two of the unit's staff at work.

POLYTHENE CABLES LAID UNDER WATER

THE FIRST polythene-covered underwater cable to be laid in Britain's national telephone network has been connected in Scotland. A mile long, it has been laid under Loch Alsh in Ross-shire and joins Ardelve and Flounder Bay. Because of its success a second cable is to be laid under the same water to join Kyle to Kyleakin in Skye and will be followed by others elsewhere in Scotland. The cable will also be used to link Portsmouth and Gosport, Hants.

In the new cable polythene lined with an aluminium foil screen moisture barrier replaces the standard lead sheath. This has achieved a 25 per cent saving in costs and a 30 per cent weight reduction, making the cable easier to lay with small ships. The cable is protected by jute bedding, 17 armour wires and a cover of double jute.

Because Loch Alsh is a sea loch the Post Office cableship, Iris, was able to get into it to lay the Ardelve—Flounder Bay cable. The alternative land route would have meant an 18-mile detour. The cable contains 54 pairs of wires and replaces a 16-core gutta percha cable laid in 1939.

The Kyle to Kyleakin link will contain 60 pairs of wires and replaces several smaller gutta percha cables laid since the 1920s. Both cables provide spare capacity for future growth.

Polythene-covered submarine cables previously laid in Britain have been high-frequency coaxial cables for the international network. The national network, however, at present uses about 350 underwater cables of conventional design totalling over 2,000 miles.

DIRECTORS APPOINTED

TWO NEW Directors have been appointed in Telecommunications Regions.

Mr R. E. Jordan, Head of Organisation, Statistics and Manpower Division in Management Services Department, Telecommunications Headquarters, becomes Director, South Western Telecommunications Region in succession to Mr S. J. Edwards who retired on 31 March.

Mr D. S. Pullin, Head of Buildings Policy and Programmers Division in Operations Department, Telecommunications Headquarters, became Director, Midlands Telecommunications Region, in succession to Mr W. L. A. Coleman who retired on 8 June.

Emergency action aids spacemen

UNUSUAL emergency measures taken by the Post Office during Apollo 13's ill-fated flight in April helped the stricken spacecraft's safe return to earth.

Microwave services operating on frequencies close to those used by the spacecraft were closed down to ensure they would not affect communications with the astronauts throughout the vital hours to splashdown.

The Glasgow-Aberdeen telephony service and a television link with the Isle of Wight were affected. Both services were re-routed until after splashdown and special maintenance arrangements were made to make sure that the alternative routes could cope with the extra traffic. The country's main microwave system was not affected.

As with previous space flights, the Post Office again provided and operated communications circuits by land line, submarine cable, high frequency radio and satellite routes. These carried speech, vision, highspeed data and telegraph signals and played an important part in the worldwide network linking Apollo 13 with the control centre at Houston, Texas.

SHIPS' SERVICE AT PORTISHEAD

A REORGANISATION of the long-range radiotelephone service for ships has centred the service on Portishead Radio, Somerset, by-passing Baldock Radio Station, Herts. It should mean a speed up in the connexion of telephone calls to and from ships at sea.

Until now a shore subscriber calling a ship has had to make his call through the International telephone exchange from where it went on through Baldock to the transmitter at Rugby and then to the radio operator aboard. Now the customer will be connected by his local operator direct to the Ships' Telephone Service, Portishead, from where contact will be made with the ship. A ship's operator calling a UK number will contact Portishead and, as soon as a radiotelephone frequency is available, will be connected into the STD network direct. This was not possible from Baldock.

