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telecommunications

JOURNAL

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AUTUMN 1968

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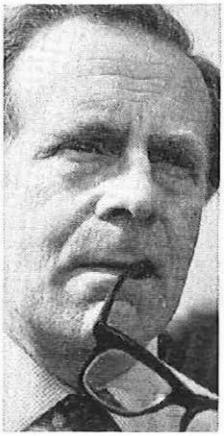

Surveying,
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Systems Design,
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Transmission by
Radio Cable and
Open-Wire Line

Frequency Division
and Digital
Multiplex

Audio, Programme,
Signalling
Telegraph and Data
Equipment

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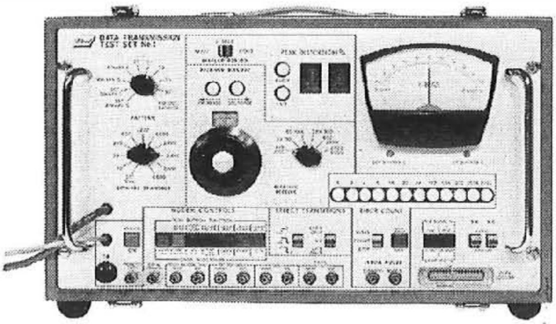


This equipment has been developed for the British Post Office and is marketed with their permission.

Transmitted Signal:
Rectangular, with voltage levels of +6V ±1V and −6V ±1V.
Ratio can be set to 1:7, 1:3, 1:1, 3:1 or 7:1, and a 511-bit pseudo-random pattern (to C.C.I.T.T. Special Study Group A—Contribution No. 61) can be used. Distortion is less than 1%. Rate can be set to any one of 10 values from 50 to 4800 bit/s, to accuracy $1:10^4$.

Received Signal:
Rectangular, with voltage levels of −3 to −25V and +3 to +25V, with any ratio and at any rate from 28 to 9000 bit/s.

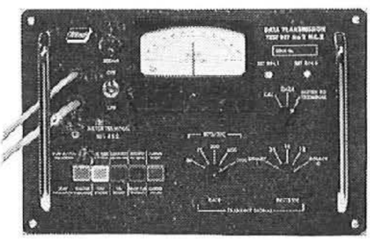
Functions Indicated:
Peak telegraph distortion (early or late) from 0 to 49% within ±1% ±1 digit.
Bias distortion from −100 to +100%.
Bit- or block- error count up to 2.047 with COUNTER FULL indication.

General:
Provides its own timing-signal output, can also be used with external timing source for use on synchronous systems.

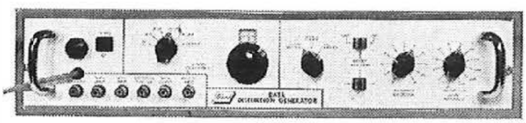
Data Transmission Test Set Type 2 is a portable, bias-distortion measuring set, and is mainly used in the field.

Transmitted Signal: Rectangular, with voltage levels +6V ±1V and −6V ±1V. Ratios available 1:3, 1:1 and 3:1. Five rates from 50 to 1200 bit/s.
Received Signal: As transmitted signal, but voltage levels −3 to −25V, +3 to +25V.
Indication: Bias Distortion ±100%. Can also be used as voltmeter for externally applied voltages from −10V through 0 to +10V.

This equipment has been developed for the British Post Office and is marketed with their permission.



Distortion Generator Type 3, developed mainly as an accessory for Data Transmission Test Set Type 1, provides a means of applying accurately-defined levels of telegraph distortion to any data transmission system.



Telegraph Distortion:
Early or late, 0–50% in 5% steps, to either or both polarities of transition. This can be applied either to every transition or to 1 in every (4 to 4096) transitions.

Data Source:
A 1:1 data source is incorporated to give from 24 to 9600 bit/s; it can also be externally driven outside this range. This signal can be distorted as detailed under 'Telegraph Distortion'.

General:
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Each of these instruments incorporates interface circuits to C.C.I.T.T. Recommendation V24.

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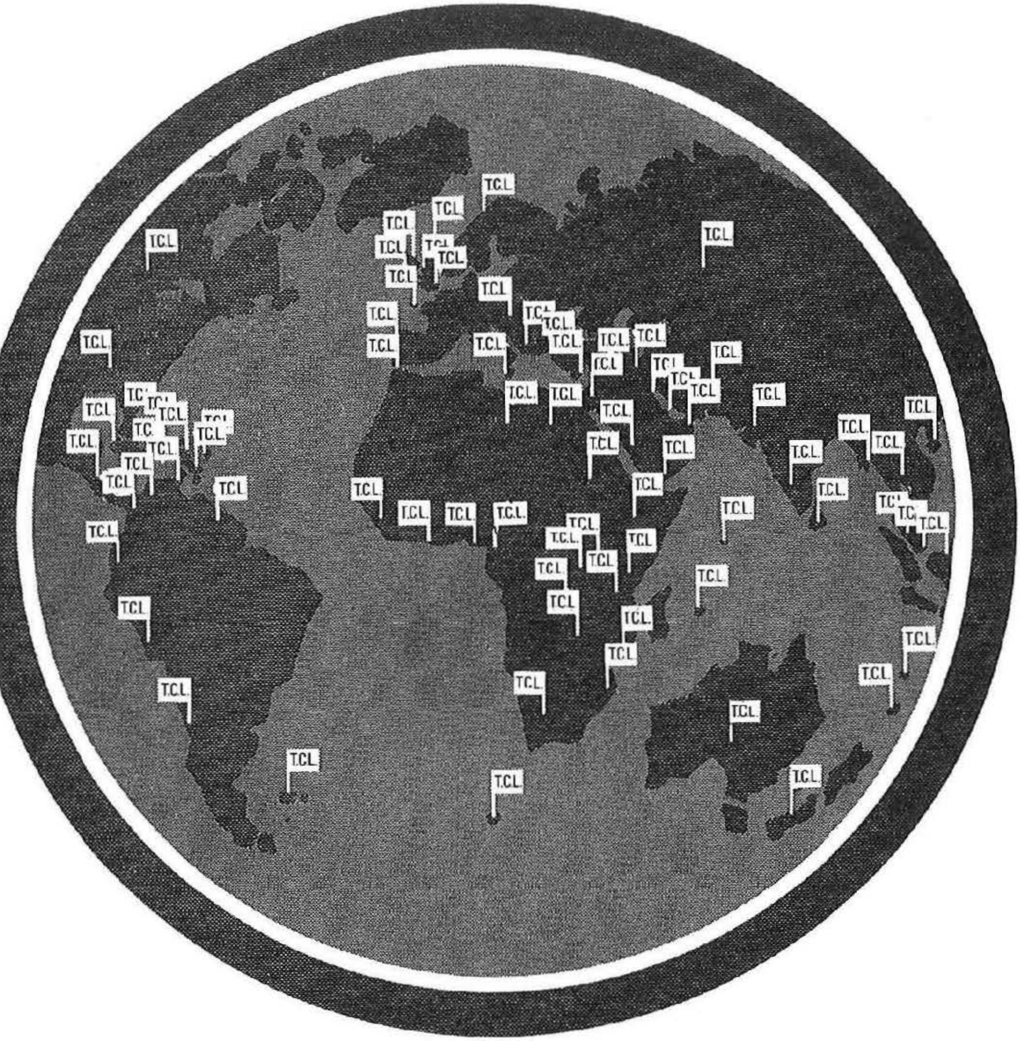

Post Office Telecommunications Journal

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

MORE COMPETITION FOR THE INDUSTRY

A MORE competitive system of ordering telephone exchange equipment—until now supplied mainly by the five big telecommunications manufacturing companies on a bulk supply basis—is being introduced by the Post Office.

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Announcing this important development in a recent statement to Parliament, the Postmaster General, Mr. John Stonehouse, said the new procurement policy had two main objectives: to obtain what is needed at the right time and secure the best value for money; and to help promote a strong and efficient British telecommunications industry at home and abroad.

Spelling out the new policy for the first time, the PMG said that the established suppliers will be guaranteed between them, subject to continuing efficient performance, a proportion of the total requirement, reducing within the next two years to 50 per cent. Their share of the business above this level will be decided competitively on the basis of current tenders and their share of the guaranteed proportion will depend on their competition position as reflected on their total output for the Post Office in the previous year.

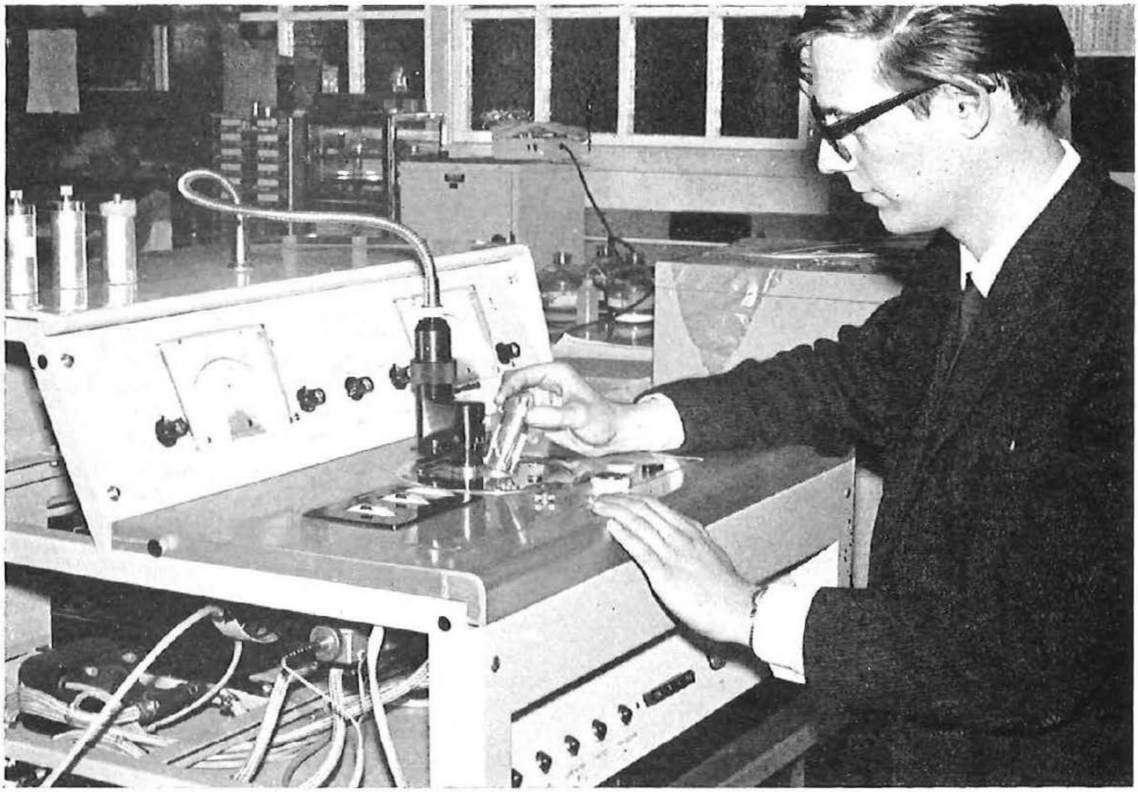
This means that from about mid-1970 onwards, the big five will have to compete with each other and with any newcomers for 50 per cent of the market. But that market will be much more valuable. By 1970-71 the total annual expenditure by the Post Office on exchange equipment is likely to increase from about £82 million in 1967-68 to between £130-£150 million so that the guaranteed amount will probably be in the region of £65 to £75 million.

Mr. Stonehouse said that in exchange for the guarantee any profit above a level to be negotiated will be shared between the Post Office and the supplier. He emphasised that tenders for all telecommunications plant will be adjudicated on the basis of price, delivery, performance and quality "taking account of such wider considerations as are, or may be, relevant and consistent with the basic procurement policy".

The new policy is consistent with the Industrial Reorganisation Corporation's view that the policy should be based on competitive tendering as far as possible but assure regular suppliers of continuity of orders so long as their price, quality and delivery are satisfactory, give the more efficient the opportunity to win an increasing share of the business and allow entry into the industry of any new *bona fide* supplier prepared to make a full contribution to the industry's development.

Post Office research engineers are working on a new kind of cable made up of hundreds of hair-thin glass fibres, which could revolutionise the present-day telecommunications systems

GLASS FIBRE CABLES!



Inserting a polished sample of optical glass into a special photometer to measure the amount of light scattering produced by the glass.

SCIENTISTS at the Post Office Research Department in Dollis Hill are working on the development of a glass fibre cable communication system which could eventually supersede existing coaxial cable and microwave links between cities.

The new type cable would consist of several hundred glass fibres in place of the copper wires in conventional telephone cables. Each fibre would be able to carry thousands of times more information than a pair of telephone wires and several times as many as the larger co-axial metal conductors in present day television and multichannel telephony cables (or equivalent present-day microwave links).

Each fibre in such a glass cable would be a composite structure measuring only about 0.1 mm in diameter, with a central core of a slightly different glass only a few micrometres in diameter.

Each fibre would carry the communication signals in the form of pulse code modulation of an optical carrier wave. The optical wavelength which at present seems most likely to be used is that generated by a gallium-arsenide laser in the near infra-red region (about 0.9 micrometre). Although glass fibre with a thicker core of higher refractive index and a thin cladding of low refractive index has been manufactured in Britain for some time for applications such as punched-card and paper-tape readers for computers, such fibres carry light in a multitude of modes, each having a characteristic velocity. This spread of velocities limits the effective modulation bandwidth to a few MHz even for short-distance working.

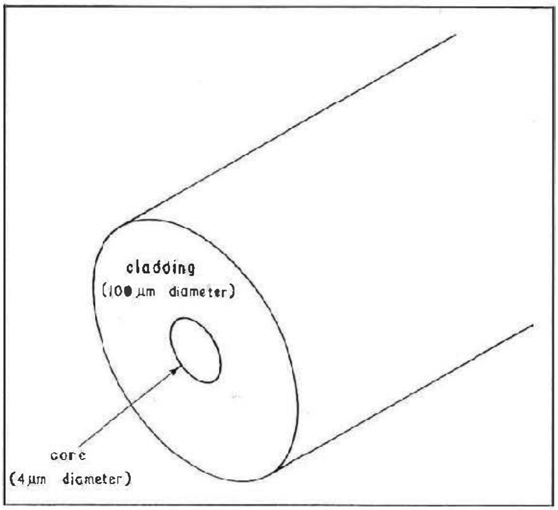
For long-distance broadband communication it is essential that the fibre should be able to carry only a single mode. This is made possible by using fibre with a central core diameter comparable with the optical wavelength to be transmitted, surrounded by thick cladding in which a significant part of the single mode wave propagates. New techniques are being developed for making such a fibre with the required high order of dimensional perfection and quality control.

To provide experimental lengths of various types of fibre, a special "pulling" machine has been constructed at Dollis Hill and used to make short lengths of fibre with a wide variety of dimensions. At present, the best glass available has a loss 100 times higher than that which will be necessary for an operational system, and in order to develop the ultra-pure raw materials required and to make and also measure the glasses of the very high optical transmission quality required, the Post Office has placed research and development contracts with British Titan Products Ltd., Barr and Stroud Ltd. and Standard Telecommunication Laboratories Ltd. The first batches of the very pure glass-forming materials have recently been prepared.

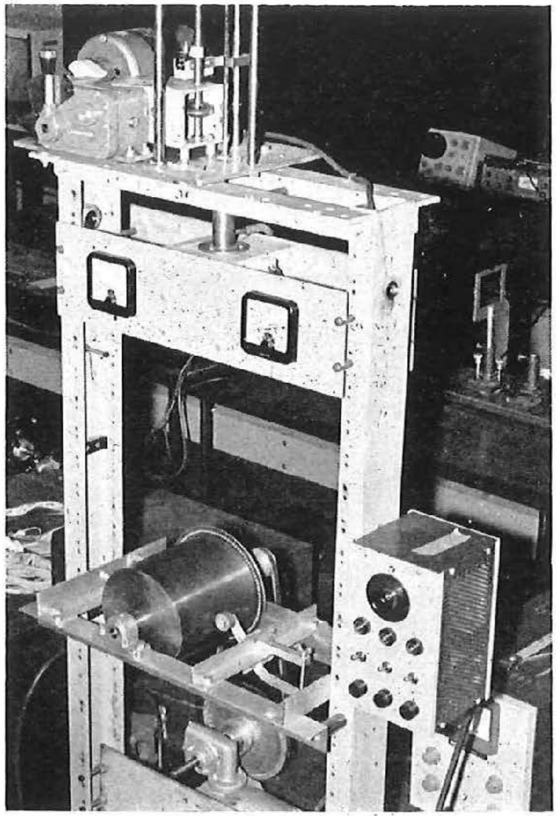
The single mode pattern of propagation of light has been demonstrated along short lengths of fibre made from glasses at present available, using a simple audio frequency test signal to modulate a helium-neon laser at a visible red wavelength (about 0.6 micrometre). Extension to longer lengths of fibre and wider signal bandwidths will require glass fibres made from the high purity oxides now becoming available for the first time.

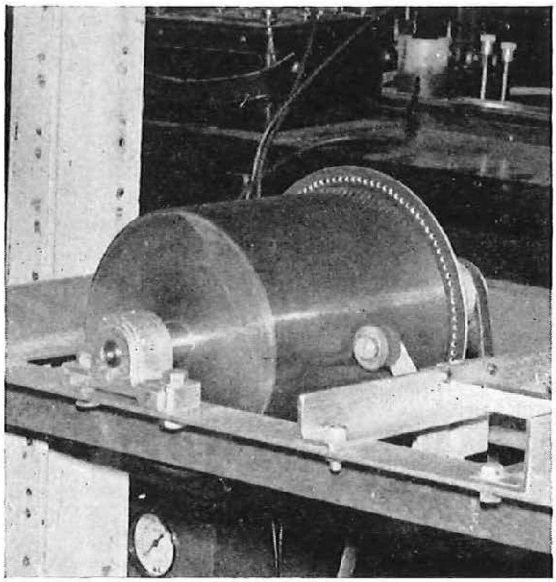
OVER

Above: A close-up view of the polished sample of optical glass. Below: The diagram shows the formation of the glass fibre cable. Each fibre, of which there would be several hundreds, would be able to carry thousands of times more information than a pair of copper wires in the present cables.



