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# JOURNAL

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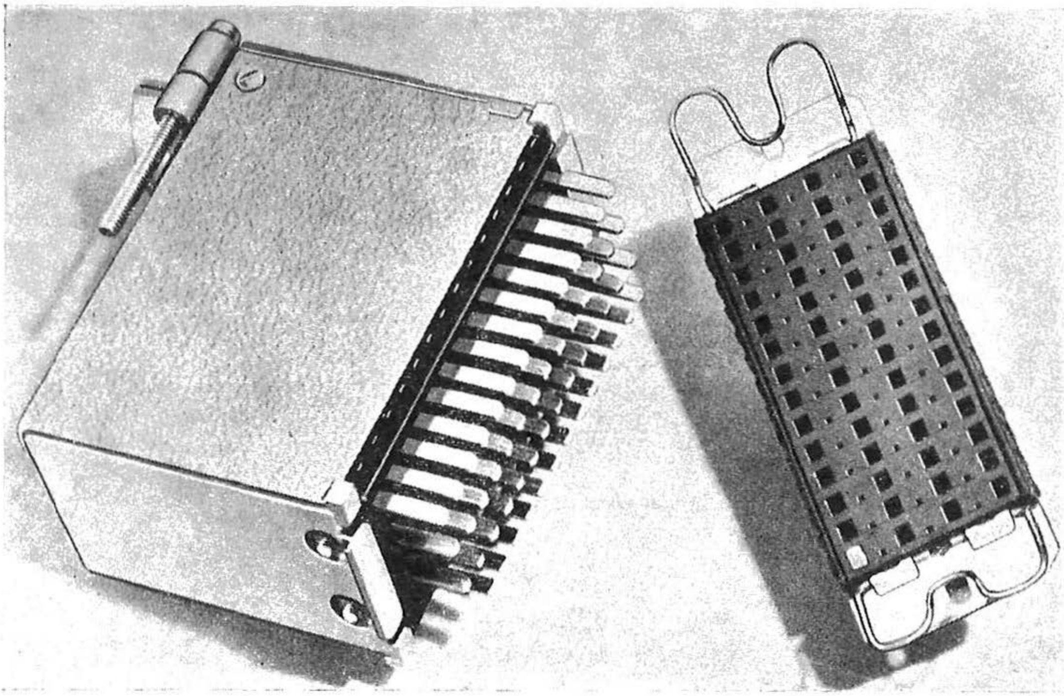

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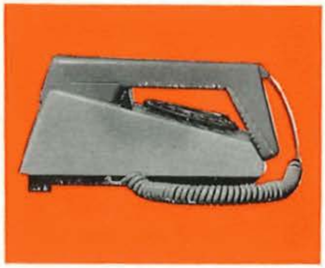
# STC TELECOMMUNICATIONS REVIEW

FEBRUARY 1965



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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 the 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.

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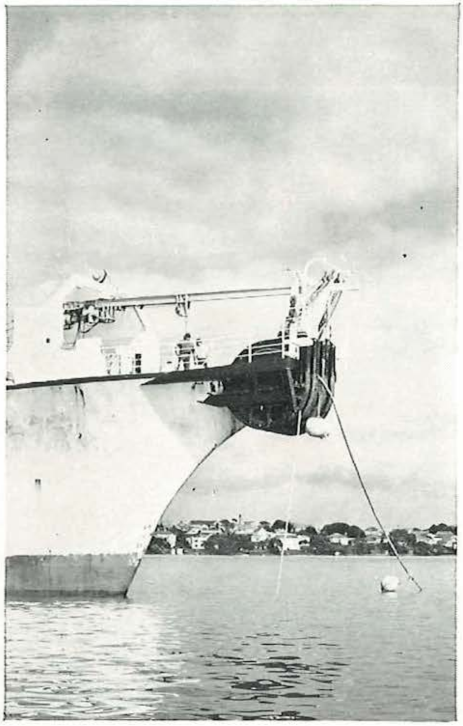

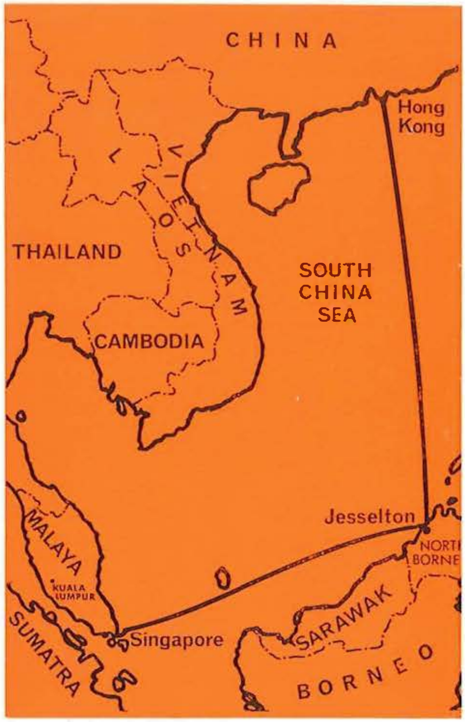


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STC has been chosen to provide the first links of the South-East Asia section of the round-the-world Commonwealth telephone cable. The £2,500,000 order includes the manufacture of equipment and cable for the routes linking Hong Kong, Jesselton (N. Borneo) and Singapore: 710 nautical miles of armoured shallow-water cable and unarmoured deep-sea cable, 70 submarine repeaters (amplifiers) and 10 submarine equalizer units using STC demountable housings. The latest STC transductor-controlled power-feeding equipment will be used. SEACOM will carry 80 high-quality telephone circuits or their equivalents in teleprinter or data circuits. At a later stage it is planned to link SEACOM to the COMPAC and CANTAT systems. This will provide high-quality speech circuits between London and Singapore and Hong Kong.

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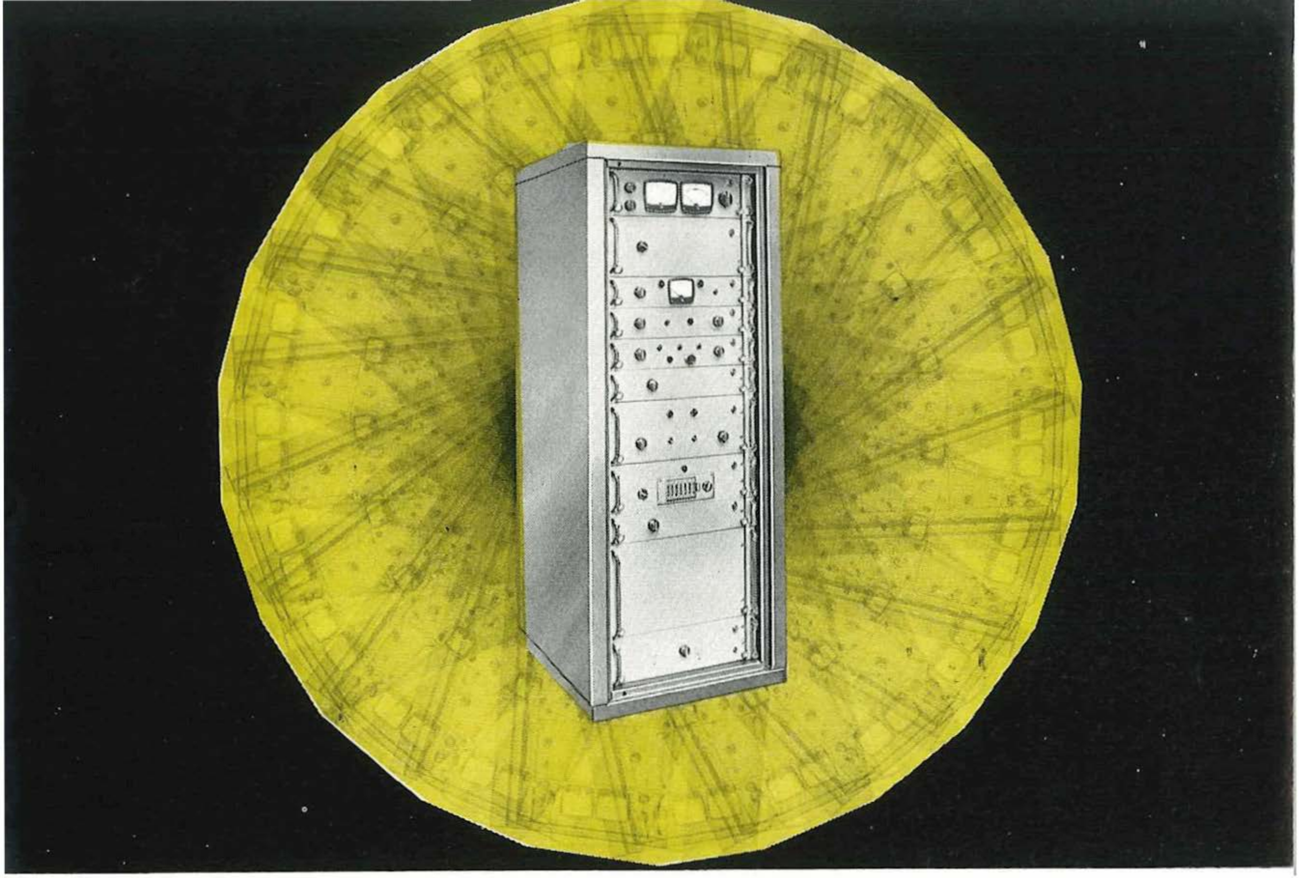

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# PVR 800 receiving system

A range of six basic receivers covering all types of reception over the range 3–27.5 Mc/s.

This all-transistor equipment provides a choice of six basic terminals which are arranged for the reception of Multitone telegraph, FSK, SSB, ISB, DSB.

1. Single path FSK reception
2. Dual diversity FSK reception
3. Single path SSB reception for speech or telegraphy
4. Dual diversity SSB reception for telegraphy
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All the receivers have six pre-set crystal controlled channels in the frequency range 3 to 27.5 Mc/s. A synthesiser is also available.

**MODULAR CONSTRUCTION** Each receiver comprises units built up from transistor modules, standard modules being used throughout where practical.

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**STABLE PERFORMANCE** The units in PVR 800 receivers are designed so that their performance is virtually independent of variations in component characteristics. Extensive use of negative feedback reduces spurious signal components, improves linearity, and ensures specified performance over a wide temperature range.

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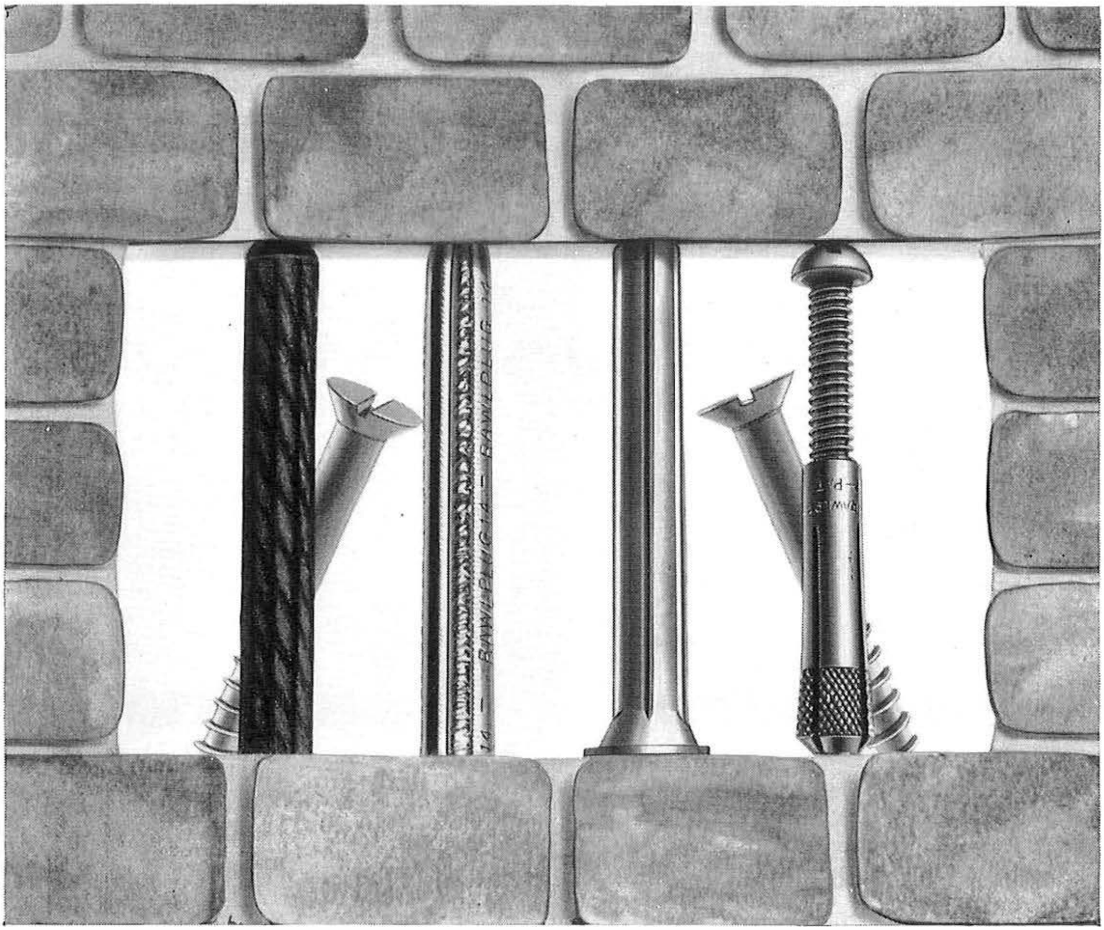

# Post Office Telecommunications Journal

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

## Contents



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*Vol* 17 *Spring* 1965 *No.* 1

## THE WAY TO MORE EFFICIENCY

**THE key to Britain's economic strength—and to the standard of living of her people—lies in greater efficiency and productivity. And in no field of activity is maximum efficiency more vital to the national well-being than in the telecommunications services which provide the communications links—often taken for granted—on which industry and commerce depend.**

As the national drive for more rapid technological advance and more efficiency gets under way this issue of the *Journal* tells in a series of articles how new practices, planning techniques and equipment are being employed, or are planned for future use, by the Post Office to achieve higher levels of performance.

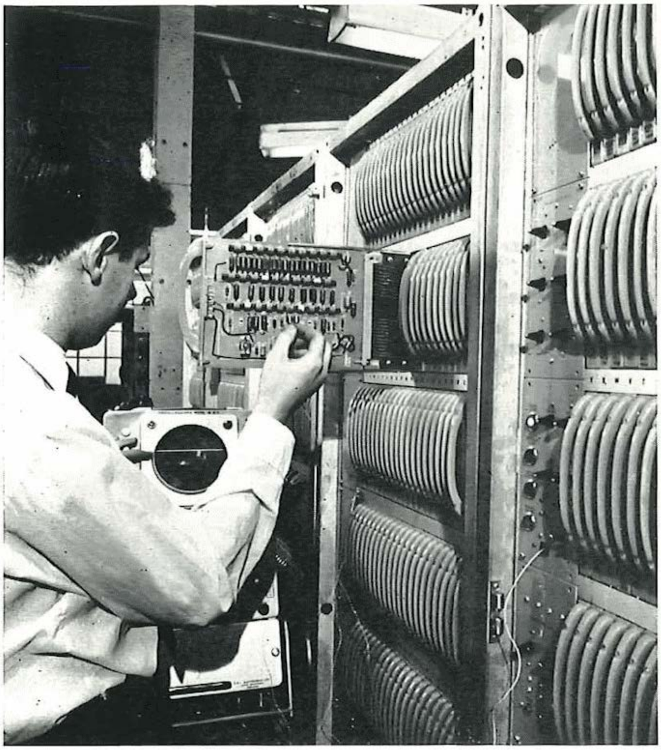
The decision to make the maximum possible use of computers to take over a variety of work at present performed manually—not least in the telephone service—is a most significant contribution. Yet this is only one step forward among a number of major advances.

A new Division has been created on the Engineering side and a new Organisation and Efficiency Branch has been established in the Inland Telecommunications Department to provide additional impetus to the drive for greater efficiency and economy. New planning techniques designed to speed operational planning and achieve the best value for money are being adopted; new streamlined office procedures are being used to eliminate delays in handling orders; new facilities, such as the Datel Services, are being introduced; and improved apparatus and equipment is being brought into service to expand and improve the telecommunications networks.

Equally important, Staff Associations are playing a full part and the recent agreement between the Post Office and the Post Office Engineering Union to ensure greater economy of manpower and the use of the most modern mechanical aids is an outstanding example of what can be achieved by co-operation between management and staff.

# ★THE POST OFFICE ENTERS

**With the placing of a £2½ million order for five more powerful computers' the Post Office brings to its aid the most modern tools to meet the challenging task of providing the best possible services at the lowest possible cost**



***An engineer tests a logic circuit on the first LEO 326 computer ordered by the Post Office.*** The pictures illustrating this article are reproduced by courtesy of English Electric-Leo-Marconi.

**"THIS marks the beginning of an exciting new era," said the Postmaster General, the Rt. Hon. Anthony Wedgwood Benn, when he recently announced that the Post Office had placed an order for five large, British-built computers together valued at about £2½ million.**

The order is the biggest of its kind yet announced in Europe for general purpose computers and means that in a period of 18 months the Post Office has ordered from British industry no fewer than seven large computing systems costing a total of about £3½ million.

Delivery of the new computers is expected to begin in September, 1965, and be completed by April, 1967. One will be used to extend the capacity of the existing installation at the London Computer Centre in Charles House, Kensington. Three will be installed in regions—the first in Home Counties Region, the second in the Midlands Region and the third in the North-Western Region. The location of the fifth computer has not yet been decided.

Initially, four of the new computers will be used to calculate telephone bills and subsequently, together with others, for up to 14 different varieties of clerical work at present carried out manually.

"We in the Post Office have very strongly believed in the computer as the most powerful tool of our modern age in the business of increasing our efficiency and we have devoted a great amount of study indeed to the problems which they pose for us in economics, technique and organisation," said Mr. Wedgwood Benn. "We have steadily built up our backing resources and extended the field of our investigations so that we now dispose of a force—probably the largest civil force in the country—of more than 200 systems analysts and programmers costing us something over £400,000 a year. Our range of study extends over almost all the main activities of the Post Office.

"The placing of this new order marks the beginning of the introduction of computer techniques into the field organisation of the Post Office. By far the biggest load for our future computers will be the work which arises in telephone managers' offices and head post offices scattered throughout the provinces. We thus aim to bring the most modern equipment directly to the aid of our local managers in the task of providing service to the public.

"The Post Office is very far ahead in the computer field. In a go-ahead and wise enterprise the computer can be an instrument for giving much better service to the public and that is what the Post Office is aiming to do."

The Postmaster General emphasised that the Post Office was extending its activities into the computer field essentially to increase efficiency in a variety of ways. "The computer will give us better use of our resources by enabling us to deploy our men, machines, motors and money to better advantage. It will, by virtue of its great speed and capacity for selective processing of information, enable us to have quicker-acting management controls so that we may take swift remedial action if unfavourable trends disclose themselves in the conduct of our business. It will also enable us to reduce the demands which the Post Office makes on that most precious of all our national assets—manpower."

The decision to employ computers first for telephone billing and then on an "integrated data processing" system in which information on a large number of subjects is fed into the machines to be processed when required, is the result of several years' study carried out by the Clerical Organisation and Methods Branch of the Post Office working in collaboration with the other Departments concerned.

The idea behind the integrated system is that data relating to any single occurrence is fed only once into the computer to be processed by and

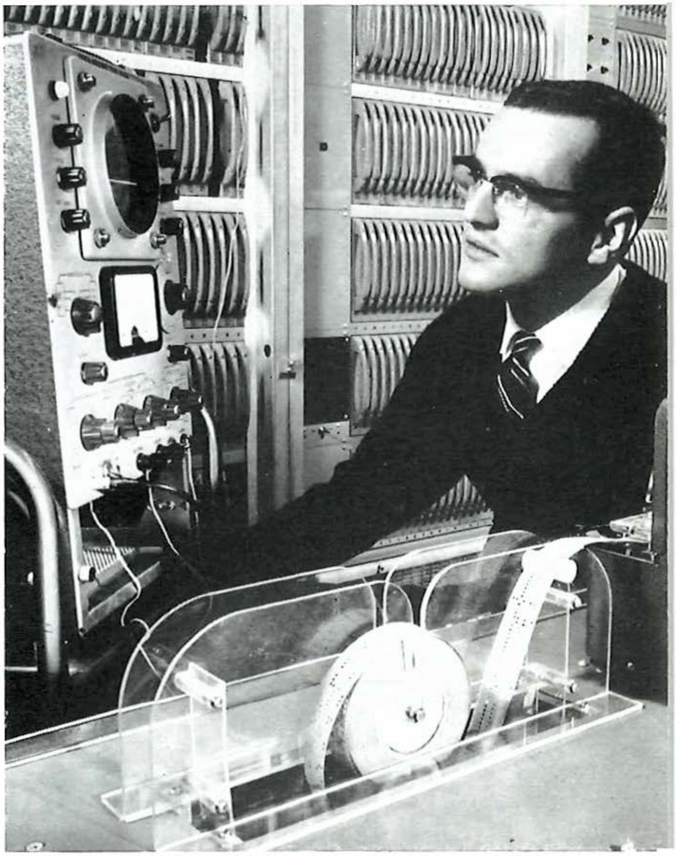
OVER

## MODERNISATION WITHOUT REDUNDANCY

**"We are not going to tackle the job of modernising the Post Office by creating mass redundancy," says the Postmaster General.**

"Turnover among our clerical staff is a headache which is with us in most parts of the country and our national wastage in these grades is running at about 3,800 a year. The advent of computers will help us to meet this wastage problem because they will replace our demand for staff by several thousands over the next few years.