IDEAL PHONES

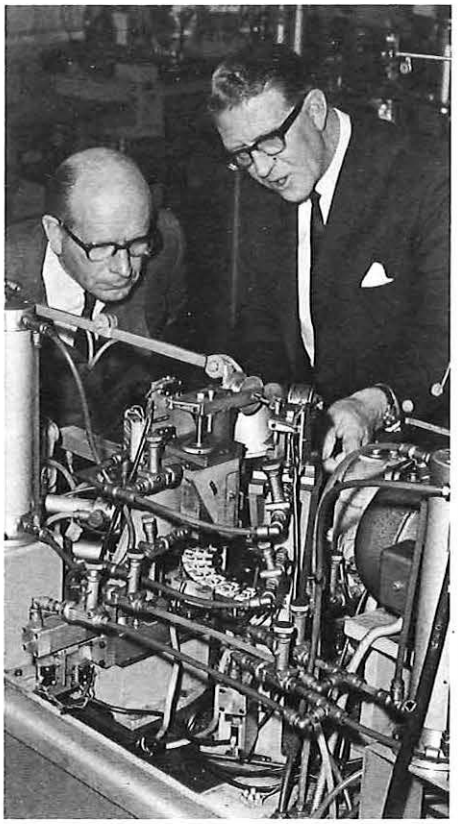
"TELEPHONES for the Home" was the theme of a display by the Telecommunications business at the Ideal Homes Exhibition in London in March. In addition to the better-known extension arrangements the display featured the Watch Receiver, an extra earpiece that can be connected to a modern telephone so that two people can hear the same conversation, and an amplifying telephone handset on which the volume of incoming speech can be adjusted by a fingertip turn of a small controlling wheel in the earpiece.

For the 12 months to the end of March this year new telephone service was provided to over 700,000 more homes throughout the country bringing the total number of residential customers to about six million. As more people have the telephone at home an increasing number are realising the value of having a second or third telephone in the house.

ESSAY WINNERS

PRIZEWINNERS in the 1969/70 Essay Competition held by The Institution of Post Office Electrical Engineers are:

Six guineas and Institution Certificate—J. W. Henderson, Technical Officer, Doncaster. Three guineas each and Institution Certificates—S. E. Crowder, Mechanic A, Birmingham; A. Buttree, Technical Officer, Wakefield; C. F. Newton, Instructor, Otley; D. E. G. Coles, Technical Officer, Birmingham. Institution Certificates of Merit—D. C. Ferguson, Technical Officer, Oldmeldrum; P. English, Tech 2A, Edinburgh; F. J. Crampton, Technical Officer, Aylesbury.



Mr. E. Fennessy, Managing Director Telecommunications (left), inspects part of the production line making rocking armature receivers during a visit to STC's New Southgate plant. With him is Mr. A. Byford of STC. The machine automatically winds the coils for the receivers which are used in telephone handsets.

BOOK REVIEWS

RADIO COMMUNICATION, by G. L. Danielson and R. S. Walker (Volume 3 of Radio and Line Transmission in the Telecommunications Technicians series). Iliffe Books Ltd., 308 pages, 45/–.

The authors, of Norwood Technical College, offer the book to students to cover the syllabus of the City and Guilds of London Technicians Certificate Examination in Radio Communication C.

The twelve chapters cover propagation, receivers, RF amplification, amplitude modulation, frequency modulation transmission and reception, transmitters and receivers, aerial systems and tests and measurements. Questions are set on each chapter and answers given where calculation is involved. The treatment is mainly descriptive with examples of typical valve and transistor circuits. Only simple mathematical treatment is given although there is adequate use of graphs and figures.

The book adequately meets its objective at the appropriate level for the syllabus.

THE PRACTICAL AERIAL HANDBOOK, by Gordon J. King, 2nd Edition (1970). Butterworth & Co., 232 pages, 54/–.

The author is well known for books on radio and television servicing and as a regular contributor of technical articles for the "Hi-Fi" enthusiast. The scope of the handbook is, not unnaturally, confined to receiving aerials, primarily for domestic radio and television reception.

This handbook will be a useful practical guide to the service technician to whom it is particularly addressed, and contains much practical detail which will be read with interest by students and others interested in domestic broadcast reception.

MBW

FIRST AUTO-REGION

THE NORTH EASTERN Region of the Post Office became the first to have all its telephones working through automatic exchanges with the opening of a new electronic telephone exchange at Corbridge, Northumberland. It was the last manually operated exchange in the region to be converted to automatic working.

About 99 per cent of the United Kingdom's 8,342,300 exchange connexions are now on automatic service.