Right (above): The experimental fibre pulling machine showing a composite rod being fed into a miniature oven. The fibre is pulled by the constant-speed capstan-drum and pinch roller at the bottom of the rack. Right (below): A close-up of the capstan-drum and pinch roller.





Not only must the high purity be maintained in the glass-melting and fibre-drawing processes, but the growth of sub-microscopic scattering centres, already shown to be adequately controllable in the bulk glass, must remain so in the drawing process, particularly at and near the core-to-cladding interface in the fibre.

The Post Office is placing research and development contracts with London University for mathematical studies of the influence of scattering centres on propagation in the fibre and also of the problem of launching a wave with high efficiency into the desired single mode. It is also collaborating with the Ministry of Technology and with the University of Sheffield in closely related glass material studies.

The repeaters, which will be required at intervals of about a kilometre along each fibre, will make use entirely of reliable low power solid-state devices to convert the light into electrical signals for amplification and then back into light. These devices would comprise mainly silicon avalanche photo-diode optical signal receivers, high speed silicon integrated circuit electrical signal regenerative amplifiers, and low-power gallium-arsenide laser optical signal senders.

Some indication of the long term capabilities of a guided optical communication system is given by the fact that a bandwidth of only one per cent of the optical wavelength is equivalent to a few million megabits of pulse-coded information a second. A simple repeater of the type outlined above might be able to transmit several hundreds of megabits a second.

Unlike the requirements for the repeater of a co-axial cable system, the gain required for the optical fibre repeater is basically independent of bandwidth. For a large enough bandwidth, therefore, an optical fibre system is expected to be more economic than a co-axial cable system.

FFR

Meter reading films are shown on a Recordak viewer and Machine Operator Sue Martin punches the details on to 80-column cards at the Data conversion centre.

PRODUCING TELEPHONE BILLS BY COMPUTER

By L. K. HINTON

At a new computer centre in Portsmouth machines have taken over the job of making out telephone bills for nearly two million subscribers

DURING the past year, three National Data Processing Service (NDPS) Computer Centres—at Edinburgh, Derby and Portsmouth—have been taking over from existing Mechanised Accounting (MATS) Units the preparation of telephone bills for all provincial Regions except Northern Ireland.

The Portsmouth Centre, the first to become operational, is responsible for billing subscribers in the South Western, South Eastern and Eastern Regions. By the end of July it had absorbed half its total commitment of about 1,800,000 bills a quarter. There is now a temporary pause in the transfer of work because of the 1968 Tariff Revision.

There were four main reasons for introducing a computer billing system. First, it would enable substantial savings to be made in the staffing of MATS Units and Area Accounts Groups. Second, more MATS machinery would otherwise be needed to contend with trunk traffic growth and to replace obsolete equipment. Third, a

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computer system would improve revenue by speeding up bill preparation and minimising delay in raising call charges and, fourth, initial, final and monthly trunk bills could be rendered more promptly.

A limited computer system—known as Telephone Billing Stages 1 and 2*—was introduced in the London Telecommunications Region in July, 1964, and run on the computer at Charles House, Kensington. This transferred to computer processing the calculating and printing work then being performed on punched-card calculators and tabulators in the London MATS Unit, and released spare MATS machinery for use in the expanding provincial Units.

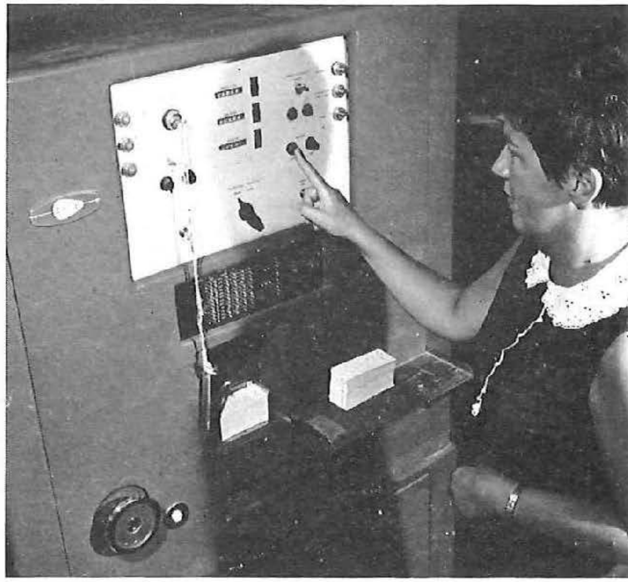
A more comprehensive system—known as Stage 3 Billing—was then developed by NDPS teams of systems analysts and programmers. Its principal feature was the creation of a main computer file on magnetic tape, containing up-to-date billing details for every subscriber—both "standing" information (telephone number, name and address, and quarterly rental) and "temporary" information (call and other single payment charges accruing during the current quarterly billing period). It also provided for bills to be addressed by computer so that they could be dispatched direct from the Computer Centre to the customer, for payments to be ledgered, and for follow-up procedure to be initiated automatically for bills which remained unpaid.

The Stage 3 system underwent exhaustive program testing and system trials before it was launched in the LTR North West Area in August, 1967. There were further proving tests at the Portsmouth Computer Centre, including a period when some of the Portsmouth Area bills were run in parallel with the existing MATS system, before it was extended to the provinces.

Live computer billing began at the Portsmouth Centre on 1 October, 1967, and in the following quarter nearly 180,000 subscribers' billing records were transferred to its computer files. During the next six months the rate of input increased to double this figure and at present more than 940,000 billing records are held in magnetic tape form at the Centre on 3,600 ft. reels of tape, each of which contains full details for about 55,000 subscribers.

The points at which data is handled are the 19 Telephone Manager's Offices in the three Regions concerned, the MATS Units at Cardiff, Oxford, Canterbury and Portsmouth, the Data

**See the Spring, 1965, issue of the Journal*



Above: Machine Operator Claire Sanger operates the 40-column card mark-scanning machine in the MATS Unit. Below: Machine Operator Garry Craig at the controls of one of the expeditors used to insert telephone bills into envelopes for direct despatch to the customer.

Machine Operator Roger Tutton at work on one of the 40-column card readers in the computer room.

Conversion Centres (DCCs) at Bristol and Portsmouth, and the Correction and Editing (C and E) and Computer Units at the Portsmouth Centre. The activities of the MATS Units and Area Offices are co-ordinated by three Regional Computer Liaison Officers.

The first task under Stage 3 Billing is to set up a main computer record for each Region containing details of subscribers' names and addresses, rentals, tariffs, meter readings, connection dates and deposit information. Broadly, this is done by using punched cards to convert existing manual records held in TMOs and MATS Units into a form suitable for transfer to a magnetic tape file in Area, exchange and telephone number order.

This process—actually a series of minor processes—is controlled by a specially-designed suite of computer programs known as the TB 3 Conversion Suite. Billing information extracted from Area Accounts Group records is punched into 80-column cards at the appropriate DCC from coded addressograph plates and other listings and read on to magnetic tape, together with MATS Unit information from existing 40-column punched card records.

Once this main file of "standing" information has been set up, the way is clear to keep it up to date each day by adding to it details of call and other charges and by recording changes that take place on each installation. The main streams of input are ticketed calls, advice notes, meter readings, payments and amendments.

The ticketed call input consists of trunk and local call tickets (40-column cards) made out at exchanges in respect of operator-controlled calls. The MATS Units receive these from telephone exchanges, the bulk of them direct, and by means of "marked scanning" machines convert the information on each card into a pattern of punched holes representing the numbers and marks entered by the telephone operator. They then send the punched 40-column cards in daily batches to the Correction and Editing Unit.

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Left: 80-column cards holding information about payments, meter readings and advice notes are fed into a reader in the computer room. The Machine Operator is Graham Watts. Below: The Analex printer, operated by Antony Jolliffe, is used to print telephone bills, trunk statements, reminders, reports and listings.

All other input streams are in 80-column punched-card form. Advice notes, meter reading schedules and films, payments (counterfoils of paid accounts) and amendment documents are sent to the DCCs daily by the Area Offices they serve. From these documents the DCC operators use International Computers and Tabulator punching machines to prepare 80-column punched cards containing the information to be carried to the computer file. Because of the need for accuracy, the punching is then checked by other operators using ICT verifying machines. The punched 80-column cards are then dispatched to the Correction and Editing Unit.

Thus, every day, the Correction and Editing Unit receives deliveries of both 40-column and 80-column punched cards from MATS and DCC Units. The C and E Unit is responsible for correctly presenting work to the computer in accordance with a pre-arranged quarterly billing program. It makes up the punched cards into separate daily runs for each of the Regional files held on magnetic tape and passes them forward to the Computer Unit for processing.

In the Computer Unit the computer processing operation is divided into three main stages—Data Vet, Main Process and Print. Each of these is controlled by a set of computer programs held on magnetic tape. The first stage—Data Vet—consists of reading on to a magnetic tape the information submitted on punched cards, vetting it, rejecting invalid data and, in the case of 40-column cards for trunk calls, automatically diverting any cards requiring call destination information to be punched in them for subscribers who need these details on their trunk statements. The machine used is an Uptime card reader which operates at speeds of up to 2,000 cards a minute and transfers call details on to a magnetic tape.

The 80-column cards are read in a similar manner, on a separate ICT reader which handles up to 600 cards a minute. Details from these cards, too, are transferred on to a magnetic tape. The information on the two Data Vet tapes is then merged together and transferred to another tape.

Machine Operator Chris Rundle (nearest camera) at the Computer Console with magnetic tape decks in the background.

At the Main Process stage the recorded data is sorted down to telephone exchange and number order and the output tape resulting from this run is used to update the main billing file. The new information is recorded on the main file, any necessary meter readings and other calculations are carried out and details are extracted of any bills due to be rendered and reminders to be sent, together with statistics and listings required by the Area Office.

This is all done at very high speed. The arithmetic unit in the English Electric LEO 326 computer, for example, adds two ten-digit numbers in four-millionths of a second and information from tapes is transferred at a rate of more than 90,000 characters a second.

An updated main file record is produced on a new set of magnetic tapes, together with a further set of tapes containing the bill and other information due to be printed out that day. The data on the billing tapes is then sorted and edited so that it is in the order required for printing.

Computer processing has then reached the final print stage which consists of reading the billing tapes and printing out bills, statements, reports and so on, on two Analex printers at speeds of up to 1,000 lines a minute.

After being printed, the bills, statements and reminders, which have been produced on continuous stationery, are guillotined. The Correction and Editing Unit then examines all the reports printed by the computer and initiates action to correct any errors in bills revealed by the inbuilt program checks. The Computer Unit then envelopes the bills, statements and reminders and dispatches them direct to subscribers.

Inevitably, with such a comprehensive computer system there have been some set-backs, but over all progress to date has been satisfactory. This could not have been achieved but for the willing cooperation of staff in Area Accounts Groups and MATS Units who had already had to face a series of major procedural changes in recent years.

The present Stage 3 system of computer billing is by no means the final version. The facilities will be extended in due course to embrace other aspects of Area accounts work, for example, telex and private circuit billing.

THE AUTHOR

Mr. L. K. Hinton *joined the Post Office as a Clerical Officer at Gloucester TMO in 1939. After Army service, he transferred to Midland Region on promotion and subsequently reached the rank of HEO at Midland Region Headquarters. In 1959 he was appointed Regional Inspector of Clerical Establishments in South Western Region and later moved to Southampton TMO as Chief Clerk. He is now Manager of the NDPS Computer Centre at Portsmouth.*

Camera at the Switchboard

Close studies of movie film of telephone operators handling "calls" are helping the Post Office to simplify switchboard procedures

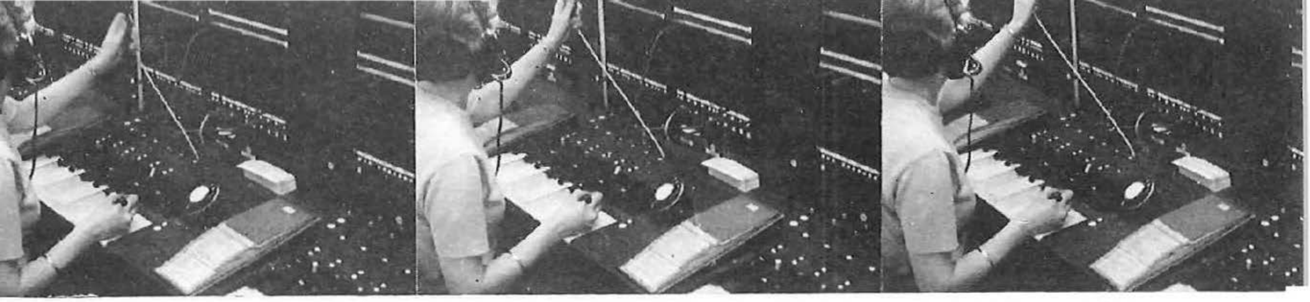
By F. Y. DUNSTAN and R. W. SCOTT

THE British Post Office is one of the first administrations in the world to use cine film as a work study tool to examine the way telephone operators handle trunk calls.

The aim of these studies, which started early in 1966, is to speed the connection of calls and simplify operating work by using the most efficient methods. Already more than twenty films have been made and an interim simplified method of handling trunk calls has been introduced as a result of the investigation.

Today, although almost 80 per cent of subscribers have subscriber trunk dialling facilities,

Left: A cameraman of the Post Office photographic unit filming a switchboard operator at work at Shoreditch Telephone Exchange. A similar camera is being used to make the special work study films of operators handling simulated telephone calls at the Rodwell House Telephonist Training Centre. These special films, shot at 32 frames per second, are being used to examine switchboard procedures in minute detail.
Above: Six frames from one of the work study films made at Rodwell House Telephonist Training Centre.



about 400 million trunk calls are still connected manually each year by about 50,000 telephonists.

Switchboard operations in the past have been timed satisfactorily for most purposes by stop watch, but when quick hand movements need to be measured in isolation, especially simultaneous right and left hand movements, the stop watch method is inadequate.

Micromotion film analysis—as the new filming technique is called—can be used to record these operations in minute detail and to time them with equal accuracy. It consists of filming a process or movement and later analysing the film frame-by-frame. For this purpose each physical movement is classified according to its purpose and given a name such as "grasp," "hold," "position," "use" and so on. Even the simple action of stretching for a pencil and writing will be made up of about six such movements (each of these kinds of movement is called a "therblig," a word derived by reversing the name of the originator of the system, F. B. Gilbreth).

The experiments are being carried out at the Rodwell House Telephonist Training Centre in London where an experienced operator is filmed connecting simulated calls. The films, made by the Post Office's photographic unit, are shot at 32 frames a second. The time taken by each separate movement is measured with great accuracy by counting the number of frames exposed by the camera while the particular movement is being made. The same method is used to determine the extent to which the operator uses each item of equipment on the keyshelf.

At the time of filming, simulated customer-operator conversations and other operating sounds are recorded on a portable tape recorder, modified so that "bleep" sounds can be inserted on the tape at certain points in calls to assist in synchronising the recording and film. (The overall running speeds of both the film and tape for a "take" have been checked and found to be within two per cent of the stop watch time.)

After the films have been developed they are run through a work study projector and each hand movement on the film is interpreted and placed in its appropriate "therblig." The recorded audible activities are analysed and timed by stop watch. Finally, the information obtained from both film and tape is recorded on simultaneous motion cycle (SIMO) charts specially designed for the purpose.

The subject of the first film investigation was the operating procedure for connecting straightforward trunk calls, that is, those on which no special facilities, such as transfer of charges, are requested (most of the trunk calls handled at the switchboard are still in this category). It was found, on analysing the SIMO charts, that on such calls the operator spends about 18 per cent of the handling time in conversation with the calling subscriber and makes use of the equipment for about 82 per cent of the time.

The unproductive activities can be readily identified from the SIMO charts. Examples are the need for the operator to hold the ticket with

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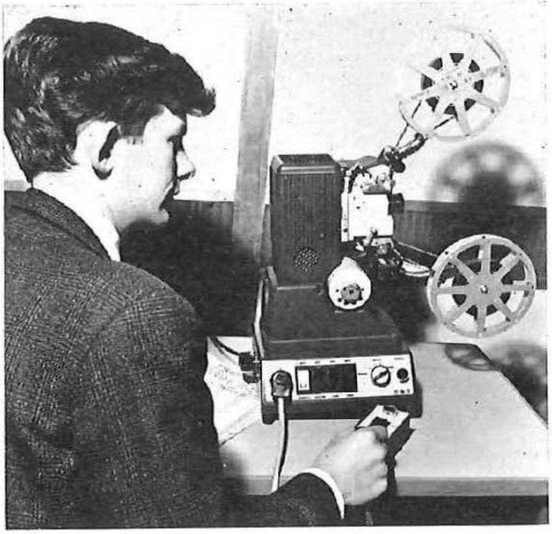
Equipment	% time equipment in use
Pen	31.7
Dial	20.1
Routing file	10.9
Calling cord	6.5
Answering cord	4.1
Speak key	3.9
Ticket clip	2.1
Timing mechanism	1.7
Dial key	0.6
Total	81.6

This table shows the percentage of the time that different pieces of equipment are used by an operator connecting a trunk call. The operator uses the equipment about 82 per cent of the time and spends only about 18 per cent of the handling time in conversation.



The special film projector used in work study. The film can be run one frame at a time while hand movements are interpreted and entered on the SIMO chart.

Therblig	Example of typical therblig movements	% time on each activity	
		Left hand	Right hand
Use	Rotating dial	8.0	37.9
Transport loaded	Moving cords	9.2	18.3
Transport empty	Moving the hands only	14.2	NIL
Hold	Steadying ticket	35.9	NIL
Grasp	Seizing plug	1.6	NIL
Position	Locating pencil in dial	0.5	1.4
Release	Releasing plug	0.6	0.1
Select	Choosing the correct VIF page in the routing file	2.1	NIL
	(Total hand movements)	(72.1)	(57.7)
Unavoidable delay	No hand movements	27.9	42.3
	Totals	100.0	100.0

A breakdown of the operator's hand movements while connecting a trunk call. Although the operator in this case was right handed it was found that she used her left hand more than her right (she held a pen in her right hand throughout the call). Since the only effective therblig is "use" the aim of the work study exercise is to minimise all the other activities. A "Transport loaded" is a carrying movement and a "Transport empty" a motion to or from an object to be carried.

the left hand while writing with the right, because of the slippery surface of the keyshelf; the need to move the ticket clip before the operator can enter her initials on the ticket; and the added difficulty caused by the routing file and dial being at extreme opposite ends of the keyshelf.