"By adopting, as we have, the internal 'service centre' concept we are able to draw work for a single machine from a large number of places. We have, therefore, a most flexible arrangement which enables us to obtain a good economic result by filling each of these expensive machines quickly—in less than a year—while at the same time broadly regulating the introduction of mechanisation at every work point to keep within the natural wastage of that office. We shall have to ask our people to accept a certain amount of re-training and re-deployment to different jobs—I hope within their own offices—but I think this will be the limit of our demands on them. We are, of course, taking the staff side unions fully into consultation as our projects develop."



***Systems testing of the electronics on a Leo 326 computer. The electronic racks (in background) receive the information input by the punched tape (in the foreground).***

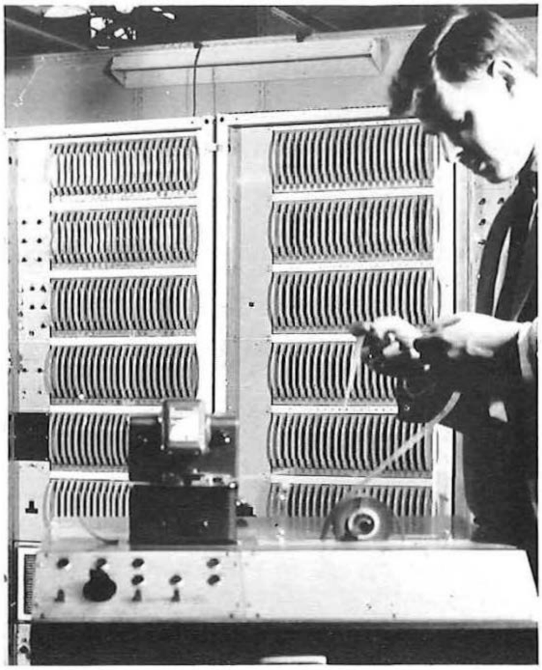
**COMPUTER AGE** (*Contd.*)

retained within the machine until there is a need for the machine to communicate the information to a human being to enable something to be done. Having designed the master plan for the integrated system the different elements can be developed one by one in the knowledge that all will fit correctly and the maximum possible use can be made of all data.

The Clerical Organisation and Methods Branch have identified 14 different systems of telephone area work which are suitable for putting on to a computer. These include systems for provision of service, billing, cash accounting, manpower control, staff and payrolls, development forecasting, exchange equipment, line plant planning, engineering stores control, and so on. Once these systems have been analysed, programmed and the data converted into machine language the information will be put into the computer to feed a number of different systems. For example, data on a customer's order will be made available not only to the provision of service system but also to the planning and control systems, the directory compilation and distribution systems and for billing purposes and ultimately probably to the line plant. Similarly, data on an engineering pay slip will be made available for the staff and payroll, engineering finance and accounting and cash balance systems.

The telephone billing system will be the first working system in an integrated arrangement to which all other systems will subsequently be added, each fitting into the rest of the structure rather like a collection of keyed blocks.

The integrated data processing plan offers two main advantages: it is much cheaper in terms of value for money and is much more flexible than a system involving a number of independent processing operations. The scheme will begin to come into force in September, 1965, when a new LEO 326 computer will be installed at the London Computer Centre in Charles House to take over the work of telephone billing for London Telecommunications Region which has already been started on a more restricted basis on a LEO III computer (see story on pages 6-8). In the meantime, Departments will push ahead with designing systems and programmes for five other work processes which will follow telephone billing: provision of service, engineering stores control, staff and payrolls, engineering finance and accounting and line plant.



***This picture shows the electronics associated with the information which is input to the computer on punched paper tape. The paper tape reader (in foreground) operates at 1,000 characters a second.***

Computerising telephone billing will itself present a formidable task. At present some 26 million bills for telephone service covering a total revenue of about £330 million are sent out to six million subscribers a year. These bills contain details of about 26 million charges for rental, 600 million charges for operator-controlled calls and dialled calls derived from 28 million meter readings. Charges brought about by subscribers' removals, alterations to equipment and so on total about three million and approximately six million reminders are despatched to late payers.

Under the computer scheme telephone bills will be re-designed and accommodate up to 14 trunk call entries. This, coupled with a revised layout for the trunk statement, will reduce the number of billing documents sent to subscribers by about 40 per cent. Under the new system about 80 per cent of all subscribers will eventually receive their quarterly bills on one piece of paper compared with 20 per cent who now do so.

# THE NEW COMPUTERS—AND THEIR TASKS

**THE five new computers the Post Office has ordered are the latest LEO 326-type made by English Electric-Leo-Marconi Computers Ltd. Each is up to eight times more powerful than the LEO III computers at present in use at the London Computer Centre in Kensington and at Lytham St. Annes, able to add two 10-digit numbers in four-millionths of a second, deal with 80-column cards at the rate of about 600 a minute, 40-column cards at 2,000 a minute and transfer information from magnetic tape files at about 90,000-characters a second.**

Associated with the new order is a medium speed data transmission equipment—called the H.6020—over which, from January, 1966, it is planned to transmit details daily of up to 750,000 cashed postal orders from the Accountant General's Department office in Chesterfield to one of the computers 150 miles away in London.

Apart from the telephone billing operation, the other tasks on which similar computers are already or will be employed are savings certificates repayments, Premium Savings Bond and Government stocks, postmasters' accounts and work carried out by the Post Office Savings Bank, the Engineering Department and the Supplies Department.

Repayments of all Savings Certificates—about 8,000 a day—are now being handled on computer at Charles House which calculates the interest payable, prints the repayment warrants and checks when they are cashed. In the near future a series of programmes for calculating and paying dividends on Government stocks will also be carried out by computer and plans have been made for Premium Savings Bonds records to be transferred to magnetic tape so that they too can be handled by computer.

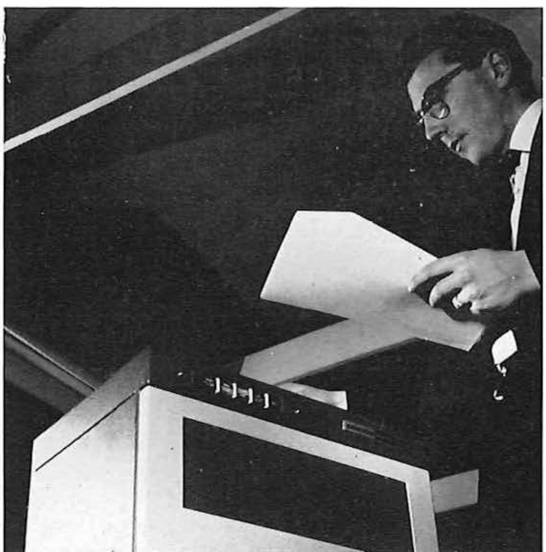
Preparatory work is being carried out by the Clerical Organisation and Methods Branch to enable computers to take over the checking, summarising and reconciliation of weekly cash accounts from the 23,000 post offices in the country and the first programmes to enable the Post Office Savings Bank to be completely mechanised are now being written. This latter operation will eventually involve computerising 22 million separate accounts—the computer recording every cash movement, calculating interest and printing the account number and balance in each new book.

Computers will also control the system for distributing vast quantities of the technical instructions used by the Engineering Department. Records of stores movements in the past three years have already been recorded on 34 reels of magnetic tape and these are now being used extensively for statistical analysis to provide the basic information for a full stock control system.

Initially, each LEO 326 computer used by the Post Office will have 24,000 word stores, 16 magnetic tape decks able to read or write about 90,000-characters a second, two 1,000-characters-a-second paper tape readers and 600-cards-a-minute readers and 1,000-lines-a-minute printers. The computers are so designed that combinations of this equipment on up to 14 different programmes can operate simultaneously.

Special developments by English Electric-Leo-Marconi have enabled the Post Office to use a 2,000-cards-a-minute, 40-column card reader at the London Computer Centre. It is the fastest reader in commercial use in Britain, able to read information from two million cards a day. Similar models will be provided at regional computer centres.

***Development model of the new H.6020 Marconi data on-line data transmission terminal.***



# THE COMPUTER CENTRE IN KENSINGTON

**Trunk statements and telephone bills for almost a million London subscribers are being produced by a computer at a centre in Kensington which will soon become one of the most powerful commercial computer installations in the world**

By H. G. ROBSON

**BY the end of January this year nearly a million subscribers in four of London's Telephone Areas were receiving trunk statements and telephone bills prepared and printed by computer at the Post Office's new London Computer Centre No. 2 in Charles House, Kensington.**

Within the next few months bills for subscribers in other Areas of the London Telecommunications Region will be prepared and printed by the same method until eventually over six million bills a year will be handled in this way.

Telephone billing by computer is one of the two major projects on which the new Computer Centre has been working since July, 1964, to set in train the second stage of office automation in the Post Office. The other major project is the calculation by computer of all National Savings Certificate repayments.

The London Computer Centre No. 2 (the No. 1 Centre, more commonly known as the London Electronic Agency for Pay and Statistics—LEAPS—has been in operation for more than five years) is the first installation to be set up under the plan to introduce computer techniques over a wide field of Post Office activities and so secure substantial economics. At present the computer in use at Charles House is a British LEO III, manufactured by English Electric-Leo Computers Ltd. It is a general purpose data processing equipment specifically designed for commercial type work, although scientific and research projects could also be efficiently handled on the machine. By the end of May this year this machine is expected to be replaced by a LEO 326 computer which is electronically about six times faster than the LEO III.

In transferring telephone billing on to the computer in Charles House it has been necessary to retain, for the time being, the existing system of MATS-type, 40-column punched cards. Rental, dialled metered call and miscellaneous charge cards are still prepared at the London MATS Unit from information supplied by telephone managers and the bulk of trunk and other call tickets supplied by the exchanges are punched automatically by Mark scanners. (These machines punch holes in the tickets according to marks made by telephone operators.) After being punched, the cards are sorted into subscribers' numerical order and sent in trays to the Computer Centre for processing. At full load the Centre will process half-a-million cards a day.

In Charles House the processing is split into four stages. The first two stages—known as the Data Vet Process—involve reading the information on the cards (the trunk tickets are kept separate by the MATS Unit and in the Centre from the other cards). Each process is controlled by its own programme held on a magnetic tape,


***On duty at the operating console at Charles House. The magnetic tape decks are in the background.***

***This picture shows the paper tape readers (foreground), the console and the Anelex printer at the Charles House centre.***

although operationally there is little difference between the two. The cards are fed into a reader which transfers the information on to a magnetic tape so that at the end there are two magnetic tapes, containing ticketed trunk call charges and all other charges, which are then used simultaneously in the next process—known as the Main Process.

The Main Process programme caters for a number of requirements. If there is only a ticketed trunk call magnetic tape input, two actions are carried out. Calls for monthly trunk subscribers and heavy users of the trunk service are put on to a magnetic tape ready for producing trunk statements. A Master Record containing totals of ticketed trunk calls (heavy users) is also kept up to date each day and the totals are subsequently transferred to another magnetic tape used to accumulate information ready for printing the bills. All subscribers are still identified by the MATS class-of-service codes.

If all types of card are processed, the metered call charges are calculated and transferred, with the information on rentals and so on, light user subscribers' trunk calls and all the third month trunk call charges for other subscribers, on to the same tape which is then used in the final Print Process.

In the Print Process the magnetic tape is read by the computer and the information is printed out on the appropriate stationery. If only trunk calls are processed, only trunk statements are printed. Otherwise, the whole bill is printed and, as a separate exercise, the trunk statements proper to the bills are produced. If light user subscribers have fewer than 15 ticketed calls on their bills these details are not printed on the trunk statement, as they are under the MATS system, but on the actual bill itself. After being printed the bills and trunk statements are guillotined and sent to the

**OVER**

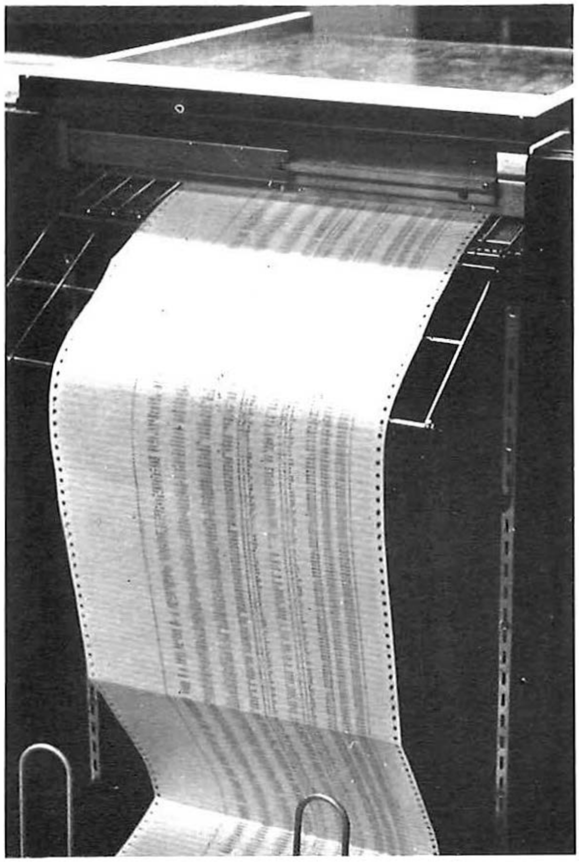
**COMPUTER CENTRE IN KENSINGTON** *(Contd.)*
Telephone Managers' offices to be addressed and posted to subscribers.

Later this year a start will be made to set up main files containing details of subscribers and it is intended that statements and bills will then be despatched direct to them from the Computer Centre.

All National Savings Certificate repayment work has also been transferred to the Charles House Computer and an average day's output is about 8,000 warrants and advices. The printing of the warrants is carried out on only one of the two printers and takes about one-and-a-half hours a day.

Other operational tasks carried out at Charles House include a very large analysis of Engineering stores demands on the Post Office Supplies Departments' depots during the past three years. The object of this project is to develop a more efficient provisioning system and to determine the optimum stock levels and the best geographical locations for main stores holdings throughout the country. The information recorded as a result of these programmes is held on more than 200 magnetic tapes.

Before any project is transferred to computer working lengthy programme testing and trials are carried out and each day a proportion of the Charles House computer time is devoted to such work. At present the programmes being developed relate to the production of van schedules for the centrally-controlled London postal vehicle fleet, to the Post Office Savings Bank and the distribution of Engineering instructions.



***The printed output seen from the rear of the Anelex printer at the Charles House centre.***

## HEAT, DUST AND NOISE PROOF

*Since the Charles House computer installation operates continuously for 15 hours a day and generates considerable heat which would otherwise adversely affect the operators, magnetic tapes and punched cards, the room conditions are strictly controlled by an air-conditioning plant specially designed by the Ministry of Public Building and Works.*

*If the air-conditioning plant becomes faulty and the room temperature rises to 80 degrees Fahrenheit the computer is switched off.*

★

*Precautions are also taken to keep the air in the computer room free from dust which would adversely affect the more delicate parts of the machinery and the magnetic tapes. All the air is filtered and operating staff have to walk over specially impregnated rugs which trap loose dirt on their shoes before they enter the room.*

★

*To reduce noise, all walls, pillars and ceilings are covered in sound-proofing material, screens cover windows nearest to the equipment in the operating area and the printers are fitted with noise-reducing covers.*

★

*The LEO 326 will be set up in a new computer room recently constructed by the Ministry of Public Building and Works and in September, 1965, a second LEO 326 will be installed in the accommodation at present occupied by the LEO III. Then, the London Computer Centre No. 2 will become one of the most powerful commercial computer installations in the world.*

# THE LEO III—AND HOW IT WORKS

**A MODERN computer is a complex of several subsidiary machines integrated into a unified processing installation.**

The LEO III at Charles House consists of five principal components—the main frame, the store, magnetic tape decks, assemblers and control units and other peripheral equipment.

The main frame contains the calculating and controlling circuitry and is really the central unit of the machine. The store, which is made up of many thousands of small ferrite cores, each indicating a binary digit, has a capacity of 16,000 words. Since each word can contain up to 10 decimal digits or five alphabetical characters, the store has a theoretical capacity of 160,000 decimal digits. In practice, the store is also used to house programmes—or sets of instructions which control the action of the machine.

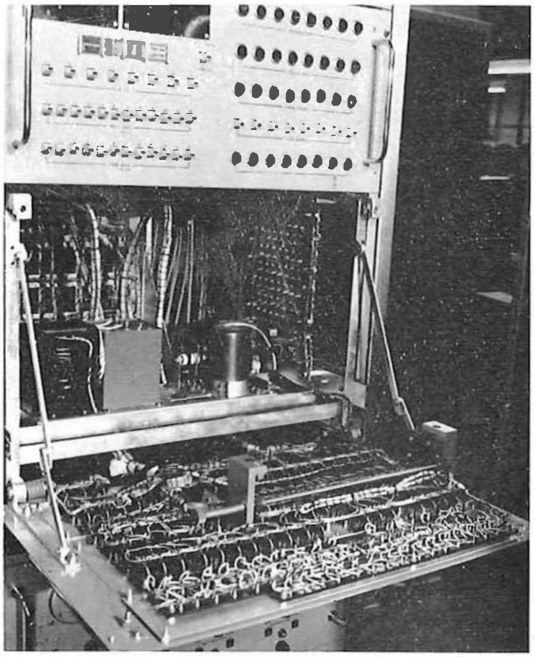
There are 12 magnetic tape decks which operate on a principle similar to that of a domestic tape recorder and record individual binary digits grouped in tracks across the width of the tape. These digits are arranged so that 800 alphabetic or numeric characters are recorded on each inch of tape which is 3,600 feet long. This information can be transferred to or from the decks at up to 96,000 characters a second. The tapes are used mainly as a second-level of stored information which can be physically removed and kept until a task needing the information is due to be run when they are mounted on the tape decks and read into the main computer store. The programmes themselves are normally maintained on magnetic tapes.

The assemblers and control units are cabinets of electronic equipment which control actual data transfers and assemble data into blocks for transferring to and from the store.

Although magnetic tape decks are considered to be input and output devices their use as a second-level store and their speed of character transfer tends to separate them from more conventional types of input/output equipment installed at Charles House. The Centre is equipped with 80-column punched card readers, each of which operates at 600 cards a minute. The LEO III has two 40-column card readers—the first a unique machine developed jointly by International Computers and Tabulators and English Electric Leo Ltd., which reads 600 cards a minute, and the second, jointly developed by the American Uptime Corporation and English Electric Leo, which reads 2,000 cards a minute. In addition there are two tape readers each with a maximum speed of 1,000 characters a second.

The main output devices are two Anelex printers, each able to operate at 1,000 lines a minute (a line can consist of 160 characters). There are also a paper tape punch (110 characters a second) and an 80-column punched card punch (100 cards a minute). Of the two output typewriters, one on the main operating console provides the main means of communication between the machine and the console operator. Comments on the progress of the programmes and instructions to and commands given by the operator, with the time of each comment, are typed in sequence to

**OVER**



***Programmes written for the LEO III can also be used for the new LEO 326 computer. Here is seen part of the electronics in the engineers' control cabinet of a LEO 326.***

# HOW COMPUTERS HELP THE ENGINEERS

★

The Post Office plan for using computers will not end with the order for the five new LEO 326 computers. Another and smaller computer has also been ordered for use by the Engineering Department on scientific, mathematical and engineering work and from 1967 onwards it is hoped to place more orders for more computers to take over more clerical work, the cost amounting probably to about £1 million a year over a period of several years. Ultimately, it is estimated that there will be one computer operating in each of the larger Post Office regions and an additional computer for the Post Office Savings Bank

***Mr. P. Strawson, senior machine operator, checks tapes as they pass through the paper tape readers of the Dollis Hill computer.***

**THE new computer for the Engineering Department will be an Elliott 503 and used primarily for scientific, mathematical and engineering work, including the simulation of exchange switching systems.**

Four magnetic tape decks, a high-speed line printer and 64,000 words of backing core-store will be provided in addition to the basic computer. The equipment, which is expected to be delivered by the end of March, 1965, and ready for operational use by mid-May, will be accommodated on the ground floor of the Engineering Department's headquarters in Gresham Street, London.

Computers have been used increasingly effectively by the Engineering Department in the past

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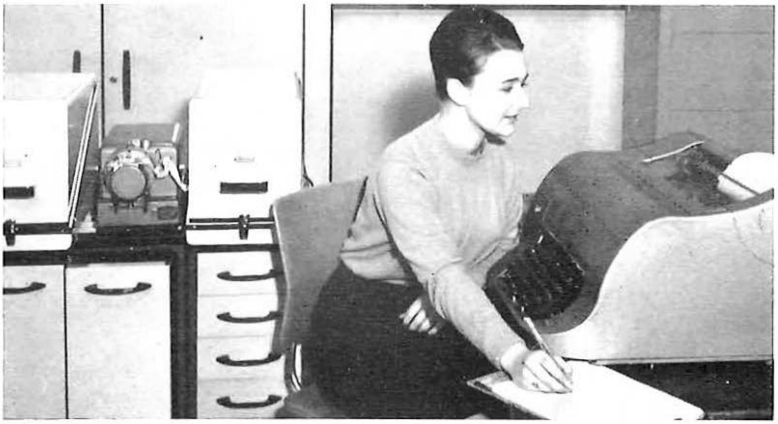
**THE LEO III** (*Contd.*)

produce the main log. Detailed analysis of the log enables management to pinpoint inefficiencies in programmes, operating techniques and, sometimes, the effects of sub-standard programme writing.

One of the outstanding features of the LEO III is its ability to process several different programmes simultaneously. At present up to four separate programmes are being run at the same time on the Charles House installation.

The new LEO 326 computer which will replace the LEO III machine uses the same type of input and output equipment as the latter and programmes written for the LEO III can also be carried out by the LEO 326. Because of the LEO 326's increased speed, size of core store and greater number of peripheral devices it is hoped that up to six programmes will be run simultaneously.