Post Office team at public schools

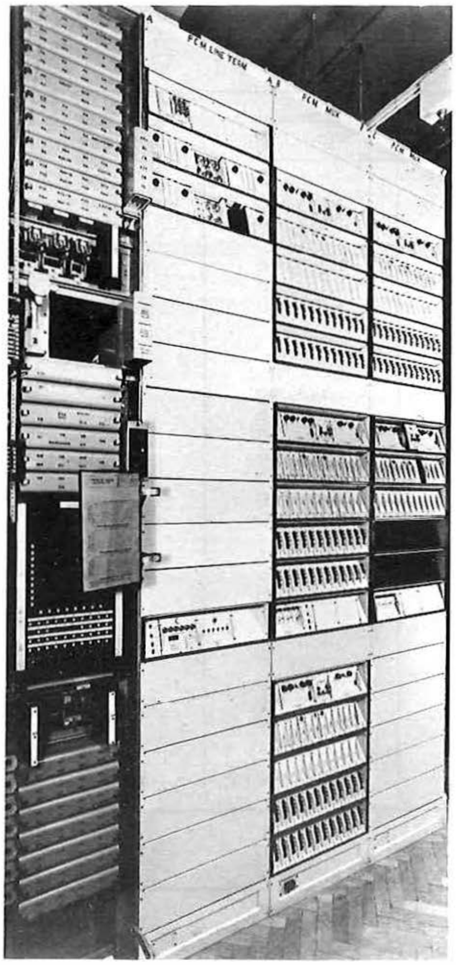
SIXTH-FORMERS interested in engineering and technology are learning at first hand what a career in the Post Office has to offer. In a series of visits to public schools, a four-man Post Office team is giving a special engineering presentation on the theme of "pulse code modulation in telecommunications".

The visits are aimed at showing pupils—and masters—how A-level science studies can be translated into an engineering career.

In the first of the series, at Harrow School in March, the Post Office team met Harrovians and sixth-formers from other schools in the area. Later, visits were made to Bradfield College, Aldenham School and Haileybury School.

With the help of appropriate equipment, the team discussed the technical and administrative problems that an engineer in the telecommunications industry has to solve in developing, designing and manufacturing a new system to meet the needs of an expanding public service.

Three of the members of the team are from Dollis Hill: Mr A. H. Ithell, engaged in research on electronic telephone exchanges; Mr J. M. Griffiths, concerned with high-speed digital transmission; and Mr R. S. Swain, who is doing research on microwave radio links. The fourth man is Mr A. G. Scott, who deals with the selection and recruitment of graduates for management posts at the Post Office Appointments Centre.



Racks of pulse code modulation (PCM) equipment installed in the telephone exchange at Lymington, Hants. A £1 million contract was recently awarded to the Plessey Electronics Group for PCM equipment to be used in field trials. PCM provides 24 two-way telephone channels over two pairs of audio cable.

NEW SCHEME FOR APPRENTICES

FIRST year telecommunication apprentice technicians will be taught "off the job" for the first time when an experimental scheme is launched in Brighton in September.

The Post Office and Brighton Education Committee are to provide a fully-equipped telecommunications centre where apprentices will spend three days a week under instruction. They will also attend Brighton Technical College two days a week and will visit telephone exchanges, transmission stations and other Post Office premises. The apprentices will be introduced to field work in the second year.

Training will follow the present national syllabus which includes instruction and practice in installing and maintaining underground and overhead plant and equipment; fitting and maintaining customers' rented equipment; installing and maintaining exchange and transmission equipment.

The present training scheme provides separate courses at Post Office regional engineering training schools and block or day release courses at local technical colleges with field training during the first two years.

The new scheme will serve the whole of the Brighton Telephone Area and will cater for an annual intake of 48 apprentices between the ages of 16 and 18.

'Packaged' power cuts costs

QUALITY CONTROL improvements and time savings in planning and on site installations are expected from the introduction of "packaged" versions of Standby Engine Alternator Sets—part of Power Plant 426.

It is hoped that normal time for installing a packaged set will be significantly reduced from the 2–6 weeks "on site" time which is the average with present installation arrangements.

Basically designed for use in telephone exchanges, the engines can be used as standby power plant for any communications centre. Up to 350 Power Plants 426 are being installed every year by the Post Office, but until now only the automatic control cubicles have been purchased centrally in bulk. Individual or small batch contracts for alternators and ancillary equipment have been placed by Regions and this makes quality control and assurance systems difficult to implement. Bulk purchase will allow the quality control technique to be fully applied and this should reduce engine prices.