As an experiment, an operating position was modified to minimise unproductive activities. Then further micromotion film analysis was used to determine the effectiveness of the changes.

The next stage was to see whether the operating method could be improved. The SIMO charts showed that 40 per cent of the time to set up a call was taken up after the connection to the required number had been established—that is, after the start of ringing tone. This was because the operator was required to carry out three further tasks —to start the timing mechanism, to monitor the call and to enter the time on the ticket.

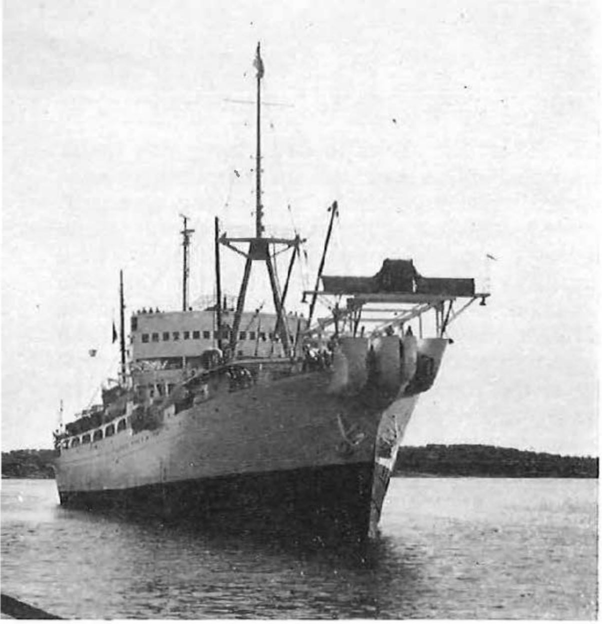
Although these operations took only about six seconds, they could not be completed until the called subscriber answered. Statistical analysis of observations indicated that, on average, subscribers take 18 seconds to answer and that it was difficult for operators to use this waiting period effectively by working on other calls.

As a result of investigation to see whether these three tasks could be eliminated or carried out at an earlier stage in a call it was found that the timing mechanism could be modified to start automatically when the called subscriber answered; that routine monitoring could be dispensed with; and that the appropriate charge rate could be entered on the ticket earlier during the setting up process. The operating work in setting up a call could, therefore, be considered as completed on the receipt of ringing tone—at which point the operator could leave the circuit and take the next call.

Micromotion film analysis is playing a big part in helping the Post Office to simplify procedures and also helping to discover ways of improving the design and layout of equipment.

THE AUTHORS

Mr. F. Y. Dunstan *is a Principal Telecommunications Superintendent, and* **Mr. R. W. Scott** *a Chief Telecommunications Superintendent in the Management Services Department of Telecommunications Business Headquarters. They are at present engaged on studies aimed at improving productivity in telephone switchrooms.*



The cableship HMTS *Monarch* arrives at Kristiansand harbour, Norway, after completing the laying of the UK-Norway cable.

New Cable to Norway

By J. B. HOLT

The new 480-circuit UK-Norway cable has brought relief to the traffic routes to Scandinavia and ISD between Britain and Norway

WHEN the Post Office cable ship, HMTS *Monarch*, recently completed laying the new submarine cable system between Britain and Norway the event marked an important milestone in the development of communications in Europe.

The new cable system, which can carry up to 480 telephone circuits, is now bringing much-needed relief to the international traffic routes to Scandinavia and on 26 August enabled international subscriber dialling to be introduced between Britain and Norway. It also provided additional circuits on traffic routes to Stockholm and Copenhagen.

The successful completion of this new cable and its very satisfactory technical performance is particularly encouraging at a time when even longer systems with the same frequency range are being constructed and when plans are in hand to bring to fruition within the next few years the 1,100–1,200-circuit systems agreed upon at the 1967 North Sea Cable Conference.

The new Britain-Norway cable is the first of two new cable systems recently laid between Britain and the rest of Europe. The second was laid early in August by another Post Office cable ship, HMTS *Alert*, to the Netherlands. A similar system was also laid in December, 1967 between Tuckton Bridge, near Bournemouth, and St. Helier, Jersey, to meet circuit requirements on the national traffic routes to the Channel Islands.

The expanding growth-rate of international telephone traffic is emphasised by the fact that the North Sea Cable Conference in London in 1961 recommended installing a 120-circuit cable to Norway and a 120- (or possibly 240-) circuit cable to the Netherlands. By 1963, when these cables were to be ordered, it was clear that many more circuits would be needed over the planning period and so the contract subsequently placed with Submarine Cables Limited (SCL) was for cables with a capacity of 480-circuits.

The submerged repeater proposed for these cables was a development of a then existing design for a 420-circuit repeater, two of which were to be installed by SCL in 1964 in the Anglo-Belgian cable between St. Margarets Bay and La Panne to make it the first international cable in the world to be equipped with repeaters operated by transistors instead of thermionic valves.

These 420-circuit repeaters, and repeaters supplied by SCL in 1967 as part of a new 480-circuit cable between Denmark and Norway, all used specially-selected commercial transistors. For the cables ordered by the Post Office, however, a new range of long-life silicon planar transistors—known as the 4A2 series, developed and manufactured in a special production unit at Dollis Hill by the Post Office Research Department and rigorously tested and inspected for adequate realiability—was employed in the repeaters.

The submarine cable teamed with these 480-circuit repeaters is of the co-axial construction, now conventional for wideband submarine system use, with the inner conductor separated by solid poly-

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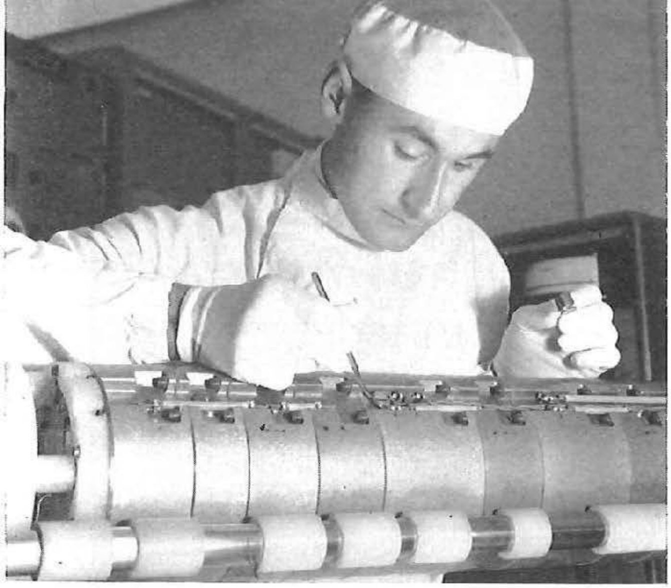


A technician examines the internal units of a repeater forming part of the new UK-Norway cable.

ethylene dielectric from an outer conductor having an internal diameter of 0.935-inch.

The choice of this cable size instead of the 0.62 inch diameter cable which had hitherto been used extensively in the North Sea, was determined largely by the relationship between the outer conductor diameter of the cable and the overall system cost. In simple terms, the larger the circuit capacity required of a submarine cable system, or, in other words, the wider the operating frequency range, the larger is the optimum outer conductor diameter required for minimum overall system cost.

The chief factor is the lower electrical loss of the larger cable which also helps to make possible, particularly in North Sea cables, a proportionate reduction in the allowances that have to be included in the system design to cope with the disturbing effect of the large sea temperature variations on the transmission characteristics of the cable.

The use of this 0.935-inch cable leads to a nominal spacing between repeaters of 8.5 statute miles for the 480-circuit systems. The actual overall diameter of the cable is, of course, larger than 0.935-inch by reason of the steel wire armouring provided on the outside as the strength element and as protection against damage.

The cable to Norway is by far the longest of the new 480-circuit cables to date, being just under 460 statute miles long and incorporating 53 submerged repeaters. Because it is so long, four submerged equalizer units, spaced uniformly along its length, are also connected into the cable. These equalizers are necessary to correct excessive deviations from the desired electrical performance of the cable system and are set to give the required correction before being laid with the cable according to the results of measurements made during the laying operation.

The process of setting an equalizer is generally done by constructing and wiring into the equalizer unit the necessary corrective networks. This is a very flexible arrangement but carrying it out and the subsequent re-sealing of the equalizer against the ingress of water can take several hours.

Since this time factor becomes more critical as the spacing between repeaters is reduced, SCL decided to use factory-sealed equalizer units containing pre-determined corrective networks so arranged that about 600 different combinations are possible.

In use, the most appropriate combination is selected by relay contacts controlled by direct current signals applied over a control wire from the outside of the unit. Once it has been confirmed that no better combination can be set up, the selected networks are connected permanently into circuit by blowing short-circuiting fuses placed across the relay contacts.

The terminal points of the Norway cable are Scarborough, where the transmission and power feeding equipment is housed in the modern ATE/TRS building recently erected in preparation for the transfer from manual to STD working, and Kristiansand, in Southern Norway, where the terminal equipment has been installed in a specially constructed repeater station.

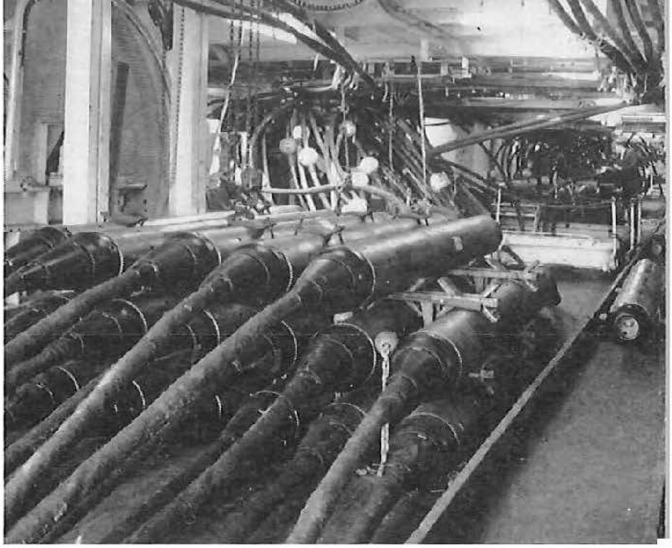
All the installation work and the laying of the two shore end cables was completed well in advance. Shortly before the start of the main crossing of the North Sea, HMTS *Iris* lifted the Scarborough shore end cable in Cayton Bay and prepared it for *Monarch*'s arrival. This proved a very worthwhile operation since the cable was found to be already well covered by shifting sand.

The Danish cable ship, *Peter Faber*, lifted and buoyed the Norwegian shore end and also placed temporary navigational marker buoys in the narrow entrance to Kristiansand Fjord. During the cable laying operation the Norwegian Naval Research ship, *HU Sverdrup* co-operated with

Monarch to provide the sea temperature information required by the transmission engineers.

The loading into *Monarch* of the cable, repeaters and equalizers at the SCL Greenwich factory and the jointing of the repeaters and equalizers to the cable took 20 days, slightly less than estimated. The total load amounted to some 4,800 tons—a maximum load for *Monarch* to the extent that it was necessary to cut down to less than normal the amount of fuel and fresh water taken on board in order to keep the cable ship above her loading marks.

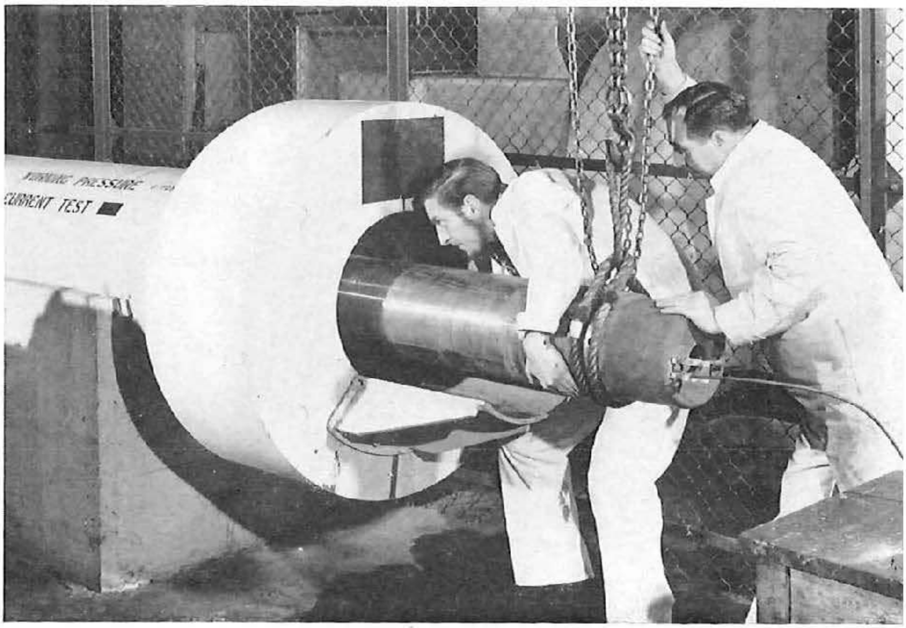
The cable was subsequently laid along the prescribed route in a continuous operation lasting just under five days. The whole of this work was carried out under the direction of an SCL project team, observed by transmission engineers from the Norwegian Administration and from Telecommunications Headquarters' Network Planning and Programming Department. After the lay had been completed on 16 June, an extensive programme of testing and adjusting the overall system was carried out in time for the system to be handed over to the operational departments on 26 July.



Repeaters for the UK-Norway cable in the centre castle of the cableship HMTS *Monarch* prior to laying.

THE AUTHOR

Mr. J. B. Holt *is Assistant Staff Engineer in charge of the Undersea Cables System Branch of the Network Planning Department in Telecommunications Headquarters.*

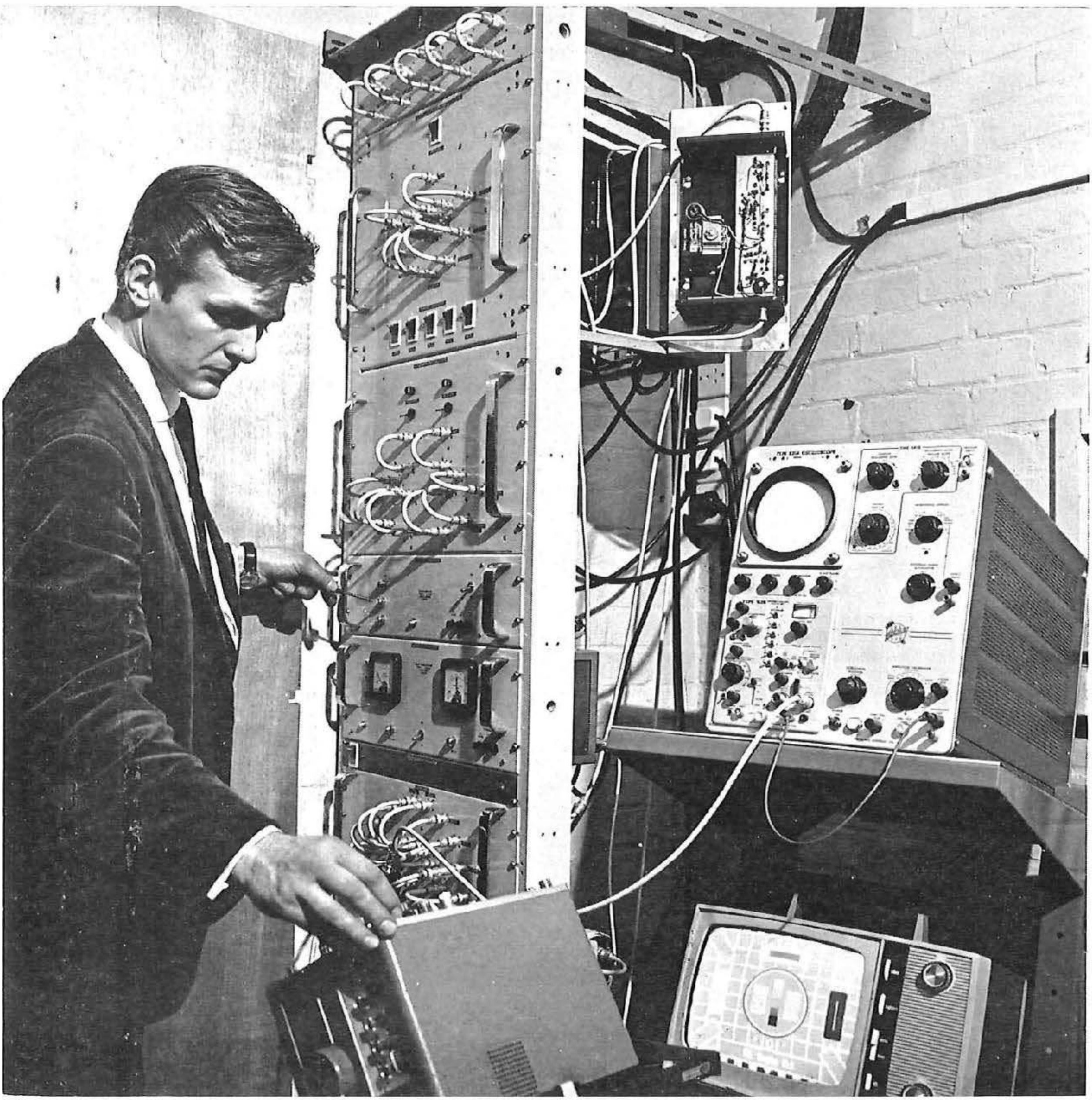


A submerged repeater for the new cable being inserted in a pressure test vessel. Tests can be carried out at pressures up to five tons a square inch.

PILOT SCHEME FOR A

MULTI-PURPOSE LOCAL NETWORK

View of the central station equipment serving the experimental distribution system at the Post Office laboratories, Wembley. Assistant Executive Engineer, Mr. M. H. Howard, adjusts programme levels.



