POST OFFICE

telecommunications

JOURNAL

ONE SHILLING AND SIXPENCE

WINTER 1965

... is four times as much as is necessary to secure the wire in:-

Painton Camblock Terminal Blocks

Painton Camblock Terminal Blocks achieve:

Better Wiring Time with ease of wire insertion and quarter turn cam replacing multi-turn screw connections. No grub screws to come loose and fall out.

Better Security of the wire, positively held against the busbar to withstand high vibration and shocks. Cams do not damage the wire, enabling many insertions and withdrawals to be made.

Better conductivity as individual strands become mechanically fused together, all carrying their share of the electrical load.

Small size enables maximum number of connections to be made in the minimum of space.

Painton Camblock terminal blocks are available in Medium, Miniature and Sub-miniature ranges, each with a variety of sizes in standard and feed-through versions.

Camblock Trade Mark U.K. and Foreign Patents.

For further information write for leaflet PCI.

Exclusive manufacturing and selling licensees for U.K. and Western Europe

PAINTON

Painton
& CO. LIMITED
KINGSTHORPE · NORTHAMPTON
Tel: 34251 Telex 31576 Grams: 'Ceil,' Northampton.

Australia Painton (Australia) Pty. Ltd. **Benelux** Painton S.A. **Germany** Painton G.m.b.H. **Italy** Painton Italiana S.p.A. **Sweden** Svenska Painton A.B. **U.S.A.** Painton Inc.

ARQ

Automatic error correction equipment type TEC.1

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

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

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

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

STC

Talking point

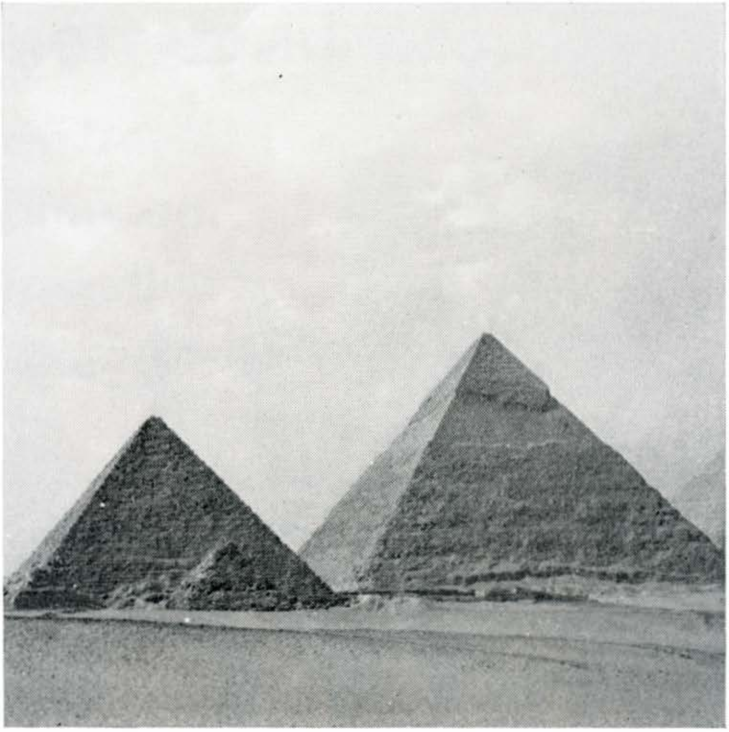
Design conscious but supremely functional—the new STC Deltaphone represents an entirely new approach to telephone design. A choice of restrained colours, lightweight handset, electronic tone caller with volume control, optional dial illumination, compactness . . . everything new!

The STC Deltaphone is particularly suited for use in homes, hotels, reception lounges and 'front offices', where harmony of design, functional elegance and prestige are essential. As well as its superb modern appearance, fit to grace any expensive service flat, the basic economies of space and effort give this new telephone utmost utility in offices and other business premises.

High technical specifications match the trend-setting symmetry of this truly new telephone.

Write for full details to Standard Telephones and Cables Limited, Telephone Switching Division, Oakleigh Road, New Southgate, London, N.11.
Telephone: ENTerprise 1234. Telex: 21612.

STC



High stability

As the pyramids are a symbol of stability in a changing world, so the RX.11-A receiver sets a high standard of stability among modern HF receivers.

The RX.11-A is a high-grade receiver for HF point-to-point communication.

Units can be incorporated to provide the following services: A1, A2, A3, A3A, A3B, A4, A7A, & B, A9B, F1, F4 and (to special order) F6. A frequency stability better than 1 in 10^7 per week is achieved by the use of a high stability synthesizer; alternatively, a 10 spot frequency crystal oscillator can be supplied where a lower order of stability is acceptable.

Local or remote control configurations can be supplied to suit the requirements of the individual user.

- ☐ Frequency range 2·4-30Mc/s.
- ☐ Single path or dual diversity for ISB/FSK operation.
- ☐ Fully transistorized.
- ☐ Local or remote control.
- ☐ Suitable for operation in tropical conditions.
- ☐ Meets C.C.I.R. recommendations.
- ☐ Tunes to within 1c/s by motorized a.f.c.
- ☐ Standard 19 in. cabinet.

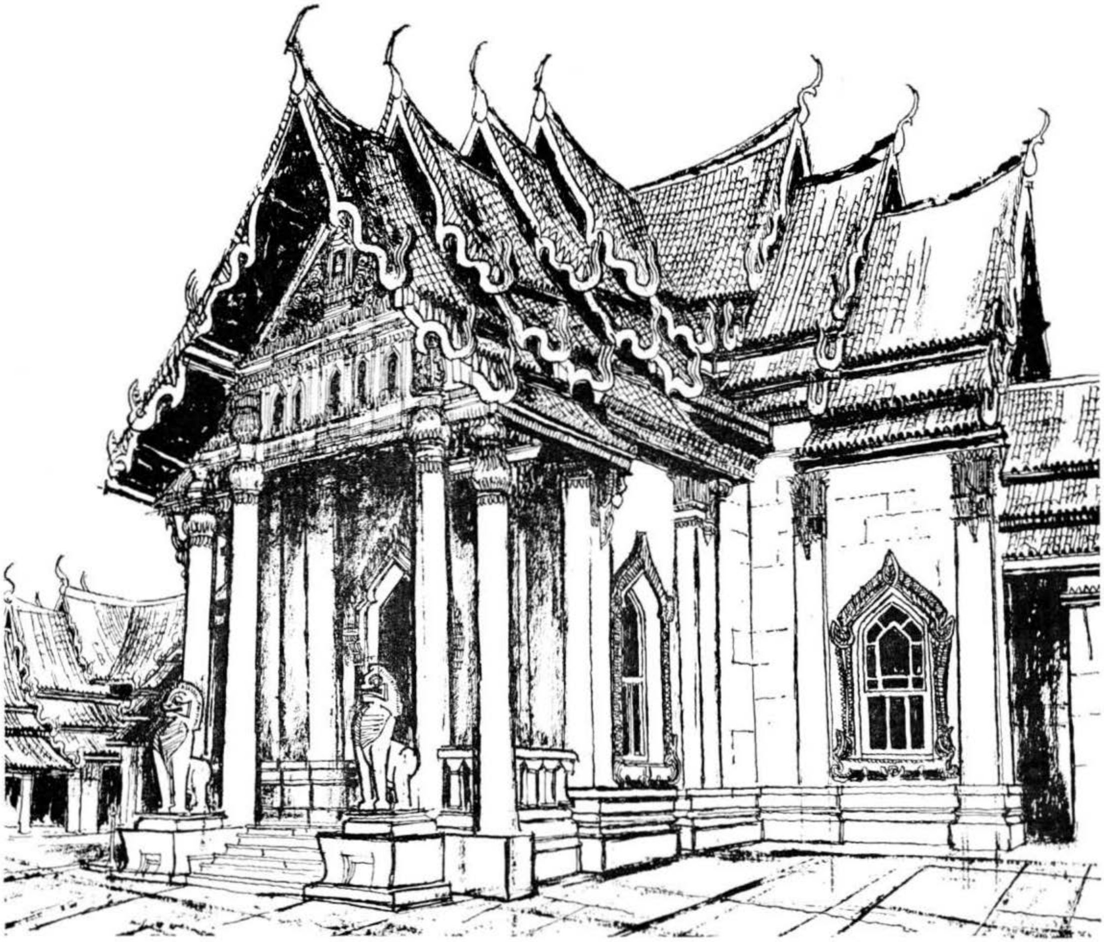
For further details, write, 'phone or telex Standard Telephones and Cables Limited, Radio Division, Oakleigh Road, New Southgate, London, N.11. Telephone: ENTerprise 1234. Telex: 261912.

world-wide telecommunications and electronics **STC**

65/19E

Marconi

COMPLETE TELECOMMUNICATIONS



WORLD-WIDE MODERNIZATION OF H.F. COMMUNICATIONS

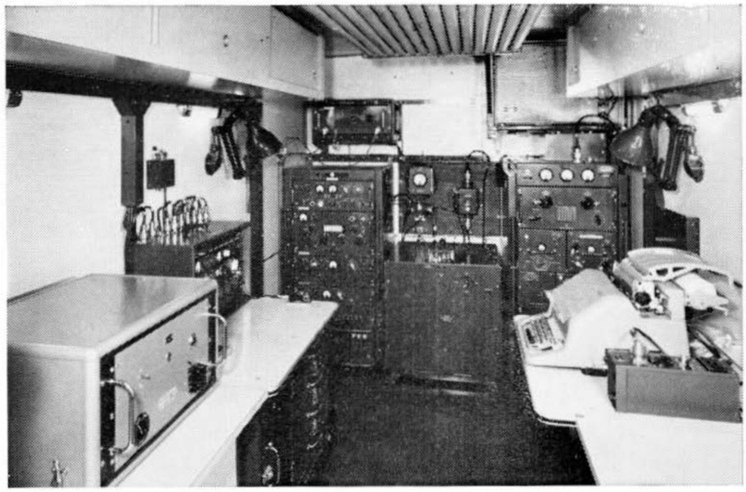
Aeronautical Radio of Thailand Ltd have ordered MST equipment to provide vital point-to-point air traffic control circuits between Bangkok's Don Muang International Airport and other major airports in South East Asia. MST is also being used in South East Asia for another important communications link, between Bangkok and Singapore.

In the twelve months since it was introduced, more than £2,000,000 of MST equipment has been ordered by the Royal Navy, the Portuguese Navy, Cable and Wireless Ltd, International Airadio Ltd, and Post and Telegraph services in Finland, Ghana, Greenland, Kuwait, and Portugal.

MST? One man control. Complete reliability. Reduced size. Rapid frequency changing. Smaller buildings. More traffic. Less staff.

SYSTEMS

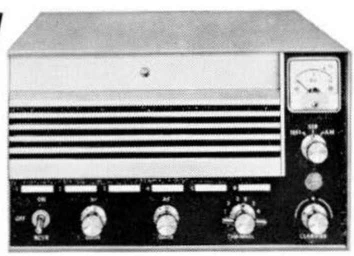
Surveyed
Planned
Installed
Maintained



MOBILE AND TRANSPORTABLE RADIO STATIONS

Over 700 complete, packaged, self-contained radio stations for medium and long distance h.f. communications have been supplied by Marconi's to the British Army, Saudi Arabia, U.A.R, India, Sudan, and to oil companies drilling in the North Sea. The radio equipment is designed for simple operation and stations are complete with all ancillary equipment to enable teleprinter and telephone communications to be rapidly established by unskilled personnel. Transportable shelters are custom-built to stringent specifications and installations are also built into a wide variety of vehicles.

NEW



100W H.F. S.S.B. TRANSMITTER/RECEIVER

The Marconi H4000 is a new transistorized transmitter/receiver for speech, telegraph, and facsimile fixed and mobile communications. 6 radio channels (1.5—15 Mc/s). Simplex or duplex operation. S.S.B. or compatible a.m. (d.s.b.) Tropicalized. Mains or battery operation. Low power consumption (receive 23W, transmit 228W). Compact $10\frac{3}{4}$ x 7 x $17\frac{3}{4}$ in. (273 x 178 x 350 mm.) Lightweight, 25 lb. (11.4 kg.)

AUTOPLEX FOR INTERNATIONAL TELEX

Much of Britain's overseas telex traffic is carried by h.f. radio. To supplement the 30 AUTOPLEX ARQ terminals already installed at their new London Radio Telegraph Centre, the General Post Office have ordered 24 more AUTOPLEX equipments to provide for further expansion of international telex traffic. AUTOPLEX not only makes it possible to use h.f. radio for telex but by enabling automation to be applied to the handling of radio telegraph traffic has also significantly increased the capacity of this busy Centre.

Marconi telecommunications systems

The Marconi Company Limited, Chelmsford, Essex, England

LTD/H62

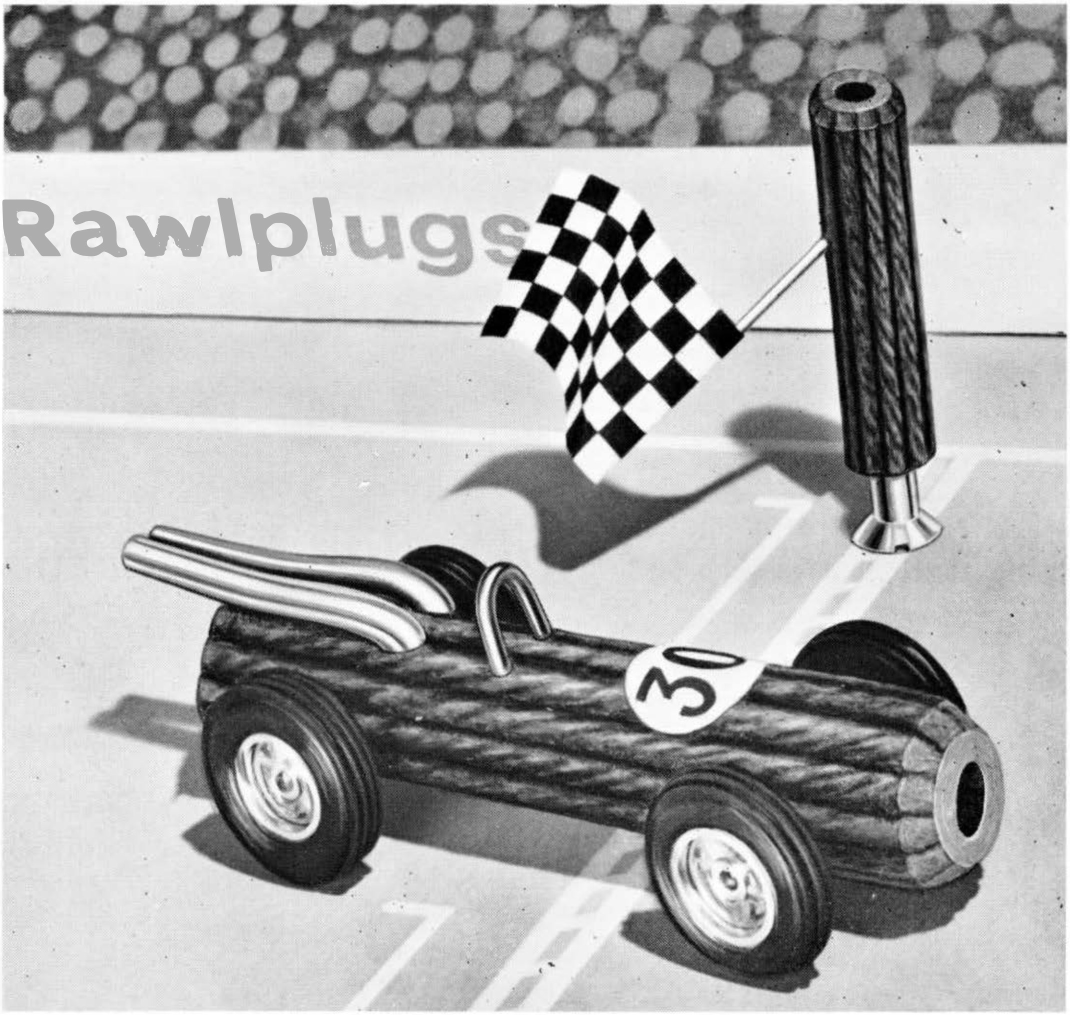
TELECOMMUNICATIONS CABLES

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

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

PIRELLI GENERAL CABLE WORKS LTD. SOUTHAMPTON TEL: SOUTHAMPTON 20381

P9315



Fastest time– every time

World Speed Record Holder and winner of all Reliability Trials, too—the famous Rawlplug production model. Ask any racing screw-driver and he'll tell you that the Rawlplug wins in any conditions—concrete, granite, brick, stone, slate, marble, even Silver-stone. With its terrific holding power it never loses adhesion, and no special skill is required to drive it. Drill the hole with Durium (world's fastest masonry drill) insert Rawlplug and screw and tighten up. There are 69 different sizes to take screws up to ⅜in. coach-screw. There are other models in the team which shine in extreme conditions. Technical representatives—for these and *all* the Fixing Devices and Tools in the Rawl Range—are at your service on request.

RAWLPLUG SCREW FIXINGS

B893

MADE BY THE RAWLPLUG COMPANY LIMITED · CROMWELL ROAD · LONDON S.W.7.

TELEPHONE CABLES

the makers with... **experience** 1837-1965

techniques paper–polythene–moisture barrier–water block–coaxial

capacity audio–1,500,000 pair miles a year
coaxial–5000 tube miles a year

current export orders exceed £7,000,000

CABLE · PLANNING · INSTALLATION

TELEPHONE CABLES LIMITED · DAGENHAM · ENGLAND

Post Office Telecommunications Journal

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

Contents

★

Vol. 17 *Winter* 1965 *No.* 4

Telecommunications and The National Plan

ASSUMING a 25 per cent increase in gross domestic product, the Telecommunications Services section of the National Plan, which is predominantly Post Office, forecasts that output (expressed as income at 1964 prices) will rise from £368 million in 1964-65 to £685 million in 1970-71; investment will increase from £180 million to £319 million; and that manpower will rise from 210,000 to 218,000.

These figures represent average annual increases of about 11 per cent in output and 10 per cent in investment. Under the effects of mechanisation, the more effective deployment of staff and higher output allowing for some economies of scale, the average annual increase in output per head for all staff is about 10 per cent. The Plan shows that Post Office investment is expected to grow at a faster rate than for nearly all nationalised industries.

We have grounds for satisfaction that the importance of our services and the magnitude of our task should be so recognised. We can also be reassured by the fact that, in present circumstances, telecommunications should be able to embark on such an unprecedentedly high programme.

We have achieved more than was previously forecast while holding basic tariffs, paying our way, earning our due return and increasing our productivity. But there is no ground for complacency. We can only expect such a share of national resources if we continue in these directions.

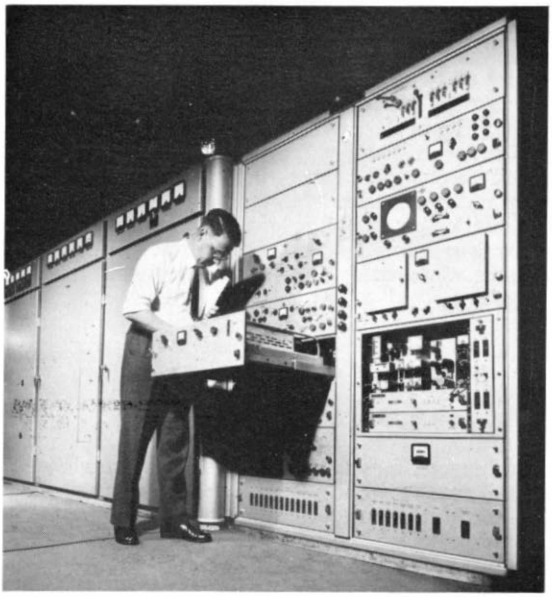
We face the challenge of accomplishing what has been forecast and, as the Plan points out, there will be difficulties. Resources within and outside the Post Office will be stretched to capacity in the next six years and demands on the building industry and on manufacturers of telecommunications equipment will be particularly severe.

The enhanced programme will, inevitably, take some years to overcome the backlog of plant shortages resulting from exceptionally high levels of demand and traffic and to provide for present and future growth. Our first consideration, therefore, must continue to be to improve the quality and efficiency of the services, including the connection of new subscribers. But, to the extent that these conflict, the connection of new subscribers must take second place. While we should continue to aim at a considerable improvement in the speed of meeting the customers' requirements, we cannot realistically expect to meet demands everywhere as they arise. For some exchanges increases in waiting lists will be inescapable before they can be finally eliminated.

TO PROSPER — COMMUNICATE

By Norman Manners

"Radio and electronics have opened new avenues of exploration which will fundamentally affect our way of life . . . shrinking distances and operating speeds to a scale not even Galileo could have conceived. Electronics is the key to the future . . . and dramatic and exciting development lies ahead for British scientists, engineers and industry . . ."



One of the 12 Marconi 25 kW ultra high-frequency television transmitters ordered for the 625-line BBC-2 service is put under test before installation. The UHF system is to serve the whole of Britain.
Picture: Marconi Co. Ltd.

COMMUNICATIONS is as much a vital part of any society as public health. Today it has become a complex but crucial factor in every sphere of life—in political, strategic, economic, industrial, commercial, scientific and even private affairs. Nations will compete to achieve new standards in methods of communications and invest vast sums of money in their development. And it is significant that the most practical benefit of space research so far has been in this field.

But, first, what precisely is meant by communications? It covers, of course, every conceivable form of communicating information whether it be "top secret" military intelligence transmitted in code; scientific data by means of telemetry; news in the local paper; a simple domestic call by telephone to the grocer; advanced control systems; or the retrieval of technical information from a research library. All these and many more go to make up the ever-increasing number of communications techniques.

Primarily, however, good communications are vital to effective government. . . . No economy can expand without communications. Yet we see already a serious paradox developing. With improved knowledge and techniques we are learning to communicate more quickly but not always more efficiently. Many modern systems are misused, which frequently results in information being transmitted often unnecessarily, and certainly more freely and in greater volume than ever before. Some serious observers predict a situation not too far ahead in which people will surely face a real risk of being entirely submerged by their own proliferation of information.

It is not simply enough to develop and provide improved means of communication. We must simultaneously develop an entirely new philosophy —and a new set of techniques—in how we use these systems and in *what* we transmit. Despite our greater technical ability and these improved facilities we must have an economy of communication.

From the runner and the pony-express we have evolved to telegraph, telephone and now television

This article is reproduced by permission of ELECTRON, the new journal of British electronics, which aims to show some of the ways in which electronics are serving industry, commerce and government throughout the world.

via man-made satellites in space. And so the purely mechanical processes of communication . . . have been overtaken by radio and electronics.

In fact, it is in these science-based fields that the greatest progress—and possibly the most glittering prizes—will be found. First, radio and now electronics have opened entirely new avenues of exploration which will fundamentally alter our way of life.