***Left: Miss K. Bray, an Assistant Experimental Officer, at work at the reading head where the computer's answers are printed in direct language.***

***Below: Machine operator T. J. McEvoy punches out a programme for the Dollis Hill computer on an autocode machine.***

few years on a wide range of scientific tasks. In March, 1961, an Elliott 803 computer was installed at Dollis Hill mainly to help solve the many day-to-day complex calculations in the research and development field. This computer was converted to an 803B type in November, 1962, to treble its computering capacity and many major scientific tasks and experiments have since been carried out on it. Up to November, 1964, more than 1,500 hours of the Elliott 803B's time had been spent on studying the development of thermionic valves and over 1,000 hours on microwave propagation studies. In addition, the computer has been used on such tasks as test and inspection techniques and trial exercises to find the best solutions to complex network problems both in switching systems and equipment design.

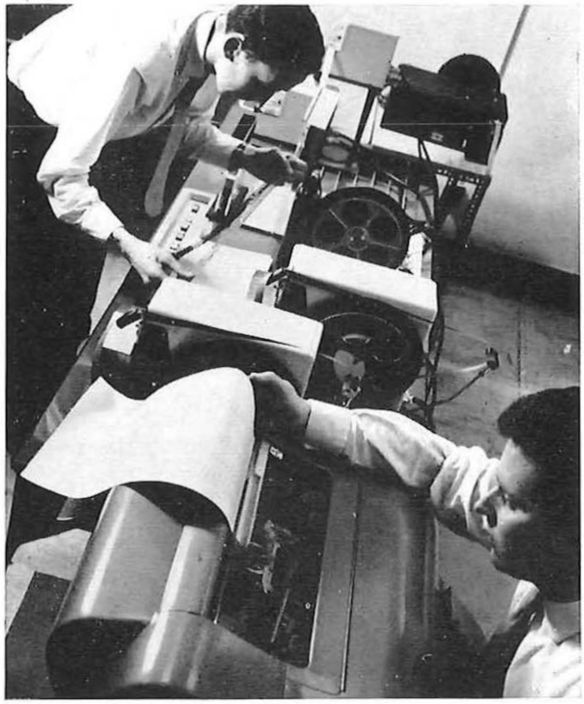
When the new Elliott 503 computer comes into service it will be used at first to carry out more complex design studies on transistors and simulation studies into electronic exchange and satellite systems, the London junction telephone network and the inland trunk network.

One of the Engineering Department's big problems in developing electronic switching systems is that the mathematical theory of switch design is extremely complicated and at best only an approximation, vitally dependent on specifying the distribution of traffic into the system by usable mathematical functions which are poor approximations to the truth.

For this reason the Engineers have developed a simulation technique in which the computer is used as a system model. Traffic is generated by the computer in a manner which is a reasonably close approximation to peak loading conditions and the computer is set up to reproduce the required system configuration to be studied and subjected to self-generated traffic. Calls are offered one at a time in accordance with the input programme and they either find a way through the equivalent network or discover no suitable path and are recorded as "overflows". The computer output produces a record of how the input varies and the proportion of occasions when all suitable paths are busy. These data enable the reaction of the proposed switching network to a given traffic

OVER

*Left: Loading the aerial steering tape into the tape reader in the computer room at Goonhilly. Below: Making a "print-out".*



**COMPUTERS** *(Concluded)*

pattern to be determined and a succession of runs provides the variance and other useful data. Variations in the switching plan can thus be checked quickly and under controlled conditions simplified formulae derived for design calculations.

The simulation studies to be carried out on satellite systems will include analyses of traffic flow and investigations into aerial tracking rates, satellite visibility and grade of service. The present Dollis Hill computer has for some time provided regular information to predict the operation of the Goonhilly earth station and Goonhilly's own computer, which controls the aerial steering, has also been used for other purposes, notably to work out the best solution of international frequency planning problems which arose during the Extraordinary Administration Radio Conference in Geneva last October and November. The Goonhilly computer was connected by data link to the Conference Centre and problems posed by the Conference were fed into it. The best solutions were transmitted in the return direction and made available for consideration before the conclusion of the same day's business. In this way the computer saved many hundreds of manhours of calculations and enabled international frequency planning of space systems to be put on a firm technical basis.

The Goonhilly computer has also been used more recently to produce co-ordinated data for the specification of a new 64-foot diameter stainless-steel reflector surface for the new aerial system at the satellite tracking station. This information was sent to the metal manufacturers who, in turn, fed it into a computer-controlled machine to produce the correct reflector elements. Specifications are now being prepared for a £250,000 computer installation at Goonhilly which will act as an on-line operational process control for the station and be able to analyse the efficiency of its operations and work out background, orbital and communications' problems.

A number of successful experimental studies into the most efficient methods of planning and utilising the inland trunk telephone network have already been carried out by the Dollis Hill computer. Now, a project team is to be set up to investigate in detail how best the new computer can be used in this field. This study will take up to two years to complete and a further three years to implement.

Scheduled for early study are the possible computerising, on regional computers, of engineering activities in the provision of telephone service and local line network. The provision of service study will link the engineering work with that of the Sales, Traffic and Accounting sections of the area organisation and the local line network study will determine the allocation of line plant according to the flow of supply and recovery of telephone service and project the forward planning of the network to meet the forecast growth of the system.

***Closely linked with the advances which the Post Office is making in the computer field are the important developments which it is pioneering in the young but rapidly-growing science of data transmission. The Post Office has already forged ahead of most other administrations in providing data transmission facilities so that the best use can be made of computers. This article tells how this has been done and what will be achieved in the future***

# DATA by DATEL

By T. W. S. RUSHTON


***A data transmission terminal, designed by Standard Telephones and Cables Ltd, showing (left to right): tape reader, reel of tape, control panel, Post Office Datel Modem No. 1A below the telephone, and the error control electronics equipment.***

**THE story of the Post Office Datel Services, which were inaugurated in July, 1964, goes back to about 1956 when a few companies began to use telex for sending business data to their data processing centres. Renters of telegraph circuits then joined in and gradually the number of users increased.**

At first, these firms used the spare time available between ordinary message transmissions but later private circuits and telex stations were rented for data transmission. Then, some of the busier users found the speed of telegraph circuits (50 "bits" a second, or 400 characters a minute using a five-unit code) was inadequate and in 1960 data transmission at higher speeds began on telephone circuits.

Normal terminal equipment can be used for data transmission on telegraph circuits but on telephone circuits special terminal equipment must be provided. At a transmitting station this will consist of a data reader, which may be a paper tape, a punched card or a magnetic tape transmitter, or even an output circuit from a computer; equipment to control the operation of the reader and provide error correction facilities; and a means of converting data pulses from the reader into tone signals suitable for transmission over a telephone circuit.

The special terminal equipment needed at a receiving station consists of apparatus for reconverting the tone signals from the line into data pulses; equipment to control the operation of the data receiver or "writer"; and a data receiver which may be a paper tape or card punch, a magnetic tape recorder or an input circuit to a computer.

The combination of the "converting" and "reconverting" equipment used to modulate and demodulate the signals is known as a modem, although this name is also now used to describe either the modulation or demodulation equipment.

OVER

***Right: An operator sets up a call on the GEC-designed installation. The error control electronic equipment is in the table pedestal on the left.***

***Above: Type PT 600 PT data transmission/ receiver equipment, designed by AT and E Ltd, surmounted by two Datel Modems No. 1A. On the left are the paper tape reader and associated control equipment; on right, the paper tape punch and control equipment.***

In the beginning, data transmission terminals used on telephone circuits contained all the required equipment. There is, however, a close relationship between the characteristics of the modem and of the circuit on which it might be used and, because the characteristics of circuits can vary very widely, the Post Office decided from the outset that it should provide the modems at all data terminals connected to the public telephone network. On private circuits, however, where the characteristics are more stable, the customer retains his traditional right to provide his own equipment, including the modem, if he wishes.

Until it was able to market its own modem, the Post Office allowed some proprietary modems to be connected temporarily so as not to restrict the growth of data transmission on the public telephone network. The first Post Office modem—known as the Datel Modem No. 1A—became available in January, 1965, and these will soon replace private modems on new installations. It was designed to the standards recently adopted by the International Telegraph and Telephone Consultative Committee (CCITT). Britain played a leading part in the discussions which led to the adoption of these standards.

The Post Office intends the Datel Services to embrace all its data transmission facilities. For convenience of marketing, all existing facilities have been formed into a series of numbered services, each covering a distinct range. Already available are the Datel 100, 600 and 2,000 Services while the Datel 200 and 300 Services are under development.

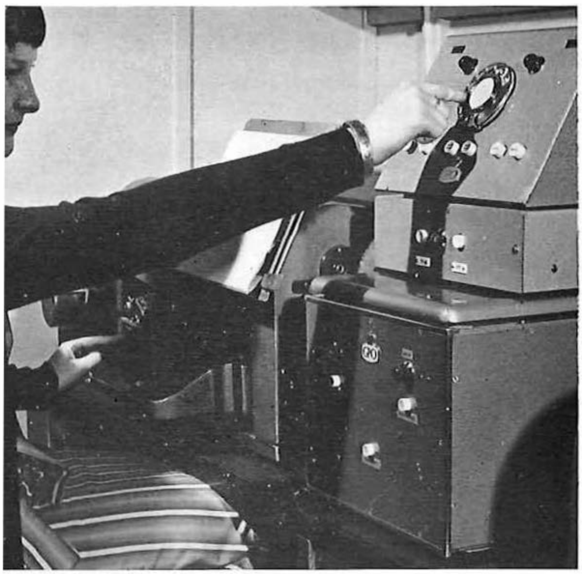
The Datel 100 Service embraces all special data facilities provided on telex, which operates at 50 bits a second, and private telegraph circuits, which operate at up to 100 bits a second. At present it offers three special facilities. First, the telex station can be modified to permit data—prepared as punched paper tape in a five-unit alphabet other than the International Telegraph Alphabet No. 2 used for telex—to be transmitted without interference from the operation of the various machine functions, such as the answer-back mechanism. This facility has been available for nearly four years and has proved very popular.

Second, equipment can be provided which enables errors which occasionally occur in transmission to be detected as soon as they are received. The rate at which these errors occur varies widely, but, on average over a long period, a figure of about one error in 30,000 characters may be expected. The new equipment, which should reduce this figure to about one error in 500,000 characters and, after development, to better than one in ten million, is primarily intended for use on telex but it will also be suitable for private circuits.

Third, a switch—known as the Unit, Telex No. 7—allows approved private transmitting and receiving equipment to be connected to a telex circuit. The Post Office teleprinter is disconnected but the switch is so designed that when the call is completed the teleprinter is automatically reconnected to the circuit which is then ready to be used again as an ordinary telex station. This facility will enable customers to transmit in a wide variety of alphabets from paper tape, punched cards or other media for which they have suitable equipment.

The Datel 200 Service, which is expected to be available in 1966, will provide simultaneous both-way data transmission at up to 200 bits a second—or about 25 characters a second—over telephone circuits. It is intended for use with cheaper customers' terminal equipment than that needed for the Datel 600 Service.

The Datel 300 Service, which should be available in 1966, will be a one-way only system operating at up to about 20 characters a second. This is intended to be a cheaper system capable of operation by unskilled staff and is mainly for use where relatively small quantities of data have to be collected at a central point from a large number of offices. It may at first cater only for numeric data but eventually will handle full alpha-numeric data.



***An operator sets up a call at a telex station fitted with the Post Office two-way error detection equipment.***

The Datel 600 Service provides transmission facilities over telephone circuits at speeds up to 1,200 bits a second (or about 150 characters a second) using the Datel Modem No. 1A. Customers use one of several approved proprietary data reading and writing and error control equipments. The Datel Modem No. 1A can provide a data channel in either direction of transmission, operating at a maximum speed of either 600 or 1,200 bits a second, and an optional return channel operating at up to 75 bits a second which can be used for supervising or controlling the progress of data transmission and operating the error control system. The type of proprietary equipment used determines whether a return channel is needed.

The Post Office is studying a number of further developments, such as switching arrangements to enable data transmission terminals to be used at will on any of a group of circuits; facilities for making telex and telephone calls to unattended offices to collect data left ready for transmission or to deposit data ready for processing when the offices re-open; facilities for computers to make their own telex and telephone calls automatically for exchanging data with customers or other computers; and the provision of separate switched networks of high-quality telephone and wide-band circuits for data transmission and other services such as picture transmission.

The overall aim behind these developments is to make a complete data transmission service available to all customers who want it.


## THE AUTHOR

*MR. T. W. S. RUSHTON joined the Post Office as an Assistant Traffic Superintendent in 1936 in Nottingham, and in 1938 helped found the Coventry Area. After war service in the Royal Signals, much of it as a prisoner-of-war, he was appointed Assistant Telecommunications Controller Class II in Midland Region Headquarters, and in 1952, transferred to the Birmingham Area as a Senior Telecommunications Superintendent.*

*Promoted to his present rank of Chief Telecommunications Superintendent in the Planning Branch of the Inland Telecommunications Department in 1956, he has been concerned with the development of telex, private telegraph service and data transmission.*

*This article — the first of a series telling how the Engineering Department is helping to improve the efficiency and productivity of the telephone service — describes how management sets targets and measures performance.*
*Later articles will deal with work study and organisation of labour, the more efficient use of tools and mechanical aids and the steps being taken to achieve greater reliability and efficiency in installing and maintaining plant and equipment*

# GETTING AT THE FACTS

By R. W. G. CARDEN

**THE Engineer-in-Chief is the head of an organisation of some 96,000 professional and technical engineers (probably the largest body of its kind in Britain), most of whom are engaged on planning, construction and maintaining the telephone system.**

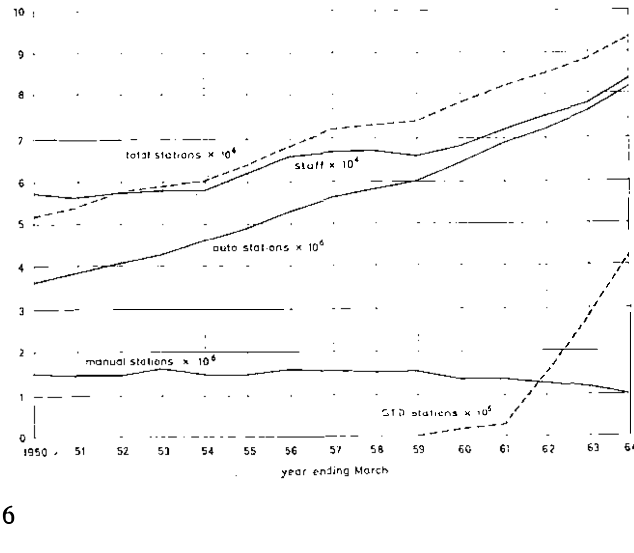
The volume of work with which Post Office engineers have to cope is constantly growing, not only because of the steady expansion of the network, but even more because of the increasing complexity of the equipment. The gradual replacement of manual operation by automatic switching has been going on since the late 1920's and by 1970 it will be possible for all local calls and most trunk calls and many international calls to be handled automatically. With this degree of automation the efficiency of the Post Office engineering force becomes an important factor in ensuring that the telephone users in this country enjoy a quick and reliable telephone service at low cost.

The drive to improve efficiency and productivity is very much to the fore these days. It may be thought relatively easy to define and measure productivity when applied to a factory with a single product output but it is certainly difficult when the end product is a public service.

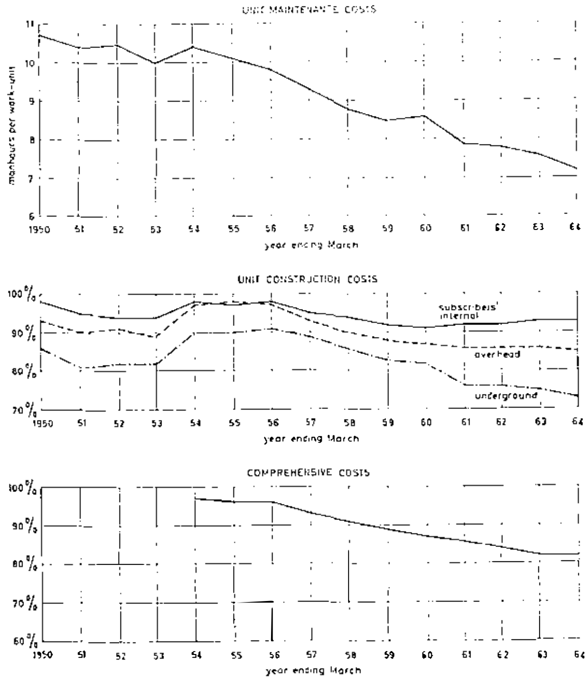
In broad terms better productivity in the telephone service means meeting the demand for telephones more quickly and providing a more reliable service at a lower relative cost while using fewer staff in proportion to the size and rate of growth of the system. Improvements can be effected by better tools, more efficient methods of working, improved designs and materials, new techniques and devices. From the inception of the telephone service there has been a ceaseless outpouring of effort to find better, easier and cheaper ways of doing things, but to apply ideas intelligently we must be able to measure the effect of changes on the performance of engineering work. For this we need management statistics.

In the engineering field three main statistical yardsticks are employed to keep watch on productivity. The first is known as Unit Maintenance Costing (UMC). The basis of this system is to measure the maintenance work effort required in work units, one work unit being defined as that amount of work requiring a labour effort of 10 man-hours a year. Improvements in maintenance performance are shown by a reduction in the number of actual man-hours employed per work-

***This combined graph shows the growth of the telephone system and of the Engineering minor staff during the past 14 years.***



***These graphs illustrate how costs have been steadily reducing since 1954.***




unit. Thus, if the standard allowance for maintaining an automatic telephone exchange is calculated to be 2,500 work-units but the actual time spent on maintenance in a year is 20,000 man-hours, the average performance rating for the year is $\frac{20,000}{2,500} = 8$ man-hours/work-unit. An improvement of the performance rating to six man-hours/work-unit would indicate a reduction in maintenance costs of 25 per cent.

The second yardstick is Unit Construction Costing (UCC), a system used to measure the performance of external construction and installation and subscribers' apparatus fitting work. Each operation is given a standard time allowance (basic man-hours) and the UCC performance rating is obtained by dividing the actual time, in man-hours, taken to complete a job by the basic man-hours allowance, expressing the result as a percentage.

The third yardstick is known as Comprehensive Costing. The UMC and UCC systems deal with labour actually used to carry out certain types of work.

The true cost of a job includes other necessary charges such as transport, travelling and subsistence costs—that is, time spent on necessary but unmeasured work. These are all brought together by the Comprehensive Costs system. All charges incurred are, for convenience of handling, grouped together under four headings (measured and unmeasured work; indirect labour and training; vehicles; travelling and subsistence) and the cost of each group is expressed in £'s per £100 of work completed. The figures thus obtained are modified by weighting factors to give performance ratings which enable an approximate comparison to be made of the performances of widely differing Areas.

Although the traditional control statistics outlined above have been, and continue to be, extremely useful management tools, they suffer from several acknowledged defects. They are expensive to operate—involving laborious counts of equipment items, detailed records and measurements and consultation of lengthy lists of standard allowances and weighting factors. They cover only certain classes of labour expenditure and not all the expenditure within those classes. The standard allowances become outmoded and periodic adjustment disturbs recorded trends. No account is taken of other relevant factors, such as the quality of work achieved and, except in Comprehensive Costs, differences in conditions from Area to Area and Region to Region.

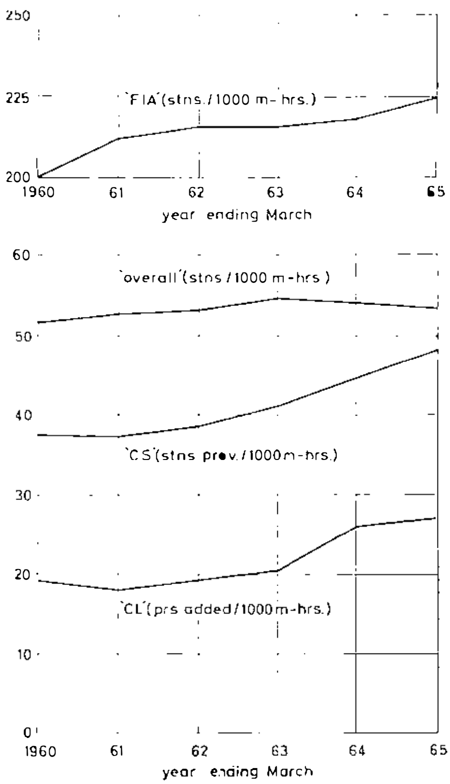
Much thought is now being given to devising a system of work measurement which is an improvement on the existing UMC, UCC and Comprehensive Costs systems. Ideally, it should be simple to derive—and, therefore, cheap to operate—give a broad picture of the cost and quality of service, react quickly when something goes wrong and yet permit adverse factors to be pinpointed. The preparation of such a system will involve considerable work study and will take some time to prepare.

Complementary to the systems of work measurement a man-power productivity index system has been developed over the last two years and is currently being applied to the nine Telephone Regions. The possibility of extending the scheme to Areas is being investigated.

The productivity index system comprises four sets of indices which, for all their apparent simplicity, give an overall indication of engineering productivity in the fields to which they are applied:

(i) *The Overall Productivity Index* gives the total number of telephone stations per 1,000 man-

**OVER**




***The general improvement in manpower productivity is illustrated by these two graphs. FLA indicates internal maintenance; CS. internal subscribers' apparatus, fitting and installation work; and CL, external cable provision, mainly local line plant.***

hours of all engineering labour, including time spent on sick leave, annual leave, training and other indirect charges.

(ii) *The Maintenance Index* is the total number of telephone stations per 1,000 man-hours of telephone maintenance labour.

(iii) *The Installation Index* is the number of telephone stations provided per 1,000 man-hours of telephone installation labour.