By S. H. GRANGER, C. Eng., MIEE

ENGINEERS foresee the future shape of the national communication network as an integrated system to meet all communication needs—television and radio, telephones and high speed data. First step in the plan to realise this is a pilot scheme at Washington New Town, County Durham, which is expected to start early in 1969.

The pilot project points the way towards the ultimate replacement of the present separate networks for each communication service by a single network piped into homes and offices through long-lasting, high quality cables carrying a wide range of frequencies. Post Office engineers, such as the Senior Director of Development, Mr. J. H. H. Merriman, and the former Engineer-in-Chief, Mr. D. A. Barron, have forecast that every dwelling would be linked by a single communication pipe to a local distribution network, linked in turn to a national network in which ultimately all transmission and switching would be carried out by coded electrical pulses.

Such an ambitious scheme will have to be approached in a number of stages, and the whole process of rationalisation could take more than 30 years. In the first stage it is necessary to gain experience of installing and operating high information capacity, wideband systems in local line networks. Initially, two underground cables will be laid together in one operation—one cable will form part of the public telephone system, the other will relay TV and radio programmes from aerials at the exchange site to customers' own receivers. Both systems will benefit economically from shared work charges and common plant such as ducts, trenches, joint boxes and cabinets. This is known as a mixed cable scheme.

The Post Office decided in 1966 to put the

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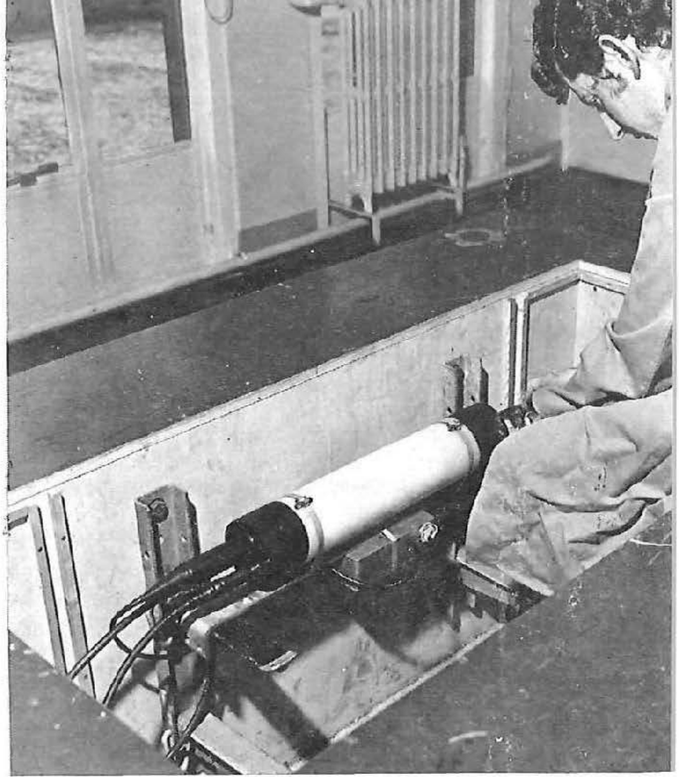
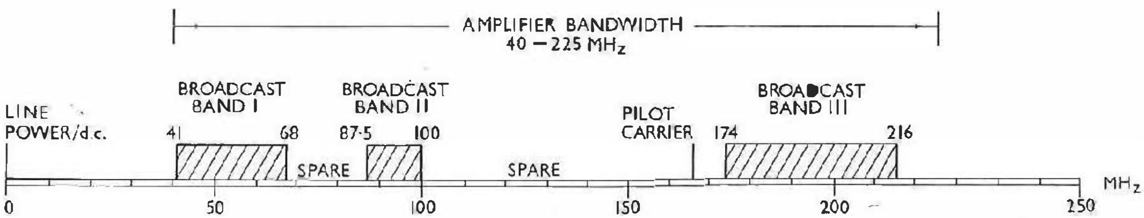


At Wembley laboratories Technician Mr. S. J. Humphrey installs a buried amplifier in a model of a joint box of the type to be used at Washington.

This diagram shows the location of broadcast bands and spare capacity in the line system to be piloted at Washington New Town. Outside the broadcast bands there is spare capacity equivalent to nine TV channels of 625-line standard which could be used for TV or high speed data traffic.



proposal on trial as a pilot scheme in a new town. Studies showed that such a scheme would be technically and economically viable and that the Post Office could offer the distribution of television and sound radio at competitive prices using current technology. The date of beginning the Washington development and its planned rate of growth were important factors in selecting the town as the site for the first scheme.

Site of the pilot project will initially be at Barmston, Blackfell and Sulgrave, three of 18 villages that will ultimately make up the new town, and the services will be extended as additional houses in the town's estates are completed. At Barmston the system is expected to be ready at the end of 1968 to give immediate service when the first of the village's 1,350 homes is completed early in 1969. It will serve 300 houses at first. The village is scheduled for completion by 1971.

The transmission of wideband information in local distribution networks is most economically achieved using present techniques by means of a co-axial cable system. The Post Office system makes use of a distribution cable consisting of a single co-axial pair on which wideband information is multiplexed in a frequency range extending over a considerable portion of the very high frequency (vhf) band. This co-axial cable and the power-fed, solid-state devices buried with the cable are likely to be typical elements in the more advanced systems which may be introduced as rationalisation proceeds.

At Washington the broadcast sound and television services will be supplied to dwellings in the form of aerial type signals, and customers may use their own television receivers of any make obtainable from retail suppliers or rental firms. The Post Office system will operate over a frequency range from 40 MHz to 225 MHz, including the whole of television broadcast bands I and III to which the majority of television receivers can be tuned. Some dual standard receivers will require a minor inexpensive modification (well known to the trade) for the reception of 625-line programmes in the vhf bands.

Initially the television and sound programmes to be distributed will be BBC 1 and ITA on 405-lines and BBC 2 on 625-lines in broadcast bands I and III together with the BBC Radio 1, 2, 3 and 4 and the Durham local-radio programme in broadcast band II. Equipment will be installed in readiness for the distribution of the BBC 1 and ITA programmes at 625-line standards as soon as the duplicate services are available in the area.

These services will use up only a part of the vhf system's potential capacity. Outside the broadcast bands capacity could be provided for up to nine television channels of 625-line standard and this may later be exploited for television, high speed data, or any other service which may be well suited to routing on this type of network.

The wideband network at Washington will consist of three main sections—the central station the main highway, and the distribution highway. The central station will be located at the telephone exchange where broadcast signals will be received off-air and processed for application to the line system. Television signals of 625-line standard received in Broadcast Band V will be frequency converted to a 625-line channel within the line frequency band. A pilot signal will be generated to serve as a lining up signal for all parts of the network, as an aid to maintenance and as a reference signal for the automatic control of amplifiers in the main highway.

The main highway will connect the central station to local line distribution cabinets, branching to serve the three Washington villages of Barmston, Blackfell and Sulgrave. The co-axial cable is rugged and resistant to water, having a solid polythene dielectric and an outer conductor of seam-welded copper of diameter 0.345 in. Line amplifiers with a gain of 23db will be located below ground at intervals of about three to four hundred yards. These amplifiers will be power-fed over the co-axial cable from the central station.

The distribution highways will supply the connections between local line cabinets and dwellings and a power source at each cabinet will feed power forward to amplifiers in the distribution highways. Dwellings will be served by means of branching devices in the form of transformers, resistive taps, or directional couplers, depending on their siting in the transmission plan. A cavity wall box installation will be used at Washington to serve a pair of dwellings. In addition to the co-axial distribution highway and two branching devices, the box also accommodates the through

THE AUTHOR

Mr. S. H. Granger *is Assistant Staff Engineer in the Line and Radio Branch of the Development Department, and is responsible for the local line transmission laboratory at Wembley. He joined the Post Office as a youth-in-training at Derby in 1935.*

telephone cable and the lead out pairs, one to each dwelling.

Washington New Town—it will cost £100 million to build—will cover 5,300 acres. At present the population of the site is 22,000 which, it is planned, will grow to 80,000 by the year 2,000. More than 700 acres of land is being set aside for local industry.

There will be six comprehensive schools, a hospital, libraries, hotels and restaurants and a modern shopping centre where people can shop protected from the weather and away from the traffic. Recreational facilities will include youth clubs, playing fields, a riverside park and a yachting and boating lake. It will be a space-age town with a space-age communication system.

HOW THE SYSTEM WAS PLANNED

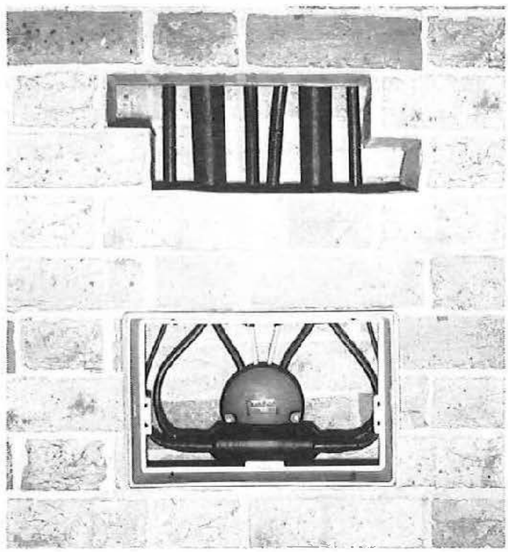
THE experimental work for the Washington project was carried out at the Wembley laboratory of the Line and Radio Branch of the Telecommunications Development Department. To simulate conditions at the new town, the laboratory built a model wideband transmission system complete with aerials and central station equipment, the equivalent of about one mile of coaxial cable, five intermediate line amplifiers and several "subscribers'" distribution points.

At Washington, television programmes will be piped into homes by cable. In the experiments for this at Wembley the three TV programmes, BBC 1 and 2 and ITV, were applied to the model system but, to simulate the heavier TV loading likely in the future, the 625-line colour signal from BBC 2 was split into four outputs, each of which was translated into separate channels.

The wideband transmission system of the kind to be used at Washington is expected to be increasingly in demand in new towns where development corporations are planning to provide TV by cable in much the same way as they will lay on gas, water and electricity supplies to houses.

The Wembley laboratory specialises in designing high frequency transmission equipment for local line networks and investigating new ways of exploiting the existing telephone pair network. It has designed systems which, by using frequencies above those of speech, can be superimposed on existing telephone circuits without interfering with subscribers' conversations.

The laboratory is at present working on a subscribers' carrier system which will enable more than one exclusive telephone subscriber to be served by one pair of wires, and a signalling system for transmitting low-speed data.



A laboratory model of a cavity wall box installation to be used to serve a pair of houses at Washington. In addition to the co-axial distribution highway and two branching devices the box accommodates the through telephone cable and the lead out pairs, one to each house.

DO IT RIGHT FIRST TIME

By A. CAMERON

. . . . . this is the aim behind a new management technique introduced in Aberdeen Area, an outstanding example of local initiative. While the new technique is not generally used in the Telecommunications Service and is not appropriate for every situation, it has produced some very interesting and worthwhile results in Aberdeen

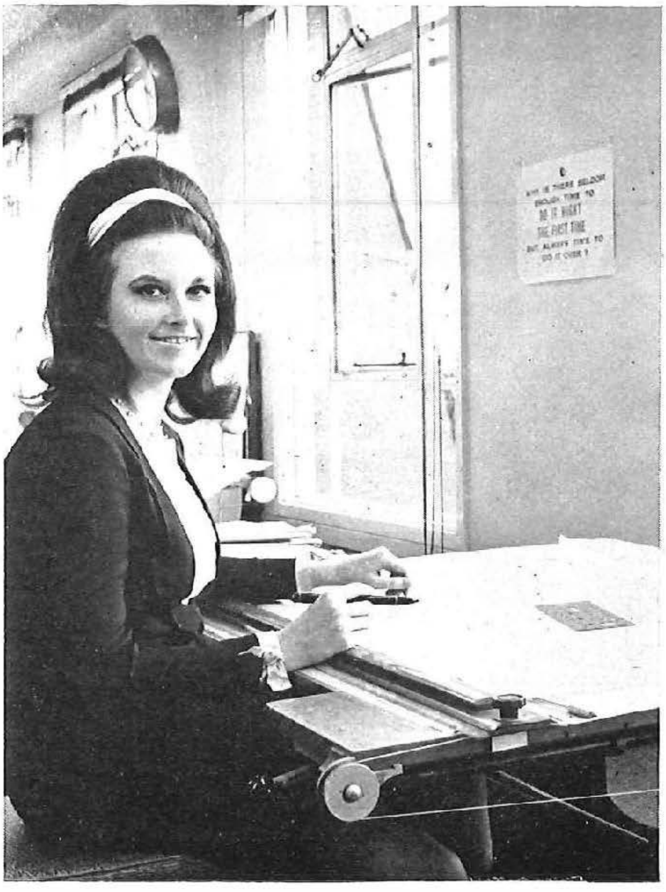
INCREASINGLY over the past few years many people must have felt they were being ground between the millstones of quality and productivity.

It is natural, perhaps, to think of the two objectives as being mutually opposed and, superficially at least, there is plenty of evidence to support such a view. At the opening of Quality and Reliability Year in October, 1966, Sir Paul Chambers, Chairman of Imperial Chemical Industries said: "There is always the danger in drives for increased productivity that so much emphasis is placed on quantity that quality and reliability are regarded as of secondary importance."

It was about this time that Post Office telecommunications people in Aberdeen Area learned of a new quality assurance concept called *Zero Defects**, the aim of which is to promote "a constant, conscious desire to do a job (any job) right the first time!"

Zero Defects is trans-Atlantic in origin and was given birth and nurtured in the sophisticated world of the missile industry in Florida. It is, in a sense, a search for perfection and challenges the

**Zero Defects by James F. Halpin (McGraw Hill Book Company)*



Mrs. Pamela Reid in the drawing office has a notice in front of her desk to remind her to 'do it right first time'.

Miss Sylvia Marcella, of the Accounts Department at Aberdeen (left), draws attention to the campaign notices. With her are (centre) Mrs. Pamela Reid of the Drawing Office and Miss Elizabeth Wilson, a telephonist.

idea that a certain proportion of mistakes must be accepted as inevitable.

The originators concluded that in some things—those which affect them personally—people do, in fact, seek perfection. For instance, will a man who has a five per cent error rate on the job accept short change five per cent of the time in his money transactions? Will he wear one brown and one black shoe to work five per cent of the time? Or wreck his car five per cent of the time he drives it? Similarly, does he ever expect perfection from other people? Would he simply shrug his shoulders if his dentist pulled the wrong tooth, or a mechanic at his local garage failed to replace oil in his car during an oil change?

Obviously, where the thing affects him personally he expects a high degree of perfection. But on the job few people are fired for making one or two mistakes a month. Besides, doesn't management expect a certain number of errors and employ quality checkers, proof-readers and the like just to spot mistakes?

Here we have a double standard—one for personal matters and another for the job. How can it be overcome? By motivating the employee to take a personal interest in *everything* he does; by convincing him that his job is as important as that of doctor or dentist. So runs the argument.

Zero Defects campaigns were mounted with typical trans-Atlantic thoroughness in the missile and space industries. The ideas spread to many other firms and organisations, including Bell Canada. Whatever one might think of the approach, it was impossible to remain unimpressed by the sheer weight of the promotional effort and the fact that firms which are in business to make money were finding it worthwhile to spend so much on their Zero Defects programmes.

It seemed to us in Aberdeen that here was something from which we might profitably borrow. It might give us a project for Quality and Reliability Year and help to ensure that in the drive for increased productivity we did not lower our quality standards.

We did not, of course, have the resources to conduct a full-scale Zero Defects programme on the American model, nor did we think that the same approach would be successful here. However, there was one phase of the Zero Defects scheme which seemed capable of being used as a self-contained project through which attention could be focused on quality. This was the part of the scheme known as *Error Cause Removal* (ECR).

ECR is a tool to help the employee do each job *right the first time*. It encourages him to identify facilities, processes or procedures which cause, or

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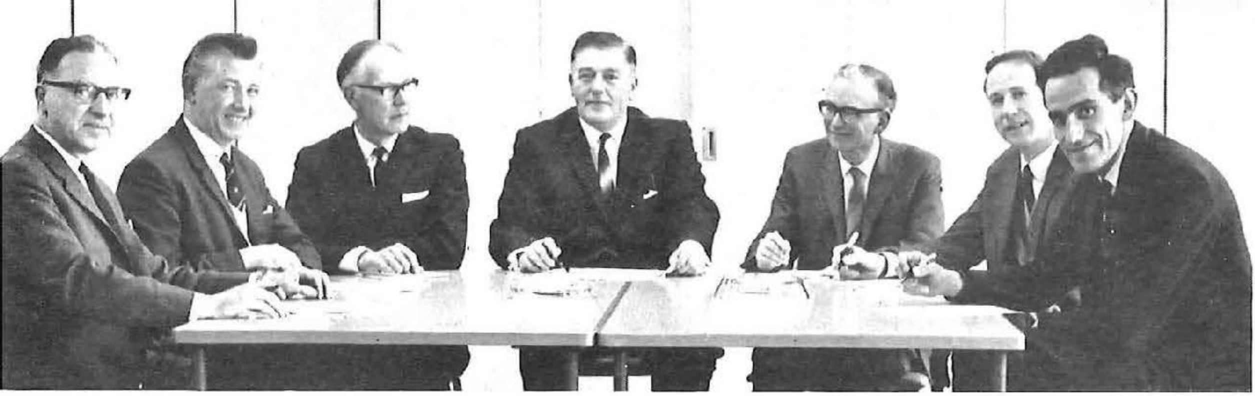


Error Cause Removal liaison officers, each representing a division, take stock of progress. They are Mr. Bob Anderson, Mr. Jimmy Leonard, Mr. Jimmy Miller, Mr. Jimmy Forrest, Mr. Frank Clough, Mr. Bill Anderson and Mr. Bob Hunter.

could cause, mistakes and which make it difficult to perform error-free work. He does not have to suggest corrective action but is welcome to do so. Management can use the information provided to eliminate the causes of error. An error cause may be anything from a badly-placed light or telephone to a badly-designed piece of equipment or a faulty procedure. Anything which leads to frustration and, therefore, to possible error may be the subject for an ECR report.