The present system involves much work for Regional planning staffs and contractors who have to engineer sets for individual stations and prepare drawings on a one-off basis. Separate installation of engine auxiliaries, interconnecting pipework and cabling has also taken up a great deal of design effort and skilled labour time on site.

The packaged set will comprise the engine alternator on anti-vibration mountings, fuel service tank, lubricating oil and water make-up tanks, fuel transfer pumps, primary silencer, radiator and cooling air discharge louvres all assembled on a skid. All pipework and wiring between these components will be carried out and the complete unit tested at the factory leaving only external connections to the bulk fuel tank, control cubicle, starter battery and exhaust and cooling air discharges to be made on site.

The position of all these terminations on the set will be defined with reference to a datum and details of flanges etc specified. This will allow all fixed wiring and pipework in a building to be installed in advance, if convenient, leaving only the final connection to be made when the set is delivered.

BITS AND PULSES

A NEW communications satellite relayed live television pictures to Britain from Mexico during the World Cup football competition—the Intelsat III F7 satellite which came into operation on May 12.

The F7, positioned over the eastern Atlantic, picked up the television transmissions from a United States earth station and relayed them to Britain through the Post Office earth station at Goonhilly, Cornwall.

The new Intelsat III will serve the USA, Europe, North Africa and the Middle East. It can carry simultaneously 1,200 voice circuits or four colour TV channels or a combination of TV, voice, data and other traffic.

—010—

FOODMARKET—a new telephone information service which provides a shopping guide for the approaching week—has been launched in London and the Home Counties for a six-month trial period.

Aimed at helping working housewives, the service will be available from 8 a.m. Sundays to 8 a.m. Mondays on the telephone numbers otherwise used for the Recipe Service.

—010—

FOR THE first time the number of telephones in service in the United Kingdom has increased by more than a million in a year.

This was achieved during the 12 months ending in February when the total number of telephone instruments in use went up by 1,021,900 to 13,838,900.

—010—

LOGICA, market consultancy experts, are to study the market for keyboard video displays for the Post Office. Results will be used in deciding whether to offer these as part of future data services. The primary object is to establish the numbers of video displays likely to enter use in the UK over the next five years. Logica will also assess the types of use to which video displays will be put and will report on the future position in the market of special devices, such as touch displays and even modified forms of the commercial TV receiver.

—010—

THE DIAL-A-DISC telephone service was extended to Belfast and many parts of London on May 1. It plays a different "pop" record from the week's "Top Seven" each day, usually between 6 p.m. and 8 a.m. and all day Sunday. People can hear a record for the price of a local telephone call simply by dialling a short code.

CABLING UNIT AT LONDON BRIDGE

HEAVY telephone cable has been laid under the roadway of the new London Bridge with the aid of a cabling unit now under development.

The problem was to lay cables, each 350 metres long, through plastic ducts which had been mounted below the roadway during building operations. The job was done with the cabling unit consisting of two vehicles, a cable drum transporter and a winching vehicle which can be operated by a crew of only three men (see pages 27-28). The transporter was set up at the northern approach to the bridge and the winch unit at the southern end. A light draw line, laid down when the ducts were mounted on the bridge structure, was used to link the winch's pulling rope with the cable on the transporter. The winching vehicle then drew the cable across the river.

Telecommunications Statistics

(Figures rounded to nearest thousand)

	Quarter ended Dec., 1969	Quarter ended Sept., 1969	Quarter ended Dec., 1968
TELEGRAPH SERVICE			
Inland telegrams (incl. Press, Service and Irish Republic)	2,059,000	2,335,000	2,144,000
Greetings telegrams	534,300	658,000	566,000
External telegrams:			
Originating U.K. messages	1,816,000	1,948,000	1,793,000
Terminating U.K. messages	1,810,000	1,805,000	1,825,000
Transit messages	1,605,000	1,670,000	1,551,000
TELEPHONE SERVICE			
Inland			
Net demand	284,000	248,000	201,000
Connections supplied	278,000	236,000	220,000
Outstanding applications	248,000	242,000	223,000
Total working connections	8,342,000	8,157,000	7,713,000
Shared service connections (Bus. and Res.)	1,517,000	1,481,000	1,422,000
Total effective inland trunk calls	336,952,000	332,674,000	302,633,000
Effective cheap rate trunk calls	80,784,000	83,562,000	68,621,000
External			
Continental: Outward	3,635,000	3,514,000	3,022,000
Inter-Continental: Outward	408,000	366,000	334,000
TELEX SERVICE			
Inland			
Total working lines	28,000	28,000	25,000
Metered units (incl. Service)	55,316,000*	63,707,000	50,775,000
Manual calls from automatic exchanges (incl. Service and Irish Republic)	39,000*	39,000	33,000
External			
Originating (U.K. and Irish Republic)	4,999,000	4,701,000	4,358,000