Radio and telephone communications, hand-in-hand with the aeroplane, have already bridged the gaps that physically divide the world. And now radio and electronics . . . are shrinking distances and operating speeds to a scale which not even the imagination of Galileo could have conceived.

Electronics is the key to the future. Here is a branch of science and technology that has been efficacious in its effect on modern evolution—and now there can be no doubt that electronics will be the barometer of future progress and success.

In two vitally important respects Britain stands in the forefront of communications endeavour and experience. Not only has Britain traditionally and historically been first in the field with a number of outstanding scientific successes . . . but the nation's administrative and technological skills have been sharpened by field experience in many parts of the world. . . . This has given British scientists and engineers what is probably a unique practical outlet and opportunity for their inventive genius and placed the industry in a predominant position technically.

Today in this field Britain can justifiably be regarded as the world's major shop-window.

Britain is in the forefront as an exporter of telecommunications equipment—and this results largely from sound research and development programmes in which the Government, the universities and industry all share. Notable is the work of the National Electronic Research Council under Lord Mountbatten, and of the Electronic Engineering Association; and a practical example is the co-operation between the British Post Office and the equipment manufacturers.

Currently, the British industry is able to provide world-buyers with all three major telephone

A frogman comes ashore after checking the Vancouver Island shore-end of a section of the Commonwealth Pacific Cable (COMPAC).

Picture: Standard Telephones and Cables Ltd.

systems but in looking to the demands of the seventies, eighties and nineties of this twentieth century we can see already a trend towards entirely new systems employing electronic switching techniques.

Electronic telephone switching is being developed jointly by the industry and the British Post Office under the aegis of a collaborative body called the Joint Electronics Research Committee. Already, their work has resulted in the practical development of a small electronic system. . . . Eventually, of course, electronic switching systems will replace many of the older electro-mechanical exchanges in Britain.

In these conventional communication systems the British electronics industry, with an immense background of experience, is still very much a world leader.

OVER

The new aerial at the Post Office satellite communication earth station at Goonhilly which combines the technical skills of a number of electronics manufacturers.

TO PROSPER—COMMUNICATE (*Contd.*)

But the dramatic and most exciting developments of the future will be found in less traditional areas. Space research and technology has already seen the emergence of communications satellites *Telstar* and *Early Bird*. And . . . a great deal of pioneering experience has been gained through the work of the British Post Office at its satellite-tracking station at Goonhilly, at the Radio and Space Research Station at Datchet and, of course, at the world-famous radio-astronomy observatories at Jodrell Bank and Cambridge.

All this work has had the support and co-operation of the British electronics and telecommunications industries—and in this way they have been kept in the van of progress. Their contribution in the design, development and manufacture of components, equipment and systems has led to important progress in basic standards—and there is no doubt that Britain's part in the collaborative space research and launching programmes in Europe will give opportunities for further development.

In communications generally the glamorous aspects should not be allowed to overshadow the more mundane, day-to-day achievements. In components and materials, for example, the British electronics industry has made a major contribution based on the underlying philosophy that the excellence of component technology will inevitably dictate the rate of progress in equipment and systems development. Therefore government and industry work closely together in strenuous programmes of research and development and environmental testing. The Ministry of Aviation's Royal Radar Establishment stimulates a good deal of this work.

It is no coincidence that Britain, with its outstanding research and technology record, has produced some of the leading manufacturers of communications equipment and components in the world. . . .

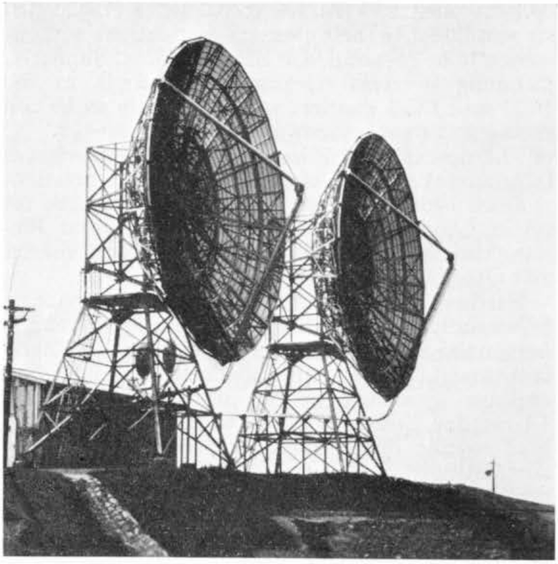
Technical enterprise has led to a number of important developments and recently we have seen in the British "shop-window" some remarkable applications of this technology. For example, large commercial organisations with a chain of branches face delays in getting business data to a central computer. The National Bank of Scotland overcame this problem recently with a communications network based on a medium-speed data transmission system to transmit branch account data to its computer in Edinburgh over the normal Post Office network.

When the first "live" transatlantic television transmissions began through the communications satellite *Early Bird*, three British television cameras were used to provide a direct television link between the Leader of the House of Commons and the Leader of the American Senate at the centres of government in London and Washington.

The television signals were converted to the American 525-line standard by the BBC in London, and then sent by land line to the GPO satellite communications station at Goonhilly.

Another British company has produced a new type of tunable magnetron . . . designed to provide the rapid and yet simple controlled frequency jumping required by diversity radar systems. Two versions both in the X-band frequency range are being marketed initially.

Frequency diversity radar systems, using the new "spinning magnetron," have the ability to change frequency between each pulse and . . . give superior range and target resolution, greatly improved resistance to jamming, and the capability of electronically scanning the radar beam.



The "autospec" system, developed by the Marconi Company, is used in this radio communications network in South Korea to detect and correct errors in radio transmissions—for broadcasting, teleprinter channels, microwave communications and so on. Picture: Marconi Co. Ltd.

A new system has been developed to provide the central office of Shell International Marine Ltd., with immediate data for day-to-day hull and engine performance figures from their tankers. The makers claim that the system achieves rapid automatic transmission, on high frequencies, direct from the ship anywhere in the world to the GPO radio station at Bearley, Warwickshire, or to the Dutch PTT station at Scheveningen. The signals are then sent on by land line to the Shell Centre, London.

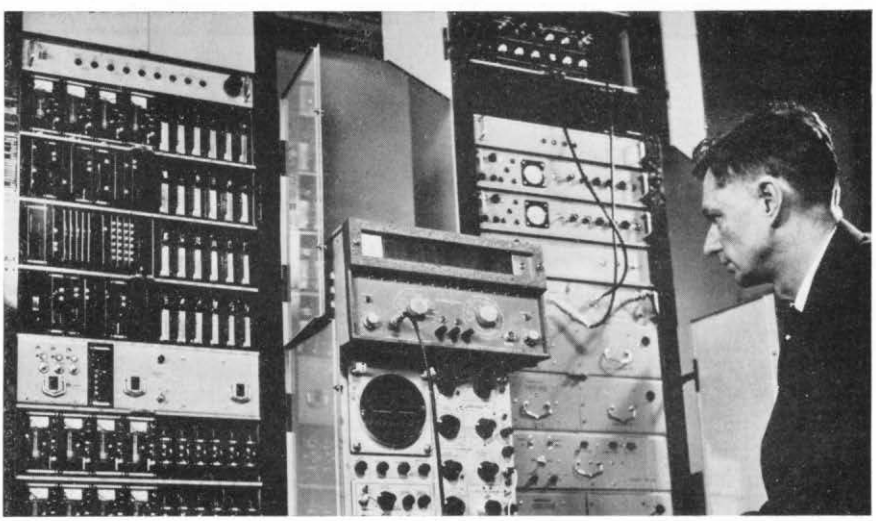
. . . Speed-up of railway traffic is being achieved by the installation of supervisory remote control systems which enable engineers to monitor and control electric traction power over large sections of rail. A new British system, now being installed, will cut the journey time from London to Liverpool from the present 3 hours 45 minutes to 2 hours 35 minutes. The mimic diagram for this project . . . consists of 50,000 mosaic tiles which contain the controls, indicators and diagram elements. . . .

Another British company has installed the microwave radio relay system which provides more than 150 telephone channels between York, Darlington and Newcastle, and will form part of the London-Glasgow link.

Radio equipment for the 3,300-mile Montreal-Vancouver microwave communication link . . . includes British developed and manufactured travelling wave tubes. . . .

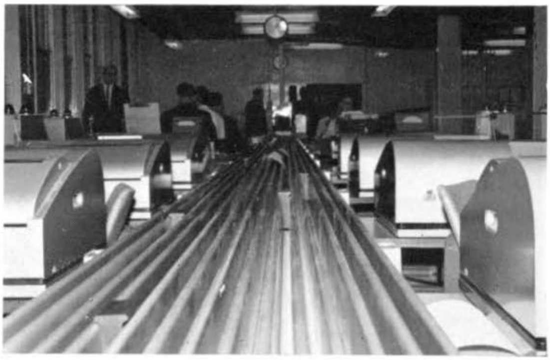
Other fields of endeavour being explored in Britain are in "lasers" (able to generate an intensely powerful and narrow beam of light, which, when modulated like a radio wave, can be used as a communication medium); in the use of broad-

OVER



Electronics also enables greater use to be made of existing communications systems. Shown here being tested after installation in a trunk exchange is pulse code modulation equipment which permits 24 channels to share simultaneously one pair of wires.
Picture: Plessey Co. Ltd.

SPEEDING THE OVERSEAS TELEGRAMS



Close-up of the multi-track conveyor belt which delivers messages to the teleprinters at the forwarding positions.

THE opening by the Assistant Postmaster-General, Mr. Joseph Slater, BEM, MP, on 28 October, of a new Overseas Telegraph Area Office in the City of London marks another step forward in speeding and improving the Overseas Telegraph Service, particularly for the 10,000 or so business firms which have their offices in the EC 1 and EC 2 postal districts of London.

The new office—at Falcon House, Aldersgate Street—has its own counter for receiving telegrams by hand; a staff of messengers to collect and deliver telegrams; 22 teleprinters and 28 phonogram positions for accepting and delivering telegrams by telephone, telex and private wire; and 32 teleprinters for exchanging traffic with overseas countries.

Most telegrams handed into Falcon House will be sent direct to their overseas destinations without having to be re-handled at Electra House. Similarly, incoming overseas telegrams for people in the EC 1 and EC 2 districts will go directly to Falcon House and then be sent to their addressees.

The new office will handle about 5,000 overseas telegrams every day—about 2,500 in each direction.

Since 1964 three new area offices have been set up in London and six in the provinces—at Birmingham, Bristol, Bradford, Liverpool, Manchester and Glasgow.

Further to speed and improve the service, a fourth office to serve the EC 3 district of London is planned for completion by the end of 1967. By that time it is hoped to install a new semi-automatic message switching system in Cardinal House, Farringdon Street, London, which will be able to read routing instructions for every telegram and automatically send them to their correct overseas destinations.

The "unpacking" point, where delivery instructions for 7,200 addressees are printed on the messages and envelopes.

TO PROSPER—COMMUNICATE (*Concluded*)

band waveguides and of co-axial techniques; of push-button dialling; of pulse-code modulation techniques to increase the capacity of existing telephone cables, and even of sophisticated video telephone systems in which callers will be able to see one another.

In information retrieval, too, research goes on. Computer techniques are being examined to produce efficient and rapid systems of handling the ever-increasing flow of technical information. Nine out of every ten scientists who have ever lived are living today—a fact which helps one begin to grasp the enormity of this problem of communicating information. Obviously, it is essential if industry is going to reap the benefits of original and advanced work by the scientific research laboratories.

This is a challenge of communications techniques which Britain has the ability to solve. . . . British engineers with their unique experience of working throughout the world have the ability to meet highly specialised demands. They do not expect overseas buyers to want only what they have "on the shelf." On the contrary, they want to utilise their skills to produce purpose-built systems and equipment for overseas use.

Britain's electronics industry is confident in facing this challenge. It knows it can supply what the customer wants—at the right price and at the right time. It will urge the overseas buyer to do more than just look through the "shop-window." It will invite him to come inside and see for himself.

Playing a valuable role in the exciting quest for oil and gas believed to be trapped beneath the North Sea are the Post Office telecommunications links

Keeping the Searchers in Touch

By W. M. DUNELL, Grad. IERE.

THE Post Office is making a valuable contribution to the day and night search for the oil and natural gas which is believed to lie hidden below the bed of the North Sea—perhaps as deep as four miles beneath the waves. It is providing the all-important telecommunications links between the drilling rigs and their shore-based offices and between these points and the supply ships.

When, in the summer of 1964, licences were granted to 23 commercial firms to explore for oil and gas under the North Sea, the Post Office was asked to propose a scheme for a communications system to meet the needs by May, 1965, of up to 15 drilling rigs operating simultaneously within 200 miles off the east coast and which would need to change their positions from time to time.

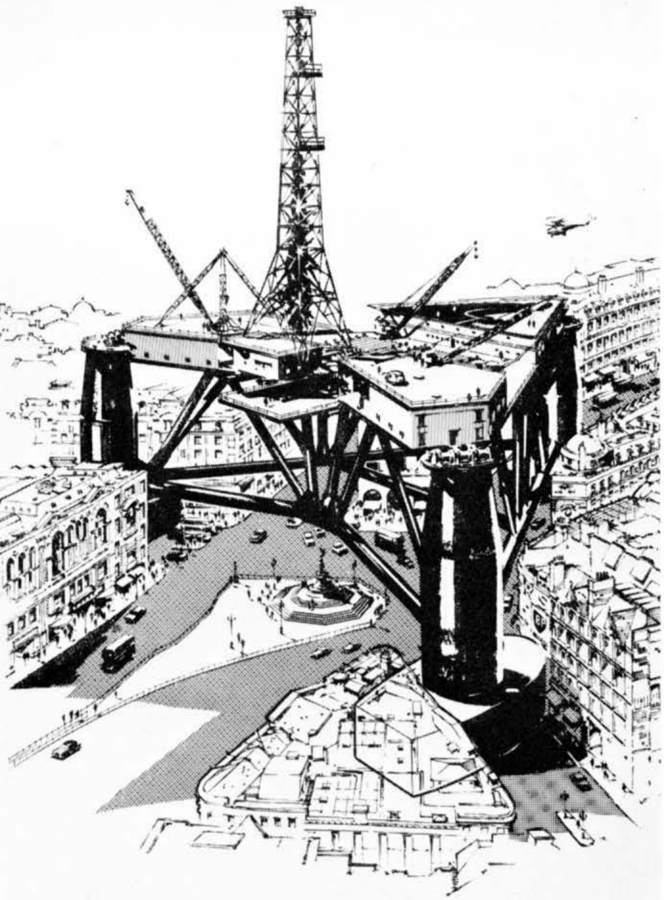
This posed the problem of devising a system of some considerable magnitude at very short notice. It was immediately clear that radio would be the only practicable communication medium and that established techniques and readily available equipment would have to be used.

At first, the oil companies specified an exclusive and reliable telephone circuit between each rig and its shore-based office but this was found impossible to provide. The North Sea is one of the most congested shipping areas in the world and the maritime band between two and four megacycles—the only practical frequencies for reliable communication over distances up to 200 miles—is already very extensively used. While it was possible for the supply vessels to join in the normal ship-to-shore radiotelegraph and radiotelephone services it was impossible to provide exclusive circuits to even two or three rigs, much less 15.

It was decided, therefore, that the best solution was to use radioteleprinters with a protected telegraphic code and radio modulation within the

OVER

This is **Sea Gem,** *British Petroleum's giant drilling platform which struck a pocket of natural gas off the mouth of the Humber.* **Sea Gem** *weighs 5,600 tons and is 247 ft long.*



An artist's impression, to scale, of* Sea Quest, *a new semi-submersible drilling barge to be built for British Petroleum, shown superimposed on Piccadilly Circus. When completed by the end of 1965 it will be the biggest single piece of oilfield equipment built in Britain.

As the *Journal* went to press British Petroleum announced that its drilling rig *Sea Gem*, operating some 40 miles east of the mouth of the Humber, had struck a pocket of natural gas after drilling nearly two miles into the sea-bed. It was too early to say, however, whether the find could be regarded as commercial. *Sea Gem's* discovery was the second in just over a week.

Methane Gas, which may be in large quantities under the North Sea, could be funnelled into Britain's national grid system to provide the cheapest gas so far available.

The 23 companies which have been granted concessions to explore for North Sea oil and gas are expected to spend about £100 million in the next six years. The most likely areas in which the biggest strikes may be made, say the experts, are off the east coast between Middlesbrough and the Wash and off the Scottish coast between Aberdeen and Dundee.

smallest possible bandwidth. By using independent sideband suppressed carrier transmission it would then be possible to provide a multi-channel radiotelegraph system on one sideband of one of the two available pairs of frequencies in the 2-4 megacycles maritime band. The other sideband and both sidebands of the other pair of frequencies could then be used for three radiotelephone channels which could be shared by all drilling rigs.

Each drilling rig could then have its own teleprinter circuit by way of one channel in the multichannel radiotelegraph system to the coast station and thence by private wire to its shore base and would also have access to the public telephone service via one of the radiotelephone circuits, rather in the manner of party lines.

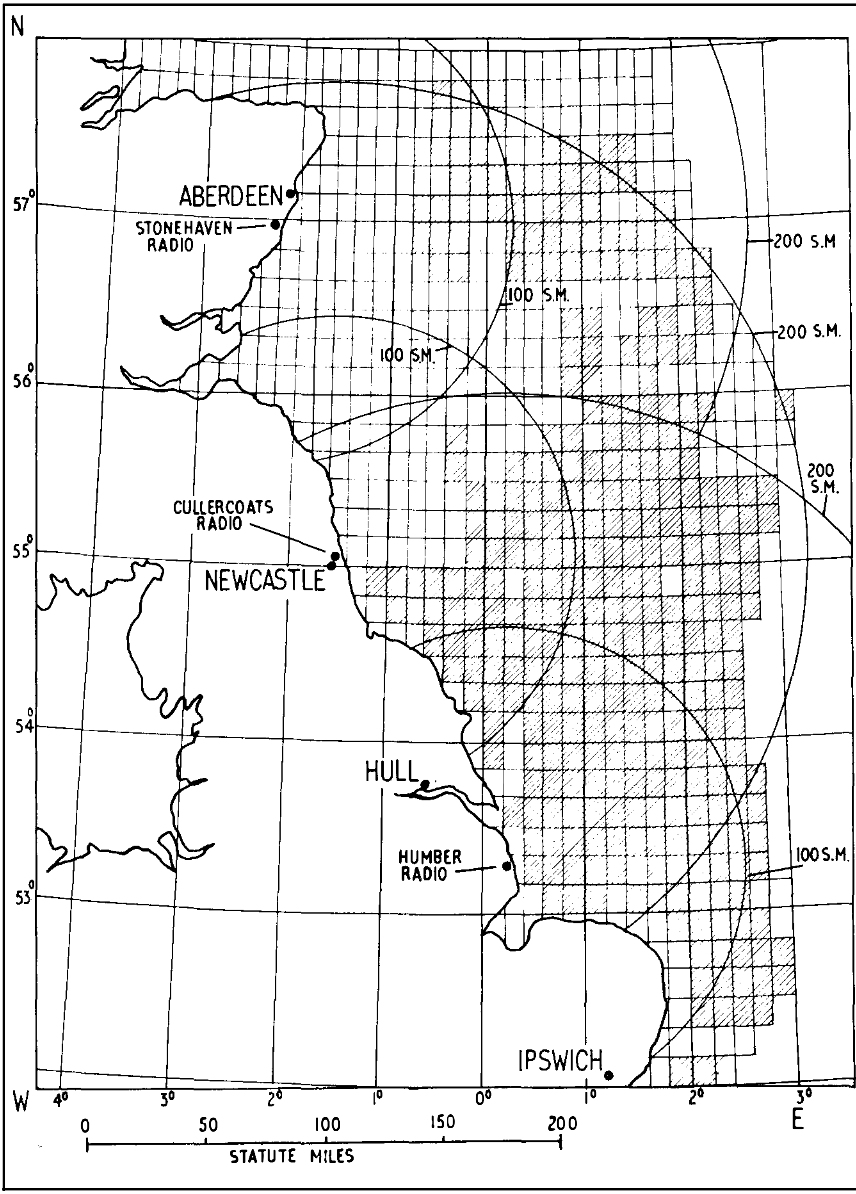
At Humber Radio—the first station to be equipped—independent sideband transmitters and receivers were provided together with VF and error-correcting equipment for the radioteleprinter circuits and radiotelephone terminal equipment for use on one of the available pairs of frequencies. The upper sideband accommodates 15 radioteleprinter circuits while the lower sideband is used for a radiotelephone circuit.

As the oil drilling rigs came into operation they were each allocated a circuit in the upper sideband VF system and private wire connections were provided between Humber Radio and their shore bases.

The next stage was to equip Cullercoats Radio for two radiotelephone circuits on the other pair of available frequencies. The exclusive radioteleprinter circuits are unattended at the coast station except for daily routine monitoring, but the shared radiotelephone circuits have to be guarded continuously by radio operators at both Humber Radio and Cullercoats Radio.

The final stage was to install independent sideband transmitters and receivers, error-correcting equipment and VF equipment at Stonehaven Radio to provide 15 radioteleprinter circuits as at Humber Radio. Stonehaven has the same carrier frequency registration as Humber but since the

This diagram of the area in which the search for oil and gas is being carried out shows the ranges which can be reached from the Post Office's coast radio stations. The permissible search area is divided into blocks of 100 square miles each and the shaded blocks are those allocated to various oil companies for exploration.



VF channels in the multi-channel radiotelegraph system are allocated individually to oil drilling rigs, a rig moving from the Humber to the Stonehaven area will continue to use its own VF channel. Thus, the circuits working through Humber Radio at any given time will be interleaved with those through Stonehaven Radio and there will be no interference between them. It is not possible, because of interference with Humber Radio, to use the lower sideband at Stonehaven for a further radiotelephone channel.

For safety purposes the drilling rigs are regarded as ships and are also equipped with conventional

OVER

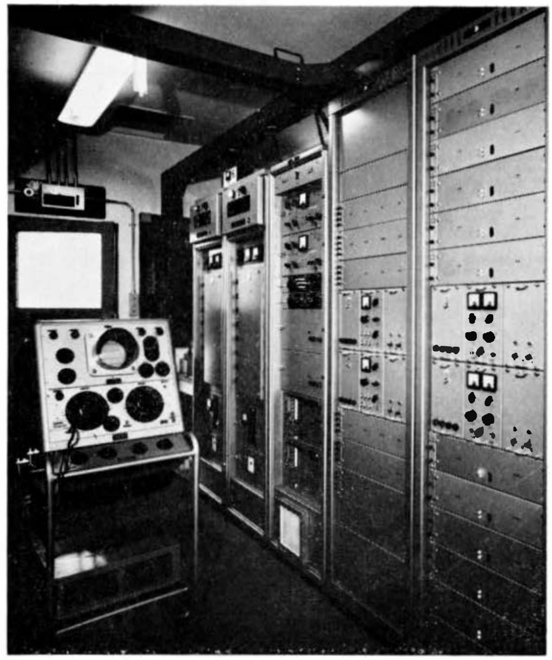
NORTH SEA SEARCH (*Concluded*)

ships' radiotelephone equipment for communicating with coast stations on the normal shipping frequencies and, in an emergency, calling for help on the international distress frequency. This equipment is also used for speaking to the supply vessels while they are on passage between the shore and the drilling rig.