It is fundamental to ECR that the supervisor must take immediate action to correct the situation if possible. Experience shows that he can provide the solution himself in most instances. Failing this, he processes the report through normal channels. Either way—and whether the error cause can be eliminated or not—the employee is advised speedily of what has been done and he can indicate whether he is satisfied with the findings. Careful explanation is called for if the error cause is simply imagined or cannot be eliminated at the time.

The key to success lies in speedy handling of reports and this is the only way in which interest can be maintained. Not more than two weeks is allowed to elapse between the time an employee submits an ECR report and the time the fault is corrected or, at least, he is told what is being done to correct it.

ECR is concerned with quality. It is designed to identify and solve only those problems which cause, or could cause, errors and is not to be confused with suggestion schemes aimed at cutting costs. Improved quality may, of course, result in improved productivity as a by-product, but sometimes it may involve additional costs.

Literature on the ECR scheme was distributed to Heads of Divisions in Aberdeen who were then personally briefed. An ECR Liaison Officer was appointed for each Division to help with organisation and serve as a focal point for enquiries. Staff representatives were given an outline of the scheme. Heads of Divisions personally explained the project to their supervising officers who were each given a copy of a Supervisor's Guide and asked to put the idea over to their staffs and encourage them to co-operate.

A personal letter from the Telephone Manager was sent to every employee. Posters were placed at suitable points and ECR report forms made freely available. After about four months a meeting of Heads of Divisions and ECR Liaison Officers was held to take stock and plan further action. The need for a fresh impetus became clear and a second letter was sent to the staff, new posters displayed and supervisors urged anew to make use of the opportunity being presented them.

The number of ECR reports received does not give a valid measure of the total effect of the campaign, but the reports themselves do give a useful indication of activity. So far, about 190 reports have been received and of these almost 80 per cent have been settled by the supervising officer.

Matters dealt with have ranged from improved preparation of A967s (underground works diagrams) to the reduction of pay queues at a Telecommunications Engineering Centre; from improved mailing arrangements to the use of coloured wire in a PVC cable; and from a more suitable height for a canteen hot water boiler tap to the provision of suitable facilities at the switchboard for operators to place their handbags.

There have been numerous reports from all fields—engineering, operating and clerical—about procedures or facilities which were causing difficulty. Many of the reports have dealt with small matters. It is basic to the ECR idea, however, to remember that employees are irritated by things that may be inconsequential to the organisation but loom large to the individual. Irritation leads to frustration and frustration to errors.

Reactions from the staff have varied from enthusiastic acceptance to veiled cynicism. Those who have put forward ideas have been complimentary about the speed with which they were given an answer, favourable or not. Some sections have been more successful than others and have developed further ideas for improving quality—in the field of letter writing, for example, and in conducting telephone conversations with customers. One report says that: "staff seem perhaps

The 'quality' notice catches Miss Marcella's eye every time she looks at her calendar.

more affected by ECR and quality and reliability than they openly admit".

Staff associations approved the project with varying degrees of enthusiasm. Significantly, one of the larger associations expressed a more positive interest after our "second shot" than it did initially. It supported the scheme with the proviso that ECR reports touching matters appropriate for discussion with the staff side must be dealt with through normal channels of communication.

While improved quality is the aim, we have also seen ECR largely as an exercise in staff communications. Besides getting home to more people the message that quality counts, we hope, also, that we have done something to strengthen the supervisor's position by showing the staff that if something is bothering them, the supervisor is the person who in most instances can put it right.

Several large firms in Britain have now introduced Zero Defects schemes of one sort or another and furtherance of ECR remains an important management objective in the Aberdeen Area for 1968-69.

How ECR works

AN EXAMPLE of how Error Cause Removal has worked successfully in practice in the Aberdeen Area is what happened when a member of the Telephone Manager's staff drew attention in an ECR report to the inadequacy of many of the works diagrams prepared by workmen when laying underground plant.

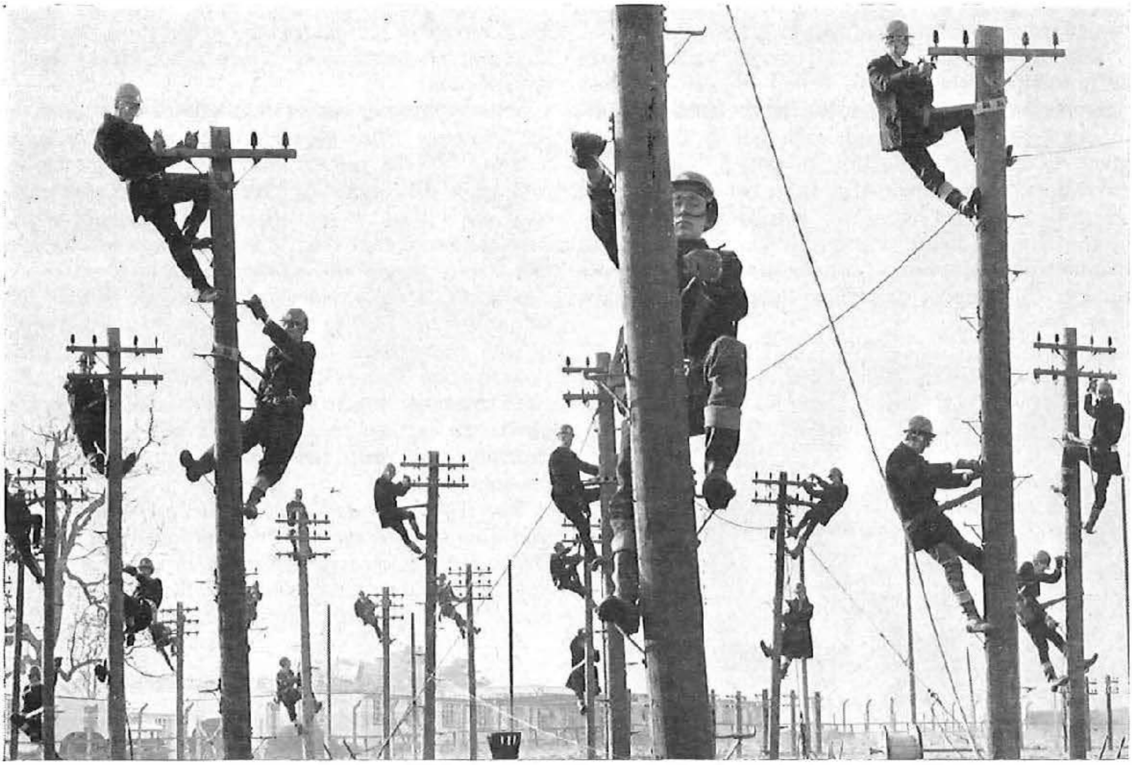
These diagrams—known as A967s—are used by the drawing office as permanent records of plant location. If the records are inaccurate, wrong information may later be given to contractors when they are called in to repair or reconstruct roads, with the result that telephone plant may be damaged and service to subscribers interrupted.

The ECR report suggested that the trouble was caused by the lack of appreciation by the workmen of the importance of the A967s and subsequent investigation showed that this was indeed the case. So, drawing office supervisors visited working parties to explain precisely what was needed in the drawings and dealt with any doubts or difficulties on the spot.

The A967s are now much more carefully prepared and contain all the information which is needed. Because the records are more accurate, the risk of damage to cables and of interruption to service has been reduced and there is less frustration all round.

A SATISFACTORY YEAR —

Business continued to expand and efficiency and productivity also increased, says the annual report for 1967-68. Future prospects are bright but a very big task lies ahead



Trainee engineers at the Post Office Training Centre, Bletchley Park, learning their trade

THE achievements of the Telecommunications Service in 1967-68 were generally satisfactory and the drive further to improve efficiency and performance met with success. But a very big task lies ahead and much more has to be done before the country has the telecommunications services it ought to have.

This is the overall picture presented by the *Post Office Report and Accounts* for the year ended 31 March, 1968.

A measure of how efficiency and productivity are increasing is indicated by the fact that although the telephone system grew by 6.3 per cent over the previous year and there was a 14 per cent increase in trunk traffic, the total number of staff employed rose by only 1.5 per cent.

"This increase," says the Report, "was largely due to an expansion of management effort made necessary because the Post Office has been under-managed in the past. Despite this, we still expect to achieve by the early 1970s our objective of a 50 per cent increase in the size of the system as at March, 1967, with no more staff overall."

Productivity on telephone installation work again improved markedly and 37,000 more

BUT A BIGGER TASK AHEAD

A Repair Service clerk answering a customer's complaint. With this system, specially-trained telephonists handle complaints, leaving engineers free to put faults right.

telephones were installed by about 1,500 fewer staff. Telephone stations maintained per man increased by 4.7 per cent compared with 2.6 per cent in the previous year and there was a reduction of 2,000 in the number of telephonists in the inland service due mainly to the extension of subscriber trunk dialling, the conversion of manual exchanges to automatic working and other measures adopted to improve productivity.

Here, in brief, are some of the achievements of the Telecommunications services during the year under review:

GROWTH OF THE BUSINESS

More demand

Growth in demand for telephone service in the first six months was relatively modest but the winter demand for residential telephones reached a very high level. There was also a rapid expansion in trunk traffic. Demand for new exchange connections rose by 9.9 per cent (business by 8.9 per cent and residential by 10.3 per cent). New connections supplied totalled 793,000, the number of connections in use increasing by 456,000 to 7.38 million — a rise of 6.6 per cent. In addition, 385,000 orders were met by taking over existing installations.

More telephones and more calls

The number of telephones rose to more than 12.1 million. Local calls went up by 6.7 per cent to 6,880 million; trunk calls by more than 14 per cent to 1,064 million and overseas calls by 16.5 per cent to 10.8 million. The proportion of trunk calls made by STD increased from 59 to 65 per cent and 49 per cent of overseas calls were dialled by subscribers.

More than 850,000 additional lines were added to the local networks connecting subscribers' premises to exchanges—15 per cent more than in the previous year. Some 7,700 long-distance circuits—a growth of 13.5 per cent—were also added. By the end of March, 1968, there were twice as many circuits in operation as in 1962. However, even these were insufficient to prevent congestion in some parts of the system during the busiest times of the day. In addition, 42,000 shorter-distance circuits were added—an increase of 7.5 per cent.

PROVIDING FOR GROWTH

Record number of buildings

184 new buildings and extensions—including 162 telephone exchanges—were completed, an

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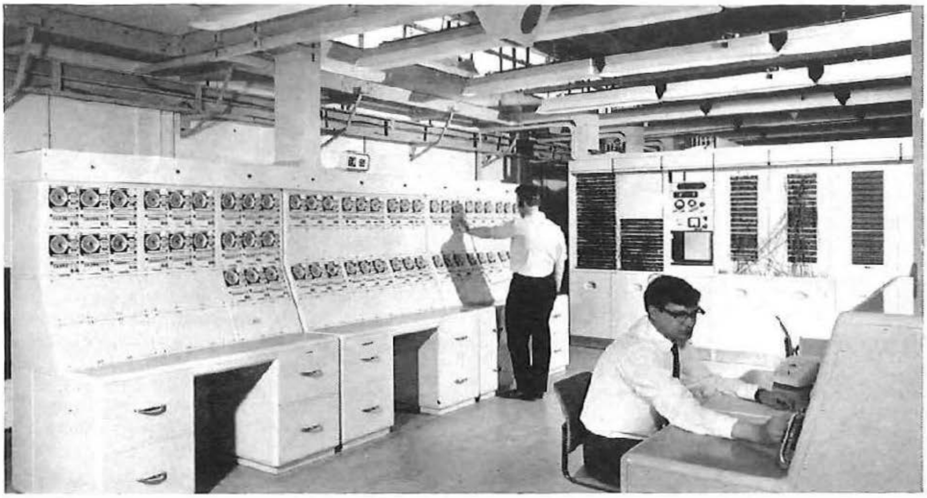


Central control at the new PO radio station at Bearley. The station can be operated by only two men.

increase of 6 per cent on overall completions and 16 per cent for telephone exchanges. A record number of 322 new buildings and extensions, including 294 telephone exchanges, were begun —a 50 per cent increase on the previous year.

More competition

Two bulky supply agreements—for telephone apparatus and for exchange equipment—expired at the end of the year during which it was decided to obtain future supplies of apparatus by competitive tender. As a long-term policy, the Post Office also decided to obtain exchange equipment by competitive tender, agreeing with the main manufacturers that the Telephone Exchange Equipment Bulk Supply Agreement should be extended while complex arrangements were worked out for competitive purchase (*see editorial on page* 1.)

By the end of March, 1968, nearly three-quarters of the exchange equipment and telephones and nearly one-fifth of telephone stores required by the Post Office were being manufactured in the development areas.

IMPROVING THE SERVICE

Improving the service to existing customers remained the first objective, and to good effect, says the Report. In the local automatic service the proportion of calls not completed at the first attempt was again reduced, although in some places the plant was sometimes congested. In the STD service, increased failures due to congested plant resulted in a slightly higher call failure rate. But the average time-to-answer by daytime operators was reduced for the fourth successive year.

The time to attend to faults in subscribers' installations continued to go down and 80 per cent of all faults were cleared on the day they were reported.

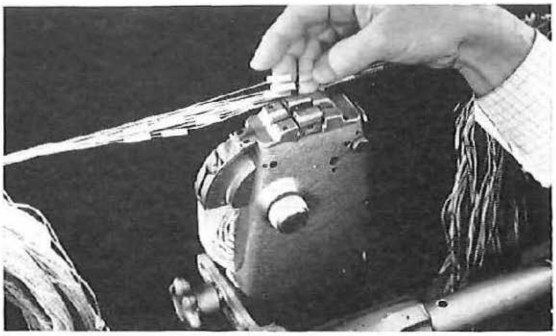
More automation

Sixty-seven manual exchanges were converted to automatic working and by the end of March, 1968, automatic local service was available to 97 per cent of subscribers. STD was extended to a further 364 exchanges serving 810,000 subscribers and became available to 5.6 million subscribers —76 per cent of the total.

More automatic equipment was installed in London to improve international subscriber dialling and to prepare the way for its extension to more overseas countries.

Speedier service

An appointments scheme by which telephones are installed on dates agreed in advance with customers, subject to plant being available, was introduced in all telephone areas. By the end of March, 1968, 40 per cent of orders were being handled in this way, most of them for completion within two weeks. Sixty per cent of other orders,



This jointing machine, designed at the Post Office Research Station, joins wires in underground cables more efficiently and rapidly than conventional methods. A number are on trial.

many for major installations, were completed within four weeks.

Better customer relations

To improve customer relations, an experiment was begun under which full-time Post Office representatives handle all the main telecommunications business of some of the larger customers. The aim is to help customers use telecommunications more effectively, to develop a better commercial relationship and to encourage the use of ancillary facilities.

Information services expanded

Recorded telephone information services continued to be popular and were extended to other centres. They attracted 250 million calls, of which 225 million were to the Speaking Clock. Several new services, including those giving traffic and weather information to motorists all the year round, were introduced.

IMPROVING EFFICIENCY

The Telecommunications Regional and Area offices are being reorganised to bring together staff of different grades engaged on tasks with a common end to produce an organisation based on the purpose rather than on the nature of work. The new organisation will clarify authorities and responsibilities for end results and emphasise the corporate responsibilities of staff who contribute separately according to their individual skills.

MORE BUSINESS — BUT LESS PROFIT

The Telecommunications Services made a profit in 1967-68 of £35.3 million compared with £37.7 million in the previous year.

Income rose by £43.3 million to a record £485.1 million, mainly because of increased business, offset by reduced charges to customers from the extension of STD (£10.2 million). The return on capital fell froms 7.7 per cent to 7.3 per cent.

An analysis of the profit shows the same general pattern as in recent years. The profit on trunk calls (£59 million) was offset by losses on telephone rentals (minus £21 million) and local calls (minus £19 million).

The past year was the last of the five-year period for which the Post Office was set a financial target of an 8 per cent net return on capital. Although the trend has been declining, the Telecommunications services achieved an average return of 8.1 per cent over the period. This was accomplished with no major increase in tariffs since trunk calls rates were raised in 1963.

"Indeed," says the Report, "charges to customers were reduced with the extension of STD. The service also had to absorb rising pay and price levels amounting to nearly £70 million over the five years."

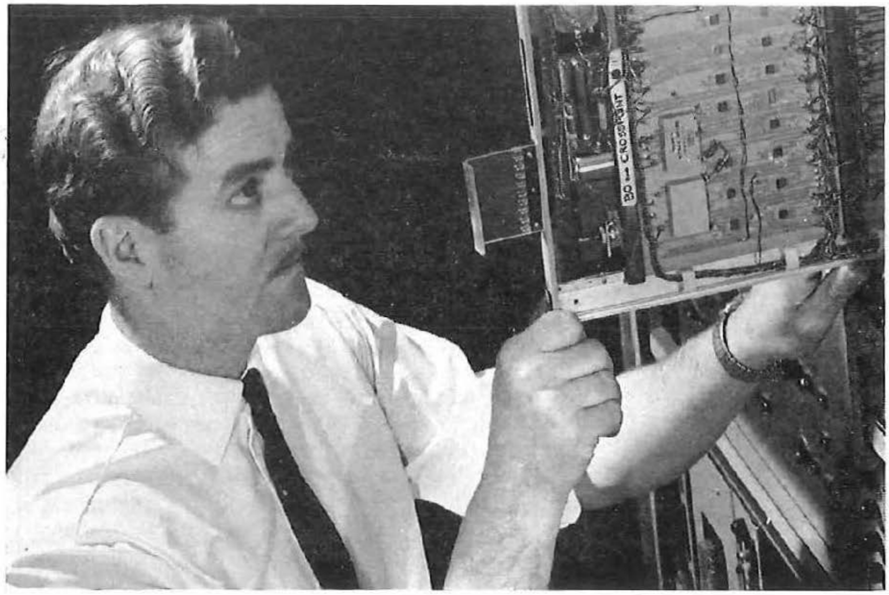
More productivity

The drive to improve the use of manpower in all fields continued. New working methods, better managerial control and the use of labour saving plant all contributed.