(iv) *The External Construction Index* is the number of cable pairs provided per 1,000 man-hours of external construction labour.

The system is used not only to measure past performance but also to compare proposed staffing with the forecast work programme in the annual five-year forecasts, to derive annual percentage improvements and to assess long-term trends. Indices (ii) and (iv) which account for two-thirds of the total direct labour, are used to look for possible causes of unexpected results shown by the Overall Index.

For effective control purposes, management statistics need to be issued promptly and frequently. As an experiment, a monthly booklet entitled "Telecommunications Management Statistics" is being issued to the higher levels of management in Regions and Areas. It consists of a selection of measured performance indices and operating efficiencies presented so as to make it easy for Regions and Areas to compare their performances.

The importance of increasing efficiency and productivity in the engineering field has been emphasised by the recent formation of a Management Services Division in the Engineering Department. This Division consists of a Training Branch and three Organisation and Efficiency Branches. Among other things, it is responsible for developing and co-ordinating engineering statistics, exercising a general oversight of engineering organisation, manpower and productivity, work studies—which aim to improve working practices, make greater use of mechanical aids and give better control and organisation of engineering work—and studying possible applications of computer techniques. The inclusion of Training Branch permits training in the new techniques to be developed at an early stage and speeds communication of new ideas to staff in the field.

By grouping under one head the Engineering Department staff concerned with management services, increasing the staff engaged on work studies and creating computer project teams, the new Division will increase the Engineering Department's contribution to the drive for greater efficiency. Some important advances have been made in the past year and even greater improvements should be achieved in the years ahead.

**THE AUTHOR**

**MR. R. W. G. CARDEN** *is an ASE in the Engineering Department (OCG Branch). He joined the Post Office in 1936 as a labourer and two years later moved to the Telephone Circuit Laboratory of the Engineering Department. In 1941 he transferred to the Equipment Branch.*

*In 1953, Mr. Carden went to the Telegraph Branch as an SEE, with responsibility for subscribers' installations and later for teleprinter development. In 1962 he became an Area Engineer in the Centre Area and in 1962 returned to the Engineering Department as as ASE in the TPM Branch, recently taking up his present appointment. Mr. Carden has had two spells of duty abroad, the first in 1944-45 in France, Belgium and Holland helping to re-establish cable communications with the Continent, and the second in 1960-62 as adviser to the Government of Pakistan on telegraphs.*

# A NEW ENGINEERING MANAGEMENT COLLEGE

By R. D. THIRSK

**AFTER 16 years at the Central Training School at Stone, in Staffordshire, the Management Training Group is moving to new quarters at Bexhill-on-Sea, Sussex, where expanding requirements can be catered for more adequately and relief given to the Central Training School for its greater concentration on technical training.**

The building housing the new college—Portsdown Lodge—stands in five acres of pleasant grounds at Cooden, two miles west of Bexhill. It is only five minutes' walk from the foreshore and the station, which has an hourly train service with London. Formerly a girls' boarding school, this attractive building of rustic brick is now being modified for use by the new Engineering Management College and should be ready for occupation by Easter 1965. Meanwhile, the new college has started work at the Warrior Hotel, St. Leonards-on-Sea.

The courses to be offered will be of one week's duration, beginning after the evening meal on Mondays and finishing on Fridays at teatime. This follows a general trend towards shorter courses, which minimise disruptions to domestic, social and office commitments and enable a brisker pace to be enjoyed. The new scheme allows every engineering supervising officer to attend for a total of two weeks within a year or so of appointment. On an officer's further promotion this may extend to a total of four or five weeks, the limit of the present provisional curriculum. In so short a space the objective must be limited. What, then, are the aims of the new establishment?

First and foremost is the provision of new Appointment courses to mark the transition of a directly promoted officer to first-line supervisory rank.

It is important that he should straightway be accorded this kind of formal recognition as a member of management and that he should be given whatever help a course can offer towards establishing standards to aim for and marks to steer by. A start may thus be made towards discarding any former attitudes no longer appropriate in a major grade and on forming some that are.

Students will return eight months later for a Development course, in which lecture content will be minimal. Full use will be made of the students' experience, working out problems in syndicate and

*The new Training College at Bexhill-on-Sea.*

group discussion and deriving from this discussion general principles of supervision and management, with stress on communication. The interview studio method, successfully worked out at the Central Training School, will be used. The self-criticism implicit in this approach and the discipline of seeing oneself as others do, are particularly valuable.

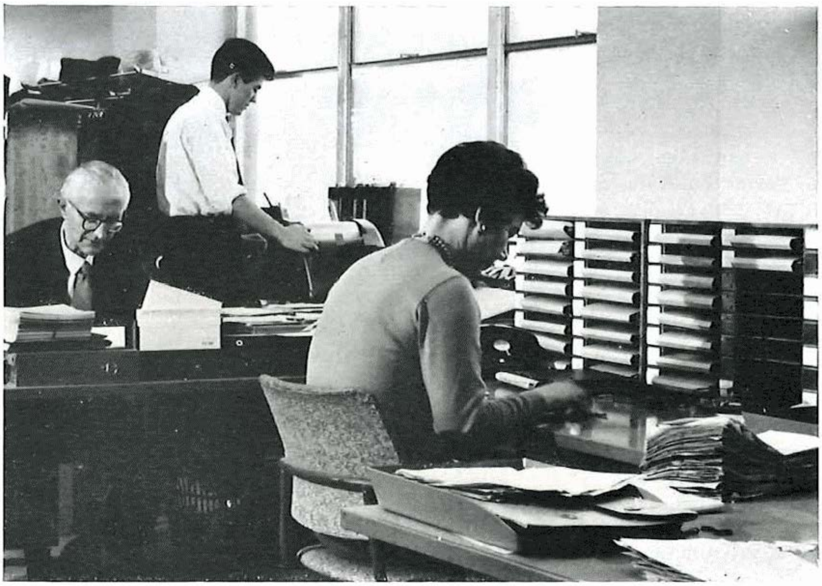
Incidental to the main purpose, but also of great potential value, is the provision of a forum through which, by occasional visits, senior management have an opportunity of putting over directly, and also indirectly through the tutors, the needs of the present. Just as important is the other half of the "control loop" presented by the feedback available to senior management, enabling them to learn at first hand the viewpoint and hopes, and perhaps sometimes the frustrations and misconceptions, of junior management. The forum can also provide a similar service in the relationships between junior management and staff associations.

**THE AUTHOR**

**MR. R. D. THIRSK,** Principal Engineering Management College, is an Assistant Staff Engineer who joined the Post Office in 1929, as a Youth-in-Training. He was a bomber pilot during the war and later as Executive Engineer became a founder of the CTS at Stone, where he also served as a management tutor. In 1953, he transferred to Lancaster Telephone Area. He was appointed Area Engineer, Aberdeen (South), in 1958, and transferred for a third tour of training to CTS in 1963, as SEE. He was Deputy Principal at CTS before being appointed to EMC in November, 1964.

# Speeding The Customer's

***New and streamlined office procedures have been introduced to eliminate delays in handling orders for telephone service. Speed, efficiency and imagination are the keynotes of the new system***



***The pictures illustrating this article come from the Brighton Telephone Area which led the way in experimenting with the new procedures. On the left, staff are seen preparing, distributing and closing advice notes in one compact unit.***

**THE White Paper *The Inland Telephone Service in an Expanding Economy* which was presented to Parliament in November, 1963, gave a clear indication to Post Office telecommunications staff at all levels of the tasks that lie immediately ahead.**

In the field of provision of telephone service, with adequate capital available at last, we have to clear the waiting list by March, 1966, and thereafter to ensure that demands for service are met, with very few exceptions, within one or two weeks of the order being received.

Both objectives are welcomed by public and Post Office staff alike. The abolition of the waiting list calls primarily for more line plant and exchange equipment and great efforts are being made to meet these needs, but speeding the provision of service where plant and equipment exist presents a different kind of challenge, not only to the engineers who plan and execute the work, but also to the sales office staff who negotiate and process the customer's order.

Since World War Two our provision of service procedures have been geared to times of shortage and restriction. Lack of capital has meant lack of line plant and exchange equipment, and waiting lists at times grew very large indeed. The very existence of waiting lists led, almost imperceptibly, to bad effects on our office processes and possibly even on our outlook—bad, that is, from the point of view of providing the speediest possible service in the future. The fair administration of a waiting list called for records and priority systems, the need to make detailed enquiries about available plant before an order could be accepted with confidence led to more time-consuming routines and the knowledge that delays were so often inevitable

# Order

By J. MACRAE

***Right: Advice note control is handled by one unit comprising a co-ordinating officer and the control officer.*** ▶

may even have led to too ready an acceptance of refinements and safeguards which might otherwise have been rejected in the interests of speed. With the end of the waiting list in sight we must look very critically at these legacies of the past and progressively banish them as soon as the improvements in our situation enable us to do so.

A start has already been made. Towards the end of 1963 experiments with simplified and streamlined procedures were conducted in selected telephone areas. The objectives were to eliminate processes which are no longer strictly necessary and delay the issue of the advice note to the engineers, and to encourage the maximum use of the telephone, both internally and externally, for the processes which remain, thus cutting delays still further. The experiments were successful and the new procedures were introduced nationally in May last year

The new system has three essential features:

First, orders for standard auxiliary items, such as internal extensions and a whole range of equipment for which charges are fixed in the Telephone Regulations, may now be accepted without the customer having to sign an application form. An advice note is issued as soon as the request is received, whether by telephone or in writing, and the charges and conditions are notified to the customer by a simple confirmation of order letter.

Second, although a signed application form must still be obtained for exchange lines (except auxiliary lines), the order is now accepted provisionally and, if plant and equipment are available, the advice note is issued immediately without waiting for the return of the signed application form by the customer.

Third, orders for service are now being

OVER

## BRIGHTON FIRST IN THE FIELD

THE Brighton Telephone Area pioneered the use of the speed of provision of service return as an aid to detecting causes of delay to customers orders, both in the issue and completion of advice notes. The return was brought into use in November, 1963, and a number of experimental procedures designed to cut out delays in the provision of service—some of which were also on trial in other Areas—were progressively introduced.

By May, 1964, 65 per cent of exchange connection advice notes handled in Brighton Area, not delayed by the customer, were being issued within one week of application and 80 per cent within two weeks, thus achieving the first target for Sales Speed set by the administration. By August, 1964, the corresponding Engineering target had also been achieved.

Experimental procedures included the abolition of plant enquiries, the acceptance of orders for new lines over the telephone, the abolition of application forms for minor apparatus and other small jobs, the use of key and lamp units for Sales teams, "split" distributor working and "zoning" and so on in the Installation Controls.

The new return has proved invaluable in providing management with an accurate picture of the speed with which orders are dealt. It has also enabled supervising officers to localise sources of delay and to ensure that experimental procedures are fully exploited. It is also proving useful in drawing the attention of individual members of the staff to the extent to which work under their control is being held up.

***Above: The officer on the right prepares an advice note master direct from information given by the customer over the telephone while his colleague deals with a postal application. Below: Tandem working. Each pair of officers has a common working load but, by using key and lamp units, any one officer can handle any other's normal task.***

accepted and the work put in train without plant enquiry except where it is known that there will be plant or equipment difficulty. This requires the closest co-operation between sales and engineering staff but the procedure is already working well in many areas.

The essence of success in the new procedures is to cut paper work to the minimum and to encourage the use of the telephone by both customer and staff. When a customer comes to the office his order, with full particulars, is taken at once. If he telephones the order, the same principle applies and if he writes the sales officer tries to find if he is obtainable by telephone so that his precise requirements can be discussed and instructions issued. Where the plant position is a little uncertain, a telephone call to the engineers can usually resolve the query.

What has been done is only a start, however. We must all be vigilant to spot further opportunities for streamlining as these arise and to repress in ourselves—whether sitting in calm detachment and drafting the rules or battling in the daily hurly burly of carrying them out—any tendency to lose sight of the prime objective that we must give the customer what he wants when he wants it. Good streamlined procedures can only help. Real success depends on the enthusiasm of the staff at all levels and experience with the new schemes shows that this is not lacking.

The benefits to the customer need no comment. The benefits to the Post Office will be better customer relations and few complaints, reduction in the number of enquiries because of speedy handling of orders and substantial financial gains because earlier connection means earlier collection of rental. It has been estimated that if every connection were made a day earlier, the additional rental received would be £25,000 a year.

Interim targets for speed of provision of service have already been set and in order to watch progress towards them a new range of statistics has been devised which will give a much better picture and closer control than has been possible in the past. These statistics, among other things, separate departmental delays from delays caused by customers and give details of speed of achievement in sales and engineering divisions and overall.

What of the future? It is hoped and expected that the sequel to the White Paper policies and the new streamlined procedures will be a substantial improvement in the service given to the customers. We shall strive to continue to improve our standing with the public and merit the reputation of a forward looking and progressive organisation.

## THE AUTHOR

**MR. J. MACREA** is a Sales Investigation Officer on Sales Office procedures in the Inland Telecommunications Department Marketing Branch. Before his appointment in 1961 to Post Office Headquarters, he was a Clerical Officer in the Dundee Area and Sales Representative in Edinburgh.

# *What is PERT?*

By A. J. FORTY, BA, AMIEE

**The Post Office is using a new planning technique—called Programme Evaluation and Review Technique, or PERT for short—to improve managerial control of development and planning operations and to ensure the most efficient use of all available resources**

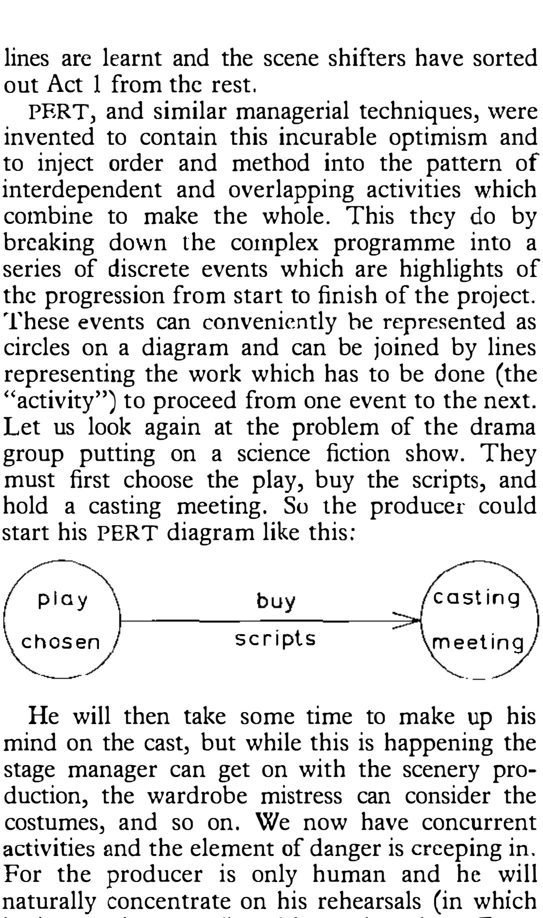
**MY dictionary defines PERT as "saucy, forward". Saucy is not particularly relevant to the current Post Office meaning attached to these four letters, but forward is certainly apt.**

Programme Evaluation and Review Technique is essentially forward planning applied to a project with the purpose of foreseeing difficulties before they arise and taking the necessary steps to ensure that the ultimate aim—completion on the due date—is accomplished.

This technique is being increasingly employed by the Post Office to improve the managerial control of major development and planning operations and to ensure that resources are deployed to the best advantage. Already it is proving of great value in such diverse operations as the building of the new trunk exchange at Houndsditch (see pages 26 - 28), the provision of a large Private Automatic Branch Exchange of novel design and the overhaul of the aerial and station organisation at the Satellite Communications Ground Station at Goonhilly. Other applications for which PERT has been proposed are the planning of a large private wire network, the provision of VHF links and site acquisitions and operations involved in the movement of large bodies of Post Office staff to new quarters.

Most people are optimists, particularly in forecasting their ability to complete their own particular job in a given time, when failure will cast a reflection on their ability to cope. If you have taken an active part in amateur dramatics then you must have encountered that well-worn phrase "it will be all right on the night". Unfortunately it seldom *is* all right on the night and the first performance is really the last dress rehearsal: the show gets into its stride only some time later when the missing props have been made, the lines are learnt and the scene shifters have sorted out Act 1 from the rest.

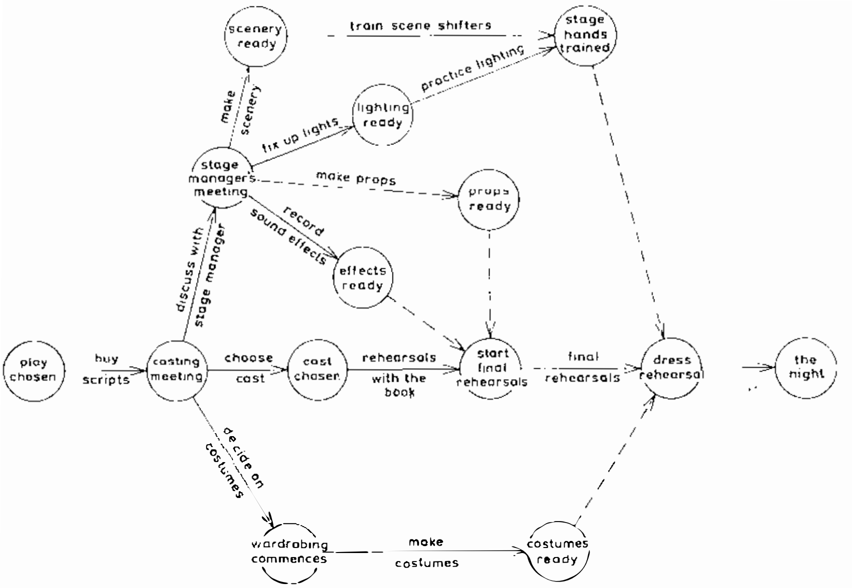
PERT, and similar managerial techniques, were invented to contain this incurable optimism and to inject order and method into the pattern of interdependent and overlapping activities which combine to make the whole. This they do by breaking down the complex programme into a series of discrete events which are highlights of the progression from start to finish of the project. These events can conveniently be represented as circles on a diagram and can be joined by lines representing the work which has to be done (the "activity") to proceed from one event to the next. Let us look again at the problem of the drama group putting on a science fiction show. They must first choose the play, buy the scripts, and hold a casting meeting. So the producer could start his PERT diagram like this:




He will then take some time to make up his mind on the cast, but while this is happening the stage manager can get on with the scenery production, the wardrobe mistress can consider the costumes, and so on. We now have concurrent activities and the element of danger is creeping in. For the producer is only human and he will naturally concentrate on his rehearsals (in which he is most interested) and leave the other officers to their own devices. Conversely he may attempt to be superhuman and interfere with work which should properly be delegated to the officers concerned provided they know their commitments, understand their job and fit in with the overall

OVER

time scale. So if the producer is wise he will continue his PERT analysis and will finally achieve a diagram looking something like this:




***The diagram on the left illustrates the first stage in drawing up a PERT programme.***

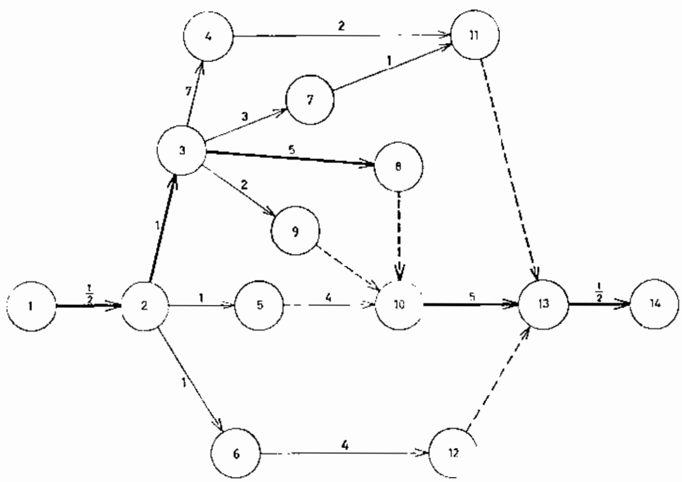
***Below: In stage two the times, in weeks, the various activities are likely to take are set out.***

Now a study of this diagram reveals several interesting points. For instance, the props must be ready, the effects ready and the rehearsals with the book finished before the second stage of rehearsing is commenced. Furthermore, time must be allowed for training the stagehands *after* making the scenery and *before* the dress rehearsal. What is not clear at this stage is whether all the various jobs will be completed by The Night, or whether one of the many paths from event 1 to event 14 will prove impossible to finish in the time.

The next step, therefore, is for the producer to request his various experts to estimate, as accurately as their experience permits, the time required for the completion of each of the activities These times (in weeks) are written in on the chart and we get a result as shown on the right.

In this diagram the events have been numbered for the purpose of identification. Activities which take time to complete (such as "make props"—activity 3–8) are shown as full lines. When no time-consuming work is needed between events (as in activity 8–10) the lines are broken.

The producer has now a quantified reason for optimism or pessimism as the case may be, for he can add up the durations of the various paths



and determine that which is longest. This is called the Critical Path (the variation on the PERT theme described in this article is referred to as CPM, or the Critical Path Method), and is heavily lined in the lower diagram on this page.

In the example given the length of this longest path is 12 weeks, and so the producer now knows that he must fix the opening night not earlier than that number of weeks after event 1—if indeed he has this choice. In most cases, however, the date of event 14 is already fixed, and the producers' problem is to tailor the length of the critical path to suit. This he can do, for example, by arranging for extra effort on the prop manufacture (these items are notoriously difficult to produce for science fiction plays) or by a ruthless pruning of the stage manager's ambitious plans at the sacrifice of some degree of realism.