**Provisional figures*

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

Correspondence. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Post Office Central Headquarters, 23 Howland St., LONDON, W1P 6HQ. Telephone: 01–631 2191 (editorial), 2193 (sales). Cheques and postal orders should be made payable to "The Post Office" and crossed "& Co.". The Giro account number is 535–1006.

The Data Modem that's proved in service

Many thousands of GEC 600/1200 baud Type TED 0136 Data Modems are already in service. This is a practical demonstration of the reliability *and* versatility of this equipment, for converting data pulse information into voice-frequency signals for transmission over a switched public —telephone connexion or via a private circuit, and re-converting received signals into data format. Features include:

- Two switch-selected speeds of operation: up to 600 bauds and up to 1200 bauds, the latter being generally possible over modern public switched telephone networks.
- Modulator and/or demodulator may be used for 600 or 1200 baud operation.
- 75 baud operation for return supervisory and control data.
- Complies with CCITT recommendations.
- Power supply: 190 to 260V 50Hz single phase, 18W.
- Dimensions: 178 mm (7 in) high, 345 mm (13.5 in) wide, 452 mm (18 in) deep.
- More data required? Write Transmission Division, GEC-AEI Telecommunications Limited, P.O. Box 53, Coventry, England.

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IB53


GEC links the world with microwave progress
AUSTRALIA • BAHREIN • CANADA • CHILE
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MALTA • NIGERIA • NORWAY • PERU
PORTUGAL • SABAH • SWITZERLAND