The use of work study techniques, including micromotion film analysis (*see article on pages 10-12*) led to the introduction of a simplified operating procedure for straightforward calls handled at the switchboard. This should enable calls to be dealt with more expeditiously and, together with other proposals for streamlining operating work in exchanges, promises substantial savings in operating costs.

New managerial techniques for planning and controlling the provision of external plant were developed and brought into use throughout the country. Methods were developed to improve by 50 per cent the productivity of staff placing cable in underground ducts.

OVER



A new digital PCM exchange is being brought into use this year. It Is the first of its kind in the world to handle live traffic.

Computers

Demands on computer services operated within the Telecommunications business in support of its research and development and other specialised technical activities increased considerably. Interim relief was obtained by additional shift working on the main computer, by additional on-line terminal facilities and by hiring bureau computer processing time. Another computer was ordered.

Preliminary studies indicated that the use of computers in direct support of telecommunications management—mainly to assist operational control and decision making—were feasible and economic. Detailed studies were put in hand for a number of computer systems—some on-line (that is, directly accessible by data links) and others off-line (processing recorded data)—all of which are designed to interwork where necessary.

Automatic data processing off-line computer projects for telephone billing and stores control were implemented. Preparation of telephone bills by computer started in one London telephone area in August, 1967, and by the end of March, 1968, it was operating in 30 telephone areas. Some 20-25 per cent of customers were then receiving bills prepared by computers.

Electronic exchanges

The second production electronic exchange, now standardised for the small-to-medium size range, was brought into service at Brampton, Cumberland. Orders for 72 of these exchanges were placed.

Trunk service

Several new types of co-axial and microwave radio relay links with larger capacities, greater reliability and lower running costs were brought into service and the first pulse code modulation links were installed.

Telephone directories

Plans were completed for using computers and the latest photo-typesetting techniques to produce telephone directories. These new facilities, which will be introduced in 1969, will reduce the overall time taken to compile and print new editions and, by introducing greater flexibility, will enable the rapid growth in the system and the changing public needs to be met more quickly. As soon as the new system comes into operation the first of the new directories for London will be produced. Customers will be asked to compare

Directory Inquiry operators at work. In 1967-68, 140 million inquiries were dealt with at a cost of £7m. Half the numbers could have been found in the directories supplied to subscribers.

them with existing directories before an independent survey of their views is commissioned.

CURRENT DEVELOPMENTS

- A new telephone kiosk, with large one-piece glass windows, fluorescent lighting and a stronger cash box—will be introduced (see page 000).
- Trials began with Confraphone, a new unit which will enable two groups of people in different places to hold conferences by telephone.
- Orders were placed for the Card Callmaker which enables its user to insert punched cards into the instrument to obtain numbers he frequently calls instead of having to dial them.
- Supplies were ordered of a new private automatic branch exchange—the PABX 7 which will accommodate between 50-100 extensions (see page 30).

Research and development

An experimental digital electronic exchange, was designed and built at the Post Office Research Station for installation in the Empress Exchange building in London (*Summer*, 1968, *issue of the Journal*). It is the first exchange of its type in the world to handle live traffic and, if successful, will encourage much greater use of PCM transmission and hence reduce the need for many new cables and roadworks.

Expanding demands for trunk traffic capacity in the future continued to spur research into new wideband media such as waveguide and optical fibre systems (see pages 2-4 in this issue).

Telex

The Telex Service grew by 14 per cent and reached 22,000 subscribers. The number of telex calls, one third of which were overseas, increased by 16 per cent. By the end of March, 1968, subscribers were able to dial to 19 countries and 92 per cent of all overseas calls were then being dialled direct.

Telegrams

A new automatic message relay centre was opened in London to speed telegrams through the capital.

Datel

The Datel Services were further expanded, the number of stations increasing by 50 per cent to about 1,900.

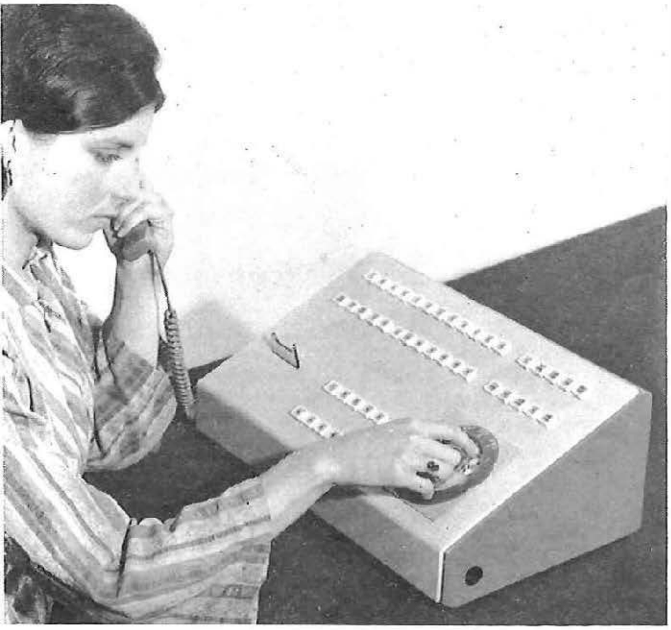
THE FUTURE

"The telecommunications Service should continue to expand rapidly," says the Report. "Efforts to minimise costs and increase profitability will continue to be vigorously pursued and the new target return of $8\frac{1}{2}$ per cent on net assets should be achieved in the first full year after the tariff changes approved since March, 1968.

"Improvements in the quality of service to existing customers will continue to have first priority. For potential customers the aim will be to provide service for everybody as and when required—already possible in a large part of the system."

THIS IS THE NEW PABX 7

By H. F. EDWARDS



An operator at the keyboard of the new PABX 7. Note the Trimphone-type handset. A headset can be used if the operator prefers.

THE Post Office is introducing a new private automatic branch exchange—to be known as the PABX 7—which is intended for rental by customers who need something larger than the largest PABX 1 (capacity of 10 exchange lines and 49 telephone extensions), but are not likely to need more than 20 exchange lines and 100 extensions.

Hitherto, these customers have had to buy from a contractor one or other of the approved large-type PABXs 3 or 4 which start with a 50-extension capacity but can be enlarged in stages up to several thousand extensions.

Although highly adaptable, these large systems tend to be expensive (in terms of cost per extension) in the smaller sizes and manufacturers have produced cheaper PABXs, for sale abroad, by applying the simple "marker" switching system, already used for the PABX 1, to a 100-extension capacity design.

The Post Office has adopted a design by Standard Telephones and Cables Ltd., has arranged with the company for a few modifications to be made and placed an initial order for 200 to be supplied during 1969 and 1970.

Although the PABX 7 will be suitable for the majority of customers, it has some facility limitations at present, for example, incoming exchange calls cannot be connected over inter-PBX extensions to other PBXs. Later versions will have the full range of facilities.

There has for long been a demand from customers for a larger PABX available on rented terms, particularly from those whose businesses have outgrown the capacity of 49 extensions of the No. 1. Consequently, almost all the first 200 PABX No. 7s are already reserved and there will be no difficulty obtaining renters for as many more as can be obtained in the next few years. Moreover, there are so many thousands of PMBXs (manually-operated branch exchanges) of this capacity still in use that an annual demand for some hundreds of No. 7s can be expected.

The PABX 7 utilises equipment of the "strowger" type already widely used in PABXs Nos. 1-6, but more economically. The large PABXs 3 and 4 use the rather expensive two-motion selectors for all calls made *from* extensions and the PABX 4 uses them also for incoming calls *to* extensions. The PABX 7 (like the PABX 1), apart from momentary seizure and release in exchange calls, uses them only for extension-to-extension calls and calls dialled in from other PBXs. "Dial 9 for exchange" calls are made and incoming calls via the operator are connected by the cheaper single-motion selectors (uniselectors) used as linefinders in a marker system.

The reason for the limitation to 49 extensions of the No. 1 design was that the capacity of an ordinary uniselector is 50 outlets and one outlet had to be used for another purpose, leaving 49 for extensions. In the No. 7, two of these uniselectors are used, calls being switched by one or the other, thus giving a capacity for connection to 100 extensions.

On a PABX 1, extensions have two-digit numbers, in the range 21-69, and the remaining first digits are used as follows: 7—Direct lines to another PBX; 8—"Dial-8" night service; 9—Public exchange; 0—PABX operator; (1 is not used).

If the PABX 7 had used only two-digit numbers there would have been none left for the above services so a three-digit numbering system is used in which all extensions have the first digit 2 and the extension range is therefore 200-299.

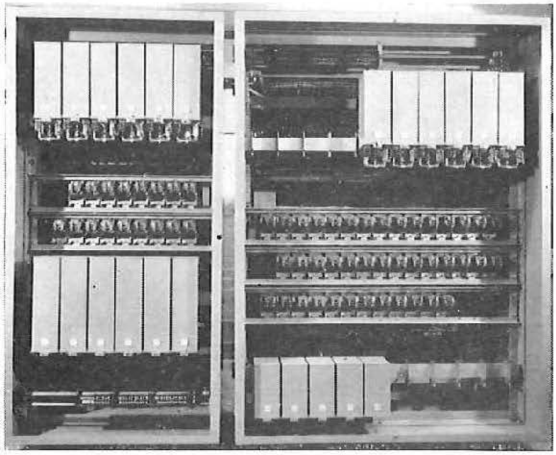
The remaining first digits are used for: 7—Direct lines to another PBX; 3, 4, 5 and 6—Direct lines to additional PBXs; 8—"Dial-8" night service; 9—Public exchange; 0—PABX operator; (1 is not used).

The PABX 7's facilities are similar to those of the PABX 1 but the No. 7 has the advantage, for some users, that it can be connected over privately-rented direct lines to more than one other PBX (for extension calls only on the present design).

The capacity has so far been quoted, for simplicity, as 20 exchange lines plus 100 extensions, without any mention of the capacity for inter-PBX lines. In fact, the figure of 20 represents the total capacity for outside lines whether to exchange or to other PBXs. Inter-PBX lines with dialling facilities also eat into the capacity for 100 extensions. For example, a PABX 7 with three such lines would have its capacity reduced to 17 exchange lines and 97 extensions.

The design of the PABX 7 is interesting in that the first of the two cabinets accommodating the equipment comprises a self-contained PABX of 9 outside lines and 50 extensions capacity—almost the same as that of the largest PABX 1. It therefore offers an attractive alternative to the PABX 1 for future use. Whereas an exhausted PABX 1 cannot be extended and must be replaced by a PABX 7 or other larger PABX, an exhausted PABX 7 first unit can be extended by adding a second unit to bring its capacity up to 20 + 100.

It is possible, therefore, that eventually PABX 7 first units may take the place of 10 + 49 PABX 1s. For the first few years, however, while the supply



A front view of the equipment cabinets (doors removed) of the PABX 7 recently installed at Ford Motors in Leamington Spa.

is limited, all PABX 7s will be allocated to customers who need to use both units immediately.

The physical dimensions of each of the two cabinets of the PABX 7 are much the same as those of the single cabinet of the 10 + 49 PABX 1. The first unit is actually a little smaller and lighter but the second unit is somewhat wider than the PABX 1, although no heavier. It may be possible, on redesign, to reduce the width and so minimise difficulty in handling through doorways and so on.

The PABX keyboard, about the size of a typewriter, pale grey and green and angular in the modern style, is entirely push-button operated, except for the dial used for making outgoing calls. The calling lamps and labels are enclosed in the push-buttons so that the keyboard is similar to the new one being introduced for the PABX 1. Since the two boards will then be practically identical in operation, no fresh training problems should arise when an operator goes from one to the other.

An early version of the PABX 7 has been in use since March, 1967, serving the Brighton Head Post Office. A few others of an early pattern are now being installed to meet the pressing needs of subscribers who have been waiting some time for them. The first of the main order are expected to become available early in 1969.

THE AUTHOR

Mr. H. F. Edwards, *now a CTS in the Subscribers' Apparatus Division of Telecommunications Headquarters' Marketing Department, joined the Post Office as a youth-in-training in 1924.*

Left: Earl Mountbatten of Burma tries out the Datel 300 Service, one of those on display at the IFIP Congress in Edinburgh. Above: The Post Office Datel modem No. 7, for the new Datel 2,400 Service, working for the first time with the STC GH210 data terminal at 2,400 bits a second.

This article discusses some of the problems of the data transmission services and takes a look at a few of the exciting possibilities for the future as . . . . .

THE DATEL SERVICES GROW UP

By B. SLUMAN

THE Datel services operating over the existing telecommunications system effectively and economically meet the present data transmission requirements. Together with the new services which are planned, they will continue to do so for some time to come.

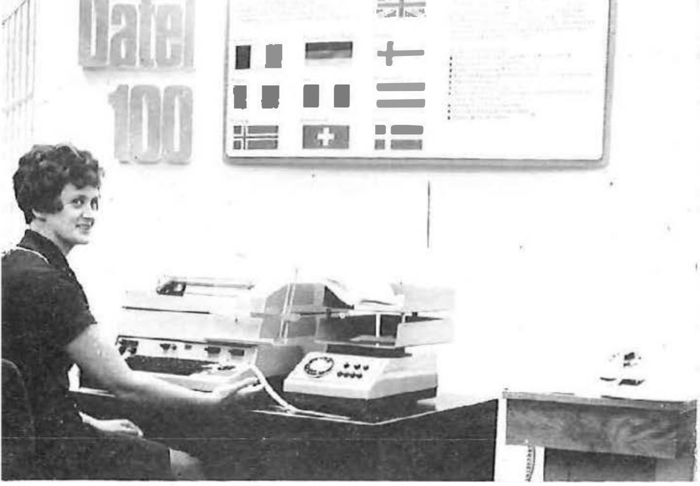
However, in face of the growth of data traffic there is an increasingly convincing case for a number of specialised networks using common transmission paths but separate switching points.

The history of public data transmission services has been one of adapting circuits designed to carry telephone or telex calls to accommodate data traffic. So, Datel 100 was restricted initially to transmission at 50 bits (binary digits) a second, matching the 50 bauds specification which was agreed as a reasonable international standard for interconnecting manually-operated teleprinters. Now, however, speeds up to 100 bits a second can be achieved on point-to-point connections although still using existing telegraph signalling techniques.

Similarly, Datel 600—the first public data transmission service over public telephone lines—has been geared to a maximum guaranteed transmission rate of 600 bits a second over any public switched connection because of inherent difficulties such as inband signalling systems and limitation on the transmission of frequencies in the upper part of the commercial speech band. This has not detracted, however, from the fact that over the great majority of connections (about 90 per cent), the restrictions are not present to the same degree, and so a transmission rate of 1,200 bits a second is possible.

All along, the basic problem of providing data services has been that of setting up a new facility. The Post Office has to suggest to the computer industry what it can do and industry then designs its equipment to use Post Office services.

This means that the Post Office must be ahead of the requirement and commercially reasonably



Left: **The new teleprinter No. 15 in use on the Datel 100 Service now also available between Britain and nine other countries. Above: The Marconidata H6010 terminals and Potter line printer working with Post Office modems No. 1 on the International Datel 600 Service.**

sure that there is an adequate market for it. The Post Office has had plenty of advice: almost every technical and professional body associated with the computer world has told it how such a project should be undertaken.

Their welcome suggestions generally contain, however, two basic weaknesses. First, they are biased in one way or another depending on the source. Rather more surprising is the second failing: that they rarely take account of capital cost and economic viability during the early build-up period.

For the next few years, data services are likely to remain based on the existing telecommunications system. Plans must, however, be formulated now for the longer term. To this end the Post Office is collecting the best possible information from all sources on the likely future trends and forward thinking, both nationally and internationally, in the use of computers and automatic data processing.

To take up again the historical development of services, Datel 100 and Datel 600 were quickly followed by the first special quality private point-to-point links for customers requiring transmission rates greater than 1,200 bits a second. These are supplied by Datel 2,000 under which the Post Office provides the circuits, engineered to work with customer equipment at speeds of up to about 2,000 bits a second.

At the right time, more public network services designed to meet customers' special needs, were launched. For instance, demand for intermittent remote computer interrogation has been met by Datel 200, soon to be extended into the international field. Then, unattended answering facilities were opened up to create greater flexibility. This will be followed fairly soon by the next move in computer-originated calling over the public switched telephone network.

Datel 300 has now been introduced for those

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The Datel 600 Service with the GPO Datel modem No. 1, being used in conjunction with a Cossor visual display unit (in the background, right) direct to a computer.

A popular use for the Datel 200 Service is to interrogate a remote computer. The Service uses a GPO Modem No. 2 (right) and teleprinter terminal over the public switched network.

At De La Rue Bull's time-sharing service centre in London, a bank of GPO modems No. 2, each linked over the public network to a modem in a customer's office. The combination enables the user to communicate with a computer.

As part of the plan to expand the Datel services, contracts have been placed for the manufacture of a further 16,000 modems—the modulating and demodulating devices which convert computer language into a form in which it can be passed over telephone circuits.

Half the new modems will be for use with Datel 600 and the rest with Datel 200. Most of them will be for computer bureaux clients who interrogate a distant computer from their own offices by teleprinter and for banks which are now setting up extensive data networks over Post Office circuits for computerising their accounting systems.

organisational empires which need to collect data of low loading from a large number of remote points. With this innovation, the Post Office provides the complete outstation equipment whereas with the other services, the special data media handling equipment—as distinct from transmission equipment—is provided by private suppliers. The outstation equipment comprises a card-reader/numeric keyboard unit which will normally operate over the public telephone service. This will be followed by a paper tape and edge-punched card version.

The next step in extending transmission services will be the introduction of the Datel 2,400 service to supersede Datel 2,000. This will see the Post Office breaking away from mere provision of circuits for a service of this rating and advanced modems giving a guaranteed transmission rate of 2,400 bits a second will be used. This must needs be over special quality leased circuits although they are still routed through the same plant as ordinary networked channels.

But Datel 2,400 will offer an important support service. While based on relatively high-speed facilities, it will provide for the user to switch to the public telephone network for standby alternative transmission rates of 600/1,200 bits a second.