The radioteleprinter system used in this new communications network employs established frequency-division multiplex techniques but in novel conditions. The experience which will be gained from it will be valuable in meeting other maritime telegraphic communication requirements which may arise in the not-too-distant future.

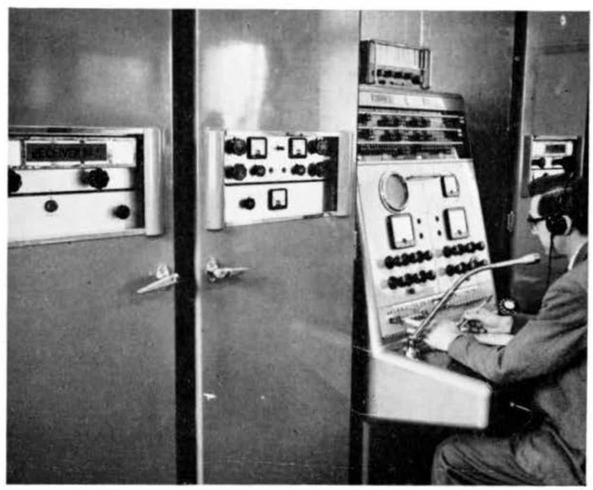
THE AUTHOR

MR. W. M. DUNELL, Grad. IERE, *entered the Wireless Telegraph Section of the Radio Services Department in 1939 after five years as a Radio Officer in the Merchant Navy. His first appointment was as Radio Operator at North Foreland Radio. He is now a Radio Superintendent with the Planning and Development Duty of the Wireless Telegraph Section.*



Above: A view of the single-sideband transmitters and channelling equipment at Humber Radio station in use on oil rig radio-teleprinters and radio-telephone circuits.

Part of the error detecting and correcting equipment which is being used on the radio-telephone circuits with the oil rigs.



Above: An operator at work on the console controlling the single-sideband radio-telephone circuits between Humber Radio station and oil rigs. Similar equipment has been installed at Stonehaven and Cullercoats radio stations. Drilling rigs also have conventional ships' radio-telephone equipment for communicating with coast stations on normal shipping frequencies.

THE PROBLEM OF CLOSING THE GAP

Polythene sheaths for cables have many advantages—but they present one big problem: how best to joint them. The Post Office and manufacturers have experimented with a number of methods and found the answer

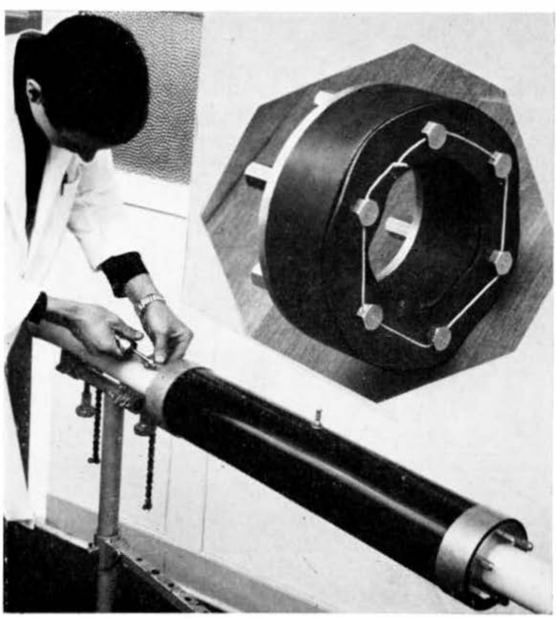
By W. C. WARD, BSc (Eng), MIEE

THE protective coverings of the underground cables containing subscribers' lines are now made of polythene instead of lead. The new material is very much cheaper and, because of its light weight, renders installation very much easier. But it is very difficult to make anything bond securely to polythene and because of this the jointing problem has been difficult to solve.

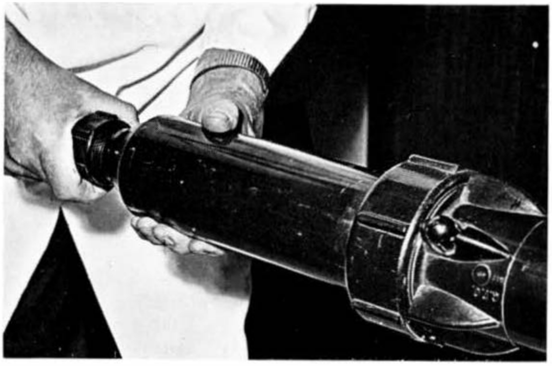
When two lengths of cable have to be jointed, the protective sheathing on each length of cable has to be removed for a distance such that the insulated wires are exposed and, after all the wires have been jointed, the gap between the two sections of sheathing has to be restored in such a manner that the joint is air- and water-tight.

One of the first successful methods, and one which is still being widely used, is a mechanical system devised by Post Office engineers using a device known as the Expanding Plug Joint. This joint makes use of a circular rubber plug which is compressed between two metal plates by bolts passing through the complete assembly. The assembly is an easy fit into the sleeve which covers the joint, and has holes through which cables are passed. When the bolts are tightened, the rubber plug expands radially and closes the gap between the cable sheath and the sleeve. A variety of sizes is used to cater for differing sizes and combinations of cables, and this is a disadvantage because a large number of items has to be kept in

OVER



One method, which has done yeoman service, is to use an expanding plug joint. In these two pictures, an engineer tightens the nuts on a single-ended (left) and a double-ended (below) plug joint. The tall nut in the centre of the single-ended joint contains a valve for measuring air pressure in the cable.



Above: Screwing up the cupped nut on a moulded polythene sleeve. This method was developed by the Post Office and a manufacturer. Right: Molten polythene is injected into a perspex mould to make an injection welded joint.

CLOSING THE GAP *(Contd.)*

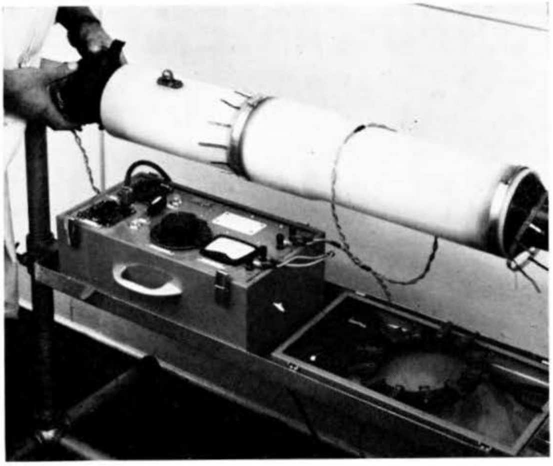
stock and has to be carried by jointers. If, for any reason, a jointer arrives on the job without the correct type of Expanding Plug, costly delay can ensue. Also, when a large cable divides into a number of smaller ones, special arrangements are necessary to cater for the mutiplicity of expanding plugs involved.

Nevertheless, this type of joint has done yeoman service in the Post Office system and is likely to continue in use for a considerable time.

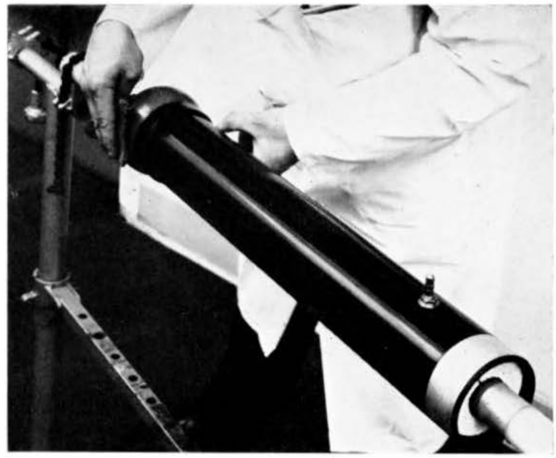
Another mechanical system of closing the jointing gap which was developed jointly by the Post Office and a manufacturer, employed a moulded, shaped polythene sleeve with a cupped polythene nut at either end. The cupped nut, when tightened, compressed a rubber sealing ring onto the cable sheath and effected a seal. As with the Expanding Plug joint, a variety of types was necessary for different sizes of cable and joints where large cables divided into a number of smaller ones were difficult to cater for.

The cable manufacturers have experimented with a number of systems relying on the fusion of polythene under controlled heating processes. One of the more elegant of these is the injection welding system, which involves passing molten polythene round the ends of the sleeve and the cable sheath to weld them together. When the diameter of the sleeve differs greatly from that of the cable, a polythene adaptor is used to bridge the gap between them. The molten polythene is injected into a perspex mould by an injection gun heated either by electricity or by gas. After the mould is filled, injection continues until the surplus molten polythene appears through a discharge hole in the base of the mould. The gun is then removed and pressure is applied to the molten polythene until it is cool after which the mould is removed, leaving the polythene in place. The system requires moulds of various sizes and special arrangements are necessary for spur joints.

Another method relying on the fusion of hot polythene is the electrical welding method, which makes use of polythene adaptors which are welded to the cable sheath and to the sleeve. A cylindrical wire mesh electric heater is inserted between the cable and adaptor and a similar, but larger, heater is placed between the adaptor and sleeve. A neoprene tape, to which is attached a wire mesh electric heater, is then wound over the adaptor or sleeve at the point where they are being heated. This softens the polythene of the adaptor or sleeve and at the same time applies a steady pressure to the joint while it is cooling. As with the other systems described, a variety of parts is



Making an electrically-welded joint using wire-mesh electric heaters.



Putting the finishing touches to a Post Office resin putty joint.

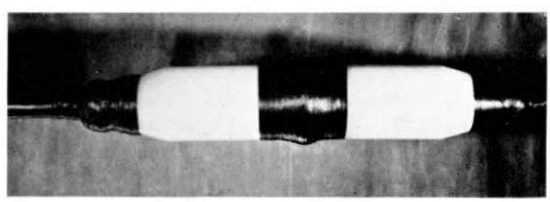
required to cater for cables of various sizes, and special arrangements are necessary at spur joints.

Another method developed by a manufacturer, but using a different principle, is the resin-wrap joint. This employs a divided polythene sheath which tapers down to the cable sheath at each end, or else employs an ordinary polythene sleeve with cast epoxy resin plugs to fill the space between the sleeve and the cable sheath. A polythene mesh tape impregnated with liquid epoxy resin is wound round each end of the sleeve and the cable or plug. This system also requires a variety of parts and special arrangements to cater for spur joints.

Although some of the foregoing systems have proved satisfactory in service, they all leave much to be desired when considered for long-term use by Post Office personnel, in view of the number of piece-parts that have to be stocked and carried and to the difficulty of making spur joints, particularly on existing cables. A method has now been developed by the Post Office and proved by extensive field trials, which uses no piece-parts, caters for any combination of spur cables and which can be applied with only slight modification of technique to sheaths of polythene, PVC, lead, aluminium or steel. Moreover, the technique is easily learned, but still allows scope for the skilled jointer to exercise his traditional skill in "wiping" a joint. This joint is known as the "Resin Putty" joint.

In this system of jointing, the gap between the cable and the plain polythene sleeve is closed with

Above: Applying the final tape to a taped joint. Taped joints are used for small cables. Below: A completed resin-wrap joint.



a mass of epoxide resin putty, which is wiped into shape in the same manner as a plumbed joint on a lead sheathed cable. To make the putty bond firmly to the polythene, polythene-coated aluminium foil is first bonded to the polythene

OVER

A NEW DEVICE FOR FINDING CABLE LEAKS

The Post Office is experimenting with a new idea for pinpointing leaks in pressurised cables, using ultrasonic units to make inaudible sounds audible

By A. F. G. ALLAN

POST OFFICE engineers in the Cambridge Area have been experimenting with an electronic sound detector originally made to study the "inaudible" squeaks and barks of bats in flight, to locate holes in pressurised cable sheaths.

A similar device has also been used to determine the range of frequencies and energy content of signals emitted by the escape of pressurised air from different sizes and shapes of holes and cracks in different types of cable sheath.

The idea is not as batty as it may sound.

Although underground cables face many hazards and can fail for a number of reasons, water seeping into them through holes or cracks caused by corrosion, fatigue, vibration and other damage, has always been the biggest enemy.

The Post Office is making considerable progress in pressurising with dry air the whole of the trunk and junction cable network and most of the subscribers' distribution cable system, particularly from exchanges to cabinets. When a leak develops in a pressurised cable the air pressure is normally sufficient to keep the water out—but eventually the holes must be found and closed. The problem is how to find the holes.

A wide range of novel pneumatic alarm and test devices has been developed in recent years

Testing for leaks with the new British device which picks up and amplifies ultrasonic sounds.

CLOSING THE GAP (*Concluded*)

surfaces, using a little heat. The putty contains little free liquid resin and will not wet the surface of the aluminium very readily, but the application of a thin film of butyl rubber solution to the surface of the aluminium foil guarantees a firm bond.

It is likely that this method will soon become standard in the Post Office cable system, not only for local lines, but for trunk and junction cables when these are sheathed with polythene.

For small cables where no gas pressure is applied, a less sophisticated system is required and taped joints are used. The tape joint encloses the gap with a polythene sleeve into each end of which is inserted a tapered polythene end piece. Each end piece is cut to fit the cable, after which a polythene-based self-amalgamating tape is wrapped round the cable, the wrapping being continued to cover the end piece and a short section of the sleeve. The tape is then compressed by tightly wrapping with adhesive PVC tape.

THE AUTHOR

MR. W. C. WARD, BSc.(Eng.), MIEE, *an Assistant Staff Engineer in the External Plant and Protection Branch since 1950, joined the Post Office as a Youth in Training in the London Engineering District in 1924. He was later Assistant Engineer (old style) in Blackburn Section and Area Engineer at Nottingham.*

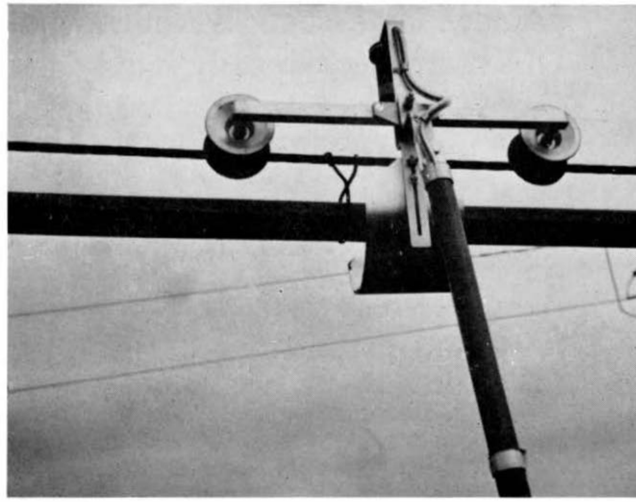
and with them great accuracy can now be achieved in locating leaks within a few feet. But pin-pointing the precise position of a tiny hole or fine hair-line crack, particularly in the dark depths of a congested manhole, is extremely difficult. For some time it has been standard practice to brush soap suds over the part of the sheath or joint where the hole or crack is known to be and watch for the bubbles to appear. Although a very simple technique and highly successful on underground cables, it is difficult to apply to aerial cables, particularly in a wind. A further disadvantage is that soap can cause serious deterioration of polythene-sheathed cable. A suitable saponim-based leak-detecting solution which does not harm polythene has been produced but not yet in sufficient quantities for Post Office purposes and in any event it might be no better on aerial cables than using soap suds.

For these reasons, the Post Office has for some time been investigating possible ways in which ultrasonic devices could be used to discover cable leaks by converting the signals emitted by escaping air pressure, which cannot be heard by the human ear, into an audible range.

When the investigations began the only ultrasonic unit known to be in general production and which could be used to detect cable leaks was of American origin. The heart of this device is a crystal transducer with a natural maximum response at 40,000 cycles a second, the output being converted, in a fully-transistorised circuit, to an audible hiss in a pair of headphones. When used for tracing leaks on aerial cables, the unit is attached by cable to a trolley, fitted with a remote transducer head and a reflector, which is moved along by a long insulated pole. The remote transducer output is fed through the cable down to the basic detector unit.

The Post Office carried out a number of trials with this device in the Cambridge Area and found that it suffered from two main disadvantages. It would detect only leaks which produce a 40,000 cycles a second signal (the noise from many leaks falls outside this range); and its awkward shape made it difficult to manipulate in congested jointing chambers.

More recently, a daily newspaper published an article describing how scientists engaged on a natural history project involving the identification of the different species of bats in Britain, were using a highly-sensitive British-made electronic device to convert bats' barks and squeaks, which



Above: The American trolley unit used to detect leaks in aerial cables. Below: The old method of pin-pointing leaks was to brush sheaths with soap suds and watch for bubbles.

are inaudible to the human being, into audible sounds. Moreover, the device can be tuned to pick up ultrasonic sounds in a wide range of frequencies between about 20,000 to 90,000 cycles a second.

The Post Office has for several months been carrying out a series of experiments with two of these new devices in detecting cable leaks. Much more research has to be completed, however, particularly into the effects of changes in atmospheric pressure and humidity on the sensitivity of the equipment, and considerable development will be needed to produce the right size and shape of the detector head probe.

Nevertheless, there is every hope that in the not-too-distant future an electronic, ultrasonic leak detector of the kind now undergoing tests, will become a permanent feature of Post Office equipment and replace the jointers' little pots of soapy water.

A new, large-capacity bothway microwave radio link is to be set up in the near future to carry hundreds of simultaneous telephone conversations or a coloured television signal between London and the Post Office satellite communication earth station at Goonhilly

LINKING LONDON AND GOONHILLY

By R. E. G. BACK

ORDERS have been placed by the Post Office for a permanent microwave radio link to be set up between London and the satellite communication earth station at Goonhilly which will be able to carry 960 telephone conversations or a colour television signal.

The new link, which will replace the present temporary arrangement, is scheduled to be brought into service by the end of 1966.

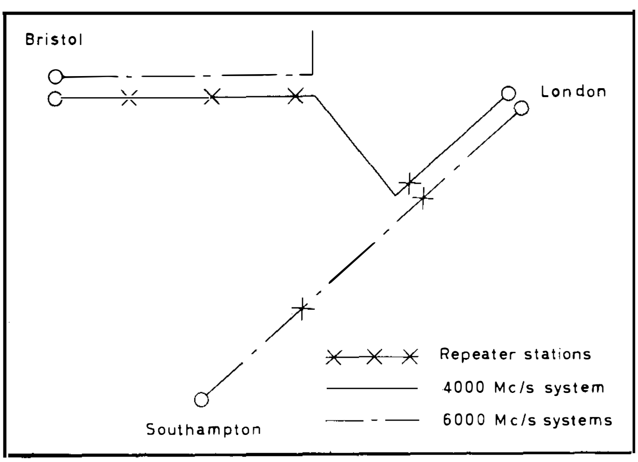
The present circuit from London to Goonhilly—a coaxial cable section from London to Bristol, an unprotected microwave radio channel between Bristol and Plymouth and three "hops" of gap-filling, transportable radio equipment between Plymouth and Goonhilly—was provided at short notice to meet requirements for the experimental *Early Bird* satellite system. Such a system could not, however, answer the needs in performance and reliability for a permanent system, particularly one associated with international circuits.

Now, therefore, arrangements are being made to provide high quality microwave radio circuits over the whole route in three sections: London to Bristol; Bristol to Plymouth; and Plymouth to Goonhilly.

The method adopted to provide the link between London and Bristol is an interesting example of the flexibility afforded by switching arrangements for microwave radio relay systems. The routes from London to Bristol and from London to Southampton share a common first "hop" so that as all six channels available in the 4,000 megacycle system between London and Bristol had been allotted for other purposes it was decided to divert to Bristol one bothway, broadband channel available but not yet allocated in the London to Southampton 6,000 megacycle system. After the first "hop", common to both routes, the circuit will share the horn aerials provided for the 4,000 megacycles system to Bristol.

To meet the high standards of reliability required for a traffic-carrying circuit, it is current practice in the microwave network to provide a standby channel which is switched into circuit automatically if the main channel fails or is out of service for maintenance. One standby channel can act as a reserve for a number of working circuits and switching arrangements are such that the standby can be substituted for working channels whether they are carrying telephone or television traffic.

A standardised switching system has recently been adopted for all routes which will cater for up to six working channels and two standby channels, each of which can be switched into circuit to replace a faulty working channel. A switching operation is initiated by the failure of a



This diagram shows the radio systems on the London to Bristol route which at the start will use 4,000 Mc/s bothway channels.

supervisory tone or by a large increase in the amount of noise in a working channel.

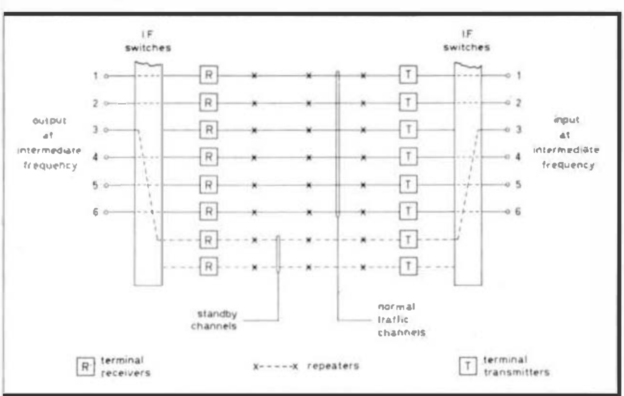
The point at which switching takes place must be one at which the characteristics of the signal are closely defined and should enclose within the switching system all major sources of fault liability. In practice this restricts the choice to the intermediate frequency section of the terminal transmitters and receivers or to the baseband input and output points. Both systems of switching have their merits but on balance the intermediate frequency switching system is preferred and has been adopted.

The input and output of each switching unit is at the intermediate frequency of 70 megacycles, which is standardised for all microwave systems irrespective of the radio frequency used for transmission. It follows, therefore, that circuits in different radio frequency bands can be connected to a single switching system if desired.