When these adjustments have been made he is still left with a critical path on which every activity must be finished in accordance with, or better than the estimated times (hence the name). All other paths on the diagram have some leeway (or "slack" or "float" as it is called) but any of these may become critical if estimated times are exceeded and so continuing vigilance is required.

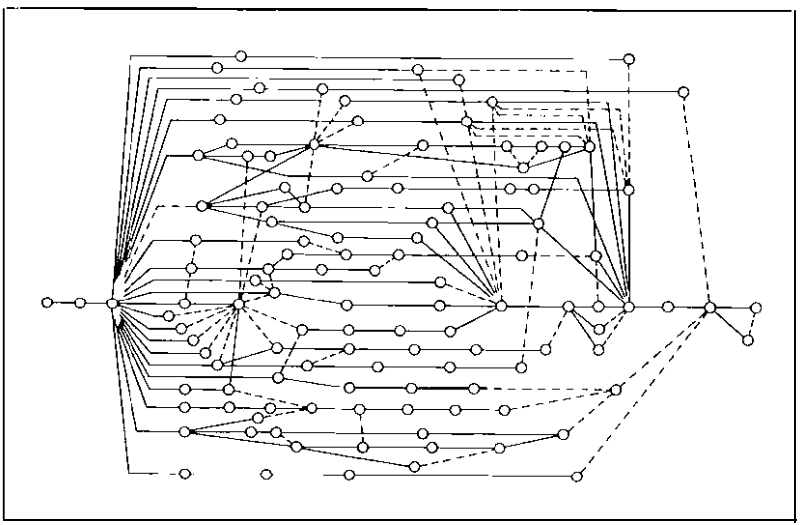
The point of the exercise lies in the fact that this forward planning has enabled the producer to foresee his troubles before they actually occurred. He knew in advance that the holding factor would be shortage of space-ship equipment and he was able to take steps to meet this deficiency in good time. Furthermore, all his helpers had definite targets to meet—targets which had been laid down in consultations in which they had joined. So they were acting as a team.

You may say that every producer worthy of his salt would know the angles and could work all this out instinctively anyway. Unfortunately this criticism is true of any illustration of the PERT principle which is necessarily oversimplified.

We did not, for example, take into account printing the tickets, booking the hall, negotiating with the council about fire risk, borrowing the chairs which are needed in the British Legion hall 20 miles away the night before, and so on. Even so, in this instance one good man might cope with the organisation unaided if he were sufficiently dedicated. When, however, the PERT idea is applied to a job of considerable magnitude the merits become at once apparent. We have at the moment a three-year development and installation programme in hand for a large register-controlled PABX requiring a diagram with 139 events and 212 activities. On this scale the determination of the critical path requires the services of a computer. Once, however, the groundwork is done the pattern of the job and the areas requiring special attention become clear. And we have every reason to hope that it will be all right on the night.


### THE AUTHOR

**MR. A. J. FORTY** is an Assistant Staff Engineer in charge of PBX development in the Subscribers Apparatus and Miscellaneous Services Branch of the Engineering Department. He was born in Oxford in 1915, educated at the City of Oxford School and at The Queen's College, Oxford, where he obtained a first class honours degree in engineering. He joined the Post Office in 1938 as a Probationary Assistant Engineer.

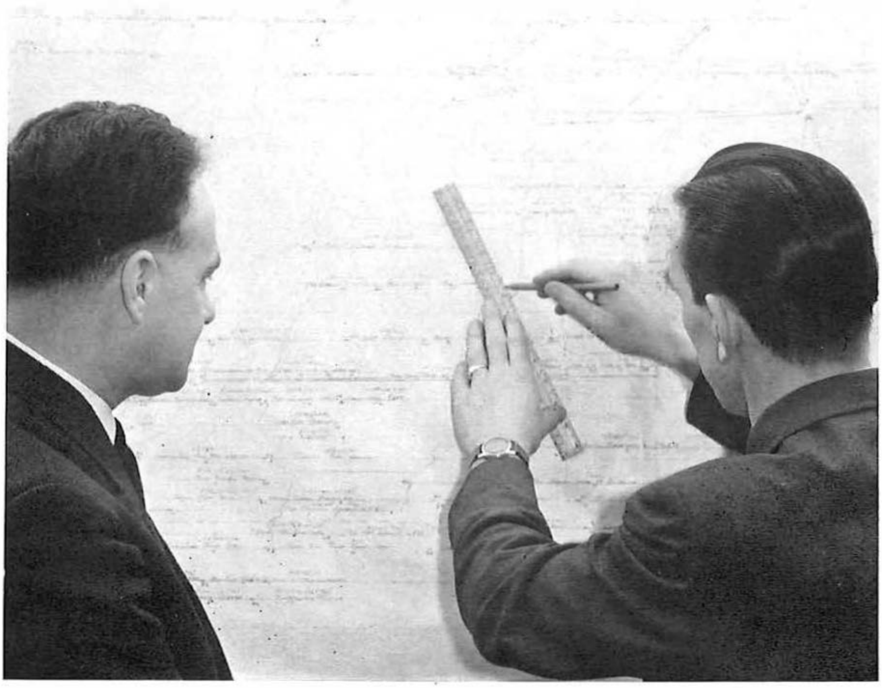



***A PERT logic diagram for the development and installation of a large register-controlled PABX.***

# THE CAVENDISH EXPERIMENT

By F. K. MARSHALL, BSc(Eng), AMIEE

**Using the Critical Path Method technique, a specially trained Post Office team is making sure that a new trunk telephone unit in London will be completed on time**



*Mr. J. F. Birt, Senior Telecommunications Superintendent, and Mr. A. G. Shaper, HEO, make an alteration to the Cavendish network diagram.*

**LAST summer the London Telecommunications Region decided that apart from those already planned, another large trunk unit—to be known as Cavendish—would be needed in Houndsditch by September, 1969, to help handle the rapidly-increasing amount of trunk telephone traffic coming into London.**

Past experience, however, suggested that the unit might not be able to be built and equipped until 1971—about 18 months too late.

So, for the first time on such a large scale, the Post Office called to its aid a new planning technique known as the Critical Path Method (CPM) and, as a result, has produced a scheme to ensure that the unit will be ready for service on time.

To avoid delay in starting the project, LTR engaged in September, 1964, a consultant from a firm specialising in CPM techniques and computer applications. His task was to prepare the network diagram and to train a Post Office team which, because it has to consult many Post Office branches, the Ministry of Public Building and Works, the builder and the equipment contractor, contains a Senior Executive Engineer (in charge), an Executive Engineer, a Higher Executive Officer and a Senior Telecommunications Superintendent.

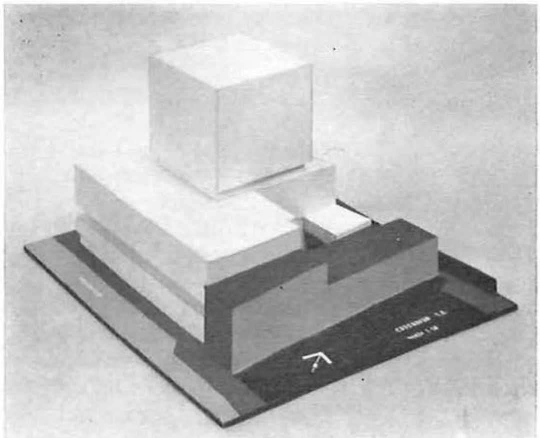
After some preliminary lectures from the consultant, he and the team began to produce the network diagram. In this, each activity is represented by an arrow drawn in a network to show its logical sequence and relationship with other activities. When the team started work, planning had reached the stage where sketch plans of the building prepared by the Ministry of Public Building and Works had been distributed to the appropriate Post Office branches. The drawing of the network began, therefore, with the activity of the group co-ordinating the circulation of the sketch plans and succeeding activities were investigated stage by stage.

In assessing a planning activity by the CPM and PERT techniques it is usual to interview the person who actually does the planning. He is asked to describe the activity and to say which activities precede and succeed it, thus helping to fix its position in the network. The unit of time used in the Houndsditch project is the week, and the person being interviewed is asked how long—in weeks—his activity will take to perform, bearing in mind the 50 or so other jobs which he invariably seems to be doing. This assessment of durations has proved to be one of the most difficult tasks, for few people think in terms of how long a job will take. However, at a second series of interviews, the victims are given a chance to revise their previous assessments and to check that their activities are shown correctly on the network diagram. At present the network shows some 300 activities and about 100 interviews were conducted in assembling the information.

A network of the size of the Cavendish project is best worked out using a computer. First the computer input sheets are filled in with information from the network, each activity having its description, duration and identification numbers recorded. This information is punched on to cards which are fed into the computer already primed with a CPM programme which is also on punched cards.

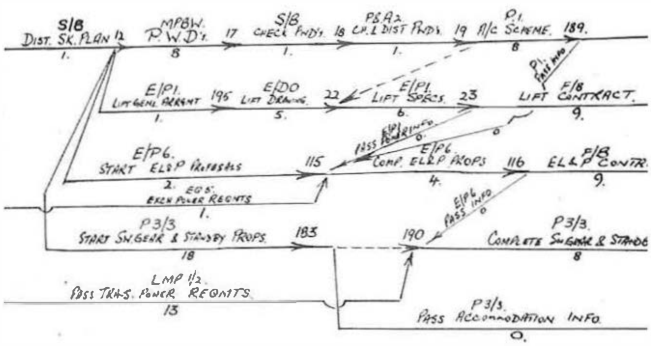
*The Critical Path Method, a British idea which is being increasingly used in industry as a management aid, was devised by the Central Electricity Generating Board research section in 1957.*

*In 1958 a similar system was adopted in the United States where it has been notably successful in planning the design and manufacture of Polaris missiles—a venture which involved co-ordinating some 5,000 contractors and agencies. Use of these techniques is said to have shortened the Polaris project time by more than two years.*



**_A model of the Cavendish Trunk Unit, showing the existing buildings on its eastern side._**

**_Below: A close-up of part of the network diagram showing the numbering of the head and tail of each arrow and the durations._**




The results produced by the computer indicate the optimum dates by which each activity should be completed, and whether it is "critical". A critical activity is one which should be performed

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The LTR Critical Path Method team is now applying the CPM technique to planning the building of two other London trunk exchanges—the Colombo Street Trunk Exchange at the rear of the Waterloo Telephone Exchange, and the Temple Bar Trunk unit which will be known as Bastion.

at the times stated. It has no spare time or "float", and if it is late the whole project will be equally late. The computer very helpfully adds up all the critical durations, thus giving the total time required for the project.

The first computer runs on the Cavendish scheme gave total project times of more than 300 weeks. These were unacceptable since the target duration was 257 weeks and a certain amount of streamlining of the network had to be made. This was done in two ways. First, the duration of some critical activities was reduced. Second, it was frequently found that a planner taking, say, 13 weeks to perform an activity, could pass on all the information required by succeeding activities after, say five weeks and complete his own detailed planning in the eight weeks still left to him. Any proposals of this nature were discussed with the people who would carry out the activities, and not included in the network without their agreement.

At this stage it became evident from the network that the project could not be completed in time since part of the building could not be erected until the "George and Dragon" public house, which sits squarely in the centre of the site, was demolished, and demolition cannot take place until the new public house is ready. The architect's solution, to which the brewers have now agreed, is that a temporary public house will be erected on a relatively unimportant corner of the site. This will allow the "George and Dragon" to be demolished at an early stage so that the new building and its equipping can proceed to time. These rearrangements reduced the network duration time to the target of 257 weeks.

Further printouts were then obtained from the computer. As well as sheets listing all the activities, smaller ones were obtained showing the activities of each group or division (these could also be printed in bar chart form, which some people find easier to interpret).

These small sheets which contain the dates for performing the activities and the dates when information can be expected to come in from the preceding activities, are distributed to those who will be performing activities in the next 56 weeks.

*A rear view of the* **George and Dragon** *which squats squarely in the middle of the site.*

At the end of each month those carrying out activities at that time are asked how many more weeks they require to finish their jobs. These periods are then fed into the computer again as new durations. Thus the network is revised or "up-dated".

If the results are satisfactory the printouts from the computer are distributed. If not, the team tries to achieve further streamlining to keep to the target date.

Is networking worth while? Work on the Cavendish project has already indicated where time can be saved and has expedited current "critical" planning activities which cannot be delayed. It has also enabled decisions, such as the provision of the temporary public house, to be made at an early stage of planning. It is hoped to publish a further article on the Cavendish Experiment in 1967. By then the builder should be well advanced with the basement floors and starting work above ground level. Let's see if we're still on target!

## THE AUTHOR

**MR. F. K. MARSHALL, BSc(Eng), AMIEE** is a Senior Executive Engineer, London Telecommunications Region, Headquarters. He joined the Post Office in 1939 and after a short spell on junction planning he spent most of the war years in the M.E.F. on radio work. He returned to Regional Headquarters in 1946 and was engaged on exchange planning before moving to North West Area as an Executive Engineer on internal planning and later on maintenance. In 1960 he transferred to City Area to cover exchange construction work for the introduction of STD. Later in the same area he was concerned with stores and telephone installation, and more recently with external planning.

**One of the many important tasks carried out in the Post Office testing laboratories is the search for more serviceable, cheaper and at the same time more robust plastics materials for telecommunications equipment**

# *Putting Plastics Through Their Paces*

By Dr. P. E. TAYLOR

**THE demands of modern industrial practice have stimulated the production of a bewildering succession of new materials. The requirement is usually for a material which will lend itself to the methods of mass production rather than for one which is either better or stronger than the old. Indeed, the tendency nowadays in all fields is to aim not at an article of superlative performance which will last for a lifetime, but rather for one which is serviceable and cheap enough to discard when it goes wrong.**

The design of telecommunications equipment has been influenced by this trend, and the Post Office has found it increasingly necessary to attempt to balance the attractions of a reduced initial cost against the possibility of more frequent replacements and the effect on the efficiency of the service it provides. To strike such a balance it is necessary to make a quantitative assessment of the probable life in service of a material or component, and this is the type of problem which is often put to a plastics testing laboratory.

The only completely certain way of evaluating a material is to put it into service and see what happens. If, for example, one was considering the use of fibre glass for the wing spar of a glider (this material has, in fact, been used successfully for this purpose), an approach would be to make such a glider, send someone up in it and see what happened. If the wing fell off one would know that either the material or the design was unsuitable. Common sense rejects this approach as being too expensive in time and material (and in test pilots),

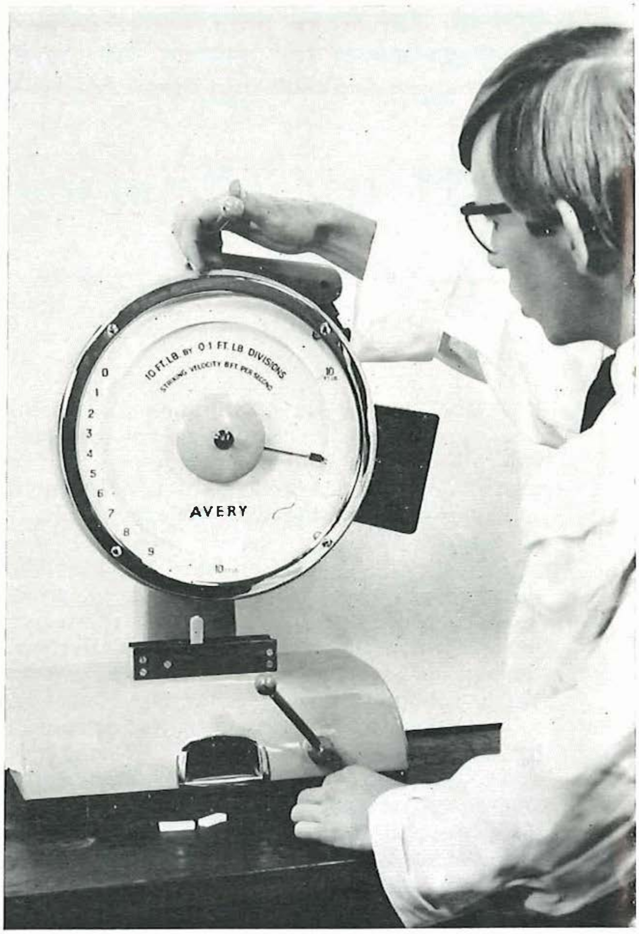

***An Experimental Officer applies the fade test to pieces of coloured plastic by using the Fugitometer machine.***

and an experiment of this sort is not made until every possible step has been taken to see that the material will stand up to the strains to which it will be subjected. Taking every possible step is what plastics testing laboratories are greatly concerned with nowadays, in finding out whether the material is likely to succeed in the proposed application and, what is equally important, that successive batches are uniform in quality and equal to the first experimental mixes.

The testing of plastics—and, indeed, the testing of all materials—is done by scientific trained staff, and the methods used rely as far as possible on what is known as "the separation of variables". If a model is made and subjected to all the adverse influences it will meet in service, it may pass or it may fail. If it passes, everyone will be happy. If it fails, however, then the question is bound to be asked: "In what way was it unsatisfactory?" Were the dimensions or shape unsuitable? Is the material perhaps inherently unsuitable and, if so, what alternative materials are likely to succeed? Or possibly, did the model fail because of lack of care in manufacture or unsuitable techniques? To answer these questions usefully it is necessary to disentangle the fundamental properties and test them one at a time.

Great ingenuity has been used to modify existing methods of test, or to invent new ones to fit them for use on recently introduced plastics. Some of the tests are valuable only as diagnostic aids and have no obvious connection with the desired properties of the particular material.

An interesting example of a test of this sort is the determination of density or specific gravity which has been used for the quality control of materials ever since Archimedes jumped out of his bath in the year 220 BC. The Post Office is not, of course, interested in gold crowns, but it turns out that polythene, now used as a cheaper alternative to lead for sheathing underground cables, is more brittle in the slowly cooled or crystalline condition than in the rapidly quenched or amorphous state. Measuring brittleness is not easy for technical reasons, and in any case it destroys the articles tested. However, crystalline polythene is more dense than amorphous, and the measurement of density affords an easy and convenient method of establishing that a piece of polythene has received the optimum heat treatment. Density is also a useful check on the quality of expanded plastics and for the detection of porosity in extruded and moulded articles.




***With the Izod machine, an Experimental Officer tests the brittleness of small pieces of plastic materials.***

A different approach has had to be made to the problem of the breakage of the new coloured telephones. They were originally made in a plastics material which, after exhaustive tests and practical experience in many fields, appeared to be quite suitable for the purpose. Nevertheless, it soon became apparent that the breakage rate was far too high to be tolerated, and although this was probably due to changes in design rather than in poor quality of the material, something had to be done about it. The designers eventually decided to change to a recently-developed material which shows a remarkably high resistance to fracture on

**OVER**

**PLASTICS** *(Contd.)*

impact. The material was proved by a series of experiments in which telephones moulded in the new material (acrylonitrile-butadiene-styrene, or ABS for short) were repeatedly pulled off the edge of a table and allowed to fall to the floor. This is clearly not a feasible method for quality control of the material, but since the impact strength is obviously a key property and moreover one which varies between ABS from different sources, this property is now measured on small pieces of material on an apparatus called an Izod machine.

There are many applications of plastics in which a cheap and not very durable pigment may be used with perfect satisfaction to achieve the required colour. But the Post Office telephone is not one of them (see *Telecommunications Journal*, Winter, 1964 issue). The colour has to be very fast in order that the instrument may retain its attractive appearance for many years of service, and this requirement has not been easy to meet. It is specified that there shall be no more than a minimal change in colour when the material is exposed to a powerful light of closely defined quality in an instrument of the type known as a Fugitometer. Some change must be expected in most of the coloured materials commonly available and plastics are no exception. Notable exceptions are glass and closely related vitreous enamels which retain their colour indefinitely.

No one working on the testing of plastics would claim that they can provide an answer to all the questions they are likely to be asked. Even if they were, the introduction of new materials or the use of existing materials for new purposes inevitably means that new questions will be asked for which there is no cut and dried answer. The production of new materials and the devising of new methods of manufacture have been paralleled by the need for new test methods, and the rapid development which has been taking place for the last decade shows no sign of slowing up yet.

# *NEW YEAR'S HONOURS*

***Mr. A. W. C. Ryland, CB. He has been Director of Inland Telecommunications for four years.***

**MR. A. W. C. RYLAND, Director of Inland Telecommunications since 1961, was appointed a Companion of the Most Honourable Order of the Bath in the New Year's Honours.**

Mr. Ryland, who joined the Post Office in 1931 as a Youth-in-Training, served with the Royal Engineers (Postal Section) throughout World War Two, reaching the rank of Colonel. In 1954 he became Principal Private Secretary to the Postmaster General, the following year an Assistant Secretary, and in 1958 Director of Establishments.

Nine other members of the Post Office telecommunications staffs also received awards.

Mr. W. J. E. Tobin, Staff Engineer in the Engineer-in-Chief's Office, who also joined the Post Office in 1931, was awarded the OBE. Mr. H. G. Crook, Area Engineer, Liverpool, and Mr. E. N. Clark, Executive Engineer in Home Counties Region, received the MBE.