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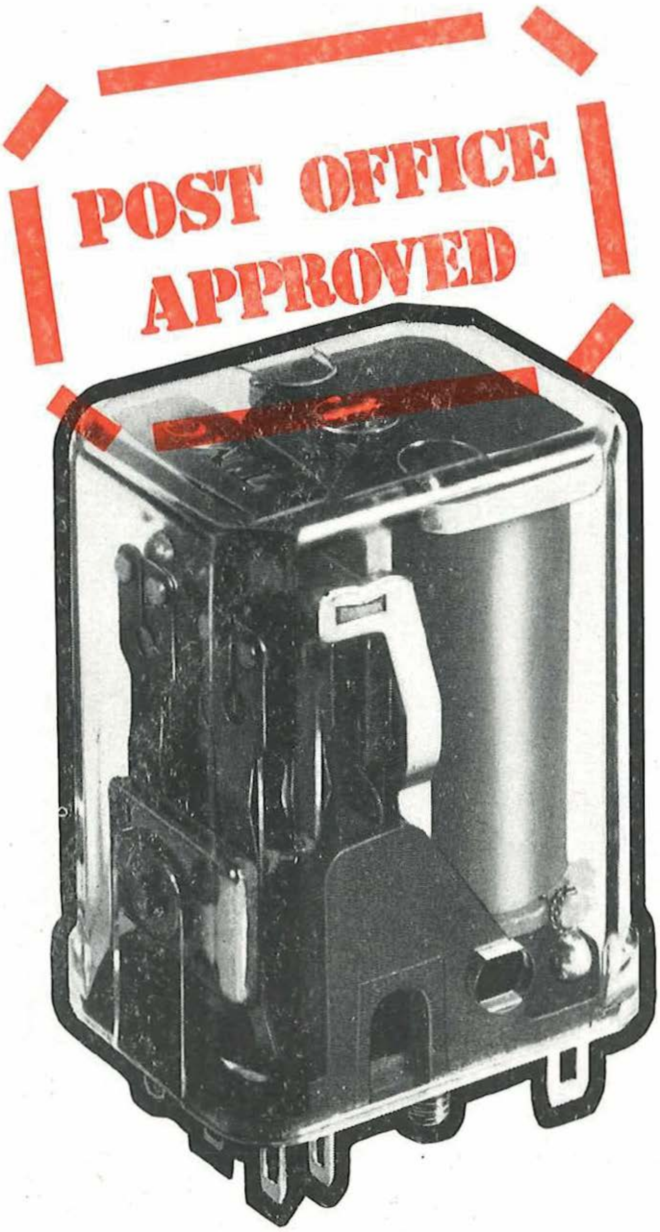
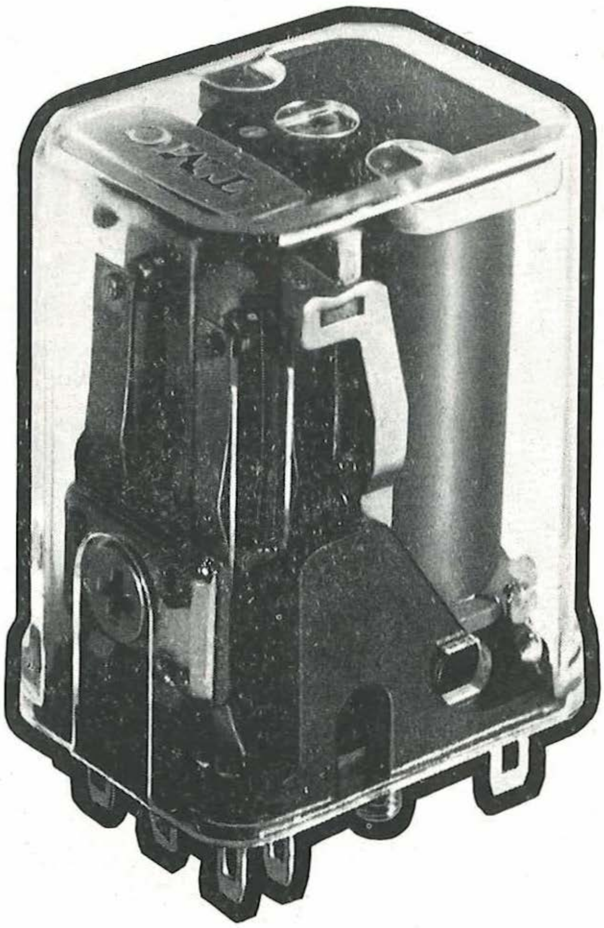
Broadband radio systems incorporating GEC microwave links are in operation in every continent in the world. The range of GEC microwave radio systems is impressive. It includes:-
● 2GHz, 4GHz, 6GHz and 6.8GHz equipments for speech or television on long haul main routes.
● 7.5GHz equipment for speech on medium haul spur routes.
● Associated equipments include F. D. Multiplex for up to 1800 circuits, supervisory alarm indication and remote control systems, I.F. and baseband switching equipments, narrowband auxiliary radio for serviceband antenna systems.
The achievement of GEC in the provision of microwave radio communication networks in so many countries of the world typifies their overall capability in telecommunications.



RELIABILITY WINS APPROVAL FOR TMC RELAYS.



Built-in reliability. That's what you get with TMC Relays.

A reliable, fully bridged mounting base—it's specially designed to prevent base distortion and fracture around the fixing screw.

A reliable, positive location for the cover at the end of the yoke, so the cover can be simply and quickly removed. Or refitted.

Large contacts (bifurcated for the twin contact relay), with reliable, high contact forces and extremely long, trouble-free life.

TMC Relays are available now for quick delivery. For full details and free leaflets, write to:

Telephone Manufacturing Company Ltd.
Components Division,
Roper Road, Canterbury, Kent
Telephone: Canterbury 66041

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a member of the Pye Group of Companies

The Dash Mounted Westminster has created a lot of talk

(the reasons are simple)