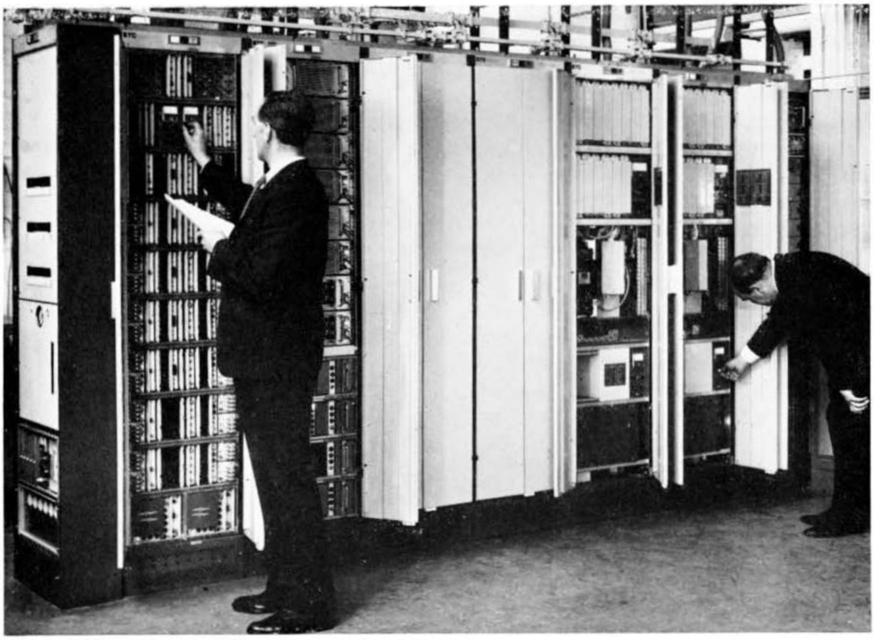
An intermediate frequency switching system was ordered for the London to Bristol route at the same time as the contract for the 4,000 megacycles radio system was placed so that it is practicable to connect the single, bothway channel for the satellite service to this switching system at the intermediate frequency points at London and Bristol. The satellite channel is thus able to share, with other broadband channels, the two 4,000 megacycle channels allocated for standby services on the London to Bristol section of the route.

OVER

A diagram of the new intermediate frequency switching system which has been adopted for the London-Goonhilly system.



Two Cassegrain aerials, similar to those which will be used on the new microwave radio link, undergoing tests at Standard Telephones and Cables lattice steel mast at St. Mary Cray, in Kent.



A suite of the new six-gigacycles equipment—the first of its kind to be installed in Britain—similar to that which will be used on the Plymouth to Goonhilly microwave radio section.

LINKING LONDON AND GOONHILLY *(Contd.)*

The route between Bristol and Plymouth is already equipped to provide some permanent broadband channels to carry television for the Independent Television Authority. Now, however, additional broadband channels and intermediate frequency switching equipment are being provided to cater not only for the satellite requirements but also for additional inland telephony trunk circuits.

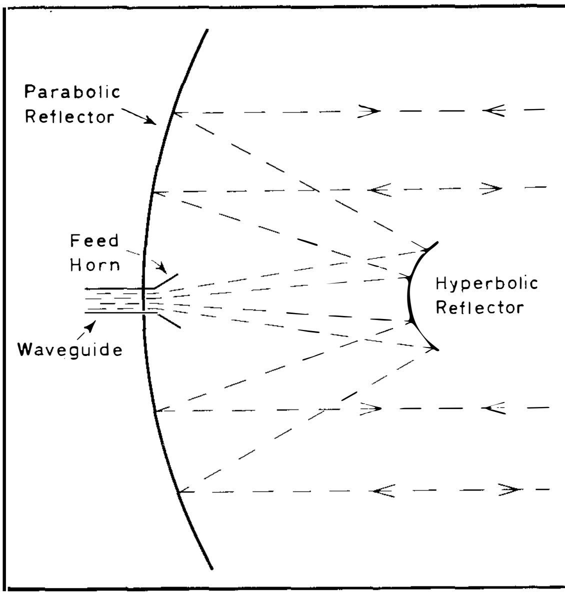
Between Plymouth and Goonhilly two bothway channels (one working, one standby), with the necessary intermediate frequency switching system, are on order. They will be the first operating in the upper six gigacycles band (6,425 to 7,110 megacycles) to be installed in this country. This new frequency band provides an additional 684 megacycles of bandwidth for radio relay links and, for this first installation, channels spaced by 20 megacycles are to be employed, each capable of carrying 960 telephone channels or a colour television signal. When fully equipped with two aerials in each direction of transmission, 16 bothway radio channels can be accommodated—a most valuable addition to the traffic capacity of the microwave networks.

The upper six gigacycles equipment uses mainly solid-state devices but some thermionic valves have had to be retained. Each transmitter contains a travelling wave amplifier giving a radio frequency output of 10 watts and there are a few valves in the modulators and demodulators. A low voltage supply is sufficient for solid-state devices but the valves require high-voltage supplies. However, because their power requirements are small, it is still possible to use battery supplies for the equipment as a whole and to produce the high tension for the valves by means of inverters. Increased reliability obtained by using battery supplies is, therefore, retained despite the fact that the equipment is not fully solid-state. The direct current supplies will be at a nominal 24 volts and a fully-equipped terminal will require some four kilowatts, compared with about nine kilowatts for all valved equipment of similar capacity.

The aerials associated with the equipment are of a novel type, operating on the principle of the Cassegrain telescope. They consist of a parabolic reflector which is fed by a circular waveguide. Radio frequency energy in the guide is directed on to a primary hyperbolic reflector with its focus at the focus of the paraboloid. Its performance, in many respects, is comparable with that of a horn aerial.

The three sections of the London to Goonhilly circuit each have input and output at the standard

This diagram illustrates the principles of the Cassegrain parabolic reflector aerials.



intermediate frequency of 70 megacycles. Access to the satellite channel at Bristol and Plymouth is not normally required and interconnection between the three sections of the route can, therefore, be at the intermediate frequency. Thus the baseband signal for each direction of transmission needs to be modulated and demodulated only once—at the terminal ends—so minimising signal degradation.

Circuit failures in the modulators and demodulators and the associated baseband equipment are much less frequent than those arising within the intermediate frequency and radio equipment so that although standby modulators and demodulators are necessary, a slower and simpler switching system is acceptable. Simple main and standby switching has been adopted for each channel.

The baseband amplifiers for a microwave link vary according to the type of traffic, mainly because input and output levels for television are much higher than those for telephony. For the satellite service, which is primarily for telephony, it is clearly necessary to be able to carry television traffic as an alternative. To meet this requirement, additional amplifiers with remotely-operated changeover switches to enable the circuit to change from one type of traffic to the other at short notice, are being provided at the earth station at Goonhilly and at the Post Office Tower in London.

When this new microwave equipment and the associated switching systems come into service the Post Office will have a large capacity bothway link between London and Goonhilly of high performance and reliability.

THE AUTHOR

MR. R. E. G. BACK *is a Senior Executive Engineer in the Radio Planning and Provision Branch (Inland) of the Engineering Department. He joined the Post Office in 1942 as a Youth-in-Training in the Canterbury Area and transferred to the Engineer-in-Chief's Office in 1949 as Assistant Engineer in External Plant and Protection Branch. He was appointed Executive Engineer in 1951 and Senior Executive Engineer in 1960.*

USEFUL TO STUDENTS

"Definitions and Formulæ for Students, Telephony and Telegraphy," by R. N. Renton (*Pitmans 2/6d*) *is the third of a handy, pocket-size booklet in a series intended to provide students with all necessary definitions and formulæ in a convenient and compact form.*

The first and perhaps the most valuable part contains some 500 definitions of terms in common use in telegraphy and telephony. In this revised edition the author has omitted many of the older terms used in classical telegraphy and this has enabled some terms concerning data transmission to be included. The definitions are based upon those contained in the much larger publications of the British Standards Institution and the International Telegraph and Telephone Consulative Committee (CCITT), and the author has done well in his selection of terms from these publications. The second part of the booklet consists of a number of formulæ.

This booklet should be very useful to all students of telecommunications.—**J. RHODES.**

A new telex service was opened in September between Britain and Doha, on the Persian Gulf, via Bahrein.

★

IPOEE ESSAY COMPETITION

Five money prizes and five certificates of merit will be awarded to the winners in the 1965-66 Institution of Post Office Electrical Engineers' Essay Competition. Entries, which should be between 2,000 and 5,000 words and can be on any subject connected with telecommunications, must reach the Secretary of the IPOEE, 2-12, Gresham Street, London, EC2 by 15 January, 1966.

The competition is open to all staff up to and including technical officers. The organisers point out that while technical accuracy is essential a high technical content is not absolutely necessary to win an award. Clarity of expression, the correct use of words, neatness and originality are all taken into account.

A PAIR OF STATISTICAL TWINS

Two experimental machines are being used in the London Telecommunications Region to obtain telephone traffic statistics. They may be the forerunner of new devices which will enable more accurate forecasts of future needs to be made

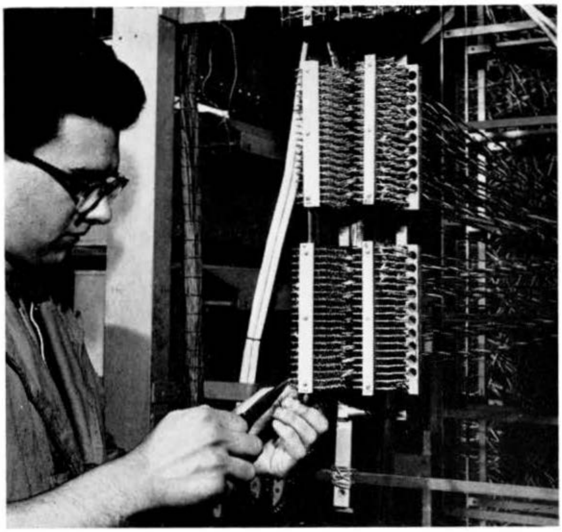
By J. A. SHEPPARD, BSc(Eng), AMIEE and H. O. TOWEY

An operator reads the meters of PETR. The meter display is of six digits, the tens and unit digits being shown on dekatron counters. The two boxes on the right contain the line units and the magnetic drum is to the left of the control and meter units.

THE Post Office's family of inanimate infants, which includes such lusty stalwarts as GRACE, ERNIE, ALF and ELSIE, has recently been increased in the London Telecommunications Region by the arrival of a pair of statistical twins: PET(e)R and EDNA.

PETR—the Portable Electronical Traffic Recorder—and EDNA—Equipment for Dialled Number Analysis—are experimental machines designed to obtain telephone traffic statistics on the calling habits of pre-selected groups of subscribers on automatic exchanges.

Financially and operationally, the future efficiency of a rapidly-expanding telephone system depends on the accurate forecasting of equipment requirements and to achieve this, estimates must be based on sound and detailed evidence. However, telephone subscribers fall into several distinct classes—for example, residential, single-line, business and PBX—and each is expanding in numbers and traffic at different rates. This means that if the most accurate forecasts of future needs are to be obtained the current calling rates per line and growth rates of calls made by particular classes of subscriber must be determined separately.



An engineer connects the single wire jumpers from the selected subscribers' lines to the temporary connection blocks.

On occasions it is also necessary to know the destination of calls made by a particular group of lines.

Since the present equipment and facilities are not capable of producing such detailed information, London Telecommunications Region decided to design and build its own machines to do the job and PETR and EDNA are the result.

PETR, which can measure simultaneously incoming and outgoing traffic in calls and erlangs for any given class of subscriber, was designed primarily for connection to subscribers' line circuits. It can, however, also be used on other types of circuit. It is contained in four cases—each about 18 inches long, 14 inches wide and nine inches high—comprising a power unit, a control unit and two-line circuit units. In addition, there is a magnetic drum of the type used in the Subscribers' Apparatus Line Tester and a display unit containing five sets of meters. The equipment is normally sited at the end of an Intermediate Distribution Frame (IDF) and a single wire jumper from the negative terminal of each selected subscriber's line is connected by way of standard pre-wired termination blocks temporarily clipped to the IDF to individual line circuits within PETR.

The prototype model has a capacity of 200-line circuits so that up to 200 subscribers' lines can be sampled at any one time, each being inspected or scanned once every two seconds. The timing of each scan is controlled by the magnetic drum on which memory tracks are used to store information until needed for processing. The rapid scanning speed enables a high degree of recording accuracy to be achieved.

The meter unit contains five sets of meters, each comprising a four-digit, veeder-type meter with two high-speed electronic counters (called dekatrons) and providing six-digit displays. The meters record five types of information: first, the total number of circuits engaged at each scan; second, circuits engaged on incoming calls; third, the number of calls completed; fourth, completed incoming calls; and fifth, the number of times the circuits have been scanned. From this information it is possible to derive details of incoming and outgoing traffic in erlangs and numbers of calls and hence the average calling rate per line as well as the average holding time per call.

During the tests which have so far been carried out, accurate recording has been found to be practicable on groups of first-code selectors (for example, coin box groups) and PABX extensions, as well as on subscribers' lines.

Full-scale operational records were taken at Eltham and Battersea exchanges during the spring and summer of 1965 when PETR was in operation continuously for periods of up to five weeks. The meters were read at half-hourly intervals for 12

OVER

Each section of the PETR equipment is built up of plug-in units. This picture shows a line unit panel serving 10 subscribers' lines.

STATISTICAL TWINS *(Contd.)*

hours each day so that the results provided records both of traffic and call incidence. Each record lasted for periods of four and five weeks during which selected samples of coin box, residential, single-business and PBX lines were connected to the recorder for one week. From the results it was possible to determine, with some reservations, the class-calling rates, various calling-rate ratios, holding times and the timing of the overall and class busy hours. Since only one PETR was available the calling rate ratios were derived from consecutive and not simultaneous records. For full operational use two PETRS connected to business and residential lines would be needed to run simultaneously with the automatic traffic recorder as a bi-annual routine.

This experimental model of PETR is limited by the capacity of its magnetic drum. However,

An operator inspects information produced on the meter check printer tape. The information includes the dialled number and the date and time of origin of each call.

An engineer checks EDNA, the device that provides information about the destination of calls by particular classes of subscriber.

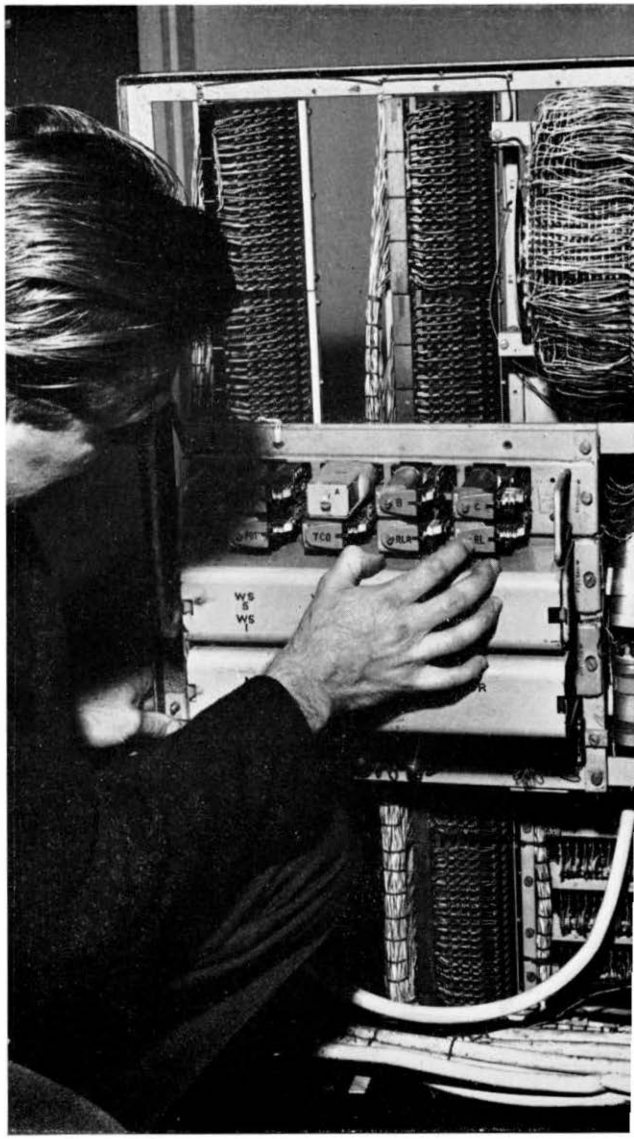
an improved version is at present under construction in which the magnetic drum has been replaced by simplified circuitry which enables information to be stored and transferred direct from the line units to the display unit. The new model will have a capacity of 300 lines, this limit being set only by the cost and time needed for connection and not by the design of the equipment.

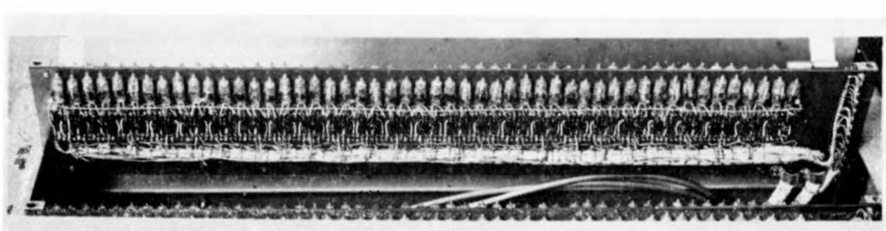
EDNA was designed to provide information about the destination of calls made by particular classes of subscriber. It is portable and contained in a cabinet 3 ft long, 2 ft wide and 1 ft 6 ins. high. It has 200 individual line units (with space for 200 more) and a motor-driven 400-line line-finder with associated common control equipment and works to a standard meter check printer. EDNA, too, is normally sited alongside the IDF and connections to the individual line circuits are made by single-wire jumpers from the negative terminal of the subscriber's lines by way of connection blocks temporarily clipped to the IDF. When a subscriber makes a call the line circuit inside EDNA operates to the calling condition on the negative wire and activates common equipment which, in turn, causes the line-finder to hunt and seize the engaged circuit. Impulses dialled by the subscriber operate the printer, which prints the dialled digits in sequence and the date and time of the origin of the call on a continuous paper tape. When the dialling is complete, the equipment is released so that it is ready to receive the next call. The apparatus is automatically released after a pre-set period if dialling is incomplete.

EDNA can be used at all types of uni-selector and line-finder exchanges, on either ordinary or shared-service lines, and the recorder has an input impedance high enough to prevent interference with the normal operation of the line and exchange equipment.

EDNA can handle only one call at a time and while engaged in recording the information any

OVER





Above: Inspecting and checking the internal apparatus of EDNA.

Left: A strip of 50-line circuits. Four strips make up the capacity of 200 lines.

STATISTICAL TWINS *(Concluded)*

other call is ignored. Consequently, a proportion of the total originating calls is lost, the amount varying with the level of traffic during the observation period, but the equipment was designed for use on a sample small enough for this loss to be negligible. The record does, therefore, provide a reliable indication of the proportions of calls made to various destinations, the total numbers of calls being obtained by other means, for example by PETR.

Since first put into operation in 1962, EDNA has been used to determine the proportion of traffic made between different classes of subscribers; the average radial distance per call between calling and called parties; and for inter-class calls—details of which are valuable in carrying out traffic studies for future planning. Until recently, EDNA was used to supply information for the London Telecommunications Directory Research team.

THE AUTHORS

MR. J. A. SHEPPARD, BSc(Eng), AMIEE, *entered the Post Office as Probationary Inspector in 1928 and spent some years in the Radio Branch of the Engineer-in-Chief's Office. On promotion to Assistant Engineer, in 1935, he worked in the Research Branch, being concerned chiefly with the problems of telephone exchange power supplies. He served in the Royal Signals during the 1939-45 War, chiefly in the Middle East. In 1943 he was promoted Executive Engineer and became Area Engineer, City Telephone Area, in 1946. In 1959 he transferred to Engineering Branch, LTR, working on Television Outside Broadcasts and Electronic Development.*

MR. H. O. TOWEY *is a Senior Telecommunications Superintendent in the Telecommunications Branch (Planning), LTR. He joined the Post Office as a Youth-in-Training in 1937. During the 1939-45 war, he served in the Royal Signals, principally in South East Asia Command. Appointed Assistant Traffic Superintendent in 1951, he was promoted to his present rank in 1964.*

The Engineering Department says that in their view although the trials carried out with PETR and EDNA have been generally successful, the method of connection they employ requires considerable labour. It is also possible that the size of the sample is too small for sufficiently accurate assessments to be made. In addition, in its present form, PETR is extravagant both in equipment and in providing a two-second scan where one much slower would suffice. Nevertheless, it is hoped that the experience gained with PETR and EDNA will be of use to the Engineering Department in designing a standard equipment.

The Engineering Department is currently reviewing the problem of how best to obtain information on subscribers' calling habits. The new equipment which it is expected will be developed will almost certainly provide a punched tape output and the sampling process will have to conform to a rigorous mathematical approach.

PICO TAKES A BOW

Pictured on the left is a new portable microwave communication terminal which, the makers claim, has both civilian and military uses. It could, for example, be used as an outside broadcast link, a television relay for industrial or security purposes, and for remoting various types of radar signal.

The new equipment—called PICO for short—weighs only 17 lb and is contained in a weatherproof package only one cubic foot in size. It is extremely flexible and easy to set up and operate. Using pulse code modulation it can carry up to 96 telephone channels or, with frequency division multiplex, up to 600 channels. Alternatively it can carry video signals—television or radar—or wideband data signals.

PICO, which will cost about £4,000, will be manufactured at Standard Telephone and Cables' new Essex factory at Basildon.

A SYMBOL OF 20th CENTURY BRITAIN

Above: This remarkable picture shows four of the eight horn-paraboloid reflector aerials which are an outstanding feature of the Tower.
Picture by Brian Seed. Copyright: "The Illustrated London News."

FRIDAY, 8 October, 1965, is an outstanding day in the history of telecommunications and of the British Post Office.

It was the day when the Post Office Tower in London was operationally opened by the Prime Minister to mark Britain's entry into a new and exciting era of communications.

"This nerve centre of a system which will help to ensure that both national and international telecommunications will be adequate to this country's needs during the next decade and beyond . . . is a magnificent example of British engineering skill, achievement and Post Office enterprise," said the Prime Minister.

"We have every reason to be proud of it, not only as a telecommunications centre but also because of the magnificent equipment it contains and because of the building itself. . . . It occupies a worthy place alongside the Post Office satellite communication earth station at Goonhilly as a symbol of the progress we are making in improving and expanding communications."

The Prime Minister went on to say that Britain had particular cause to take pride in its achievements in microwave radio and especially in the microwave equipment which formed the kernel of the Tower. It was the then Engineer-in-Chief of the British Post Office, Sir William Preece, who, 60 years ago, was foremost in encouraging the young Marconi in his pioneer radio work.

It was the British telecommunications industry, working in close collaboration with Post Office

OVER

Right: The Prime Minister talks to the Lord Mayor of Birmingham during the inaugural call while the PMG listens in.

Above: Mr. R. Hall, a contractor's engineer, assembles a magnetic drum register translator for routing calls to the provinces.
Right: The television control room and switching centre which handles all television traffic passing through London.