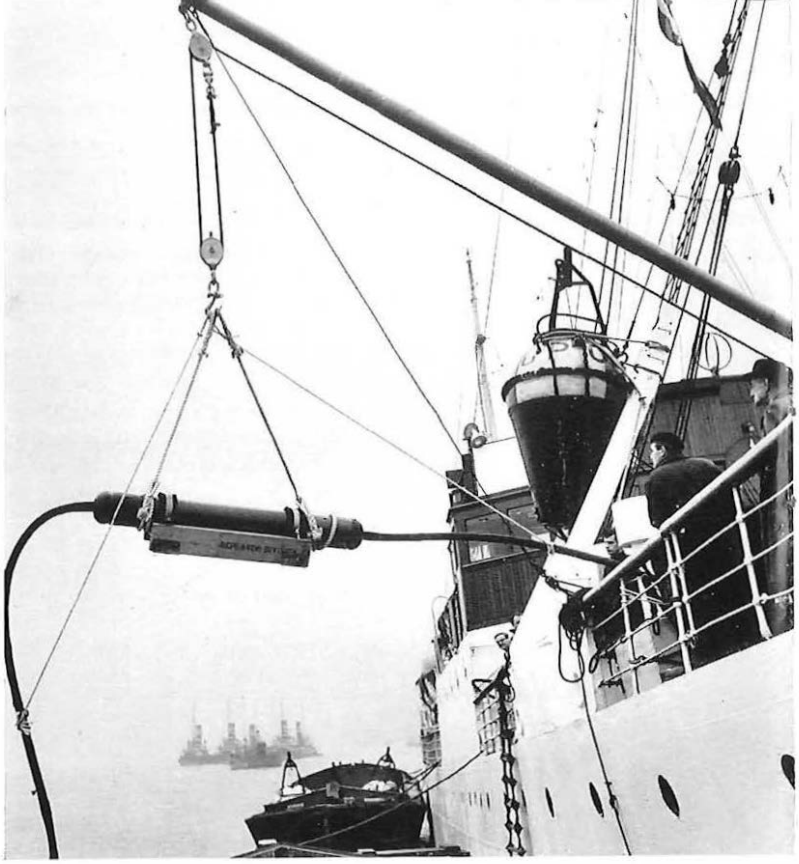
Three chief supervisors, a leading technical officer, a technical officer and a telephonist were awarded the BEM. They are: Mrs. Lilian Betts, Chief Supervisor at Maidstone since 1955; Miss Hilda May, Chief Supervisor, Wolverhampton, who joined the Post Office in 1922; Miss Matilda King, Chief Supervisor at Kilmarnock, Ayrshire, since 1959; Leading Technical Officer E. Snape, of the Midland Telephone Exchange, Birmingham; Technical Officer R. C. Weller, of LTR's South West Area; and Mrs. Mona Cooper, a telephonist at the Dalton Street Telephone Exchange, Douglas, Isle of Man.

***Mr. C. C. Baillie, MBE***

***Mrs. Lilian Betts, BEM***

Mr. C. C. Baillie, a Higher Executive Officer in the Engineering Department's External Plant and Protection Branch, received the MBE.

**Transistorised repeaters—the first ever used in an international submarine cable—are now in service. They have almost doubled the circuit capacity of a cable between Britain and Belgium**



***At the Post Office Submarine Branch Depot in Woolwich, one of the transistorised repeaters is loaded aboard HMTS* Iris.**
Courtesy Submarine Cables Ltd

# AND NOW TRANSISTORS ON THE

**When the Post Office cable ship HMTS *Iris* sailed from the Post Office Submarine Branch depot at Woolwich recently to insert two transistorised submerged repeaters into the cable between St. Margaret's Bay, in Kent, and La Panne, in Belgium, her voyage marked the closing stages of a major advance in submarine cable techniques.**

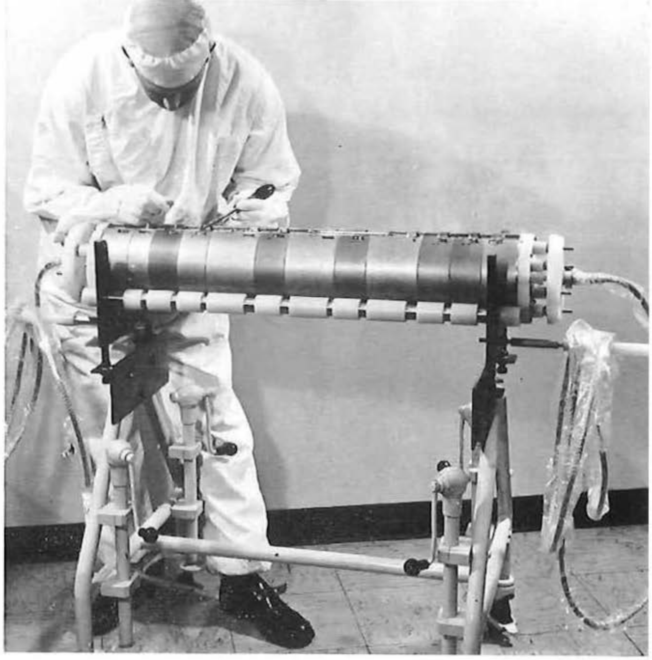
The insertion of the two new repeaters—the first transistorised repeaters to be used in an international submarine telephone cable and the first of such large capacity to be put into service anywhere in the world—has almost doubled the capacity of the cable from 216 to 420 telephone circuits.

The decision to increase the circuit capacity of the cable by inserting these new-type repeaters was taken at the North Sea Cable Conference held in London in 1961 to consider how best to cater for the expected growth of telephone traffic between Britain and the Continent of Europe (*see the article Expanding the North Sea Cable Links, Summer*, 1963).

The original cable, completed in 1948, was of an unusual design which made it possible to provide 216 telephone circuits without using submerged repeaters. To produce a cable with sufficiently low electrical losses it was constructed with an outer conductor 1.7 inches in diameter—much larger than the normal coaxial submarine cable—and an air space was incorporated into the dielectric by laying a helix of polythene over the centre conductor before the main polythene insulant was extruded.

The frequency bands used in the original system were 60Kc/s to 956 Kc/s from England to Belgium, and 1,152 Kc/s to 2,048 Kc/s in the other direction. The new system uses line frequencies in the bands 312 Kc/s to 2,044 Kc/s and 2,544 Kc/s to 4,276 Kc/s. In terms of the equivalent radio wavelengths

***Soldering the coaxial connectors in the internal unit of one of the transistorised repeaters. Some parts of the unit are gold plated. Picture:*** Courtesy Submarine Cables Ltd.



in free space these transmissions are from about 70 metres to 1,000 metres.

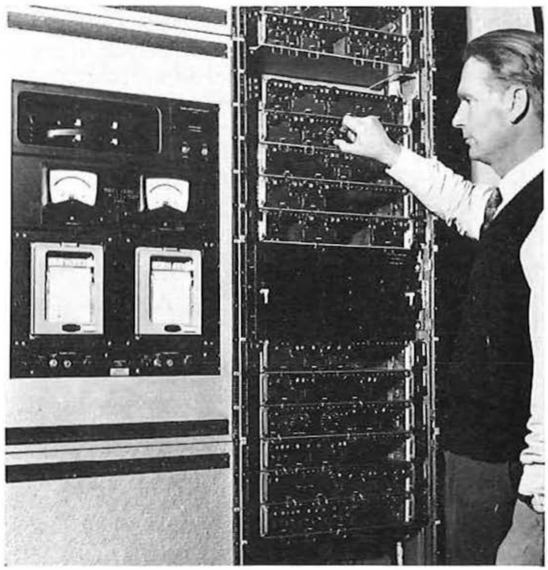
At the highest frequency on the new system the power loss over the 48 nautical miles of cable amounts to about 130 decibels. This means that unless it is amplified the strength of a signal received at one end of the cable would be ten million million times smaller than the transmitted signal. The two new transistorised submerged repeaters—inserted in the cable at about 16 and 32 miles from the La Panne terminal—amplify both directions of transmission and each has a gain of about 45 dB at the highest frequency.

The submerged repeaters were designed and manufactured by Submarine Cables Ltd., who were also responsible for the satisfactory performance of the completed project. In outward appearance the repeaters are very much like the valve-type repeaters which have been produced recently, except that they are a little shorter. There are, however, several novel mechanical and electrical features in their design.

# SEA BED

By R. J. W. MYERSON, AMIEE

Great efforts are made to achieve a high order of reliability in submerged repeaters and only well-proved components and techniques are employed in their construction. The transistor appeared to be very attractive for application to submerged repeaters because its operating voltage and power requirements are much less than those for a valve of comparable performance. But before adequate confidence could be placed in the selected high-grade commercial transistors it was proposed to use for this project, a large number were subjected to an extensive programme of proving tests at the Post Office Research Station in conjunction with the contractor. During these tests the behaviour of batches of transistors was studied while they were subjected to varying conditions of electrical, thermal and mechanical stress. A statistical analysis of the results confirmed their reliability.



***Assistant Executive Engineer D. O. Grandison adjusts the terminal equipment at the terminal station at St. Margaret's Bay.***

The terminal equipment was developed, manufactured and installed to Post Office specifications on behalf of Submarine Cables Ltd., by the Telecommunications Division of Associated Electrical Industries Ltd., one of its parent companies.

OVER

**TRANSISTORS ON THE SEA BED** (*Contd.*)

This equipment, which is also fully transistorised, is powered by 24 volt direct current supplies. The supply for the submerged repeaters is a closely regulated direct current maintained by a power unit at each terminal and fed along the inner conductor of the coaxial sea cable. If a power unit fails at one terminal, the system is automatically maintained in operation by the other unit.

The performance of the whole system is automatically monitored in each direction of transmission and facilities are provided to compensate for the effects on the cable of seasonal variations of sea temperature.

The operation of the submerged repeaters is periodically checked by testing equipment produced by the Post Office. Pulses transmitted from St. Margaret's Bay cause returning signals from each repeater to be displayed and measured on a cathode ray oscilloscope by a method akin to radar.

Since the cable was already carrying an important amount of telephone traffic, close co-ordination of many aspects of the project was necessary to ensure that the cable was out of service for the shortest possible time. The associated equipment was installed in advance at the terminal stations

*It is a happy coincidence that the first international telephone cable system in the world to include transistorised submerged repeaters should have been constructed between Britain and Belgium and fitting that it should land at La Panne.*

*When Leopold, fourth son of Francis, Duke of Saxe-Coburg Saalfeld, was received on Belgian soil on 17 July, 1831, to become the first King of the Belgians, the formal reception took place at La Panne. Leopold had come from England where he had been responsible for the general education of his niece, the Princess (later Queen) Victoria.*

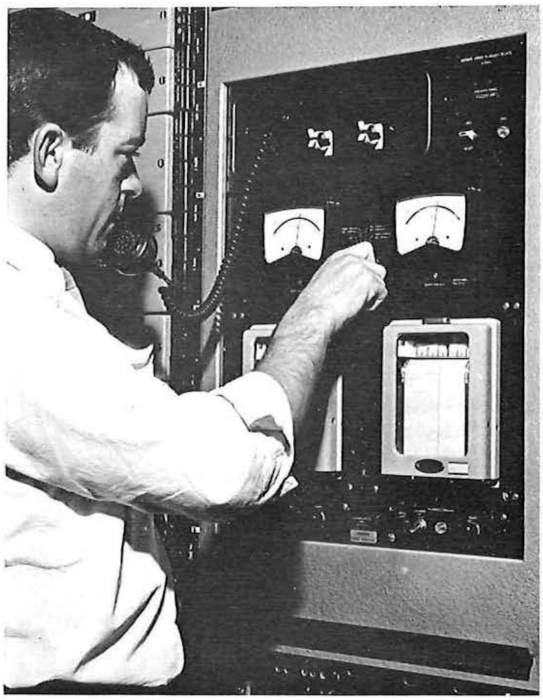
*Appropriately, too, the overall testing of the new system was in progress on 15 November, 1964—Belgian Dynasty Day.*

and everything made ready for the insertion of the repeaters. The electrodes and cables for the sea earths which form part of the power supply circuit for the submerged repeaters were laid off St. Margaret's Bay and La Panne by the Netherlands cable ship *Poolster*—a shallow draught vessel able to work close in shore. A few days before HMTS *Iris* sailed to lay the repeaters all circuits working on the cable were temporarily diverted to a microwave radio link to France and thence to Brussels by way of a land coaxial cable system.

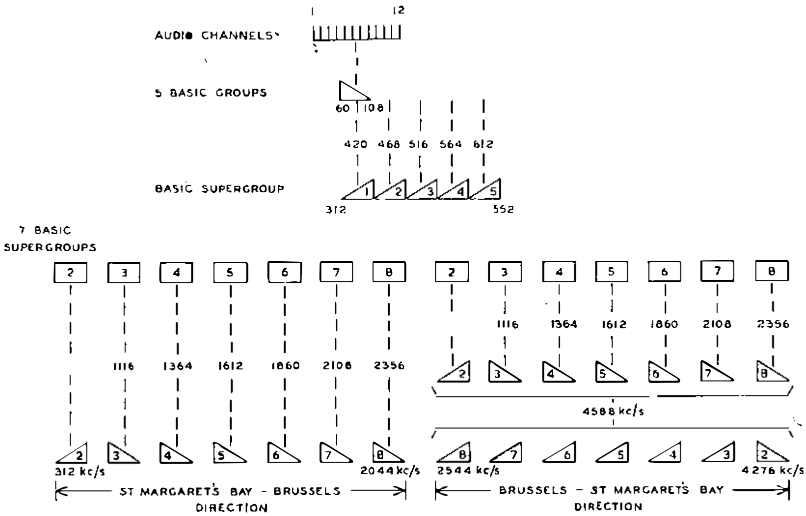
The repeater laying operation entailed grappling and lifting the cable and, following careful confirmatory tests to the terminal stations, splicing in the two repeaters at the predetermined positions. Lifting the cable was expected to prove difficult since it weighs 19 tons a nautical mile and it might have been heavily sanded. In the event, the weather was favourable and the operation went very smoothly.

Adjustments and exhaustive tests from the two terminal stations confirmed that the system fully meets the specification and the recommendations of the International Telegraph and Telephone Consultative Committee (CCITT) for international circuits.

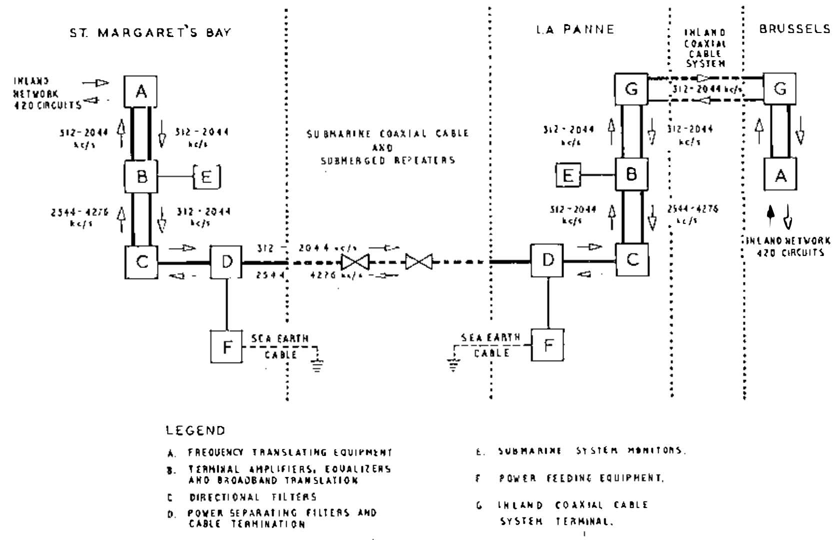
Following a stability run lasting a week the new system was put into service on 27 October, 1964, thus marking a major step in the development of



***An AEI engineer checks the submarine system monitors at St. Margaret's Bay***




*Left: This diagram shows the frequency allocation of the St. Margaret's Bay to Brussels system.*




*Right: A block layout diagram of the system.*

submerged repeaters by British manufacturers. The system almost immediately proved a valuable asset since it was able temporarily to carry the 120 circuits from another UK to Belgium cable when the latter became faulty.

Development is continuing and several new 480 circuit transistorised submarine cable systems are on order for completion by 1967. These include new cables from Covehithe (near Lowestoft) to Katwijk, in Holland; from Scarborough to Kristiansand in Norway; and from Bournemouth to Jersey.

**MR. R. J. W. MYERSON, AMIEE** is an Executive Engineer in the Main Lines Development and Maintenance Branch of the Engineering Department. Since 1953 he has been engaged in the planning, development and installation of submarine cable systems around the British Isles and to Europe.

He entered the Post Office as a Youth-in-Training in the Guildford Area in 1933, where he later was clerk-of-works for the second 12-channel carrier cable system to be installed in the country. He served in the Oxford Area from 1940 until 1944, when he entered the Engineering Department.

# SPEAKING CLOCK TO RECIPES

By N. C. NELSON

***More than 120 million calls a year are now made to a series of recorded information services, the first of which was introduced in 1936. This article tells how the system has expanded in the past 29 years and of the problems it faces***

*Miss Pat Simmons, winner of the Golden Voice contest in 1962, at work recording the time of day—and night—for the Speaking Clock Recorded Information Service.*

**THE Post Office is paying increasing attention to the need for stimulating profitable business and increasing the calling rate.**

One important way in which this is being achieved is through the recorded information services—the Speaking Clock, Teletourist, Test Match and Weather Services and the like—which are rapidly growing in popularity. Last year, for example the number of calls made to all the recorded information services reached a record total of 124 million, compared with 110 million in 1962–63.

The information services began in 1936 with the introduction of the Speaking Clock service in London. Those who doubted that the new service would succeed soon had their fears dispelled, for nearly 13 million calls were registered in the first 12 months. To-day, calls for this service, which is available for a local call fee to about 90 per cent of all subscribers on automatic exchanges, have almost reached the 115 million-a-year mark.

The second recorded information service, introduced nearly 20 years after the Speaking Clock, was the Weather Service. A proposal to have such a service was, indeed, mooted before World War Two, but shortage of capital and more pressing calls on equipment and manpower resources delayed the project. In 1955 the Meteorological Office in London was having great difficulty handling telephone enquiries about the weather and seeking ways to relieve the pressure on their switchboard and limited forecasting staff. So in March, 1956, the Post Office launched a recorded weather service giving forecasts covering an area of 25 miles around London. The service was extended in the following year so that callers in London could also hear forecasts for the Essex, Kent and Sussex coasts. Subsequently these coastal announcements were made available in Colchester, Canterbury and Brighton and Hove.

The weather service has since been extended to Belfast, Birmingham, Blackpool, Bristol, Cardiff, Edinburgh, Glasgow, Liverpool, Manchester, Portsmouth, Southampton and Southport. More recently the services at Liverpool and Manchester have been augmented by two coastal forecasts one for the Lancashire coast between Formby Point and Morecambe, and the other for the North Wales coast from Conway to Chester, including such popular resorts as Colwyn Bay, Llandudno, Prestatyn and Rhyl. The Lancashire coast announcements are also available, as the local weather service, in Blackpool and Southport, and those for North Wales will be relayed for distribution at Chester and Colwyn Bay. The forecasts are all prepared by staff of the Meteorological Office and then passed to a pre-determined telephone exchange for recording by telephonists. In 1962-63 over six million calls were made to the weather services.

As a general principle it is the aim to ensure that the revenue from each service shall at least cover the expenses, including the charge made by the Meteorological Office for the forecasts. Although the ideal arrangement would be a separate forecast for each large town, the income from calls, except in the largest cities, is insufficient to meet the fixed annual charges. The problem has, therefore, been to increase revenue and, at the same time, reduce to a minimum the yearly running costs at each centre. After a survey of the whole country and negotiations with the Meteorological Office, it has been decided that forecasts should cover larger areas, although this will mean an increase in the average message length in order to ensure their accuracy. This will enable, say, three or more centres to be set up in the forecast area, with a single recording centre. It has also been decided to dispense with standby circuits between centres, which were earlier considered essential, and to rely on nominated traffic circuits in emergency. As a result of these and other economies it should be possible, within the next two to three years, to expand considerably the scope of the weather service and still show a profit.

In 1956 the Test matches against the Australians aroused such interest that the switchboard of the MCC was overwhelmed with enquiries. For the second match of the series the Post Office arranged for the score to be recorded and connected to the public telephone network, but the traffic proved to be greater than the equipment could handle. The announcements were therefore relayed to most of the larger exchanges in London to avoid too great a flow of traffic to the recording centre. They were also relayed, by means of a special trunk network, to centres throughout the country.

To ensure that the Test Match Service is always up-to-date, the Post Office arranges for observers to attend Tests played in this country and they pass details of the score over direct lines from the ground to the London recording centre. Fresh recordings are made by the telephonist team after each change of score or the fall of a wicket. As many as 512 recordings were made during the first Test Match in 1962. During the visit of the West Indians, in 1957, over seven million calls were recorded. Last

***The original Girl with the Golden Voice, Miss Jane Cain, whose recorded voice told the time to millions of callers for more than a quarter-of-a-century.***

**OVER**

***The console used for the Test Match Information Service to which are wired two machines, operating alternately. About 600 separate recordings are made each day during test matches.***

year, during the series against Australia, more than eight million calls were made—the highest for any series. The most calls made during a match were the 2.1 million during the fourth Test at Old Trafford. More than 30 centres are equipped for relaying the announcements.

The provision of plant for the Test Match Service poses a particularly difficult problem. A general expansion of the special trunk network and equipment sufficient to cope with the astonishingly high level of traffic which an exciting phase of a Test engenders adds greatly to costs but unless this is done, congestion in the public network can easily arise. In addition, the volume of traffic fluctuates wildly according to the visitors and to date no use has been found for the equipment outside the 30 days of actual play. The solution, of course, is a service possessing the two main characteristics of the cricket service—short, informative messages and a high level of traffic but with a season stretching from September to May. The search for such a service continues.

The fourth service combines the general interest in the state of the weather with the needs of motorists. The Road Weather Service was started at the request of the Automobile Association, in the Autumn of 1957, and is available in London and 10 provincial centres (those at Portsmouth and Southampton were opened in October, 1964). The service operates each year from the beginning of October to the end of April and the announcements, which describe weather conditions affecting roads within a 50 mile radius of each centre, are compiled by the Automobile Association from the routine reports sent in by their patrolmen and service vehicles. The service naturally largely depends on the weather for its success—and profitability. A mild winter, without the hazards of fog, ice, snow or flood to the motorist, can be a financial frost to the Post Office, whereas the snows of early 1963 enabled the service to reach a record number of 640,324 calls.