This front mounted solid-state radiotelephone operates in the VHF band from 25–174 MHz. Both AM and FM versions are available.
The transmitter power output of the series ranges from 5–15 watts (AM 5–8 watts; FM 12–15 watts) with 1–10 channels. Various other features include anti-flutter squelch, and an illuminated channel indicator.
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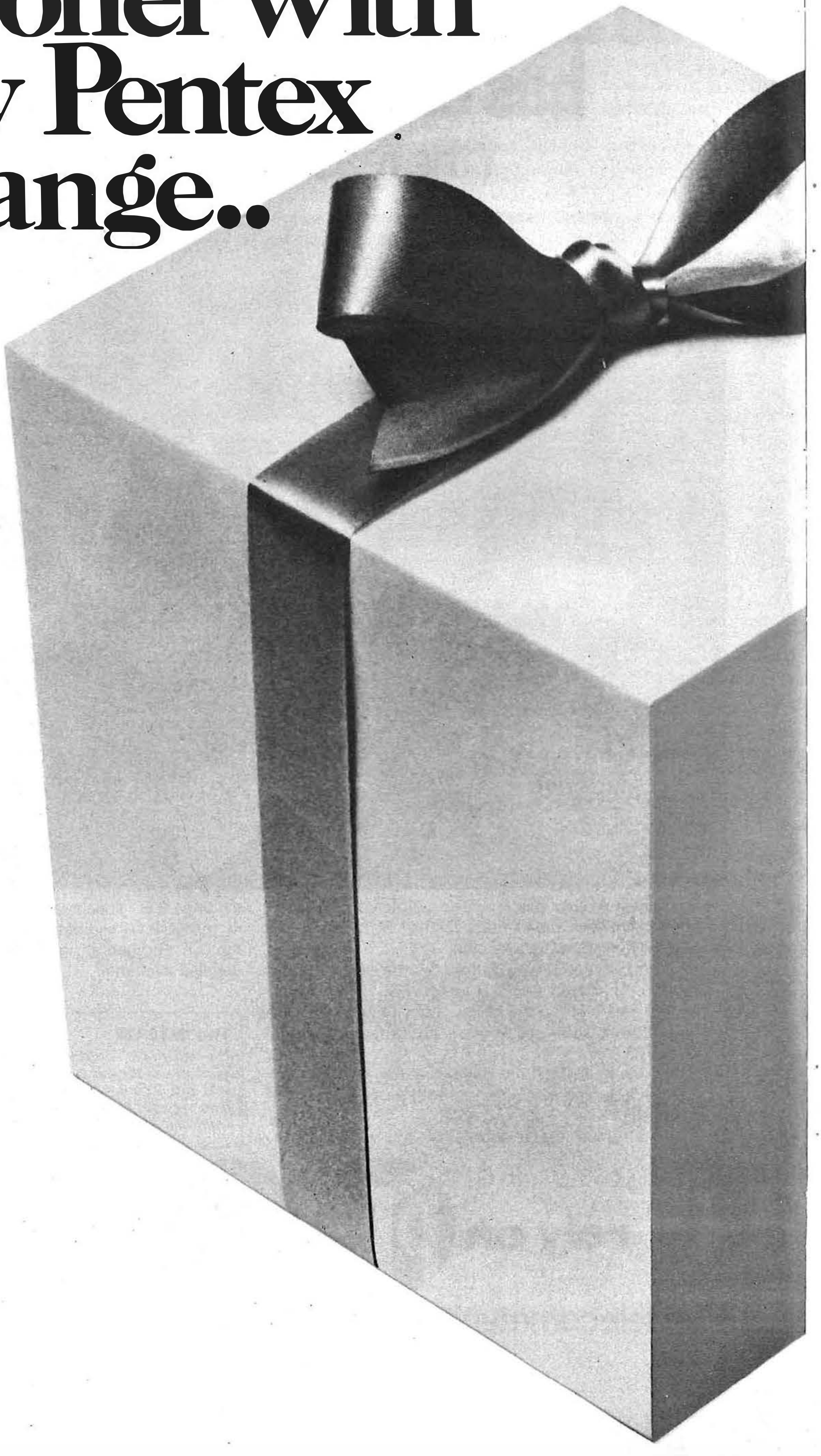

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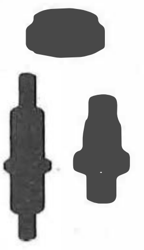

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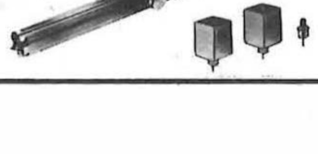

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