A SYMBOL *(Contd.)*

engineers, which worked out in the 1930s ways by which one radio signal could be made to carry many simultaneous telephone conversations.

It was Britain, in World War Two, which led the way in developing the use of waves of shorter length and, therefore, of greater traffic carrying capacity. It was the British physicists—Randall and Boot—who, 25 years ago, invented the cavity magnetron, an event of the utmost importance in radio engineering. Its immediate effect was to stimulate intense development of microwave radar which played a leading part in helping to win the war. It was unlikely that techniques as advanced as those in the Tower would exist today but for the stimulus resulting from the magnetron invention.

It was Britain, too, in an active partnership between industry and the Post Office which led the way in laying down standards, now internationally accepted, which enabled the microwave systems of Britain not only to be linked very easily with those of the rest of Europe and the world but also to be exported throughout the world. The microwave equipment in the Tower was second to none anywhere in the world.

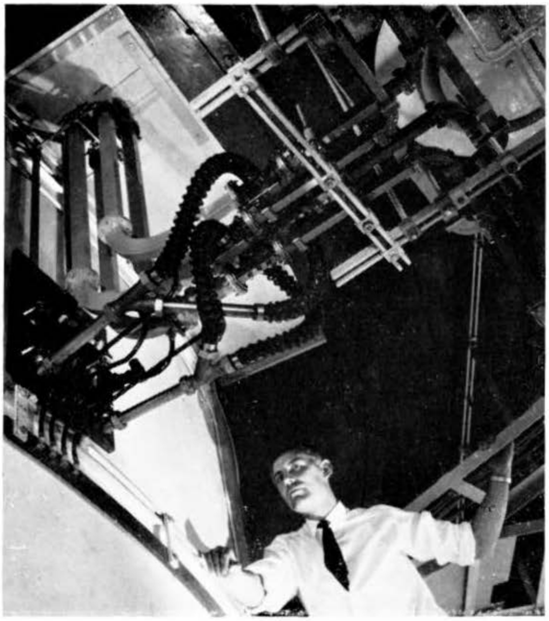
"Britain has always been in the forefront, too, of the development of microwave radio relay links," added the Prime Minister. "In 1952 the first link in the world to use travelling-wave valves was set up between Manchester and Kirk-o'-Shotts for transmitting television signals. Since then considerable development has taken place so that radio links are able to provide an adequate and economic alternative to cables for long-distance telephone traffic as well as television.

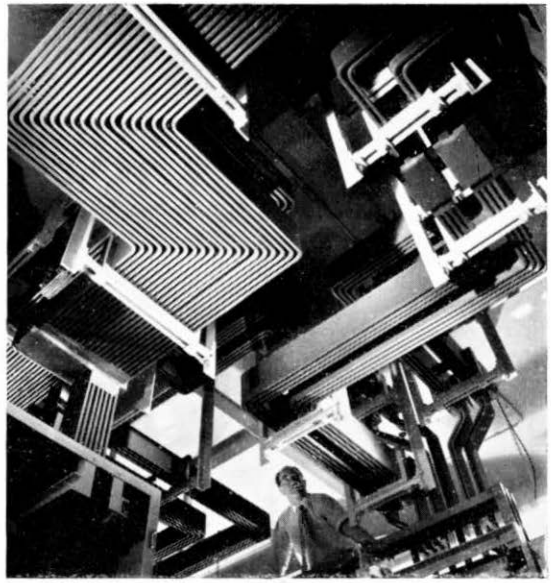
"In the national plan, we look forward to the output per head in telecommunications increasing from about four per cent a year, as it has been in the recent past, to about 10 per cent over the years up to 1970. That is the measure of its importance.

"The increase of productivity in telecommunications, as indeed in most other fields, will be achieved by technological advances; by the most

The Prime Minister opened the Tower by making a telephone call to the Lord Mayor of Birmingham. Later, Mr. Wilson unveiled a plaque near the foot of the Tower and then rode in a lift to the restaurant floor for a view of London 540 feet below.

Among the distinguished guests at the ceremony were three former Postmasters-General: Lord Attlee (PMG in 1931); the Rt. Hon. Ness Edwards, MP (1950-51), and Lord Hill of Luton (1953-57).





***Left:* An engineer examines wave guides in one of the apparatus rooms high up in the Tower. *Above:* An unusual angle shot of the main 50-volt power distribution arrangement for the electro-mechanical switches.**

economic use of labour; the fullest possible co-operation between staff and management; and by economies resulting from higher output."

★

Introducing the Prime Minister, the Postmaster General, the Rt. Hon. Anthony Wedgwood Benn, said that the Post Office Tower symbolised 20th-century Britain. Lean, practical and futuristic, it epitomised the technical and architectural skills of the second industrial revolution.

"It is a great communications centre that will make possible a vast expansion in telephony, telegraphy, data transmission and the distribution of sound and television programmes in black and white or by any colour system. Linked through Goonhilly to the world satellite system it is part of a global network.

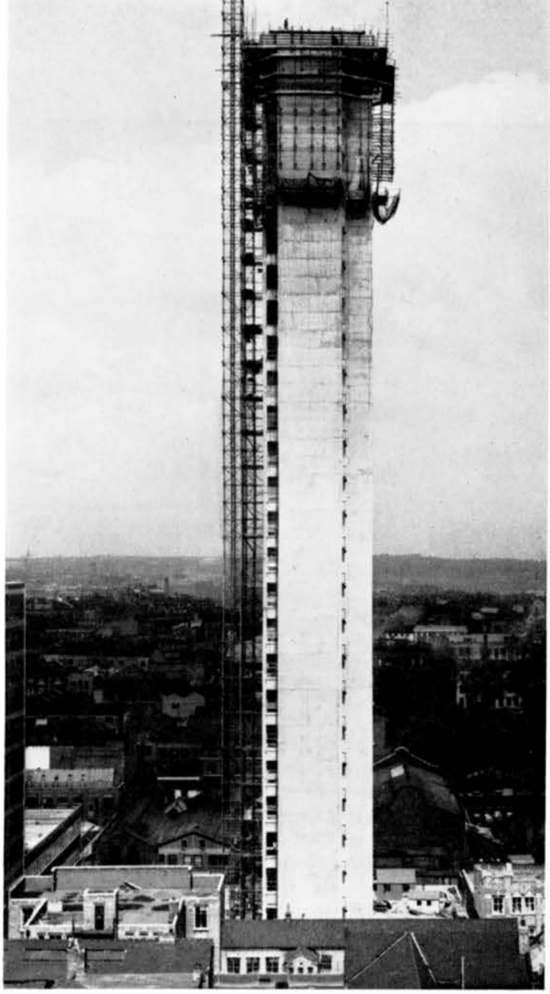
"A highly complex industrial society needs a highly complex communications system. The services we now provide must be improved and expanded to cater for the future. Good and rapid communications are essential if the nation is to increase its productivity and make the best use of its resources. By providing them we can help raise production, help exporters and speed the spread of computer technology.

"There is already a great growth in telephone traffic . . . far more trunk circuits are needed. In 1960 about 2,000 were added. In 1964, 7,000. By 1970 the number will probably reach 15,000. In the next five years we plan to put in more trunk circuits than were put in in the last 50 years. We shall be rising from 50,000 to 100,000 and we expect a continuing high rate of growth thereafter.

"The Post Office Tower will ultimately provide for 150,000 simultaneous telephone circuits. It will thus help to eliminate present congestion and delays and greatly improve the telephone service. It will carry data from one computer to another . . . its 40 simultaneous television channels will also play a notable part in improving mass communications.

"In short, this Tower stands at the heart of our new microwave communications system and marks the beginning of the vast capital investment programme on which we are engaged. We are thus set to clear the backlog of the years and to meet the needs of the future."

A series of articles describing the Post Office Tower, its equipment and the microwave system appeared in the Summer, 1964, issue of the Journal, copies of which can be obtained direct from: The Business Manager Telecommunications Journal, PRD, GPO Headquarters (Telephone HEAdquarters 3624), price one shilling.



THE OTHER TOWER IN BIRMINGHAM

By B. L. G. HANMAN
and N. D. SMITH

Providing the same basic facilities as the London Tower, the new Tower in Birmingham will link the Midlands and the rest of Britain in the nation-wide microwave radio system

The Tower rises from the centre of Birmingham.

ALREADY looming high above Birmingham's new city centre, another Post Office Tower which will play a significant part in the nation-wide microwave radio relay system, is almost complete.

Somewhat eclipsed for news value by its taller and more illustrious forerunner in London, the Birmingham Tower, which will be 500 feet high and cost over £3 million to build and equip, will provide basically the same facilities as the London Tower. When it comes into operational use, probably in the autumn of 1966, it will be able to handle up to 150,000 simultaneous telephone conversations and 40 television programmes and thus form the central hub of the microwave links between the Midlands and the rest of Britain.

By 1958 it was clear that the Birmingham microwave radio terminal would be inadequate for future traffic and a search began for a suitable site for a new terminal station in the city outskirts. This proved difficult and by 1962 the traffic forecast had increased sufficiently to justify, on economic grounds, putting a station in a high tower in the city centre. It was, therefore, decided to build such a tower on a site owned by the Post Office adjacent to the Regional Director's new office and close to Telephone House.

Since the basic requirements for housing aerials at a height above all other buildings in the area and providing a building which would accommodate large quantities of radio equipment were much the same as those in London, the first intention was to build a Tower similar to the London Tower. However, mainly for economic reasons, this scheme was abandoned, first in favour of a simple cylindrical tower and finally for the present square-section main trunk rising to nearly 400 feet, surmounted by a 100 feet high circular column supporting circular aerial galleries.

The Tower structure is entirely of reinforced concrete, heavily strengthened at the corners to provide sufficient stability. The thickness of the wall of the main square section varies, in three steps, from 18 inches at the bottom to nine inches at the point, 340 feet high, immediately below the band-branching room. The walls of the band-branching room are 12 inches thick to provide extra strength for supporting the aerial galleries. The foundations are also of reinforced concrete in the form of a truncated-square pyramid.

At the top of the Tower, standing on the highest aerial gallery, is an aerial hoisting crane, the cylindrical steel body of which provides lateral support for the aerials. When the crane jib is raised it can rotate through 360 degrees and thus place the aerials on any gallery in any position. This crane is electrically operated for hoisting only; raising or lowering the jib and turning the aerials in the horizontal plane are carried out by hand. To prevent damaging the aerials when they are being hoisted or lowered they are attached to a cradle which runs up and down guide rails attached to one side of the Tower from ground level to the top of the main square-section.

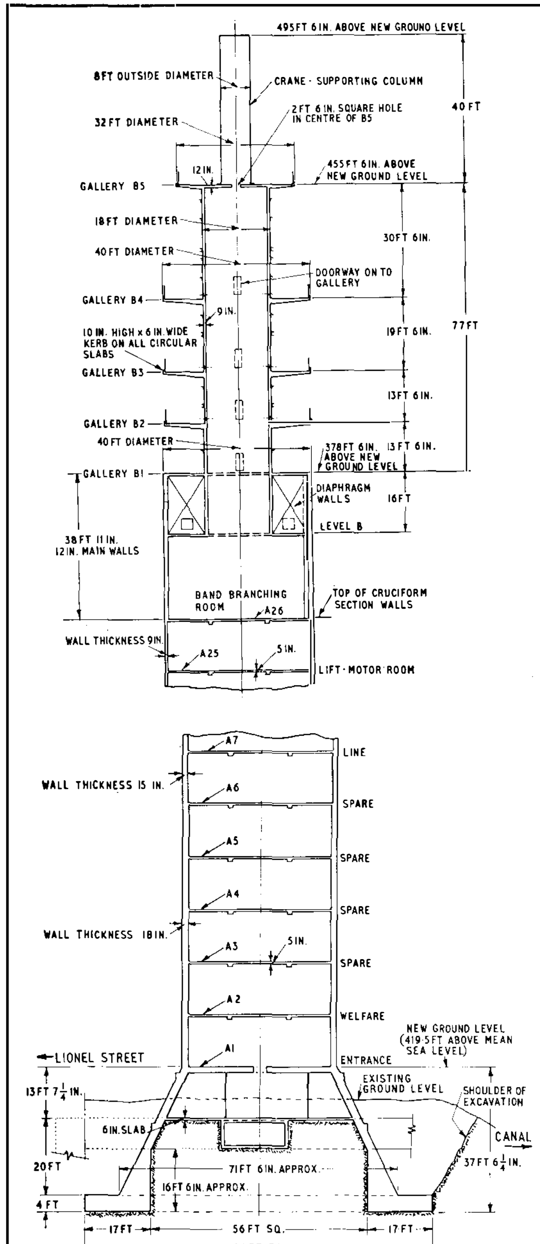
There are four circular aerial supporting galleries, all of which can accommodate paraboloid (or dish) aerials. The larger parabolic-reflector horn-type aerials can be used only on the top two galleries. The lower three galleries are 40 feet and the top gallery 32 feet in diameter.

The aerial galleries are cantilevered from a circular concrete column, 18 feet in diameter, which also provides lateral support for the aerials. Access ladders and platforms are built into the inside of the column.

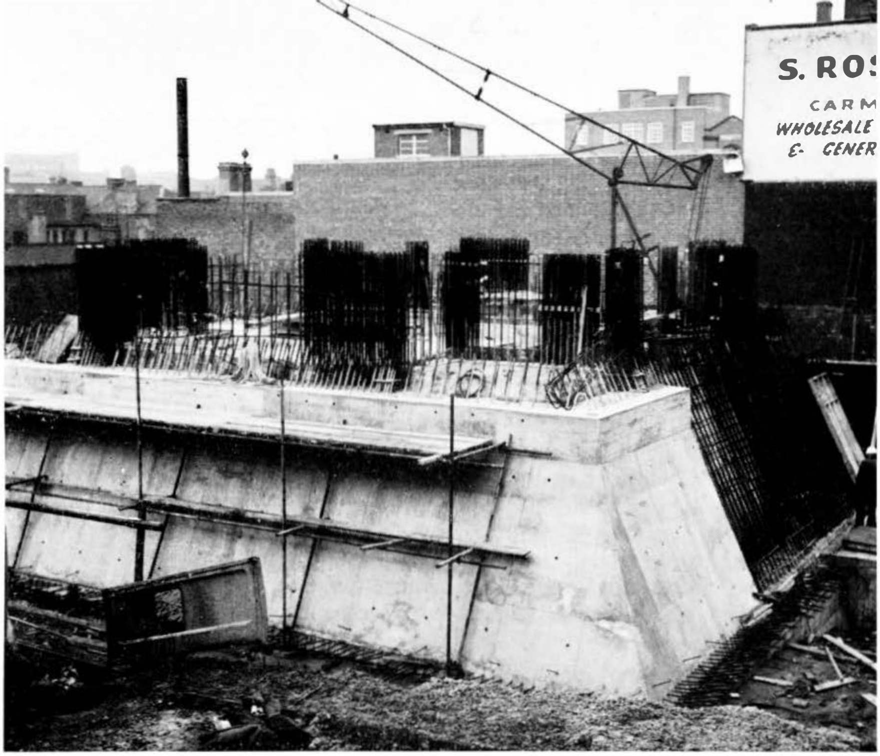
For microwave transmission rigid waveguides provide connection between radio equipment and the aerials. The waveguides to the dish aerials are rectangular in cross-section and enter the column through apertures at each gallery level, dropping down inside to the equipment rooms below.

The waveguides to the horn aerials, however, are circular and must drop down vertically from the bottom of the horn directly into the band-branching room through holes in the gallery floors, in the top of the square section of the Tower and in the ceiling of the band-branching room. The band-branching room is used to connect rectangular waveguides to equipment in the apparatus rooms below.

OVER



This diagram shows a vertical cross-section of the Birmingham Tower. Floors A8 to A24 are spaced at 13 ft 7 in. intervals and used to house line-control equipment, 2,000, 4,000, 6,000 and 11,000 Mc/s baseband and r.f. equipment, stores, batteries and waveguide pressurising equipment.



The foundations of the Tower are of reinforced concrete in the form of a truncated-square pyramid.

The room immediately below the band-branching room houses the lift motors and equipment for two lifts—one a passenger, the other a goods lift. The water storage tanks are on this floor.

The room below the lift motor room accommodates miscellaneous equipment, such as aerial pressurisation gear, and below this are 23 more rooms housing mainly radio and transmission equipment. Basically, the radio equipment is in the top floors so as to keep the waveguides as short as possible. There are two battery rooms and a staff welfare room. At the foot of the Tower are two large concrete areas, one above the other and each about 130 feet square. The upper level, called the podium, provides car parking space and contains the entrance to the building. The power and engine rooms are in the basement area beneath the podium.

All power and communication cables run through slots in all the floors, except the low-voltage busbars from the battery room which, because of their size occupy a separate vertical duct in the lift lobby. The communication cables enter the Tower through a six feet by six feet tunnel under the base of the Tower which is connected to a street tunnel in adjacent Lionel Street. This tunnel is extended across the site and will eventually be linked to the rear of Telephone House. The cables are fed through holes into the Tower basement, which is used as a cable chamber, and then through holes in the chamber ceiling.

Although normal window ventilation is at present used throughout the Tower, arrangements are being made to fit, when required, two air-conditioning units on each floor. There are duplicate mains power supplies and two engine standby sets are provided to guard against a total power failure.

As the *Journal* went to press the Birmingham Tower was almost ready to receive the first of the equipment for the apparatus floors.

THE AUTHORS

MR. B. L. G. HANMAN *is a Senior Executive Engineer in the Exchange Equipment and Accommodation Branch of the Engineering Department in charge of a Works Group which deals with the provision of accommodation for repeater and radio stations. He was previously employed in Training and Research Branches.*

MR. N. D. SMITH *is an Executive Engineer in the Exchange Equipment and Accommodation Branch of the Engineering Department where he is engaged on the acquisition of sites and provision of buildings for microwave radio stations. He was previously employed for some years in the Subscribers Apparatus and Miscellaneous Services Branch.*

In this third article in the series telling how the Post Office is improving the efficiency and productivity of the telephone service, the author describes how the cost of providing and maintaining trunk and junction circuits is being reduced

CUTTING THE COSTS OF THE TRUNK AND JUNCTION NETWORKS

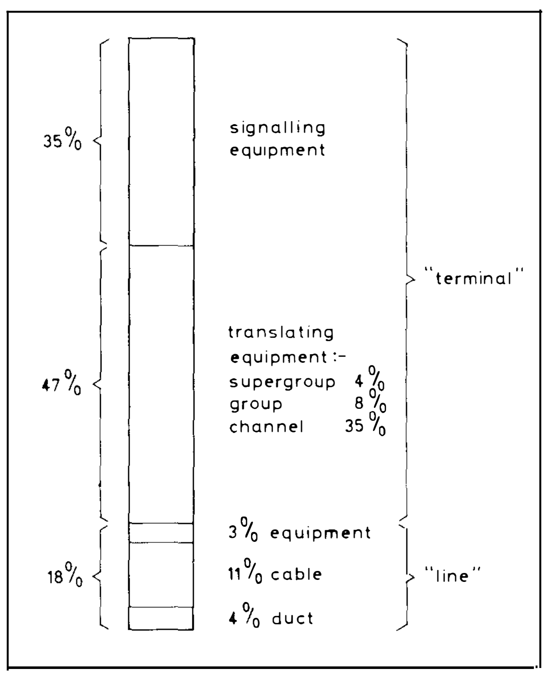
By R. H. FRANKLIN,
ERD., BSc.(Eng.) MIEE.

INCREASED productivity as applied to the Post Office trunk and junction network means providing circuits in response to demand more quickly and at lower cost while maintaining, and even improving, transmission quality and reliability and reducing to the minimum demands on maintenance effort.

Traditional products, such as cables and electrical circuit components, are being made by more efficient factory processes and installations are being carried out more quickly. Reduction in the cost of some of these items reflects the improved productivity (in the usual sense) on the part of the manufacturer. This improvement compares well with the national average among other engineering products but, with cables in particular, rising costs of copper and lead have inevitably led to increases in overall costs.

Significant reductions in the cost of providing new circuits result from the continuous process of transmission system development which is changing the balance between internal and external plant, particularly by increasing the number of circuits which can be carried on a transmission path.

The Engineering Department collaborates with industry in these improvements not only in encouraging the development of new systems and devices but also in refining its specifications to take account of new techniques and manufacturing methods.



This diagram shows the sub-division of capital costs in 1965 of a 100-mile trunk connection provided over heavy traffic routes on modern broadband plant.

In the paper-core telephone cable manufacturing industry, productivity over the years has also improved at a rate close to the national average. Manufacturing processes have been simplified; improved and less time-consuming testing methods have been introduced. However, after a period of relative price stability, rising costs of raw materials and labour have caused the installed cost of a

OVER

typical loaded cable to rise by some 20 per cent over the last two years. Nevertheless, eight per cent of this increase will be offset by the introduction of cables with a polythene sheath (and a thin aluminium water barrier) instead of a lead sheath. Improved materials and better manufacturing methods have also enabled the cost of providing the loading coils on these cables to be held in spite of increases in labour and material costs.

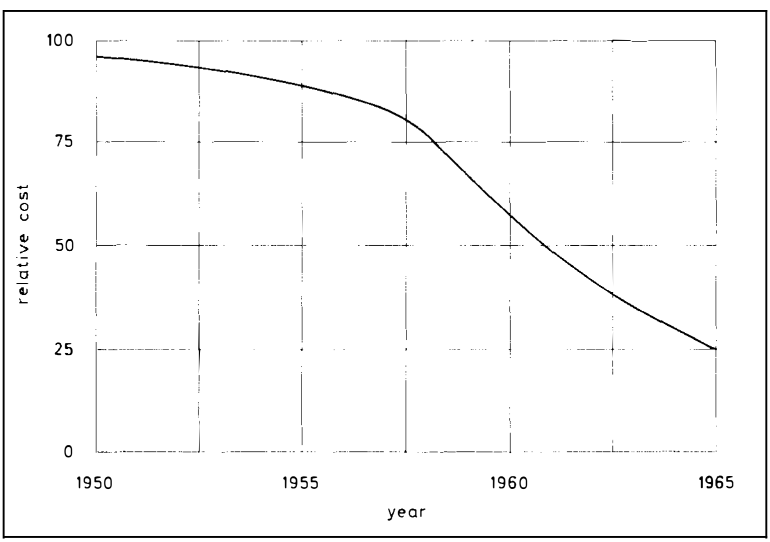
Another development has been the introduction of cables with finer-gauge conductors, enabling the amount of copper per circuit in new cables to be reduced. Copper is an expensive commodity. The smaller gauge conductors result in increased transmission loss but this can be overcome by the use of simple, inexpensive transistor repeaters. Audio cables are still used extensively for providing junction circuits whereas trunk circuits nowadays are provided on coaxial cable or radio relay systems. The number of circuits carried on each pair of coaxial tubes has been successively increased over the years from 320 to 2,700, with a steady reduction in line cost per circuit during this time. For new work 960 circuit and 2,700 circuit transistor-operated systems are used.