The Teletourist Service gives information about the events of the day in and around London, in English, French, German and Spanish. All, except the English service include a short weather bulletin. The material for the announcements is supplied by the British Travel Association and is recorded by BBC staff.

In Edinburgh a similar service, in English only and sponsored by the Edinburgh Corporation, operates each year from May to September. The recordings are made by local telephonists. There appears to be little future for the service outside London; in fact, a service at Glasgow had to be closed down because of lack of support and a sponsor. An examination of the possibilities of extending the London announcements, in English, to centres within easy reach of the capital, has not been encouraging.

The latest of these special recorded services—the Recipe Service—offers callers a lunch or dinner dish for the day. The recipes are supplied by the British Farm Produce Council and are fully tested by their trained cookery experts. The service was introduced in Birmingham in July, 1961, on an experimental basis and during the first year's operation attracted more than 186,000 calls. Since then the service has been extended to Liverpool, Manchester and, more recently, Bristol. The

British Farm Produce Council, which can supply at least six different recipes every day to cover the whole country, ensures that all the items can be obtained easily and at reasonable prices in each recipe area. If the service is extended widely more than six recording centres may be required and the recipes arranged to suit local tastes.*

In London the Post Office also provides a temporary telephonist recruitment service, which is complementary to the advertising campaign in the Press. The announcements give detailed information about the grade which it is impossible to condense into the advertisements inserted in daily and weekly newspapers.

In recent years the Inland Telecommunications Department has examined a wide range of ideas for information services, varying from a simple tuning note A to football pool results, a children's Christmas programme, Stock Exchange prices, racing results, and so on. Unfortunately, many of the suggestions have foundered on the hard rock of finance and others because the information needed for the announcement is either unobtainable or, at the least, is not readily available to compete with other sources giving the same information. It is essential that services should meet a real public demand and be financially self-supporting.

When the Information Services began any spare terminal equipment was used and access codes to them varied considerably. Since such a situation could not continue indefinitely, the Post Office developed special final selector equipment. The

***Edinburgh provides its own Teletourist Service. In this picture an Edinburgh telephonist records a message.***

***A recording console at the London multi-service installation. An operator selects the service before recording.***

essential features of this selector are that up to 100 separate services can be catered for and access to any individual service can be given from more than one switch at a time. In addition, each new service requires recording machines and amplifiers.

Normally a Region planning equipment provision at a group switching centre, asks the Inland Telecommunications Department well in advance whether information services, other than the Speaking Clock, are likely to be required during the design period of the centre. After investigating the financial implications of services suitable for the proposed centre, the ITD advises the Region on the number of services for which provision should be made.

When it was realised that standard codes would be an advantage it was decided that each service should have a four-digit code starting with "80" and prefaced in the director areas by "ASK". A local weather service, for example, will eventually always be obtained by dialling "ASK 8091" in director areas and "8091" elsewhere. Callers from exchanges with no information services will have to dial a code consisting of their normal routing digits to reach the nearest centre, followed by the appropriate information service code. These standard codes are gradually replacing the initial make-shift codes, although it will probably be some years before uniformity can be achieved.

There are two exceptions to this arrangement—the Test March Service and, in director areas, the Speaking Clock Service. Since the former is liable to sudden peaks of traffic that tend to overwhelm normal exchange equipment special arrangements are made to make the best use of the switching

**OVER**

**As this article went to press another Recipe Centre was opened at Cardiff.*

**SPEAKING CLOCK TO RECIPES** *(Concluded)*

equipment and to minimise its effect on other traffic. This is done by giving callers access not to final information selectors but to circuits operating off group selector levels. The code used in director areas is "UMP" and at non-directors it will eventually be "16". Another effect of the peak nature of the traffic has been the imposition of restrictions on access to the service in order to safeguard junction routes and switching equipment.

The Speaking Clock code in director areas has always been TIM and no change is proposed. In non-director areas, as STD is introduced. the existing numerical code will be changed to 8081.

The Post Office recorded information services have come to stay but the rate at which they grow depends largely on the availability of exchange plant and equipment at the existing and potential information centres, as well as on the more general demands made on the resources of the Department.

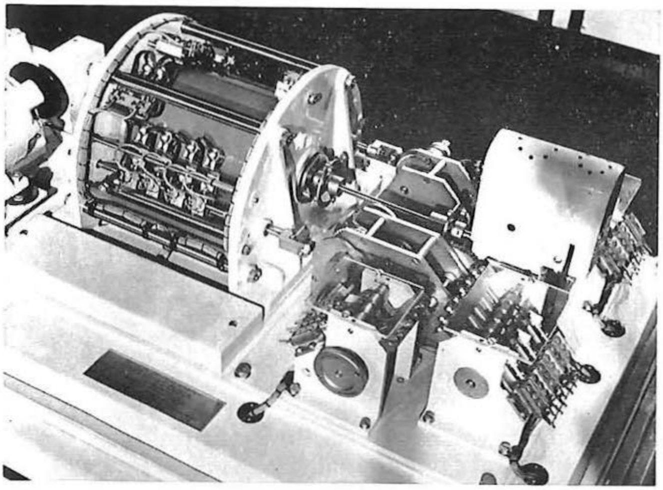
**THE AUTHOR**

**MR. N. C. NELSON** joined the Post Office in 1934 as a Sorter in London Postal Service Foreign Section. He became a Clerical Officer in 1936 and transferred to GPO Headquarters. He worked in the Telephone Branch between 1938-40 and after service in the Forces he returned to Headquarters Public Relations Department as an Executive Officer. He was promoted Higher Executive Officer in 1957 and has been closely associated with the development and expansion of the information services in the Inland Telecommunications Department.

RECORDED INFORMATION SERVICES—2

# HOW THE EQUIPMENT WORKS

## By D. R. H. LUCAS



***This picture shows the mechanism of one of a pair of new speaking clocks which use a new magnetic recording medium.***

**THE equipment for recording and playing back the first recorded announcements, other than the Speaking Clock, were commercial tape recorders which used a loop of tape and gave a fixed message length. The message was recorded on two machines—one to supply the service and the other a standby.**

The machine supplying the service was connected by plugs and cords to a distribution amplifier, the output of which provided a common connection point for incoming calls. If the recorder failed an alarm was given and the standby machine was manually connected to the service.

This system was costly to operate and suffered a number of disadvantages, the most important of which was the delay encountered between a message being received and connected to the service. This delay was due mainly to the need for editing the message so that it occupied the tape length with a minimum silent period between the beginning and end of the announcement.

To reduce operating costs and simplify operating procedure commercial dictating machines have since been modified to provide messages varying from eight seconds to three minutes. The machines used today are *Emidicta* dictating machines modified for Post Office use. The recording medium is a flat plastic disc, impregnated with iron oxide, which revolves on a turntable while the record and playback arm traverses the disc in a spiral. The beginning and end of a message is mechanically

***The equipment announcer No. 5A. The mechanism on the left erases old information before a new message is recorded. On the right is the record playback arm.***

marked during recording by a retractable arm which becomes locked at the end of recording. When the end of the announcement is reached on playback, the arm operates a microswitch which drives the return mechanism of the record and playback arm. When the arm reaches the beginning of the announcement it operates another microswitch which stops the drive. The record and playback arm takes less than 12 seconds to return from the end of the longest announcement of three minutes to the beginning.

Before making a new recording existing information on the disc has to be erased and this is done by energising a powerful electro-magnet and revolving the disc beneath it.

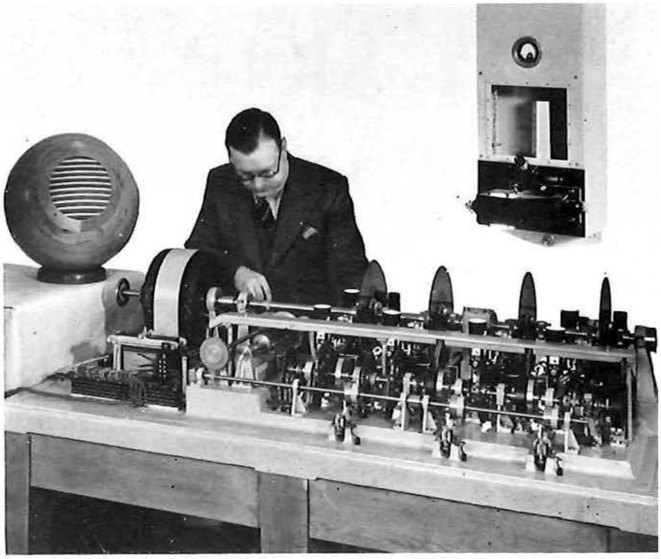
The machine also has a facility to erase, record and playback an announcement by remote control from a console in an acoustically-treated studio, sited as close to the manual board as practicable.

There are two versions of standard equipment: a three-service installation and a 20-service installation. In the three-service installation, which consists of a single console with an apparatus rack and six machines, the recording of the announcement is controlled by the operator from the console. Each service has two machines—one providing the service and the other always available for a new recording to be made.

The 20-service installation consists of three recording consoles, an apparatus rack and 24 announcing machines in a common pool so that three recordings can be made simultaneously and any console can select any free machine.

The problem of variation in the volume of announcements produced by differences in operators' voices has been overcome by connecting a constant volume amplifier in the record path. A distribution amplifier is also needed to distribute

*The old Speaking Clock used a photographic technique, the recording being played by scanning it with a beam of light. The modern clock uses a new magnetic recording material made of Neoprene loaded with magnetic iron oxide and is accurate to within one-twentieth of a second.*



***Part of the old Speaking Clock mechanism.***

announcements simultaneously to a large number of subscribers. This amplifier has a very low output impedance so that variation in the number of subscribers simultaneously connected to it causes little variation in output and the degree of coupling between subscribers is negligible. An alarm circuit is built into the amplifier so that if the volume of the announcement falls below a pre-determined level, or fails entirely, an alarm is given and number unobtainable tone is connected to the service.

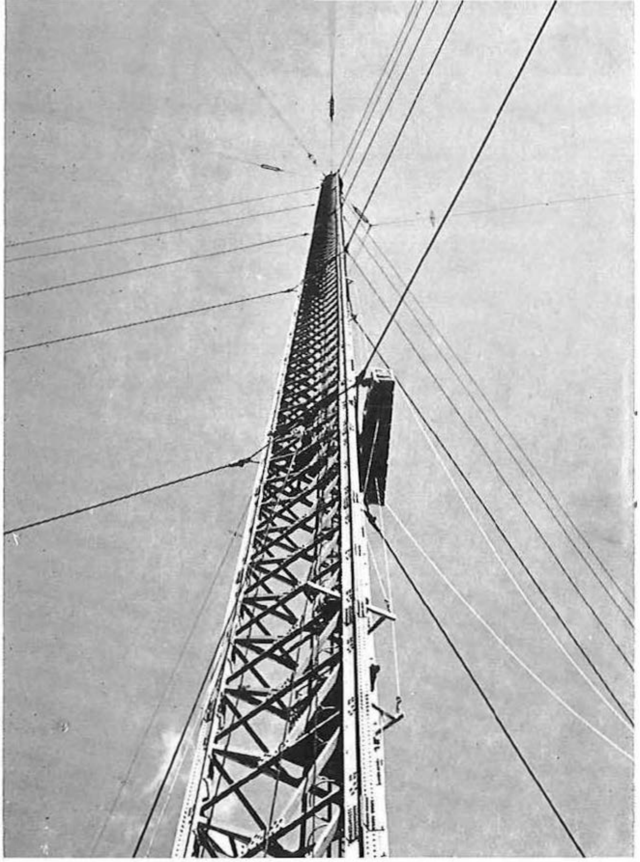

**THE AUTHOR**

**MR. D. R. H. LUCAS** is an Assistant Executive Engineer in the Engineering Department concerned with Recorded Information Services Development and Maintenance.

He joined the Post Office in 1949, as a Youth-in-Training in the London Telecommunications Region, South West Area. He was transferred to the Engineering Department Circuit Laboratory in 1955, and was promoted Assistant Engineer in 1961.

# EVEN SAFER BY SKIP

By J. J. ADLER



**AN 820 ft aerial mast at the Post Office Rugby Radio Station was the recent scene of a dramatic demonstration of a new method of safe high level access jointly developed by Post Office engineers and Sir William Halcrow & Partners.**

The new system, which can be applied to a variety of high structures, allows painters and maintenance men to work from the comfort and safety of a skip instead of relying on potentially dangerous climbing and scrambling techniques which hitherto has had to be used on these three-sided, lattice steel constructions.

Painting of the tall radio masts at Rugby has been halted since an accident at the Portishead Radio Station, Somerset, in 1960. Two men engaged on a maintenance practice on mast stays were involved, one losing his life and the other sustaining severe injuries.

In a thorough review of external safety measures which followed, the Post Office called in civil engineering contractors Sir William Halcrow & Partners to report. The new method demonstrated at Rugby recently is based on the Halcrow report findings and satisfies safety regulations and extensions to the Factories Acts passed since 1961.

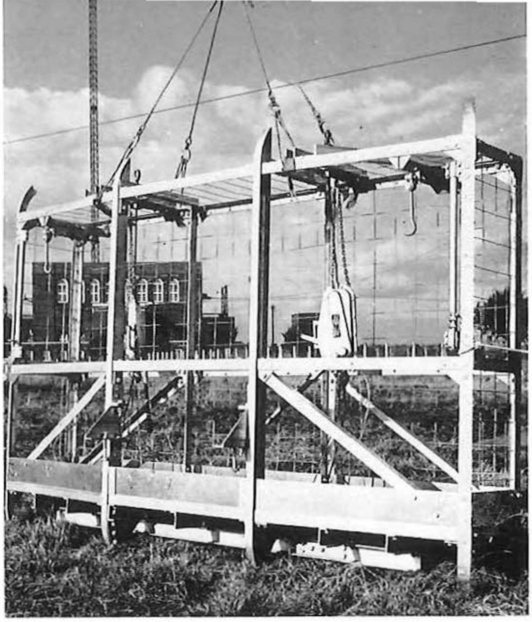
An essential component of the new Post Office system, is a bean-shaped *Tirfor* machine, which when actuated by two levers, will climb up or down a vertical rope. Two *Tirfors*, each with a safe holding capacity of 5 cwt, are used to control the movement of the 1,300 lb load of a skip and its two passengers. Parallel seven-sixteenth inch thick wire ropes on which the *Tirfors* climb are stretched between demountable outriggers clamped to the mast about 200 ft apart.

At the start of operations the skip is hoisted to the required height for a particular work stint. The skip is then fastened to the mast face by means of hinged support brackets and adjustable hooks. Rigging of the skip working ropes, which pass through the roof of the skip, the *Tirfors* and the floor of the skip for attachment to the upper and lower outriggers, can then proceed. Once rigging is complete, the skip is unclamped from the mast, allowing the *Tirfors* to take the load. Rigging screws are used to tighten the ropes and prevent the skip from swaying in the wind By jacking in unison on the *Tirfors* "down" levers, the skip operators can lower themselves at the rate of about three inches to each pull.

When the skip reaches the lower outriggers, having given its crew access to one entire face of the mast on its downward route, it is again bolted to the mast face for re-rigging for the next 200 ft stint. In Practice three interconnected skips will be used, completely encircling the mast and giving access to all outside and inside surfaces. Existing arrangements, consisting of an internal electrically-operated hoist

***Left: Worm's eye view of the skip as it climbs up the 820-ft high aerial mast at the Rugby Radio Station.***

***Right: The skip at rest, showing the bean-shaped* Tirfor *machines which control the skips movements. Each* Tirfor *has a safe-holding capacity of five cwt.***



cage and a ladder fitted with safety hoops will continue to be used for transporting the outriggers from one level to another and for general access.

The safety record on the Rugby masts has been blameless since they were built in 1924. The new equipment will make for even greater safety and the continuation of the record is much more assured. Moreover, working conditions, say the two six-men rigging gangs, will be much cleaner and more comfortable, and for the first time they will be able to take vacuum flasks of hot tea aloft!

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## New Branches For ITD

*TWO new Branches—to be known as the Organisation and Efficiency Branch and the Marketing Branch—are being set up in the Inland Telecommunications Department.*

*The function of the former will be to seek, develop and recommend measures to improve service and reduce cost over the whole field of traffic, sales and commercial work. In particular it will develop and promote the use of management control statistics designed to improve efficiency, intensify organisation and method studies, keep abreast of and exploit new developments in scientific management and keep service objectives under review and recommend changes where appropriate. The new Branch will absorb the existing O & M Statistics Division of the ITD, Operations and Organisation Branch (now to be known as the Operations Branch), together with the element of efficiency work at present carried out in the ITD Subscribers' Services Branch (whose title will remain unchanged).*

*The Marketing Branch will absorb the existing Sales and Subscribers' Apparatus Divisions of the Subscribers' Services Branch, each of which will be augmented and reorganised. The forecasting functions of the Sales Division and the Market Research functions of the Subscribers' Apparatus Division will be brought together in a new Division, thus enabling additional effect to be given to marketing policy generally.*

## Two New Regional Directors

MR. E. G. HUCKER, Deputy Director, took over from Mr. H. T. W. Millar as Director of Midland Region on the latter's retirement on 10 February.

Mr. Hucker, who joined the Post Office in 1929, was Deputy Director of the Indian Army Postal Service in World War Two. In 1952 he became Controller of Operations in London Postal Region and in 1953 head of the Post Office Management Training Centre before moving to Post Office Headquarters in 1956 as Chief Inspector of Postal Services. In 1962 he was appointed Assistant Secretary in charge of the Postal Mechanisation Branch and in 1963 became Deputy Director of Midland Region.

Mr. Millar had 37 years' service with the Post Office, joining the Engineer-in-Chief's office in 1927. After World War Two he became Telephone Manager, Birmingham, in 1946, and later Telecommunications Controller, Midland Region; Deputy Regional Director, London Telecommunications Region in 1954; Director, Northern Ireland, in 1960, and Director, Midland Region, in 1962.

Mr. Leonard Hill, an Assistant Secretary in the Inland Telecommunications Department, will become Director, Home Counties Region when Mr. A. Kemp, CBE, retires on 1 April. Formerly Telephone Manager at Colchester, Brighton and Manchester, Mr. Hill served as Deputy Director, LTR, between 1960-62.

Mr. Kemp joined the Post Office in 1920 and in his early years served in the York, Manchester, Nottingham and Liverpool areas. After service in Palestine, where he organised the conversion of the Jerusalem and Tel Aviv exchanges to automatic working, Mr. Kemp became Assistant Telecommunications Controller in the newly-formed North West Region in 1939; Telephone Manager, Preston, in 1943; Deputy Controller and then Controller of Telephones in LTR and, in 1950, Assistant Secretary, ITD, before being appointed Director, Home Counties Region in 1962.

★

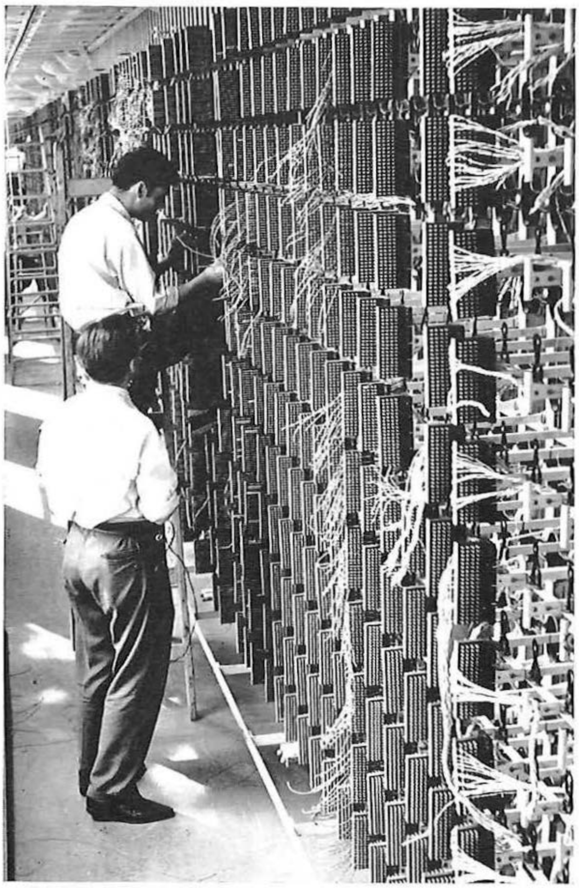
*WHEN Subscriber Trunk Dialling was recently introduced in Hull and the Post Office telephone exchange there was formally named Anson Exchange after a Post Office engineer who helped to pioneer automatic telephony, the plaque commemorating the event was unveiled by his nephew, appropriately another Post Office official.*

*The man whose name is perpetuated in the new STD exchange was the late Bernard Oglie Anson, of Kingston-upon-Hull. The man who unveiled the plaque was Mr. H. Anson Longley, an Assistant Secretary in the Inland Telecommunications Department.*

***The operational opening of three new trunk switching zone centres in the Home Counties marks a highly significant step forward in Post Office plans for improving and expanding the trunk telephone service.***
***These new zone centres will provide several thousand more trunk circuits to handle traffic in the Home Counties and also give much needed relief to other zone centres, such as Bristol, Leicester and Birmingham.***
***But even more important, they will play a big part in bringing relief to London. Until now nearly all trunk traffic coming into and going out of London and the Home Counties has been handled by trunk exchanges in London acting as switching centres. The new zone centres will hive-off a great deal of this traffic and at the same time enable many more new trunk circuits to be set up between London and provincial exchanges.***

# BRINGING RELIEF TO LONDON

By V. M. ISHERWOOD and A. H. ELLENDEN

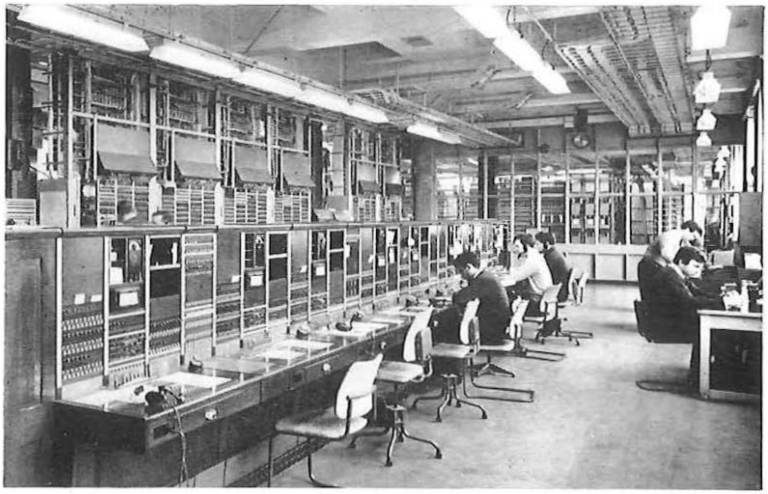


**SHORTLY after World War Two Post Office Headquarters reviewed possible methods of handling long-distance inland telephone traffic and set up the Trunk Mechanisation Steering Committee to design a system which would allow the majority of long-distance calls to be connected by the controlling telephone operator without the intervention of a second trunk operator. It was accepted as an important principle by the Committee that the system should be compatible with the later development of Subscriber Trunk Dialling.**

One of the consequences of the Committee's findings was a plan to establish three new Zone Centres at Cambridge, Reading and Tunbridge Wells, and a new sub-zone at Salisbury. Partly because of post-war restrictions on capital expenditure and partly because of difficulties in site search and building planning, work on the first building, at Cambridge, did not start until early in 1960, to be followed closely by the other two.