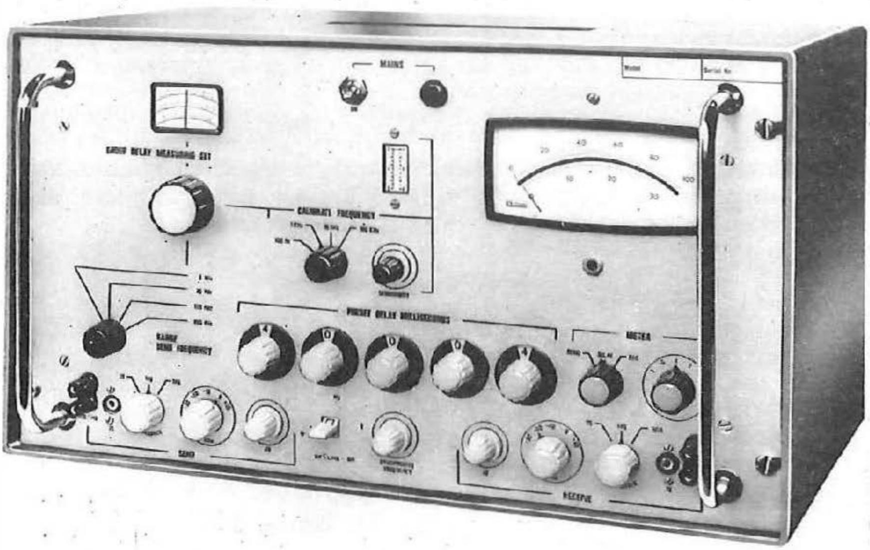
This service marks an important stage in the development of higher speed services over "improved" speech type circuits but there will remain a significant gap between the transmission rate of the new service and rates attainable on the growing network of wideband circuits. Post Office research is working on means of reducing this gap by achieving even higher speeds over "improved" speech type circuits.

On the far side of the gap, work is going on to permit more effective customer use of wideband channels, whether over existing routes or on other, specially-created sub-networks. The tendency to date has been for users to transmit unique traffic on wideband. Some national newspapers, for example, have speeded up provincial production by passing facsimile pages on such routes.

The most exciting venture in this field has been the *Daily Express* front-page transmission via *Early Bird* and other centres to Puerto Rico (*see the Winter, 1967 issue of the Journal*). This began with a wideband link to the Post Office satellite earth station at Goonhilly Downs. Data, speech and telegraph can just as easily be used as the unique load. Plans are also being made to set up a switched network of wideband circuits covering a frequency range 60.6 to 107.7 kilocycles for casual or relatively short duration connections. The Post Office also plans to introduce in 1969 two new modems for use with the switched network which will be designed to operate at 48,000 bits-a-second.

The present Post Office systems were designed for speech and teleprinter working. There are also television circuits. The tremendous growth of data traffic that is forecast and the special nature

The new Group Delay Measuring Set. It is portable and mains-operated.



To assist in the rapid setting-up and maintenance of the growing number of data circuits of various types and speeds, the Post Office is about to introduce a new Group Delay Measuring Set for field use.

These sets will measure the differences in transmission time which would be suffered by the various frequency components of a pulse type signal. Ideally, of course, there should be no time difference so that the components of the signal bear the same relationships to each other at the receiving end of a circuit as they do at the sending end. When necessary, group delay equalisers can be inserted in a circuit to correct for time differences.

The new set, which is being manufactured by Bardic Systems Ltd., of Southampton, will be portable and mains-operated, weigh about 40 lb and cover the frequency range 200 Hz to 600 kHz. This range includes the audio band basic group band (for 48 kHz channels) and basic supergroup band (for 240 kHz channels). Accuracy of measurement is expected to be plus or minus five microseconds at audio frequencies and plus or minus one microsecond above 20 kHz.

Each set includes sending and receiving equipment so that one is sufficient for loop measurements. When two are used for A to B measurements no return circuit is necessary.

of data messages indicate a case for a separate dedicated network.

This network will almost certainly be a system offering multi-speed facilities—rather than a straightforward unispeed network—with rapid set-up time and an appropriate tariff structure. Consideration must also be given to improved facilities for telegraph type messages offering faster transmission times than are possible over the existing telex service. Facsimile could also grow to proportions justifying consideration of a separate system.

Whatever traffic has to be handled, it is vital for the basic and early planning of systems to provide for extension into a complete national network with full international compatibility. Current effort is geared to determining what facilities will be required; from this will spring the necessary technological development.

Co-operation is particularly active with computer equipment manufacturers who have special access to Post Office lines for testing their equipment. The same close links with customers are encouraged, specially through the Post Office Customer Advisory Services which, apart from feeding information and guidance to the user, enable official sources to keep in direct touch with

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developments elsewhere. Superimposed on all, there are the important meetings of the various international committees.

Having established a profile of customer requirement for a dedicated data network, technical planning will be necessary to devise the service. Costs can then be assessed and tentative tariffs worked out which can be put to customers to determine demand. The capital cost of creating a new network must be justifiable in terms of additional or improved facilities and customer use must be sufficient for a reasonable return to be secured: that is only sound business.

It is debatable how far we are from the time a separate network will be required. The Post Office is examining every appropriate, enlightened source. The intelligence gained will enable it to continue to play a responsible part in creating the most efficient and most economical communications service on an international basis.

To keep pace with rapidly-expanding demand for data transmission services, the Post Office recently commissioned an independent market survey to find out the likely needs of business users for facilities to transmit digital and analogue data over the next five, ten and 15 years. The survey will run in parallel with the Post Office's own research and development programme.

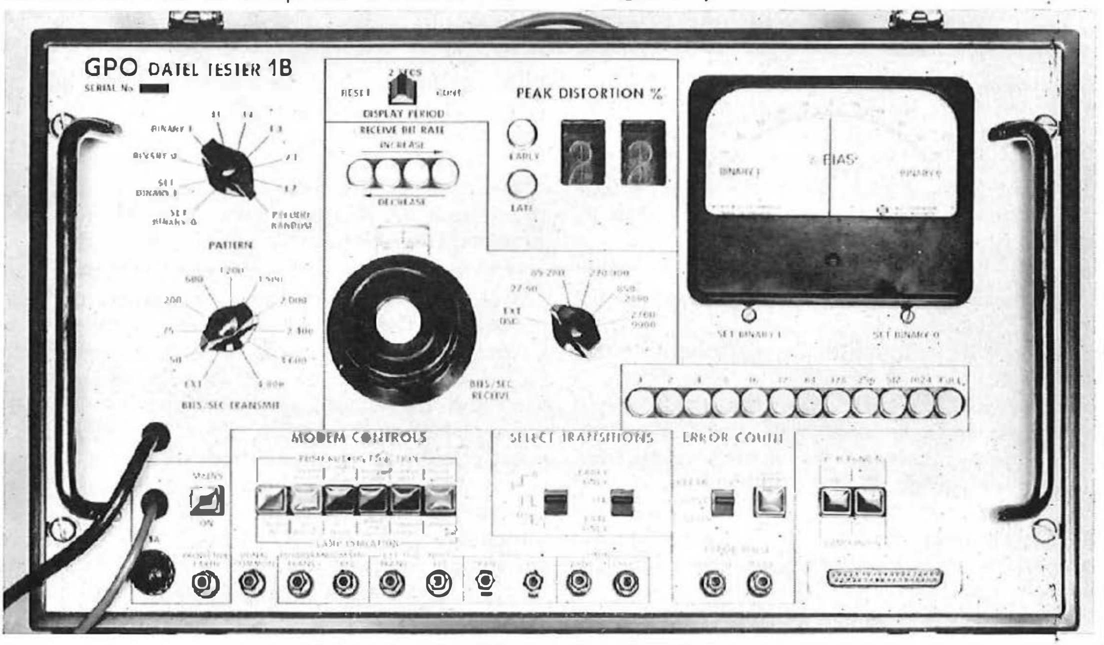
A team of specialist consultants will interview every kind of organisation likely to use data transmission—business and industrial firms, medical and research establishments, universities, public utilities, Government departments and so on—and also visit computer and allied equipment manufacturers and professional institutions and trade associated linked with science and industry.

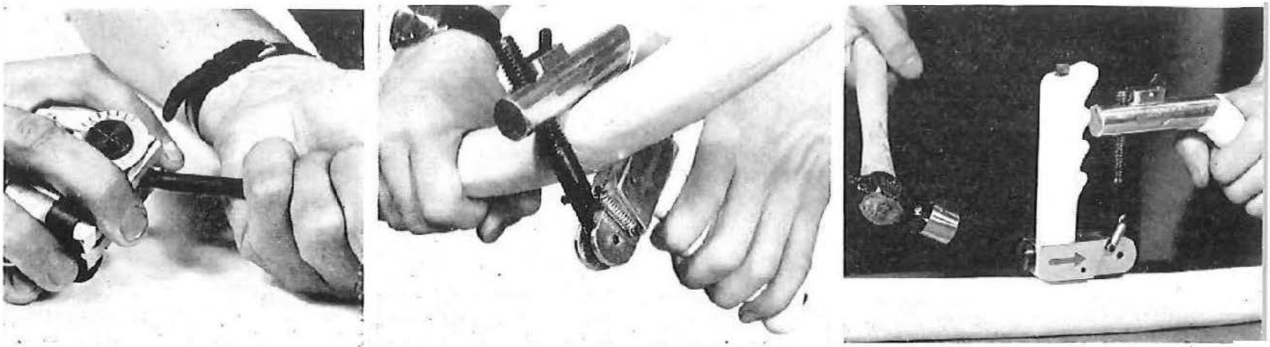
A NEW TEST SET

This is the new portable data transmission test set—called the Datel Tester No. 1—which is used to test modems and to check data transmission equipment and computer data links.

Designed to specifications laid down by the Post Office and manufactured by Trend Electronics Ltd. it comprises a transmitter and receiver of dc signals in which the former generates a range of test patterns and the latter synchronises them to display peak distortion, bias distortion and error count.

The new test set is only $19\frac{3}{4}$ inches long, nine inches wide and $11\frac{1}{4}$ inches high and weighs only 38 lb.





Left: Making a longitudinal cut on a small diameter cable sheath using the new Stripper Cable Sheath No. 3. Centre: The No. 4 stripper being used to make a circumferential cut. Right: To make a longitudinal cut the No. 4 is tapped along the cable by hammer.

STRIPPING MADE EASY

By F. HAYTON

A NEW cable stripper—to be known as the Stripper Cable Sheath No. 3—which will make both longitudinal and circumferential cuts in cables up to one inch in diameter has recently been introduced by the Telecommunications Development Department. A similar tool for larger cables—the Stripper Cable Sheath No. 4—is expected to be available for general issue by the end of the year.

The No. 3 will strip the sheath from $\frac{3}{8}$ inch to one inch diameter cables and, using a special adaptor, from $\frac{3}{16}$ inch diameter cables.

Two independently-adjusted cutters are set at right angles to each other and the depth of cut can be finely controlled. The tool is clipped on the cable and rotated to make the circumferential incision. The "rotate" cutter is withdrawn and the longitudinal cutter lowered by turning the depth setting wheel. The tool is drawn along the cable and off the end and the sheath can then be stripped off.

The No. 4, which looks like an elaborate nutcracker, will be suitable for stripping lead and polythene covered cables of between one and three inches in diameter. Incisions are made in both directions with the same blade which is protected by a spring-loaded guard. For the first cut, the tool is clamped round the cable and rotated, the depth of cut being controlled by a knob at the end of one of the two handles. Adjustment for different size cables is made by rotating the second handle along the screwed rod linking the two handles. The second handle is then locked by a spring catch.

To make longitudinal cuts in large cable sheaths the tool is fitted with an "anvil" so that the stripper can be tapped along the cable with a hammer.

★

Sir John leaves for ICL

Sir John Wall, Deputy Chairman of the Post Office Board for the past two years, has retired to take up appointment as chairman of both the executive and holding companies of International Computers Ltd.

Sir John, who came to the Post Office on secondment from EMI, the world's biggest recording company of which he was managing director, played a leading part in planning the reorganisation of the Post Office.

No successor to Sir John had been announced by the time the *Journal* went to press.

THE 101st PMG

Mr. John Stonehouse, MP.

MR. John Stonehouse, MP, who became Postmaster General on 1st July, is the 101st to hold the appointment and the only Postmaster General whose father—William, a technician at Southampton and a branch secretary of the Post Office Engineering Union—worked for the Post Office.

The new PMG's close family links with the Post Office do not end there. His brother William was a teleprinter engineer at Southampton before World War Two and his sister Kathleen worked as a counter clerk in the Southampton Post Office. And, for good measure, Mr. Stonehouse's brother-in-law, Mr. Tom Hayes is a technician at the Redbridge Engineering Centre, Southampton.

Mr. Stonehouse, former Minister of State at the Ministry of Technology, has been Member of Parliament for Wednesbury, Staffordshire, since 1957. Educated at elementary and secondary schools in Southampton and at the London School of Economics, he was a director and president of the London Co-operative Society and in 1952 went to Uganda for two years to set up co-operatives there. Mr. Stonehouse has been a Parliamentary Secretary at the Ministry of Aviation, Under Secretary of State for the Colonies and, in 1967, Minister of Aviation. He is married, with two daughters and a son.

Mr. Stonehouse replaces Mr. Roy Mason, MP, who left the Post Office to become Minister of Power after only 86 days as Postmaster General. Only three Postmasters General spent a shorter time in that office than Mr. Mason. The record is held by the Marquis of Coyningham (22 days from 18-30 May, 1835), followed by Mr. Ormsby-Gore, now Lord Harlech (69 days in 1931) and Sir William Joynson-Hicks (78 days in 1923).

Yellow for Safety

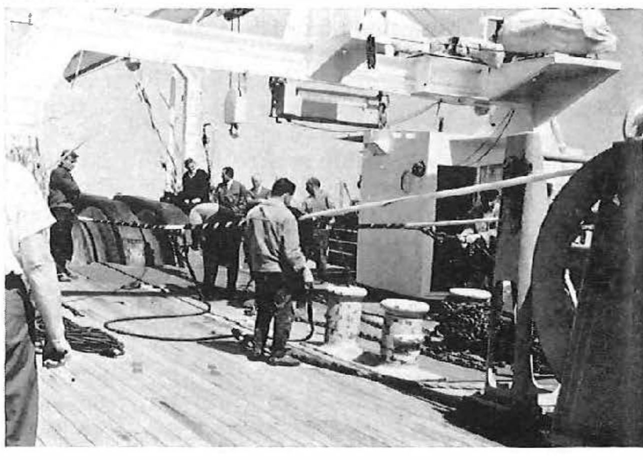
AS an aid to safety, the Post Office's telecommunications transport fleet of 40,000 vehicles is to be painted golden yellow.

But the change from the present traditional dark green will not happen overnight. The transformation will take five years and be carried out as new vehicles are introduced and vehicles at present in use become due for repainting.

The change from green to yellow is one of the most important decisions on safety which the Post Office has made in recent years. Although

Post Office engineers were present when Submarine Cables Ltd. demonstrated their new large-diameter, deep sea co-axial cable for wideband international submarine telephone cable systems off the west coast of Spain.

Operations included the laying of production lengths of 1.47 in. cable, complete with dummy repeaters containing electronic equipment; recovery from the sea bed in the region of an assumed fault; and relaying and final recovery of all the demonstration cable. The demonstration took place on board the Cable and Wireless Ltd.'s cable ship *Mercury*.



there is no statistical evidence to prove that the dark green colour of the present engineering vehicles is difficult to see, especially in rural areas, and that it is one of the causes of accidents, there is good reason to believe that this is the case.

There is plenty of support for the view that golden yellow is an effective safety colour. Internationally, yellow is recognised as an official safety colour and the International Organisation for Standardisation interprets it as the colour which warns of danger and attracts attention.

The Ministry of Transport says that yellow is a conspicuous colour which has been recommended for use on emergency warning signs. The Road Research Laboratory believe that yellow will help daytime visibility considerably. The Virginia State Highways Authority, USA, which says scientific tests have proved yellow to be the most conspicuous vehicle colour, goes even further, claiming that "the use of yellow will result in definite benefits from the point of view of safety".

The German Postal and Telecommunications organisation (whose vehicles are painted yellow) believes that the colour helps to improve the overall safety of road traffic.

Road safety is obviously of great importance to the Post Office and to the drivers and passengers of the telecommunications fleet of 40,000 vehicles which, each year, cover some 280 million miles and suffers about 10,000 accidents. Of these accidents, some 2,000 happen to stationary vehicles.

The cost of the colour transformation will be relatively small. Over a five-year repainting cycle with the present green paint the cost is about £500,000. Use of the yellow paint, which is a little more expensive, will add £30,000 to the bill—or about 15s. a vehicle.