Transistor repeaters are much smaller than the valve-type equivalent and they also use much less power. Advantage has been taken of these two factors to overcome the difficulties and reduce the cost of obtaining building sites for the closely-spaced intermediate repeater stations required on a coaxial link. A watertight container suitable for mounting in cable manholes or footway boxes has been developed to house the transistor repeaters, the operating power being supplied over the cable conductors. There has been also the development of small diameter tube coaxial cables, each pair of tubes now being used for providing up to 960 circuits.

To supplement the coaxial cable network, radio relay systems are coming into use on main routes. Each system provides several channels, each of which can carry up to 960 circuits. Later systems will have a capacity of 1,800 circuits per channel. Radio relay systems can provide trunk circuits on heavy traffic routes at costs similar to those of coaxial cables.

The coaxial and radio systems have already produced large savings in line costs compared with earlier methods of provision, so much so that these account only for some 18 per cent of the cost of a 100-mile trunk circuit. More work is being done which will give further savings but, as will be seen, even halving the line costs would give only some nine per cent overall saving in trunk telephone circuit costs. For larger savings, therefore, it is necessary to look to the terminal equipment.

At the ends of coaxial cable and radio relay systems, complicated and costly multiplexing equipment has to be provided for assembling the



The cost of adding circuits to the trunk network has been considerably reduced over the past 15 years as this diagram shows. The costs illustrated here are for cable, radio and transmission equipment only. The downward curve prompts the question: Can further reductions still be made?"

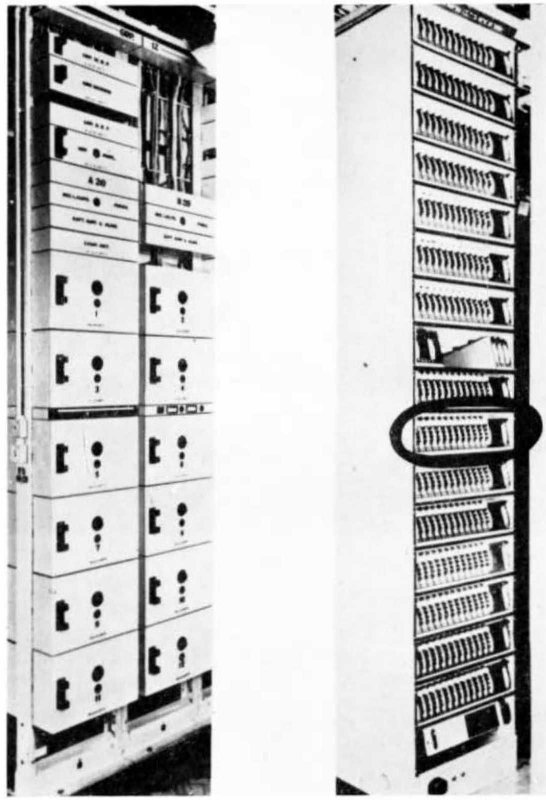
telephone circuits into the appropriate frequency range for transmission over the system and for separating the circuits at the distant end. This multiplexing equipment includes channel, group and supergroup translation stages.

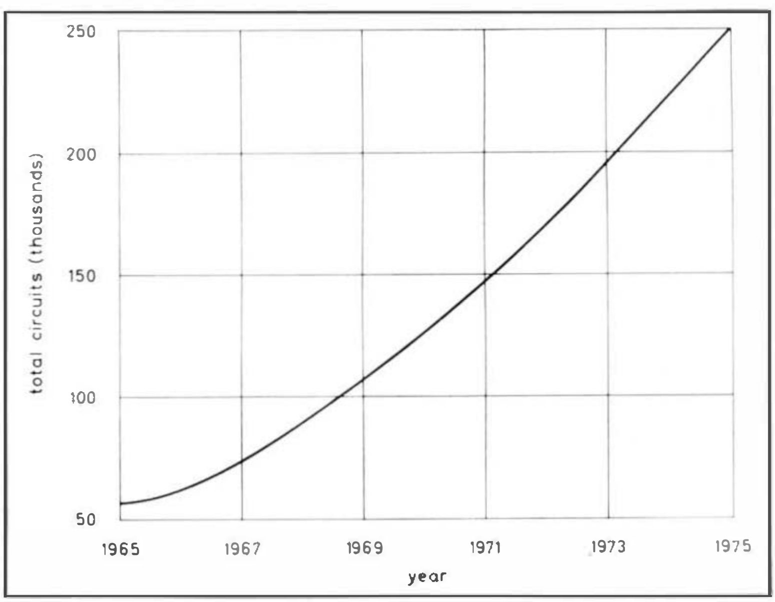
All of this equipment is now manufactured in the new 62-type equipment design (*see the Summer, 1965, issue*) with transistors in place of valves, printed wiring and so on. Transistor equipment operates from low-voltage direct-current supplies and the power consumption is much less than that of the equivalent valve equipment. The power plant required—a not inconsiderable item in the cost of transmission systems—can thus be simpler and, therefore, less expensive.

Notwithstanding these changes, the cost of the translating equipment still accounts for nearly half the cost of a 100-mile trunk circuit. Further reductions can be achieved only by consistently encouraging the most modern approaches in the manufacture of equipment and the use of new devices and techniques.

Another means by which overall productivity can be improved is to increase the utilisation of the existing network. Simple, inexpensive negative-impedance audio repeaters are being used in large quantities to provide additional circuit capacity over existing audio cables by the conversion of 4-wire amplified circuits to 2-wire working. For short routes, carrier systems have been intro-

OVER





Top right: The equipment for one end of a 12-circuit group in 1941 (left) occupied both sides of a 10 ft 6 in. rack. In the new standard design one 12-circuit group (circled) is contained in one 6 in. shelf on a 9 ft rack. Right: Forecast of the trunk circuit growth in the next 10 years.

Transistors have played a big part in increasing productivity. Left: An intermediate valve-type repeater needs a surface building to house it. Below: The new transistor intermediate repeater equipment is accommodated in a small, watertight box only 2 ft long, 15 in. high and 15 in. wide, which can be put into a cable manhole or a footway box.

CUTTING THE COSTS *(Concluded)*

duced which enable 12-circuit groups to be provided on deloaded audio pairs. These systems are particularly useful for extending groups from a main-line system to an exchange needing only a modest number of long-distance circuits. Only a few systems can be operated in each audio cable because of the crosstalk problems at the high frequencies used. Systems using the pulse code modulation method of transmission (*see the Summer, 1964, issue*) are more tolerant of crosstalk, and will find a much wider field of application, particularly for junctions, and will result in very large savings because by their use the circuit-carrying capacity of existing audio cables will be several times increased.

The use of transistors and other semi-conductor devices, together with advances in component manufacturing techniques, has resulted in equipment with an inherently high standard of reliability, and the lower-operating voltage and power dissipation of transistor equipment ought to result in longer component life. Corrective maintenance will, therefore, be reduced and preventive maintenance, such as was required to detect the gradual deterioration in valve performance, will be eliminated on new plant.

During the past 10 years the number of trunk and junction circuits has more than doubled, but the maintenance staff has not increased significantly. The introduction of more reliable equipment and of improved maintenance techniques have contributed to this improvement in productivity. For example, in the past, day-to-day variations in the signal level on long distance 12-circuit groups, due to a number of causes—variations in cable temperature, equipment ageing and so on—used to involve the maintenance staff in frequent manual corrective action that was both time consuming and tedious, in order to maintain a satisfactory overall performance. The automatic gain control equipment now being provided on all 12-circuit groups throughout the country (there are about 4,000 groups at present) not only corrects for these variations but also provides an alarm when a group fails. With the rapid expansion of STD, faulty circuits may not necessarily be reported at once and the effect on service to subscribers could be serious. With this group-fail alarm feature, steps can be taken quickly to restore service or to remove the faulty circuits from traffic.

The extension of gas pressurisation throughout the cable network has resulted in considerable savings by greatly reducing the number of cable renewals. In the past, considerable damage often occurred to a cable because of the ingress of water through a sheath fault. Gas pressurisation prevents water entering the cable so that the extent of cable renewals work is correspondingly reduced. When fully operative, gas pressurisation is expected to result in a saving of at least £500,000 a year.

Looking to the future one can see the capacity of new and existing coaxial cable systems being increased from 2,700 to 10,000 circuits or more, which will result in a further reduction in line cost per circuit. In terminal equipment, further reductions in costs are likely to result from the use of new components and techniques such as thin film devices, integrated circuits and so on. Pulse code modulation systems on deloaded audio pairs will be used extensively and manufacturing costs will no doubt decrease. For certain applications, integrated pulse code modulation line and exchange systems are expected to give significant overall savings. Maintenance costs per circuit will continue to fall as transistors and other new and reliable devices are increasingly accepted into the network.

The continuing demand for new circuits is one of the most important factors in reducing the cost of trunk circuits. It is clear that the savings resulting from the use of 2,700 circuit coaxial systems, for example, can be achieved only where there is a need for this number of additional circuits.

More and more trunk and junction circuits are being provided more quickly and at lower cost. This has contributed substantially to the financial health of the telephone service. The cost reduction has been achieved with no reduction in circuit quality; in fact, long-distance circuits have better transmission performance than ever before. Plant reliability must continue to improve, because the vast increase in the size of the trunk and junction network will have to be accompanied by a very much smaller increase in the number of maintenance staff.

BOUQUETS

To the Engineers

"My Board of Directors have instructed me to write and express their unqualified admiration for the way in which your engineers have worked unremittingly in giving us operational use of the vital 10-line switchboard installed at our new premises in Spring Street.

". . . as a result of several trans-Atlantic telephone calls made on the first afternoon after the switchboard was operational we closed an export order to America worth nearly £100,000.

"It is difficult to single out particular members of your engineering staff who deserve especial praise but I would ask you to see that the personnel mentioned below learn of our gratitude: Messrs. Harding, Venn, Conroy and Hadlow. Nothing was too much trouble for these men and they firmly upheld the tradition of service which the GPO has won for itself in the minds of aggressive businessmen like my Directors."—Extracted from a recent letter sent to the Postmaster General by Mr. G. W. Bishop, General Manager of Honorhouse Products Ltd., Norfolk Place, London, W.2.

★

To Telephonists

"I stood in a telephone box, the rain lashing down outside. Suddenly I pretended I did not know how to make a call, opened the door and stopped a passerby. He almost rushed forward to help. He pressed into the box, put the coins in and dialled the number I gave him. When the number answered, he handed me the receiver, smiled and hurried off into the rain. I then dialled the operator, gurgled a little in German and finally asked if she would explain how to make a call. With great formality and charm, picking out each word carefully, she explained in detail. Before disconnecting she said: 'If you do have any trouble please call me back and I will connect you myself.'

"If the British can be as friendly as this, in Manchester on the worst day of the summer, what must they be like in the sunshine?"—Extracts from a recent article in *The Guardian* by Alec Knipsel recording his experiences when posing as a foreigner to find out how friendly British people can be to visitors from overseas.

★

"We would like to report a first-class service given by your operators. We had a vehicle breakdown and when our driver telephoned we thought that he gave the exchange name as Barton Townley. Other than this, we know he was within about 80 miles of Workington and that he was at a large garage. It was essential that we made contact with him to give him his instructions. The young ladies at your exchange were extremely kind and helpful and ultimately found that Barton and Townley, rather than being the exchange, was the name of the company of garage proprietors in Lancaster. We would like to record our sincere appreciation for the trouble taken in helping us."—A recent letter from K. S. Berger, Director of Alfred Bishop and Son Ltd., Conway Street, Fitzroy Square, London, W.1.

THIS PABX NEEDS NO OPERATOR

By A. H. HEARNDEN

A NEW unattended small private automatic branch exchange which dispenses with the need for the services of an operator and allows incoming exchange calls to be answered at extension points and re-directed as required will soon become generally available. It is the PABX 6, an improved version of the PABX 5* which was introduced in 1963.

The new PABX 6. It has a maximum capacity of 20 extensions and five exchange lines.

The PABX 6 has a maximum capacity of 20 extensions and five exchange lines. Two inter-PBX lines can be terminated in place of two of the exchange lines. The equipment, including the mains power unit and ringing converter, is contained in an elephant-grey steel cabinet 3 ft 9 ins wide, 5 ft 4 ins high, and 1 ft 2 ins deep. The switching equipment employs Post Office standard components such as relays and uniselectors which act as linefinders and final selectors.

The extension numbering range is 20–29 and 30–39. Extensions are classified as "designated," that is able to answer incoming calls, or "non-designated" and may be allowed or barred outgoing exchange line calls. Non-designated extensions may also be allowed or barred transferred incoming exchange line calls. Calls between extensions have first party release.

To make an outgoing exchange call the extension user presses the button on the telephone to obtain the public exchange dialling tone. Connections to other PBX's are made via the interconnecting private wire lines by first dialling a single routing digit. In the absence of an operator, an extension which has answered an incoming call must be able to hold it for enquiry to another extension and to transfer the call if necessary. Enquiry access is open to all extensions (including barred extensions) or to an extension or operator over an inter-switchboard circuit.

To make an enquiry call the telephone button is depressed and the appropriate extension or inter-switchboard line number is dialled. A holding condition is applied to the exchange line during the enquiry and, by depressing the button again, the original extension can return to the exchange line at the end of the enquiry.

Transfer of the exchange call to the second extension is effected by simply replacing the handset on the attending telephone. If the second extension is busy when an attempt is made to transfer a call, intrusion is possible by dialling a further digit "1" which overrides the busy condition.

Another facility offered by the PABX 6 is that an incoming call can be parked on an engaged extension which, having previously been offered the call, will be re-rung as soon as the call in progress is finished. During the waiting period no tone is returned to the caller and no indication is given to the extension that another call is waiting.

The provision of night service on an unattended PABX differs from that on other PABX's in that it is essentially a method of altering the classification of extensions to suit night staffing arrangements. This is achieved by a night service key

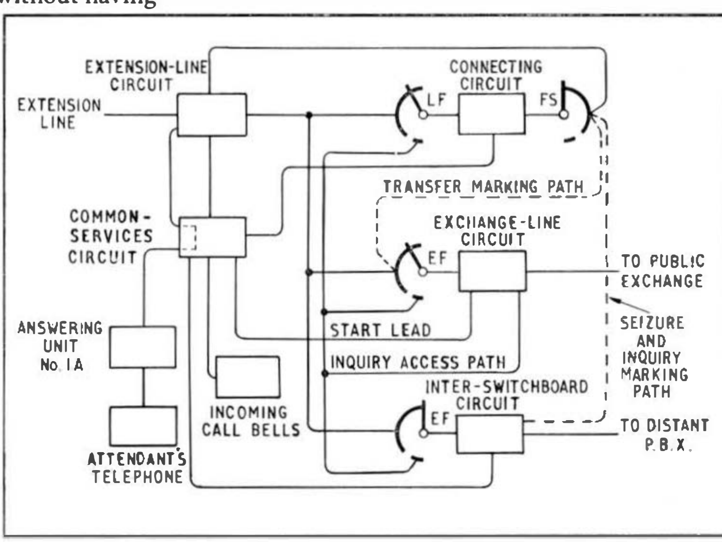
**An article describing PABX 5 was published in the Summer, 1964, issue of the* Journal.

Above: A close-up of the new PABX 6 telephone. Right: An inside view of the steel cabinet which contains the equipment.

fitted on one designated extension which alters the designation and barring condition of the other extensions as required. Additional bells can be added for night service.

If the mains supply fails each exchange line is diverted to a predetermined extension which then functions as a direct exchange connection.

Since it may fall to the lot of a typist or secretary to answer the bulk of incoming calls on an unattended PABX a special attendant's telephone has been designed to cater for this requirement. The telephone concentrates two designated extensions at one station and provides facilities for holding a call on either line. During busy periods, the user can handle incoming traffic without having to have two designated extension instruments on her desk.



Trunking diagram of the PABX 6. LF: Linefinder associated with connecting circuits; EF: Linefinder associated with exchange-line circuit or inter-switchboard line circuit; FS: Final selector associated with the connecting circuit.

THE AUTHOR

MR. A. H. HEARNDEN *is an Executive Engineer in Subscribers' Apparatus and Miscellaneous Services Branch of the Engineering Department and is engaged on PABX design.*

HMTS Monarch, *lately back from the Far East, at work in the trial grounds in the Bay of Biscay.*

MONARCH TRIES OUT A NEW IDEA

By G. J. CRANK BSc (Eng), AMIEE

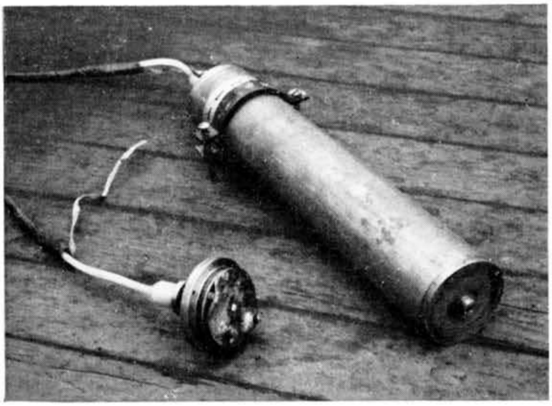
The latest submarine cable systems need more repeaters which makes the problem of laying cables even more difficult.
So HMTS Monarch *sailed from Greenwich to the Bay of Biscay to carry out tests with a variety of new devices*

WHEN the Post Office cable ship HMTS *Monarch* set out from Greenwich for the Bay of Biscay to carry out a series of trials she had over 100 lb of TNT aboard—enough to justify the presence of an explosives expert.

The trials—a co-operative effort between the Research and Submarine Branches—were conducted mainly in deep waters between 2–3,000 fathoms and their main object was to try out a variety of new equipment and techniques to meet the increasingly-stringent laying requirements of modern wide-band submarine systems which contain more repeaters than earlier systems.*

** The Research Branch is also experimenting with an improved form of cable-laying instrumentation which the Journal hopes to describe in the near future.*

A submarine cable must be laid accurately on a previously surveyed route. This is often difficult where there are no radio navigational aids and reliance has to be placed entirely on celestial navigation and dead reckoning, especially during long spells of overcast weather when it is impossible to obtain the necessary sights. The situation is aggravated by the need for the cable-laying ship to slow down to lay submerged repeaters. When the ship slows down in rough weather it may have to turn into the wind, with consequent departures from course. Although allowance is made for this, inaccuracies are inevitably introduced into the navigational plot, increasingly so as the repeater spacing is shortened.



Left: The explosives expert makes the final adjustments to an explosive charge and fuse before flinging them overboard. Above: A time-bomb before being exploded (top) and (below) what remains after the explosion.

When cables are laid in such waters, an auxiliary vessel, which can, of course, wait for good star sights and place buoys accurately, first marks the route at a number of strategic positions. This procedure has greatly assisted cable laying but has limitations and disadvantages. For example, because of their bulk, only comparatively few buoys and moorings can be carried aboard the auxiliary vessel. Nor is there any guarantee that the buoys will remain in position in bad weather. In addition, the cost of the buoys and moorings—and of recovering and placing them—is very high.

For these reasons, the Post Office is considering the use of sonar devices—which can be dropped to the sea-bed in known positions by the auxiliary vessel and may be cheap enough to be regarded as expendable—as an alternative to laying marker buoys. Since very large and expensive batteries and transducers would be needed to obtain a minimum range of between 15–20 nautical miles from a conventional sonar beacon, the Post Office is also considering using explosive as a cheap form of high-intensity sonar power and adopting a system of explosive transponder beacons as navigational aids.

In such a system, each beacon would consist essentially of a TNT charge, a hydrophone and associated electronic detecting and firing equipment. As the cable ship laid the cable it would interrogate the beacons in turn, using a high-power sonar transmitter to send a signal to the beacon hydrophone which would amplify it and trigger the firing mechanism to set off the TNT charge. The underwater explosion would be picked up on a three-hydrophone array on the cable ship. The time intervals between the sending of the interrogation signal and the receipt of the explosion signal at each of the ship's hydrophones would be automatically recorded by a timing device on board the ship. From this information the range and bearing of the beacon would be calculated and the cable ship would obtain a correct navigational fix.

To avoid the accidental firing of beacons by passing ships, marine life or seismic disturbances, coded interrogation signals would be needed, each beacon having its own unique code. Such a system would also ensure against a chain of closely-spaced beacons being detonated by one signal.

Testing the practicability of such a system was

OVER

These two pictures show how operators on the closed-circuit television screens saw the test cable running astern (right) and (above)* Monarch's *centre-castle tank bell mouth through which cable enters and leaves the tank.

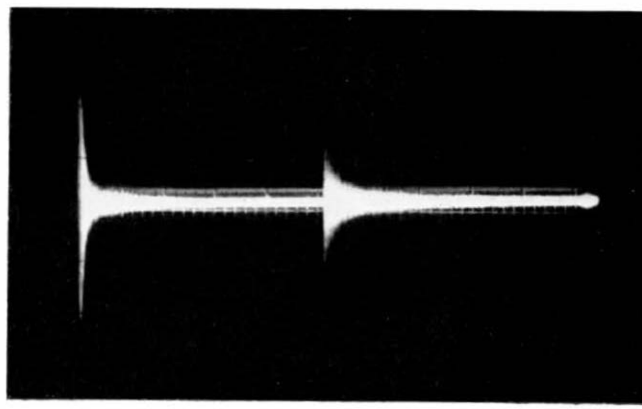
MONARCH *(Contd.)*

one of the trials carried out by HMTS *Monarch* in the Bay of Biscay and involved investigating the propagation and reception of sonar signals from the surface to the sea-bed and from the sea-bed to the ship and measuring the extraneous noise levels at various frequencies and under various conditions at the ship's hydrophones. This noise is the limiting factor in determining the sensitivity of the receive system on the ship.

To measure the level of the interrogation signals received on the sea-bed, a microphone element and a transistor amplifier—mounted in a watertight case able to withstand the very high pressure (about five tons a square inch) at depths of between 2-3,000 fathoms—were jointed to a 30-nautical-mile length of submarine cable and laid, with the cable, on the sea-bed. The end of the cable, remote from the hydrophone unit, was retained on board so that the signals could be monitored by a variety of wide and narrow-band detecting and recording devices.

More than 70 explosive charges—made up of 20-gram (about five-sevenths-of-an-ounce) and one-pound-lots of TNT attached to underwater fuses of varying lengths to control the depths at which they exploded—were used to simulate the surface interrogating sonar signals. As *Monarch* laid the cable, the explosives expert—Mr. W. G. Larby, who had been loaned by Imperial Chemical

Conventional electro-mechanical sonar beacons—known as "pingers"—have wide potential application in submarine cable work, for example for marking cable ends or as expendable grappling references. During the Monarch trials tests were carried out with 10 kc/s "pingers" which produced 900 watt sonar pulses at one-second intervals. The maximum range obtained was three nautical miles, but considerable improvement should be possible when efficient hydrophone installations become available.