The opening of the three Home Counties Region zone centres produced a considerable reduction in the boundaries of the London zone. Before they opened it included the whole of the Home Counties and London Telecommunications

***Post Office engineers check the cabling on the exchange intermediate distribution frame at the Reading Trunk Switching Centre.***



***The test desk, with the trunk test at the rear and Trunk Unit Three (behind the glass screen in the background) at the Tunbridge Wells centre.***

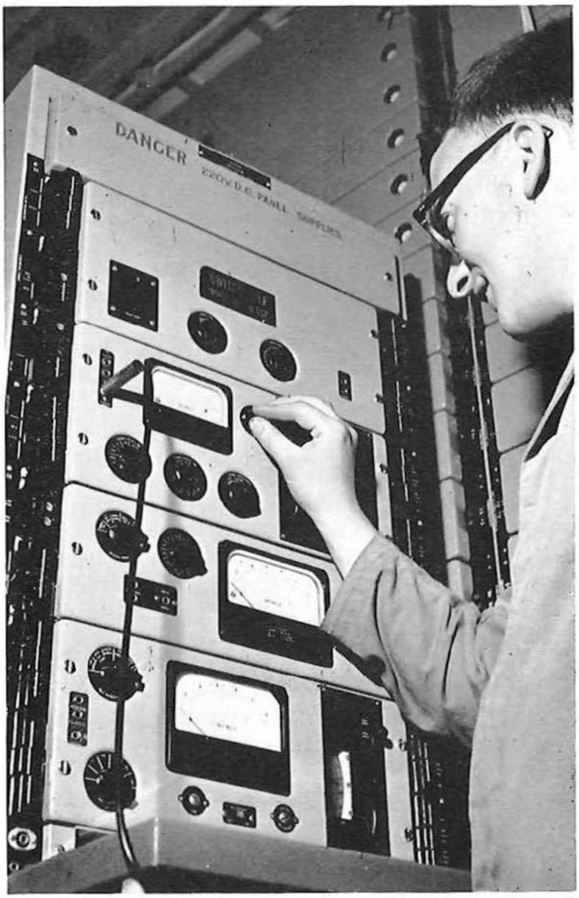
Regions and the district around Andover and Winchester in the South Western Region. It extended from Kings Lynn and Cromer in the north to Ryde and Eastbourne in the south, from Lowestoft and Margate in the east to Banbury, Andover and Portsmouth in the west—an area of more than 14,000 square miles. After the three centres had opened the London zone was reduced to the London Telecommunications Region plus the southern part of the Southend Telephone Area—in all about 1,500 square miles.

Of the territory served by the Home Counties Zone Centres (less the Salisbury Sub-zone), Cambridge covers the north-eastern part of the Region extending eastwards from Bedford, Hitchin and Luton, but excluding Chelmsford, Basildon and Southend. Tunbridge Wells serves that part south of the River Thames to the east from Crawley, East Grinstead and Brighton; and Reading serves the remainder of the Region, plus the Swindon group from the Bristol zone. A small part of the Region (Chelmsford, Basildon and Southend) remains in the London zone for the time being. The total cost of the three schemes amounted to over £8 million for buildings, equipment and main cables.

The new centres have added over 6,300 circuits to the national network. Cambridge has 2,000 circuits, Tunbridge Wells 1,500 and Reading 2,800. Many circuits to London were scheduled to cease after the zones opened but, even after allowing for these, the net addition to the national network was of the order of 4,000 circuits. Work on the Cambridge building was completed in February 1962; on Tunbridge Wells, in August 1962; and on Reading, in November 1962. Installation of equipment was largely completed in January 1964 at Cambridge; in February 1964 at Tunbridge Wells; and in August 1964 at Reading.

Very shortly after these dates public trunk traffic was being switched at all three centres. The original programming for each centre was based on providing a nucleus of trunk circuits on all routes initially so that STD (coupled with the transfer to automatic working at Tunbridge Wells) could be introduced and followed by bringing all routes up to full strength before zone working

OVER




***Measuring the high frequency response of a supergroup link (it can carry 60 simultaneous circuits) at the Reading centre.***

**RELIEF TO LONDON** *(Contd.)*

was introduced. However, at the beginning of 1963 it was clear that conditions in all the London switching units were so difficult that their relief must be given first priority. Thus it was necessary to recast the zone opening programmes so that the trunk switching element could be brought into service first, even if only on a partial basis. In each instance the trunk tandem and automanual board equipment were completed first and by this means it was possible to bring Cambridge into use on a limited basis in January 1964, and Tunbridge Wells in March 1964. In September 1964, the Reading Centre opened on a similar basis but with a much higher proportion of its trunk circuits available.

Since trunk traffic in the Home Counties has grown rapidly since 1958 and reserves of spare line plant have been used more quickly than was expected it was clear at an early stage that there would be shortages of circuits on some routes. A preliminary apportionment of the channels or transmission equipment expected to be available was made in mid-1962, first priority being given to building up the basic network. These apportionments formed the basic plan for circuit provision and preparation of advices for routes over 25 miles was put in hand, the whole task taking well over six months to complete. The back of the job having been broken, renewed attention was given to routes where shortages existed and ways were devised of overcoming the worst of them.

Simultaneously, a comprehensive schedule was prepared in the Regional Engineering Branch outlining the work required at all three centres. It listed all the new zone routes and detailed the total time required to carry out the engineering work, thus enabling the tasks to be arranged in the most economical manner and drawing attention to instances where there was a risk of demands for co-operation clashing at particular repeater stations.

The additional major task of bringing the three zone centres into service made very heavy demands on engineering staff with the required skills.

The pattern of development at Cambridge and Tunbridge Wells differed from that at Reading. In the former two places circuit provision followed equipment provision so that about 30 to 40 per cent of circuit requirements were available when they were brought into service, and the progress subsequently was gradual. At Reading, however, delay was mostly on the equipment side and a good deal of circuit provision work was carried out before the equipment was ready. The bulk of the high frequency lining-up work, for example, was finished by the summer of 1964 so that about 80 per cent of the trunk circuits were in service within about a month of opening. By the end of 1964 circuit provision had reached 90 per cent at all three centres.

***Part of one of the trunk units at Tunbridge Wells showing (left) M/U routiner registers and (right) register routiner pulse machines.***

Because of the need to get the zones working without delay once the equipment was ready, limitations on the amount of traffic that could initially be handled had to be accepted.

For several months there was no access via the Cambridge zone equipment to Cambridge numbers or to other exchanges in the Cambridge group and a similar situation existed at Tunbridge Wells up to the time of the local conversion, that is for very

THE Reading Zone Centre, valued at over £3 million, has transmission equipment representing the largest single order of its kind ever made by the British Post Office.

Twenty-seven underground cables, containing 12,000 pairs of conductors, carry all the inter-exchange circuits connected to the Reading district.

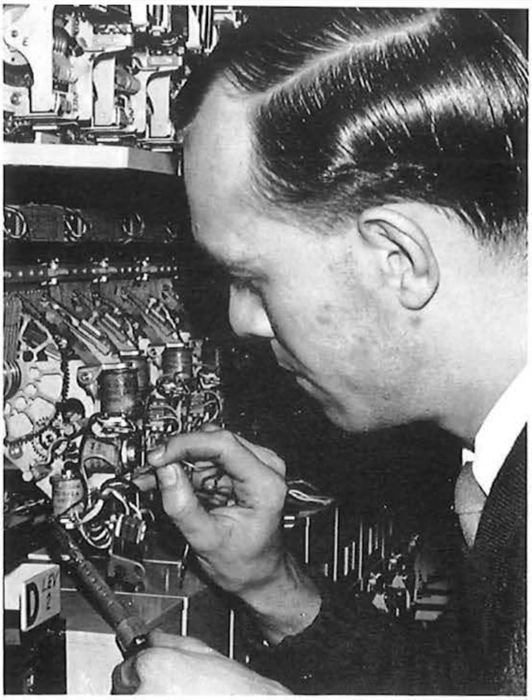
The Repeater Station, notable for the extensive use of transistors in place of valve type amplifiers, also provides amplifiers of various types for circuits passing through the town, in particular from London to the West country.

The operator-staffed switchroom is equipped with 33 positions, and in addition there are four positions to handle subscriber's enquiries, fault reports and so on and a further 12 positions to deal with enquiries for subscriber's numbers anywhere in the country.

The main ventilation plant pumps fresh air into the building at the rate of 18,000 cu. ft a minute and passes it through filters to ensure it is dust free.

nearly a year. Reading was similarly placed but only for about two months. Exceptional measures had to be adopted to cope with the large volume of traffic re-routings involved and the consequential amendments to Visible Index Files in automanual exchanges.

Despite the relief given by the Home Counties zone centres it is expected that London will require additional relief in two or three years time. Some will be given by reducing the boundary of the London zone still further—from 1,500 square miles to the London Director Area of, say, 500 square miles—by serving more territory from the Home Counties centres. Major extensions will be needed at each of the three centres and equipment orders valued at more than £2 million have already been placed for this purpose. These extensions are expected to be completed during 1967. Group centres in the London zone outside the director area will be transferred to their new zone centres on a piecemeal basis as circuits and routes become available. It is hoped that this process will be completed by 1969 or 1970.



***Technical Officer A. T. Wiffin replacing faulty stator coils in a motor uniselector group selector at the Cambridge trunk centre.***

Some thought is already being given to the possibility that a new zone might be needed later in the area served by the Reading zone. As a first step the justification for new routes from group centres within the zone to other zone and group centres is being examined. When these plans have been completed a realistic assessment of Reading's needs can be made. The pattern of new route provision might also give some guide to the most likely situation for a new zone if one is needed.

Another development in the near future is the introduction of the transit switching system, as a result of which Reading will become a Main Switching Centre and Cambridge and Tunbridge

OVER

***A view of the operators on duty in the automanual room at the Cambridge Trunk Exchange.***

# How The Post Office Helped Say Farewell to Sir Winston

PROVIDING the special lines for television and sound broadcasts of the Lying-in-State and funeral of Sir Winston Churchill proved to be the biggest operation of its kind ever carried out in the history of the London Telecommunications Region.

Working by day and night, telephone engineers of the City and Centre areas laid additional vision, speech and music circuits, using nearly five miles of special cables, including multi-tube coaxial cables from Faraday Building into the crypt of St. Paul's Cathedral.

These lines connected the cameras and microphones set up in Westminster and along the funeral route by way of local telephone exchanges and the main underground cable network from which several hundred circuits were taken to the BBC and ITV sound and television control centres.

High-quality sound circuits were provided to Montreal and New York via CANTAT and TAT cables, with extensions to Sydney via the COMPAC cable. In addition, broadcasts over ordinary speech channels were set up to these countries.

On the day of the funeral a total of 67 Continental programme (broadcast) circuits were provided to 16 countries, 32 simultaneously; 77 trans-Atlantic transmissions were arranged including 59 on ordinary speech channels to the United States, 11 to the Commonwealth, plus four high-quality transmissions to the United States and three to the Commonwealth.

Numerous picture transmissions were also arranged to a number of countries. Sound commentary and control circuits were set up for television transmissions to most European countries together with sound channels for association with television relays via Telstar to North America.

To help their colleagues handle the flood of telephone calls on the switchboards at the House of Commons, Scotland Yard and the public departments involved in organising the Lying-in-State and the funeral, additional London telephone operators were called in.

★

## MANY A SLIP(ped Disc)

*Left: The right way.*
*Right: The wrong way.*

*"There's many a slip . . ." and the illustration on page 19 of the Autumn issue of the Journal shows a classic example of a bent back that could lead to a slipped disc.*

*In expectation of a spate of correspondence and also to placate those (not least in my own Branch, including the Safety Officer) who have so long campaigned for an intelligent technique in manual handling and lifting, I feel that some apology is necessary. I can only plead excessive concern with ducts at the expense of discs. I enclose a further illustration showing how my volunteer would have lifted the duct had he been asked to do so.*

*It cannot be too strongly stressed that incorrect techniques entail serious risks of ruptures and slipped discs. Within the Department a great deal of effort has been, and is being, made to bring home to people the importance of learning to carry out these simple operations correctly. These techniques are not only easier and less tiring but, correctly used, will undoubtedly lead to a considerable reduction in pain and discomfort to individuals.*

*May I also correct a small error at the end of line seven on page 18. This should read "concrete nests" and not "concrete ducts."* — **D. W. Stenson, Cn Branch, Engineering Department.**

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**RELIEF TO LONDON** *(Concluded)*

Wells, with others at Colchester and Norwich (both now in the Cambridge zone) and Oxford (in the Reading zone) will become District Switching Centres. It is expected that the three zones will take on their new function in 1968 or 1969. Special building and equipment extensions will be required.

Despite their comparative youth, the three zones can expect to see some major changes in their early years. Thereafter, they should settle down to establish their own growth patterns, although it is hoped that some of this growth, both two-wire and transit-switched, can be diverted to new direct routes. Even so, the need for the creation of a further major trunk switching centre to supplement Reading within the foreseeable future cannot be entirely ruled out.

# *Telecommunications Statistics*

| | Quarter ended 30 Sept., 1963 | *Quarter ended 30 June, 1964* | *Quarter ended 30 Sept., 1964* |
|---|---|---|---|
| *Telegraph Service* | | | |
| Inland telegrams (including Press, Railway Pass, Service and Irish Republic) ... ... ... | **3,244,000** | 2,757,000 | 3,522,000 |
| Greetings telegrams ... ... ... ... ... | **757,000** | 635,000 | 754,000 |
| Overseas telegrams: | | | |
| Originating U.K. messages ... ... ... | **1,914,900** | 1,657,000 | 1,646,000 |
| Terminating U.K. messages ... ... ... | **1,871,000** | 1,690,000 | 1,669,000 |
| Transit messages ... ... ... ... | **1,264,000** | 1,255,000 | 1,264,000 |
| *Telephone Service* | | | |
| *Inland* | | | |
| Gross demand ... ... ... ... ... ... | **155,000** | 181,000 | 186,000 |
| Connections supplied ... ... ... ... ... | **129,000** | 162,000 | 160,000 |
| Outstanding applications ... ... ... | **174,000** | 167,000 | 173,000 |
| Total working connections ... ... ... | **5,457,000** | 5,709,000 | 5,797,000 |
| Shared service connections (Bus./Res.) ... | **1,097,000** | 1,124,000 | 1,135,000 |
| Effective inland trunk calls ... ... ... | **156,364,000** | 174,687,000 | 187,448,000 |
| Effective cheap rate trunk calls ... ... | **37,318,000** | 38,692,000 | 44,968,000 |
| *Overseas* | | | |
| European: Outward ... ... ... ... | **1,496,000** | 1,366,000 | 1,161,000 |
| Inward ... ... ... ... | ***1,206,000** | *1,078,000 | *1,034,000 |
| Transit ... ... ... ... | ***12,000** | *12,000 | *11,000 |
| Extra European: Outward ... ... ... | **129,000** | 123,000 | 92,000 |
| Inward ... ... ... | ***165,000** | *148,000 | *115,000 |
| Transit ... ... ... | ***19,000** | *21,000 | *17,000 |
| *Telex Service* | | | |
| *Inland* | | | |
| Total working lines ... ... ... ... | **11,000** | 13,000 | 14,000 |
| Metered units (including Service) ... ... | **27,637,000** | 38,644,000 | 39,486,000 |
| Manual calls (including Service and Irish Republic) ... ... ... ... ... | **39,000** | 42,000 | 48,000 |
| *Overseas* | | | |
| Originating (U.K. and Irish Republic) ... | **2,205,000** | 2,111,000 | 1,692,000 |

Figures rounded to nearest thousand. *Includes estimated element.



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

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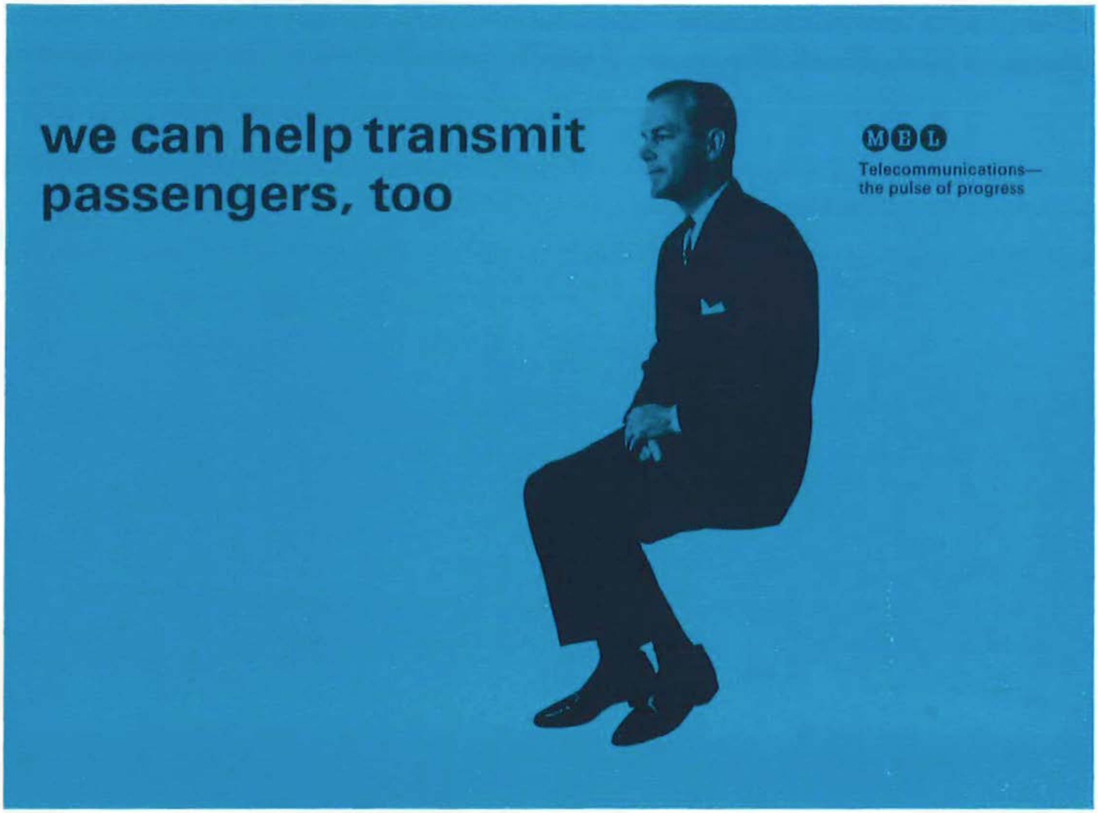
GPO

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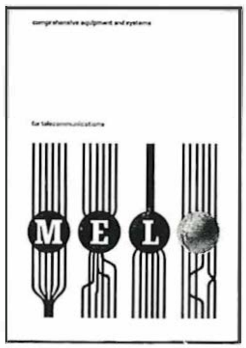


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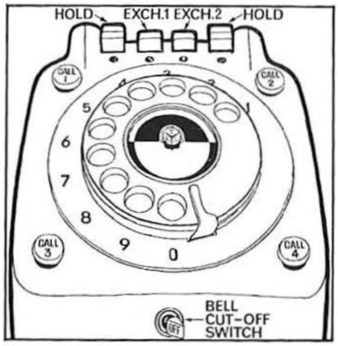


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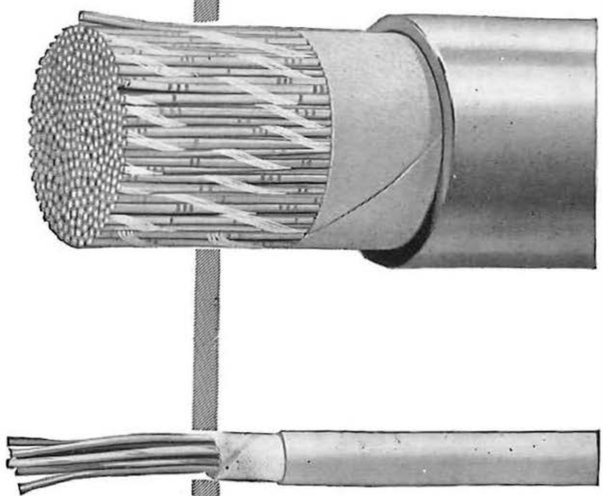

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