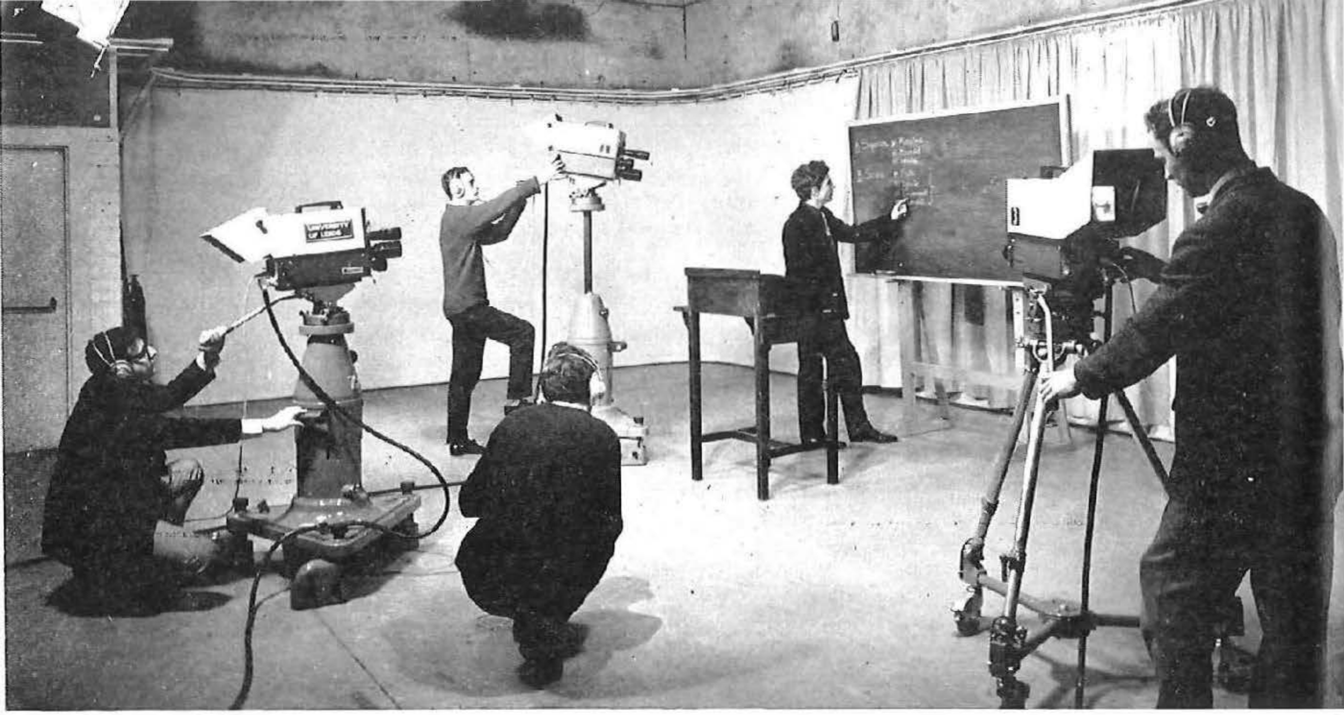
When he announced the change to golden yellow in Parliament, the Postmaster General, Mr. John Stonehouse, said he had no intention of changing the red colour of the telephone kiosks.

New Kiosk has only 50 parts

The first of the Post Office's new-style telephone kiosks—the Kiosk No. 8—were brought into public service early in July. Appropriately, the first was installed outside Post Office Headquarters in King Edward Street, London, EC 1. The others are in Palace Yard, Westminster; Shiel Road, Liverpool; Broad Street, Dagenham, Essex; and in the Lee Chapel North Shopping Centre, Basildon, Essex.

The new kiosk has a number of new and attractive features which should make it popular with the public. It has large windows of toughened glass, is made mainly of cast iron, has only 50 component parts compared with the 400 parts of the present kiosk, and is designed to reduce the risk of vandalism and theft. All the surfaces are easier to clean.

The Kiosk No. 8 was designed by Mr. Bruce Martin for use in both rural and urban areas to blend with modern as well as traditional architecture. It will eventually replace the present kiosk, designed by Sir Giles Gilbert Scott and introduced more than 30 years ago.


The scene in the Leeds University TV studio during a "take." Vidicon cameras are being used.

University sets up closed circuit TV system

By H. HUDSON

THE Post Office has provided and installed the interconnecting line systems for the University of Leeds Television Service, one of the first fully-operational closed circuit television systems to be set up at any British university.

The service, which has a full-time staff of about 20, is being used by more than 30 departments to transmit programme material to lecture theatres throughout the 100-acre campus and to supplement live lectures. It is also being used to investigate the application of television to all aspects of the University's educational work, in order to plan a regular service of teaching programmes.

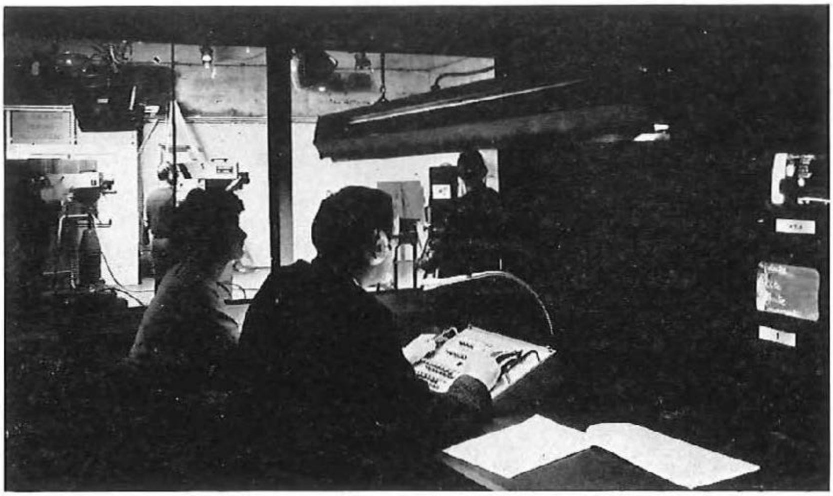
Leeds University is already one of the chief centres in Britain for research into the use of TV for educational purposes—it has its own centre for television research with a staff of seven. Apart from its teaching role, the service is also being used to provide training courses in TV production.

Discussions on the setting up of the service began in 1963. Later, backed by a £50,000 grant for capital equipment and a further £6,000 a year for three years from the University Grants Committee, plus its own resources, the University converted an old warehouse into a TV studio and equipped it with three industrial vidicon cameras.

This studio building has since been internally reconstructed and now includes a design office, observation room, a film cutting room and a sound and vision control room. Telecine and videotape equipment has been installed.

The VHF distribution system—the first stage came into operation early in 1967—feeds about

View of the studio at the Leeds University television centre from the control room. On the right are two of the seven monitor screens.



40 lecture theatres. Specially designed 25-in. receivers are installed in selected viewing rooms and the network at present feeds about 60 "master" and 45 "slave" monitors.

In addition, there is a contribution system feeding the studio from 20 selected locations or injection points in the University. Both systems have extension telephone facilities to the studio.

The distribution system is a co-axial cable VHF network giving nine channels spaced at intervals of 10.5 MHz (as an expedient until modulators developed to Post Office requirements are available, three channels have been provided using commercially-built modulators). The vision and sound carriers are 6.0 MHz apart, the sound being the higher in frequency. The vision is vestigial sideband, amplitude modulated to a depth of 67 per cent, and is negative in sense, that is, it gives maximum power to line when the carrier is unmodulated. The bandwidth is adequate for standard 625-line channels.

The sound is frequency-modulated with a deviation of plus or minus 50 kHz and the unmodulated carrier is transmitted to line 12 decibels down on the unmodulated vision carrier. The line amplifiers give a maximum gain of 22 decibels and have cable equalisation gain adjustments. The amplifiers may be powered, locally or remotely, from a unit giving 12V d.c. and operating from a 240V 50 Hz supply.

Complementary to the distribution system, internal wiring is provided for transmitting video and sound signals between the "master" monitor and any number of "slave" monitors within a lecture room. The "master" connected to the VHF system selects the required channel and provides video and sound outputs to feed the "slaves." Seating capacities range from 20 in the smaller lecture rooms to 300 in the larger lecture theatres and halls. The 25-in. screen monitors are

OVER

Students at Leeds University watch and listen to a lecture on a "master" monitor screen in one of the smaller lecture rooms. Large screen projection may be used in the new lecture theatre block now being built.

connected by way of fly leads to the permanent complementary wiring.

The contribution cable system is an unamplified network designed for one video and one sound transmission to the studio centre from any one of a number of contribution point locations by way of balanced quad cables. At the contribution point the video signal is injected via a fixed flat gain amplifier to match the unbalanced 75 ohm impedance of the mobile unit camera feeders to

The sound control room at Leeds is equipped with a record player, tape recorder, monitor screen and control console.

the balanced 140 ohm impedance of the quad cable.

At the studio centre variable gain equalising amplifiers are adjusted for that particular point of injection. The circuits are set up periodically using pulse and bar equipment to have "K" ratings better than 44 per cent. The amplifier control settings are recorded so that subsequently the circuits can be set up quickly and without test equipment.

The sound pair has low attenuation, and impedance matching problems do not arise because the impedance seen at the studio centre will be substantially that connected at the injection point.

The present system is only a beginning. Work began at Leeds last year on a new lecture theatre block which will incorporate a highly-sophisticated permanent television centre for the University. This will include two studios—one of 1,700 sq. ft. and the other of 1,000 sq. ft.—with associated control rooms, equipment maintenance and technical stores. There will also be materials workshops, design and graphics studios, film and videotape recording rooms, offices, viewing and scripts rooms and film cutting rooms. All 25 of the lecture theatres in the block will be equipped to receive TV through monitors or by large screen projection.

THE AUTHOR

Mr. H. Hudson, *C.Eng. MIERE, was development engineer for the Leeds University television systems described in this article. At that time he was an Executive Engineer in the Line and Radio Branch. He is now a Senior Executive Engineer in the Test and Inspections Branch of GPO Telecommunications Headquarters.*

TV SERVICE FOR LONDON SCHOOLS

As the Journal *went to press, Post Office engineers were busy testing the wiring and co-axial cable circuits which have been installed for the Greater London Council's schools television service due to open in September to serve initially* 300 *schools in Greater London.*

The London schools TV system is the biggest closed circuit scheme in Britain and one of the largest in the world. Up to nine 625*-line channels are being provided from the schools TV centre in Laycock Street, N.*1*, all of them passing over Post Office cables and amplifiers to television sets in the schools.*

Seven channels will provide simultaneous programmes produced by the Inner London Education Authority in its own TV studios as well as BBC and ITA programmes. The Post Office is setting up a special maintenance and repair centre to assist the scheme.

Eventually the London schools TV scheme will be extended to serve some 1,300 *schools.*

Telecommunications Statistics

The figures below are for the complete financial year ended 31 March, 1968, compared with those for the previous two years.

	Year ended 31 Mar., 1968	Year ended 31 Mar., 1967	Year ended 31 Mar., 1966
Telephone service at the end of the year			
Total telephones in service	**12,112,600**	11,391,600	10,720,000
Exclusive exchange connections	**5,990,800**	5,576,000	5,240,600
Shared service connections	**1,396,400**	1,355,700	1,293,900
Total exchange connections	**7,387,200**	6,931,500	6,535,000
Call offices	**74,856**	74,511	74,629
Local automatic exchanges	**5,926**	5,838	5,687
Local manual exchanges	**192**	259	342
Orders in hand for exchange connections	**240,500**	220,800	227,100
Work completed during the year			
Net increase in telephones	**720,922**	671,667	739,929
Net exchange connections provided	**793,323**	746,979	808,477
Net increase in exchange connections	**455,693**	397,166	504,942
Traffic			
Effective inland telephone trunk calls (inc. SV effective)	**1,064,000,000**	930,000,000	841,000,000
Cheap rate inland trunk calls	**234,000,000**	207,000,000	186,000,000
Overseas telephone calls:			
European outward	***9,888,000**	8,454,067	
Extra European: Outward	***943,000**	788,682	
Inland telegrams (inc. Press Service, Rail Pass and Irish Republic)	**9,305,000**	9,968,000	10,892,000
Greetings Telegrams	**2,390,800**	2,471,500	2,575,000
Overseas telegrams:			
Originating UK messages	**7,196,065**	7,196,998	7,192,000
Terminating UK messages	**7,217,602**	7,200,743	7,180,000
Transit messages	**6,468,389**	5,939,821	5,635,000
Inland telex:			
Metered units	**230,000,000**	203,000,000	173,000,000
Manual calls	**114,000**	112,000	80,000
Overseas telex calls (originating UK and Irish Republic)	***14,814,000**	12,694,239	10,630,000

*Figures estimated

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

Correspondence. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, GPO Headquarters, St. Martin's-le-Grand, LONDON, E.C.1. Telephone: 01-432 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co.".

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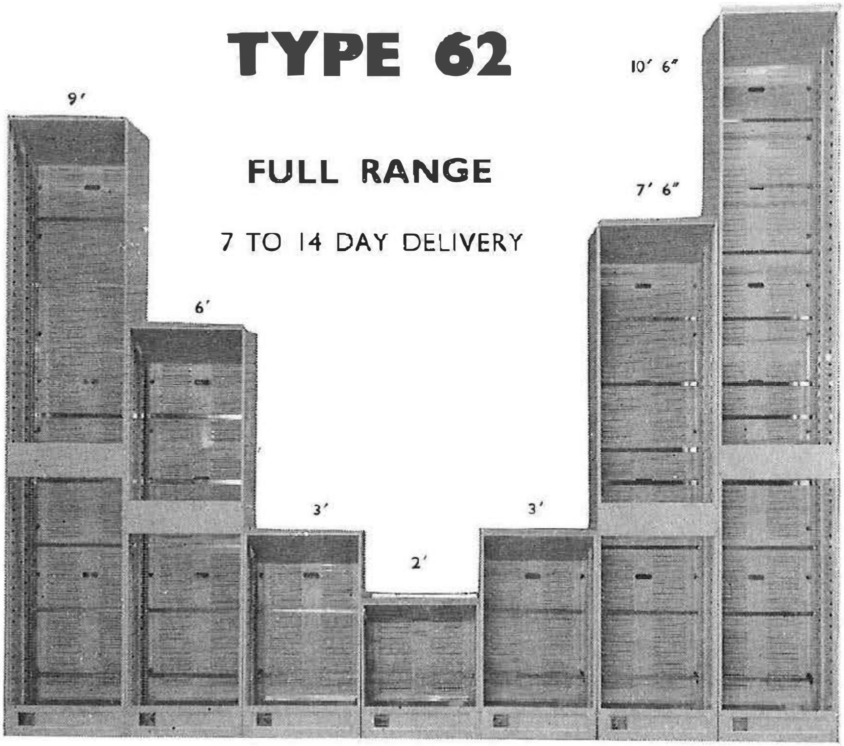

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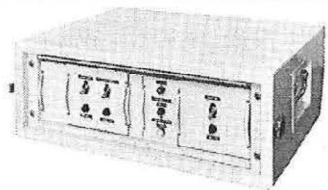

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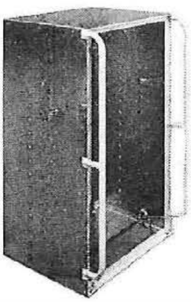

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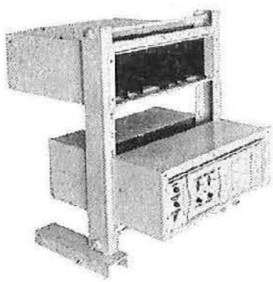

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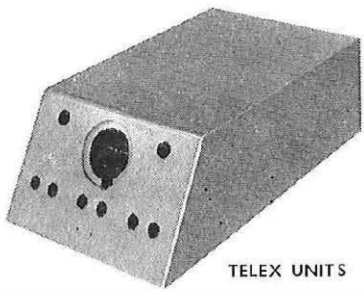

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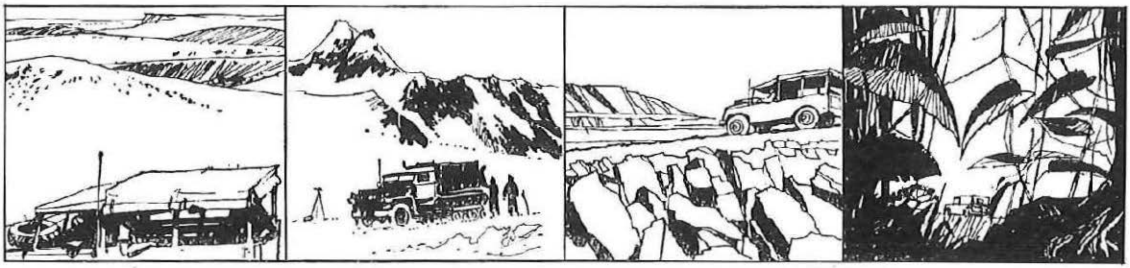

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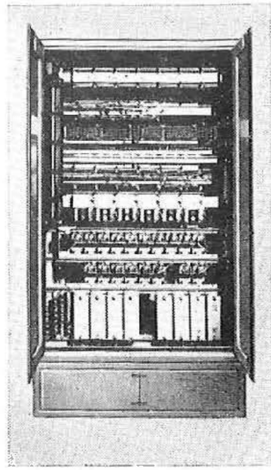

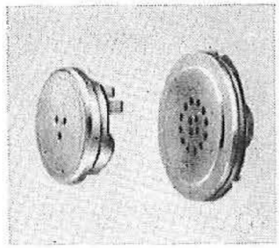

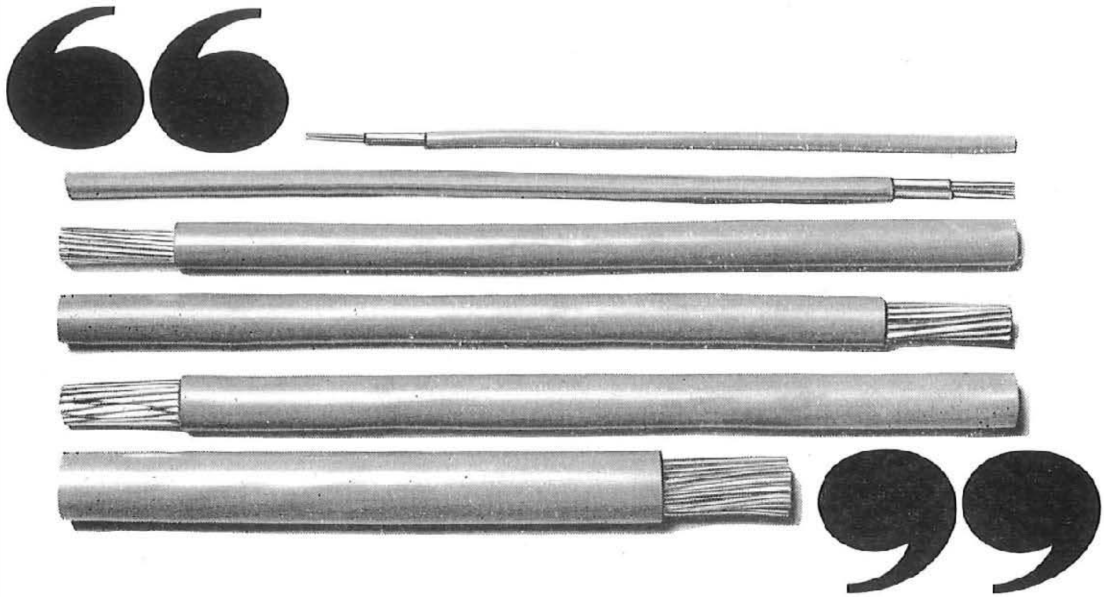

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