This picture is a record of the effect of a sonar explosion at 2,100 fathoms as seen on the oscilloscope on board HMTS* Monarch *after having been received by the ship's hydrophone. The second impulse is an echo.

An engineer at the Post Office Research Branch at Dollis Hill, which also took part in the* Monarch *trials, at work on a time-bomb. Note the clockwork mechanism on the right.

Industries who also provided the explosives—lit the fuses and one at a time during the next five hours threw the charges overboard. The strength and frequency spectrum of the signals caused by the explosions and received by the hydrophone on the sea-bed were measured and recorded in the ship's test room.

At the end of the lay, the cable was transferred to the bows and the ship stood to end while a further series of similar tests was conducted at the extreme 30-nautical-mile range. The results were very encouraging, the signals produced by the explosion of the smaller charges being detected at the maximum range.

To study the propagation of sonar signals between the sea-bed and the ship, "time-bombs," made of one-pound TNT charges connected to a time clock, battery and detonator and enclosed in watertight casings, were used. These were dropped overboard and timed to go off on the sea-bed at pre-determined distances from the *Monarch* as she steamed in a circle at normal cable-laying speed. The signals emitted by the explosions were picked

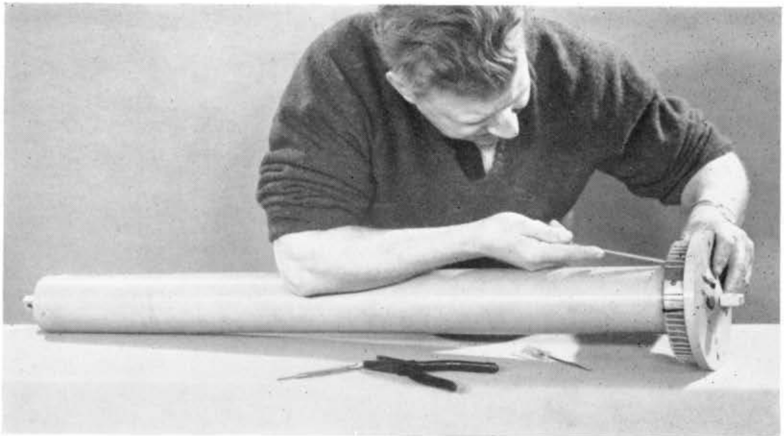
OVER

SINCE the large increase in the number of submerged repeaters required for wide-band submarine cable systems will mean a great deal of extra work for ships' officers and crews who are becoming increasingly difficult to recruit, closed-circuit television is being considered as a possible aid in laying operations.

During the *Monarch* trials, tests were made with a number of television cameras and monitors to investigate the engineering and operational requirements of closed-circuit television on cable ships and, as a result, a detailed specification for a closed-circuit television system to be installed on HMTS *Monarch* has now been completed.

To be completely effective, a closed-circuit television system must be supported by a reliable and flexible communications system on board. For this reason *Monarch* has been equipped with a new loud-speaking telephone system which was evaluated when she laid the Hong Kong to Guam section of the South-East Asia Commonwealth Cable recently.

For mobile communication requirements aboard ship a number of Very High Frequency radio sets—some small enough to fit into a coat pocket—were also tried out. These proved extremely useful for many purposes, often being used in preference to conventional telegraphs. On the strength of these and other tests, some of these radio sets are now in use on the Post Office cable ships HMTS *Monarch* and HMTS *Alert*.



An engineer puts the final touches to the base-plate of a sonar beacon, or "pinger," containing the transmitting equipment, before it is lowered to the sea-bed.

MONARCH (*Concluded*)

up by a spherical hydrophone attached to the ship's pitot sword projecting some three feet into the water and recorded on a variety of narrow and wide-band devices.

The results of these tests were less satisfactory, a maximum detection range of only five nautical miles being achieved. This was due to limitations in the ship's hydrophone system which had to be provided at short notice. However, subsequent discussions with the Royal Navy suggested that much better results would be obtained if the hydrophone was flexibly mounted and totally enclosed in a streamlined dome filled with static water. Such an arrangement would more effectively mask the noise level produced by the ship and the surrounding water.

The trials carried out by *Monarch* to test a possible acoustic navigation aid system were purely exploratory and although the results were in many respects satisfactory much more remains to be done before such a system could be adopted.

THE AUTHOR

MR. G. J. CRANK joined the Post Office in 1945 as a Youth-in-Training in Radio Branch (WP), Harrogate. He was promoted Technician IIA in November, 1947, and transferred to Radio Branch (WE) at Dollis Hill two years later. In October, 1950, he became Assistant Engineer and transferred to I Branch and in 1954 was promoted to Executive Engineer to work on the TAT-1 submarine cable. In 1961 he was promoted Temporary Senior Executive Engineer in I Branch to work on the TAT-3 cable and in 1963 became Senior Executive Engineer in I Branch, being transferred to Submarine Branch in 1964 and to Research Branch in November, 1965.

'WARE CROAKERS AND SNAPPING SHRIMPS!

SMALL fish, known as croakers, create sonic disturbances which can seriously interfere with sonar equipment and could accidentally set off an explosive transponder beacon if coded interrogation signals are not adopted.

The croaker fish has a gas-filled bladder on which it beats a rapid tattoo with a vibrating muscle every five to 10 seconds. The noise made by an individual croaker fish close to a hydrophone and reproduced on a loudspeaker is similar to that of a persistent woodpecker. In Chesapeake Bay, off the Atlantic coast of the United States, where croaker fish sometimes congregate in colonies of up to 300 million, the noise level is sometimes as high as 74 decibels.

Another offender is the snapping shrimp which continuously clicks a pair of pincers on the end of its claw. Although a snapping shrimp is only one inch long, the noise from a colony of them has been described like the "crackling of a forest fire."

The time-bombs and hydrophones used during the trials were manufactured at short notice by the Research Branch at Dollis Hill which also provided other items of test equipment.

This article consists of extracts from a feature, recently published in the *Architectural Association Journal*, which was based on a talk given by the author to a seminar at the Architectural Association School of Architecture on the subject of *Communications in Planning*. His thesis was that "telecommunications cannot be considered without reference to the physical and other structure of the society that uses them. If one is going to try to fit them in in this way contact with the planners of the physical environment seems an obvious place to start"

TELECOMMUNICATIONS IN PLANNING

By J. M. HARPER

One way of speeding a firm's communications, both externally and internally, is to make use of the rapidly growing telex service.

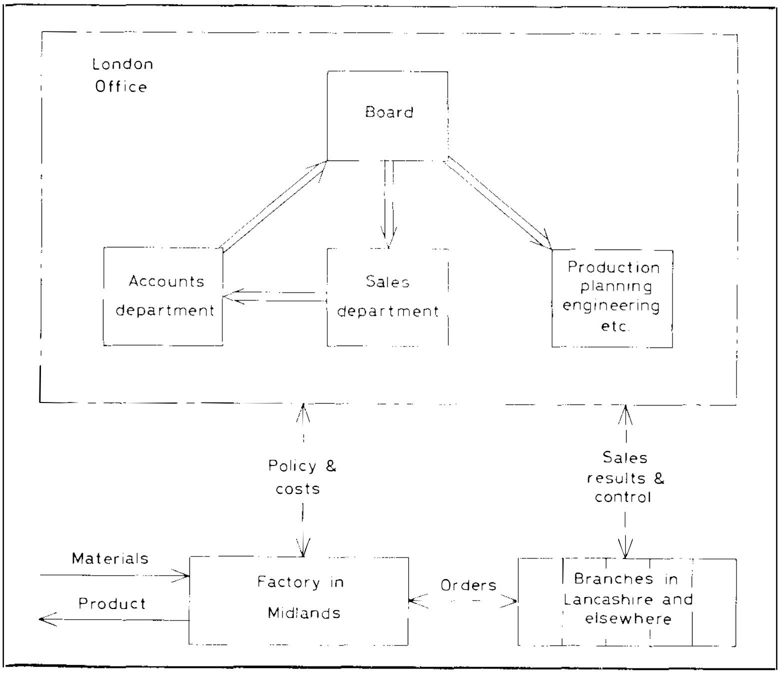
"**IF you want, you can express the whole development of society in terms of communications.**

"The caveman, dependent on walking and crawling over rocks for physical communications, was limited for communication of information, ideas and so on, to direct speech and gesture. Each subsequent stage of development had a corresponding stage of physical communication and communication of information. For thousands of years the only way to send a message was to send a man. Writing made a difference, because the man who wanted to send the information no longer had to teach it to a messenger or go himself, but, basically, *someone had to go*.

"The Greek City State, hemmed in by mountains, is an example of cultural concentration due to lack of communications. Napoleon, as usual, took an important step forward with the famous semaphores between the coast and Paris. Disraeli, Gladstone and company started sending telegrams all over the world as soon as they could. . . . The closing shot of the hotline telephone on the President's desk [during a recent television programme on the American Presidency] . . . makes my point sufficiently: if we are all blown up by an H-bomb, both the efforts to prevent its launching and the order to launch will rely on communication of information, ideas and instructions the function of what is called telecommunications.

"Each phase of human activity has its communications needs. Economic activity needs transport for people, money and goods, communication for accounts and orders from management; social activity needs transport for people and presents, communications for invitations and gossip, and so on.

OVER



This diagram illustrates communications pattern of an imaginary firm, with a factory in the Midlands and branches elsewhere, which has concentrated its board, accounts and sales departments and production planning staffs in one London head-quarters.

Legend:
Physical communications for materials and products;
Physical communications carrying only information (inside the London office);
Information communications by post or telephone.

TELECOMMUNICATIONS IN PLANNING (*Cont.*)

"The emphasis of this seminar is on the physical part of all this—roads, city centres, airports, and so on. I want to establish the functions and potential of the alternative, the communication of information. What is the significance of this for architects and planners? Obviously, you've got to leave room for telephones in buildings and somewhere in a town there's got to be a telephone exchange. Provided we think in these terms and cater for the telephone at this level, what else does all this mean for us?

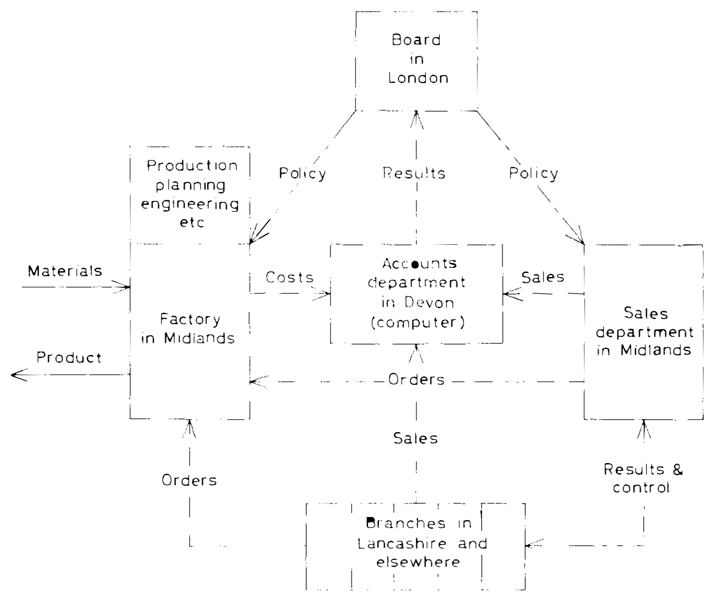
"To sketch in some sort of answer I should like first of all to point a moral with two pictures. The first you might call a memorial to physical concentration—a rebuilt section of the City of London. The consequences of this kind of development are so threadbare a subject of discussion that I need not dwell on them. . . . The reasons for it, and indeed for the reasoning behind many of the attempts to do something about it, however neatly, exemplify the approach which thinks of communications essentially in terms of physical movement.

"Let us imagine that in one of those buildings is a firm making some unspecified product. About 1950 the chairman of the firm said, 'We must have a new prestige headquarters'. The firm has a flourishing factory in the Midlands and customers all over Britain but, let us say, particularly concentrated in Lancashire. When the new headquarters was planned it had to be in London—the directors wanted to be near the Board of Trade, the head offices of customers, their Trade Association, and so on. The accounts and sales departments had always been in the same building as management, and no one thought to question this in the new building. Result: by 1960 clerical costs had gone up sky high, the staff was always changing, and so on. The factory was as efficient as Head Office would let it be, but the latter was under so many different pressures that it imposed a real limit on the firm's performance: all because someone had not seen that the bonds holding Head Office together were those of communicating information and that 90 per cent of the staff need not be in London at all.

"The factory needs transport for material and products and its planning must be governed by this. Head Office does not. Accounts, sales, pay rolls, statistics *had* always been together so that Victorian boy messengers could carry quantities

The communications pattern of the same firm which has located its departments where they are more efficiently able to carry out their tasks: say, the accounts department in Devon; the sales department and production planning and engineering staffs in the Midlands.

Legend:
——— Physical communications;
—•— Information communications suitable for telephone;
– – – Information communications suitable for data transmission.



of paper from department to department without delay. Really, of course, all they were carrying was facts and figures—information.

"The subject of my other picture [the new Post Office Tower] represents in itself an enormous capacity for carrying information without physical movement and one which is not limited by distance, as the boys were. When fully equipped, that Tower alone will be able to carry 150,000 simultaneous telephone conversations, or their equivalent, not to mention a number of television pictures—surely enough to convey the information our firm has to communicate between departments and a bit more besides? Could the firm not use some of this capacity offered by the Post Office and not only do away with the boys but also put each department in its optimum location—accounts, say, in the West Country where they can get staff; sales in Manchester where the customers are, and so on?"

Mr. Harper went on to outline the main characteristics of each of the public telecommunications services, emphasising the status and functions of each from the point of view of the seminar. Planners, he suggested, should think of the telephone as the basic telecommunications service which, at some reasonably predictable date should be available at the great majority of structures which exist or will be erected. They should also appreciate that once a telephone circuit exists to a building it forms, in addition to its obvious function for speech, a basic telecommunications link which can be exploited within certain limits to convey any information which can be converted into electrical form. Data transmission was the most obvious, although not the only, example. Again, the significance of telex in this context was clearly that a growing number of organisations could communicate in written form without the need for physical transmission of the written material.

"Quite apart from the familiar private branch exchange and its associated facilities such as centralised dictation systems," Mr. Harper continued, "firms and organisations often have specialised communication needs which cannot be met by the basic public services. To take a simple example, theatre booking agencies make thousands of calls a day to central points where seats are controlled. They could make them over the public system, but it is often more convenient for them

OVER

TELECOMMUNICATIONS IN PLANNING (*Cont.*)

to subscribe to a separate or 'private' system on which, by just lifting a telephone, they are in instant contact with the central point. Some of the largest organisations ICI, Shell Mex and BP and Government Departments have large and very efficient private networks, provided by the Post Office but tailor-made to their requirements, serving many offices all over Britain. Many of these systems are straightforward telephone or teleprinter systems. Increasingly, however, private telecommunication channels are being used for high-speed, high-capacity data transmission and for what is called closed-circuit television. Under this system a full-dress television picture is transmitted in both directions between, say, two conference rooms—one in London and one in Glasgow. In this way, the two halves of a learned society or a board of directors can have a full-dress meeting without stepping outside their respective buildings.

"Transmission of television requires even higher quality or wider bandwidth circuits than high-speed data transmission. Closed circuit television is thus always at present a matter for special circuits and is rather expensive. Nevertheless, there is no theoretical reason why television telephones should not be developed.

"I have purposely kept this summary down-to-earth and talked about systems which seem to me within the scope of existing technique or current development because I do not want to create an impression of 'pie-in-the-sky'. Most of the facilities I have mentioned are at least potentially available *now*. There are many other possibilities which might be exploited if demand for them emerges.

"Let us now come back to my imaginary firm. In the diagram (*page 45*) I have set out the main information flows inside the firm and how telecommunications services might be used to cope with them. To keep the diagram simple I have confined myself to speech transmission by telephone and data transmission. In fact, the chances are that the firm would use telex or a private teleprinter network to do some of the jobs I have allocated to speech. A typical layout would be to have a teleprinter system to main branch offices all over the country; there might well be a teleprinter system, say, within London and one or two other large towns. Beyond this, the staff would be permitted to use the public telephone system when what they were doing could be done most efficiently by immediate two-way speech.

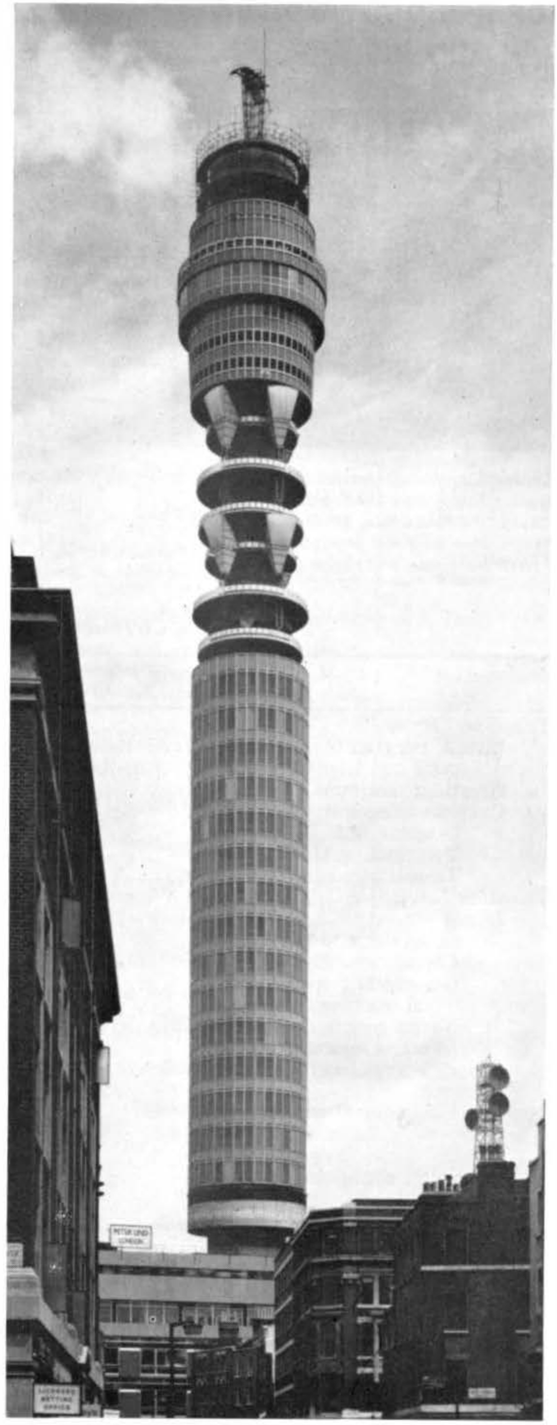
"I have physically located each bit of the firm in the area which best suits its particular requirements. . . . I imagine that very few real planning situations look like this. You are probably concerned with the planning of a particular locality, or at most a new town, and these broad sweeps of the telecommunications brush seem a little irrelevant. Nevertheless, the logic is the same. *All* the communications needs, even of a block of flats, deserve analysis, and the best solution will be one which makes balanced use of *all* the communications facilities available—physical and information. After all, the penthouse dwellers will be much happier if the hall porter consults them by internal telephone before he sends unwelcome guests up in the lift!

"I would expect a planner to look critically at the characteristics [of communications systems] as part of a plan in themselves. For example, communications needs of any kind are growing all the time and it is reasonable to ask of a system 'how easily can it cope with increased traffic and how easily can its capacity be increased when it is exhausted?'

"Consider communications between London and Birmingham—which are a principal function both of the Post Office Tower and of M1. By itself, the Tower adds something like 150 per cent

Blocks of skyscraper offices—"a memorial to physical concentration"—in the rebuilt London Wall area of the City of London.

The Post Office Tower in London which has "an enormous capacity for carrying information without physical movement and over unlimited distances."



to the telephone circuit capacity of London and when that runs out it will be comparatively easy to build a second one—if, indeed, technical development has not removed the need even to construct a tower by then. It would be interesting to know what the road planners will do when M1 becomes intolerably congested, how soon this will happen and what it will cost.

"Again consider the impact of these modern, high-capacity roads on the countryside or, for that matter, the planning and space problems of urban motorways. Loss of land, noise, smell, disfigurement, and so on, are often coped with by the ingenuity of designers, but they are inherent in physical transport systems. Telecommunications systems, on the other hand, need only a relatively small number of buildings, each of which can usually go anywhere within a radius of several hundred yards, and some cables which can be buried in the ground.

"I do not want to overstate the telecommunications case. Obviously, physical transport will always be fundamental to communications. What I want to do is to register the thought that a balanced treatment of the communications element in planning should analyse *both* physical and information transmission requirements and exploit the advantages of modern techniques in *both* fields.

"To sum up, I am asking you as planners: (*a*) critically to examine every planning problem and try to identify its communications elements; (*b*) to aim at a solution which exploits the possibilities and advantages of modern communications systems of all types transport and telecommunications; and (*c*) to get and keep up-to-date on what we have to offer."

THE AUTHOR

MR. J. M. HARPER *joined the Post Office as an Assistant Principal in 1953. He was Private Secretary to the Director-General, Sir Gordon Radley from 1956 to 1958, and as a Principal in ITD from 1958 to 1964, was responsible for exchange equipment design and facilities, including STD, and for electronic exchanges. Mr. Harper was Secretary to the team which produced the Ray Report and had two articles published in the Journal on the statistical and other results of STD. During 1964 he worked in the Postal Services Department Postal Mechanisation Branch and was subsequently seconded for a time to Shell Mex and B.P. Ltd. He is now in the Establishments and Organisation Department.*

TOP RADIO AWARD FOR HPM AND HIS WIFE

Mr. and Mrs. Woolley receive the Mullard Trophy from the Engineer-in-Chief of the Post Office, Mr. D. A. Barron. They were also presented with a codar transmitter and power supply.

Mr. Joseph Woolley, Head Postmaster of Wigan, and his wife Frances—organisers of the Radio Amateur Invalid and Bedfast Club which provides radio communication facilities for the blind and incapacitated—have been jointly awarded the Radio Society of Great Britain's highest award: the Mullard Trophy.

The Mullard Trophy—given to members of the Radio Society of Great Britain who, through the medium of radio have rendered outstanding personal service to the community by their own endeavour or example of initiative or courage—was presented to Mr. and Mrs. Woolley at this year's Radio Communications Exhibition in London.

Mr. Woolley is treasurer of the Radio Amateur and Bedfast Club which has 500 members throughout the world. Mrs. Woolley is the Club's secretary who also edits a monthly magazine, some printed in Braille. Both are enthusiastic radio hams.

ALL FIGURE NUMBERS

Your article All Figures By 1970 *in the Autumn issue was most informative and interesting. However, in the introductory blurb you say that all exchange names will be abolished by 1970. Is this really true?*—J.G.K., GPO Headquarters.

★*This statement referred only to exchanges in the big cities—London, Birmingham, Edinburgh, Glasgow, Liverpool and Manchester. This is made clear in the main body of the article.*

The Editor apologises for the error on page 3 of the same issue in confusing the Singapore and Hong Kong telephone dial with the Egyptian dial.

Telecommunications Statistics

	Quarter ended 30 June, 1965	*Quarter ended 31 March, 1965*	*Quarter ended 30 June, 1964*
Telegraph Service			
Inland telegrams (including Press, Railway Pass, Service and Irish Republic)	**2,747,000**	2,512,000	2,757,000
Greetings telegrams	**619,000**	592,000	635,000
Overseas telegrams:			
Originating U.K. messages	**1,724,000**	1,632,000	1,657,000
Terminating U.K. messages	**1,679,000**	1,605,000	1,690,000
Transit messages	**1,343,000**	1,353,000	1,255,000
Telephone Service			
Inland			
Gross demand	**186,000**	211,000	181,000
Connections supplied	**185,000**	201,000	162,000
Outstanding applications	**176,000**	175,000	167,000
Total working connections	**6,138,000**	6,030,000	5,709,000
Shares service connections (Bus./Res.) ...	**1,197,000**	1,176,000	1,124,000
Effective inland trunk calls	**199,245,000**	188,417,000	174,695,000
Effective cheap rate trunk calls	**45,108,000**	38,628,000	38,665,000
Overseas			
European: Outward	**1,611,000**	1,499,000	*1,366,000
Inward	**1,387,000**	1,321,000	*1,078,000
Transit	**14,000**	13,000	*12,000
Extra European: Outward	**151,000**	*147,000	*123,000
Inward	**189,000**	*182,000	*148,000
Transit	**25,000**	24,000	*21,000
Telex Service			
Inland			
Total working lines	**15,000**	15,000	13,000
Metered units (including Service)	**41,828,000**	41,790,000	38,644,000
Manual calls (including Service and Irish Republic)	**18,000**	15,000	42,000
Overseas			
Originating (U.K. and Irish Republic) ...	**2,499,000**	2,471,000	2,111,000

Figures rounded to nearest thousand. *Includes estimated element.

INDEX to Volume 17

SPRING 1965—WINTER 1965

ALPHABETICAL INDEX

GROUP INDEX

CONTINUED OVERLEAF

GROUP INDEX—*contd.*

Editorial Board. K. H. Cadbury, M.C. (Chairman), Director of Inland Telecommunications; E. W. Weaver, Deputy Regional Director, London Telecommunications Region; L. J. Glanfield, Deputy Regional Director, Home Counties Region; H. A. Longley, Assistant Secretary, Inland Telecommunications Department; J. T. Baldry, Deputy Director, External Telecommunications Executive; H. Williams, Assistant Engineer-in-Chief; Public Relations Department—E. J. Grove (Editor); Miss J. Kelly (Assistant Editor).

Regional Representatives. G. A. Smith, North-Eastern Region; R. F. Bradburn, Wales and Border Counties; F. B. Rudman, North-Western Region; D. Davies, Northern Ireland; R. E. Walpole, Home Counties Region; P. H. Treasure, R. C. Friend, London Telecommunications Region; E. R. P. Chant, Scotland; L. Beeby, Midland Region; P. J. Hart, South-Western Region; J. E. Judson, Engineering Department.

Publication and Price. The *Journal* is published in February, May, August and November, price 1/6. The annual postal subscription rate is 6/6 to any address at home or overseas.

Copyright. Copyright of the contents of the *Journal* is reserved. Application for permission to reprint all or part of any article should be addressed to the Editor.

Advertisements. No official responsibility is accepted for any of the private or trade advertisements included in this publication. Communications, advertisement copy, etc., should be addressed to Sawell & Sons, Ltd., 4 Ludgate Circus, LONDON, E.C.4. (Telephone: FLEet Street 4353.)

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.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, GPO Headquarters, St. Martin's-le-Grand, LONDON, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co.".

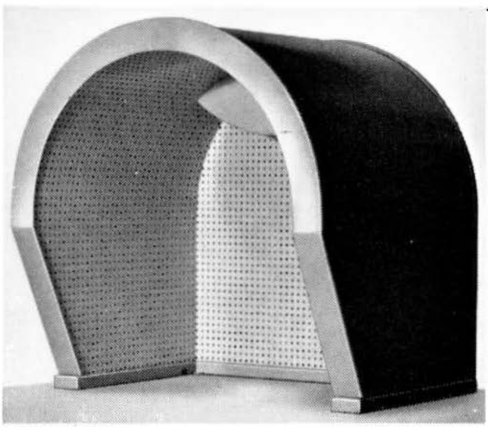
GPO

WHITELEY

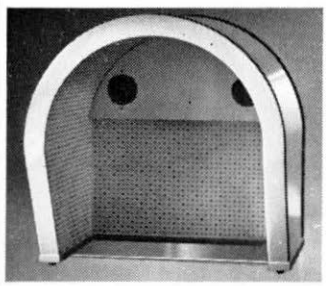
for acoustic hoods

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

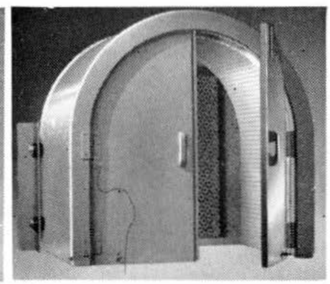
Whiteley acoustic hoods are strongly made from resin bonded ply and finished in a cellulose enamel which makes them suitable for indoor or outdoor use.



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



Fitted with loudspeakers

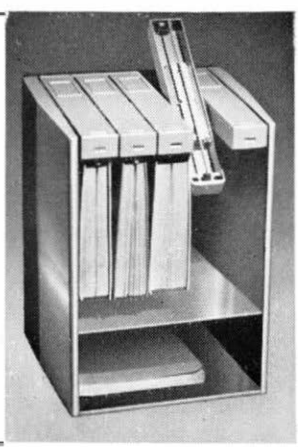


Fitted with doors for outside use

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

& directory holders

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

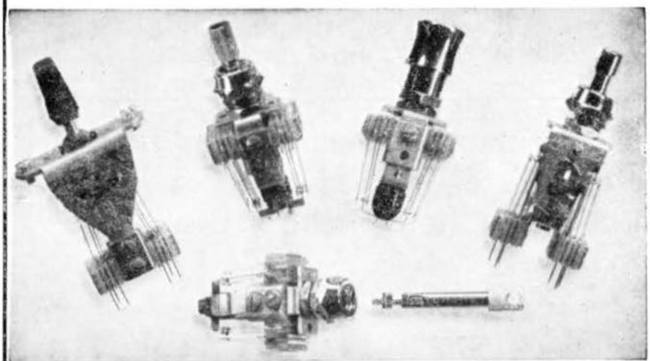


These attractive, and extremely functional, directory holders will hold five directories neatly and securely, in individual swivel holders permitting easy identification and reference. The lower shelf provides additional storage space. The units are of cast alloy, finished in an attractive grey epoxy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

For further details please write or telephone:—

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

BECUWE MINIATURE SWITCHES



LEVER KEYS, PUSH-BUTTON SWITCHING KEYS with mechanical VISUAL indicator, ROTARY SWITCHES, SLIDE SWITCHES, TOGGLE SWITCHES . . . etc . . .

A comprehensive range of precision Switches with low contact resistance, high insulation resistance, compact dimensions and very long working life.

BRITEC LIMITED
17 Charing Cross Road
WHItehall 3070 London W.C.2

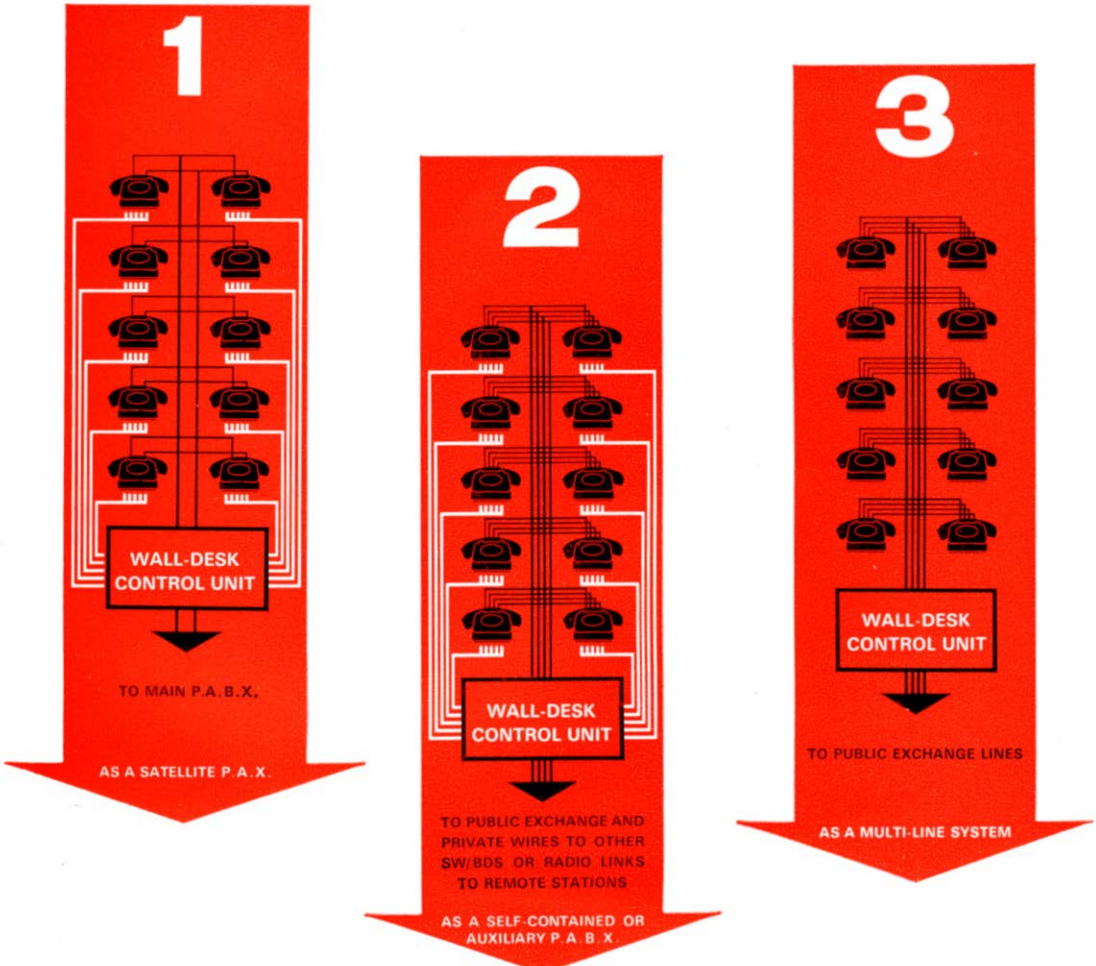
HACKBRIDGE CABLES

OFFICIAL CONTRACTORS TO

GPO
NCB
CEGB
BR

BRITISH COMMONWEALTH GOVERNMENT DEPTS.

HACKBRIDGE CABLE CO. LTD
KELVIN WORKS
HACKBRIDGE · SURREY
Phone: FRAnklin 1101-7



MULTIPHONE

Makes a triple attack on telecommunications problems

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

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

For further information please apply to:—

Plessey Telecommunications Group

ERICSSON TELEPHONES LIMITED · ETELCO LIMITED

Head Office & Main Works: Beeston · Nottingham · Tel: Nottm. 254831 · Telex 37666
Registered Office: 22 Lincoln's Inn Fields · London · WC2 · Tel: HOLborn 6936

PTE 73MA

LUSTRAPHONE
THE MASTER MICROPHONE

British Designed - British Made

MICROPHONES TO KEEP FAITH WITH SOUND

Lustraphone's very extensive range of microphones and accessories include models specifically designed to meet almost every requirement. Indoor use, and outdoors, for close talking, for heavy working conditions. Sound construction and design ensures an exceptional degree of reliability and service.

Designers and manufacturers of dynamic and ribbon microphones. Microphone accessories. Microphones for telecommunication. Radio microphone systems. Transistor amplifiers. Transistor portable public address systems. Noise-cancelling intercommunication systems. Ancillary equipment.

ILLUSTRATED BROCHURE ON REQUEST

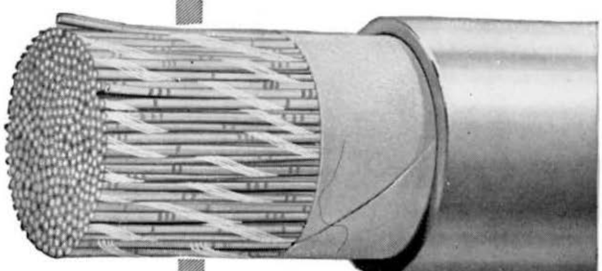
LUSTRAPHONE LTD.

ST. GEORGES WORKS, REGENTS PARK ROAD, LONDON, N.W.1

Telephone : PRImrose 8844

Reliability

A dependable telephone system is essential to modern society. Connollys cables, with built-in reliability, have played an important part in maintaining the efficient operation of the public telephone service in this country since 1890 : and Connollys reliability has been further proved in telecommunication installation in the many countries overseas.



CONNOLLYS

Connollys (Blackley) Limited
Cable Division
Blackley, Manchester 9
Telephone: Cheetham Hill 1801

CL.71

GRAPHIC PROOF

This is one simple way of expressing, in graphic form, the difference between the old and new ways of Pay-on-Answercoin-operated telephones—the difference between Button A/Button B call-boxes and the new S.T.D. public telephones, streamlined in much more than mere appearance. The difference, in short, between three big coins and one small one.

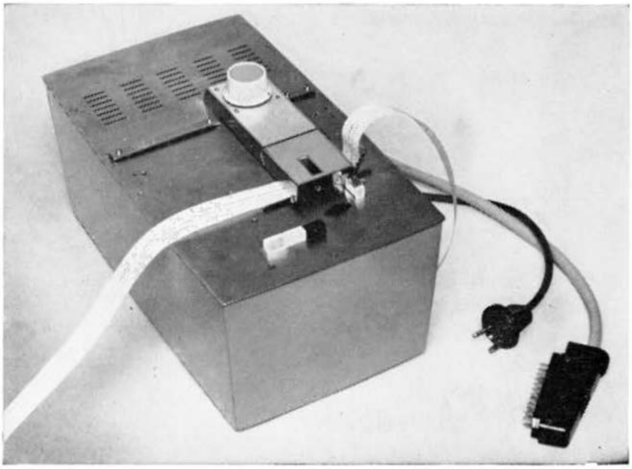
Inevitably, operator-operated public call boxes gave place to the new Pay-on-Answer S.T.D. telephones. In all this inevitable development, Associated Automation have taken a leading part—not only in Britain, but in many other countries in the world. Cents, pence, pice—whatever the currency, Associated Automation coin-operated mechanisms combine with new telephonic apparatus to give first-class public service.

ELLIOTT

Associated Automation Limited
Dudden Hill Lane, Willesden, London NW10
Telephone: WILlesden 8070

A Member of the Elliott-Automation Group

Combined Tape and Edge Card Reader



MODEL 23

5, 6, 7, 8 unit reading of tape and edge card.

Tight tape, tape out, tape latch alarms.

Unlimited manual forward and back-spacing of tape and card.

Free standing or flush mounting in a desk unit.

Signal Contacts made for 95% of each reading cycle.

G.N.T.

GREAT NORTHERN TELEGRAPH WORKS

DIVISION OF THE GREAT NORTHERN TELEGRAPH CO. LTD.

Sydhavns Plads 4, Copenhagen SV, Denmark-London Office: 5, St Helen's Place, London, E.C.3. Tel. LONdon Wall 4567

THE Trade Mark No. 600863 consisting of the words STROMBERG-CARLSON and registered in respect of telephones, telephone receivers, telephone transmitters, electric condensers and repeating coils, radio telephonic and telegraphic receivers, and radio telephonic and telegraphic receivers in combination with gramophones, was assigned on 31st December, 1964, by General Dynamics Corporation of 1 Rockefeller Plaza, New York, State of New York, U.S.A., to Stromberg-Carlson Corporation of 100 Carlson Road, Rochester, State of New York, U.S.A., **WITHOUT THE GOODWILL OF THE BUSINESS IN WHICH IT WAS THEN IN USE.**

C.R.E.I. (LONDON) HOME STUDY COURSES

IN ELECTRONIC AND NUCLEAR ENGINEERING TECHNOLOGY

Special programmes for CITY & GUILDS OF LONDON INSTITUTE TELECOMMUNICATION TECHNICIANS' SYLLABUS (Subject No. 49 and SUPPLEMENTARY STUDIES Subject No. 300)

THE COURSES OFFER A WIDE RANGE OF PROGRAMMES VARYING IN SUBJECT AREA AND DEPTH, AND REPRESENT THE HIGHEST LEVEL OF HOME STUDY TECHNICAL EDUCATION. THEY EFFECT AN IDEAL ALIGNMENT OF EXPANDING KNOWLEDGE WITH CAREER SHAPING PROGRESS.

C.R.E.I. enjoy high level recognition and, in the United States, many of the leading industrial and scientific organisations subsidise C.R.E.I. programmes for their employees.

In the United Kingdom, C.R.E.I. courses are approved by H.M. Forces and three programmes are available to Service personnel under the Forces Correspondence Course Scheme.

C.R.E.I. courses covering City & Guilds Supplementary Studies in Telecommunications and Electronics (No. 300) have also been approved by the General Post Office for sponsored employees.

HOME STUDY COURSES AVAILABLE IN

- Electronic Engineering Technology
- Nuclear Engineering Technology
- Automation
- Mathematics for Electronic Engineers
- Radar
- Servo Systems
- **Telecommunication Technicians' Syllabus (City & Guilds Subject No. 49)**
- **Supplementary Studies (City & Guilds Subject No. 300)**

Write for FREE brochures stating your field of interest to:

C.R.E.I. (London) Dept. P.O.7. Walpole House, 173/176, Sloane Street, London, S.W.1

(International Division of Capitol Radio Engineering Institute, Washington, D.C.)

Name..............................

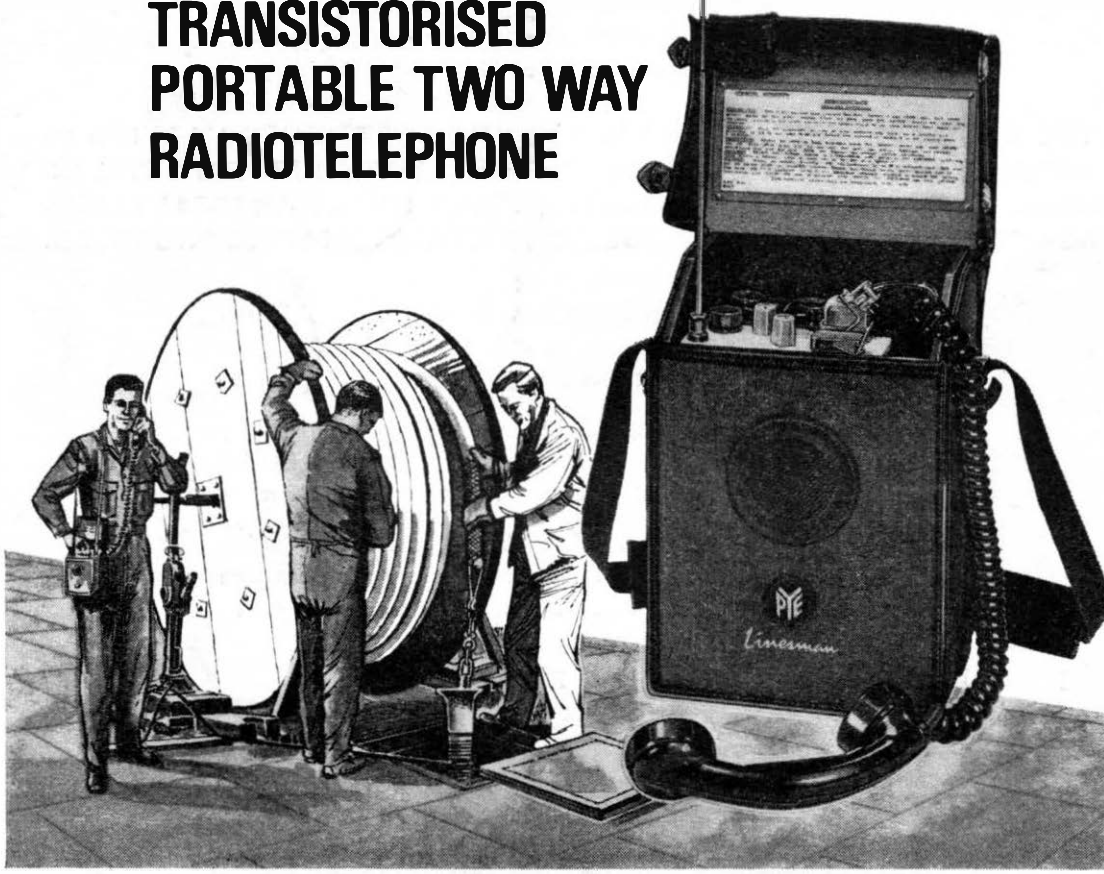
Address..............................

....

THE POST OFFICE TELECOMMUNICATIONS JOURNAL IS PRINTED FOR H.M. STATIONERY OFFICE BY FOSH & CROSS LTD., 80/92 MANSELL STREET, LONDON, E.1, AND IS PUBLISHED QUARTERLY IN NOVEMBER, FEBRUARY, MAY AND AUGUST BY H.M. POSTMASTER GENERAL AT THE POST OFFICE HEADQUARTERS, LONDON E.C.1

THE PYE Linesman

FULLY TRANSISTORISED PORTABLE TWO WAY RADIOTELEPHONE



Based on the now famous Pye Bantam solid state Walkie/Talkie, the Pye Linesman with many additional features makes it suitable for use in all types of weather, the Pye Linesman is proving invaluable in cable laying, road construction, building sites etc.

Important features are that it is free-standing, and incorporates large capacity batteries, is weatherproof and has a voltage indicator to show the state of the battery.

The 'Linesman' is designed never to let you down in the field. It is available for AM and FM in frequency bands from 25 – 174 Mc/s. It is used by the British Post Office.

PYE TELECOMMUNICATIONS LTD

CAMBRIDGE · ENGLAND · TELEPHONE: TEVERSHAM (CAMBRIDGE) 3131 · TELEX No. 81166