POST OFFICE

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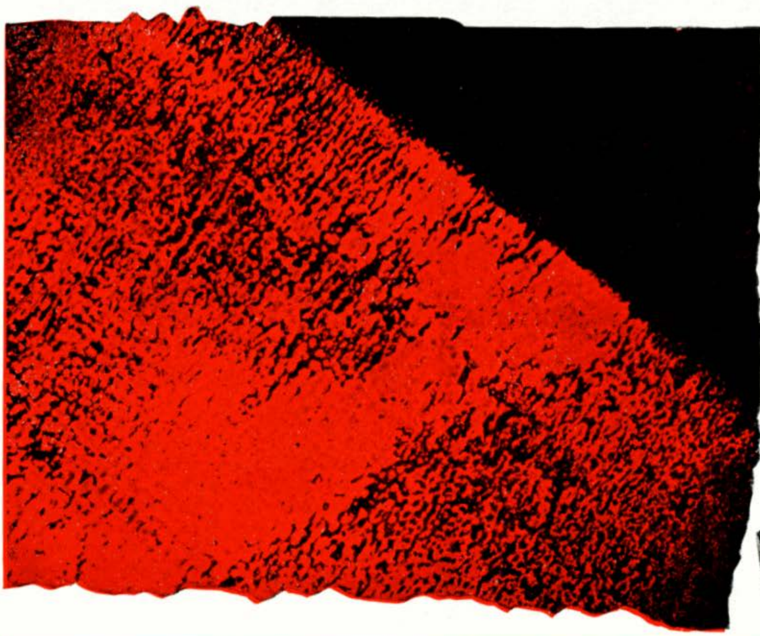

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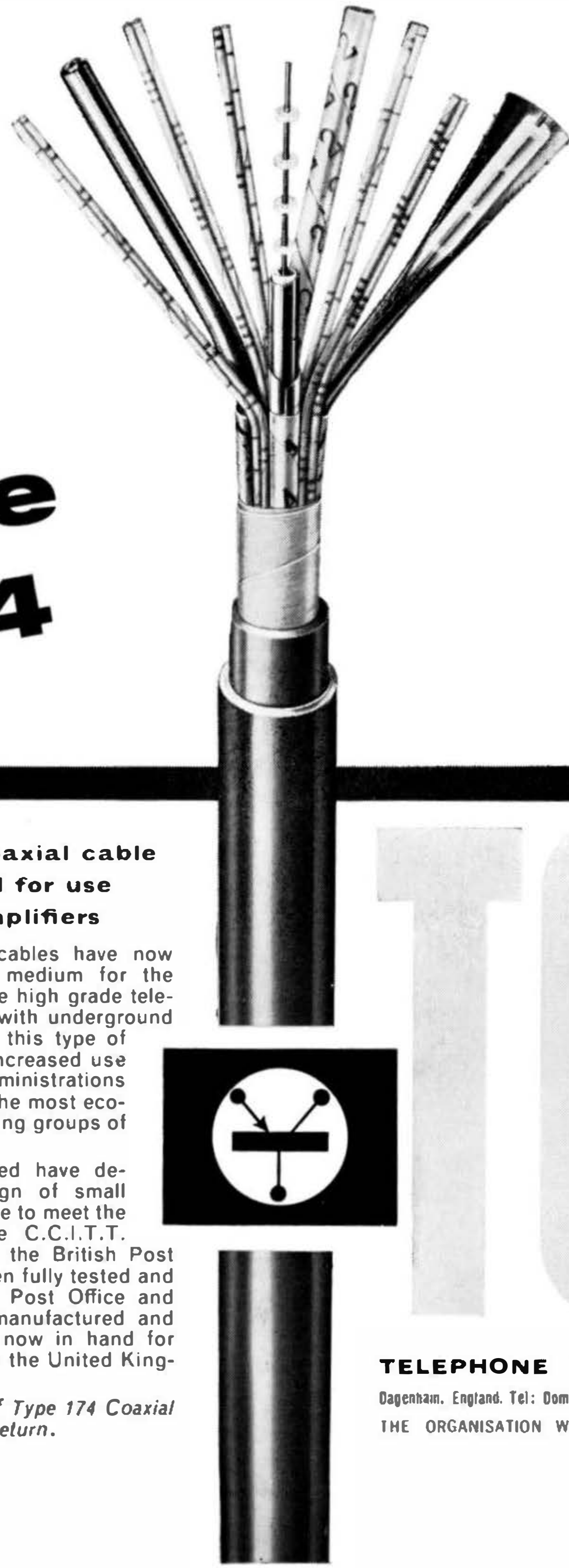

Post Office Telecommunications Journal

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

THE FIVE-YEAR PLAN

THE announcement as the *Journal* went to press that the Post Office plans to spend in the next five years £900 million on expanding and improving the inland telephone system—nearly twice as much as in the past five years—is very welcome news indeed.

A White Paper published on 21 November says that the £900 Million, Five-Year Plan has four main objectives.

The first is to have sufficient plant by 31 March, 1966, at the latest to avoid telephone applications being delayed by shortage of plant and so abolish the "Waiting list" for all practical purposes by that time.

The second is to provide for expected increases in the number of telephones, including extensions, by March, 1968, to just over 11 million—two million more than on 1 April last—and the number of exchange connections from 5¼ million to about 6¾ million.

Third, the Plan is designed to cater for handling 2,000 million more telephone calls a year at the end of the five year period than are handled now. "The number of local calls," says the White Paper, "is likely to increase from 4,750 million in 1962–63 to 6,500 million in 1967–68 and the number of trunk calls from 550 million to 1,000 million."

To meet this striking growth, the number of trunk circuits will be increased from 35,000 on 1 April, 1963, to 55,000 at 31 March, 1968. This expansion will be achieved partly by the use of a microwave system now being established. Some 90 microwave relay stations have been or are being provided and a further 37 will be needed during the five year period. In addition to carrying many trunk circuits, the microwave system will allow facilities for a number of television services.

The fourth main feature of the Plan is to press on with progress towards full automation and modernisation of the telephone system. Subscriber Trunk Dialling, for example, will be available to about 80 per cent of all subscribers by 31 March, 1968, by which time only about 150 manual exchanges will remain to be converted to automatic working and some 98 per cent of all subscribers, compared with 86 at present, will have automatic service. The rate of replacement of the older automatic exchanges will be stepped up and more switching equipment provided.

The White Paper says the Plan assumes that if the Inland Telephone Service achieves an average return of 8 per cent on its net assets some £550 million of the investment will be financed from internal sources and some £350 million by borrowing from the Exchequer. If the expansion of the national economy and growth in personal incomes are in line with the National Economic Development Council's assumptions, inland telephones should be capable of achieving this result without any increases in basic prices to the customer.

The Plan is the most ambitious the Post Office has ever undertaken and its purpose is to give the country the best possible telephone service. It presents a great challenge and exciting opportunities which will be welcomed at all levels in the Inland Telephone Service.

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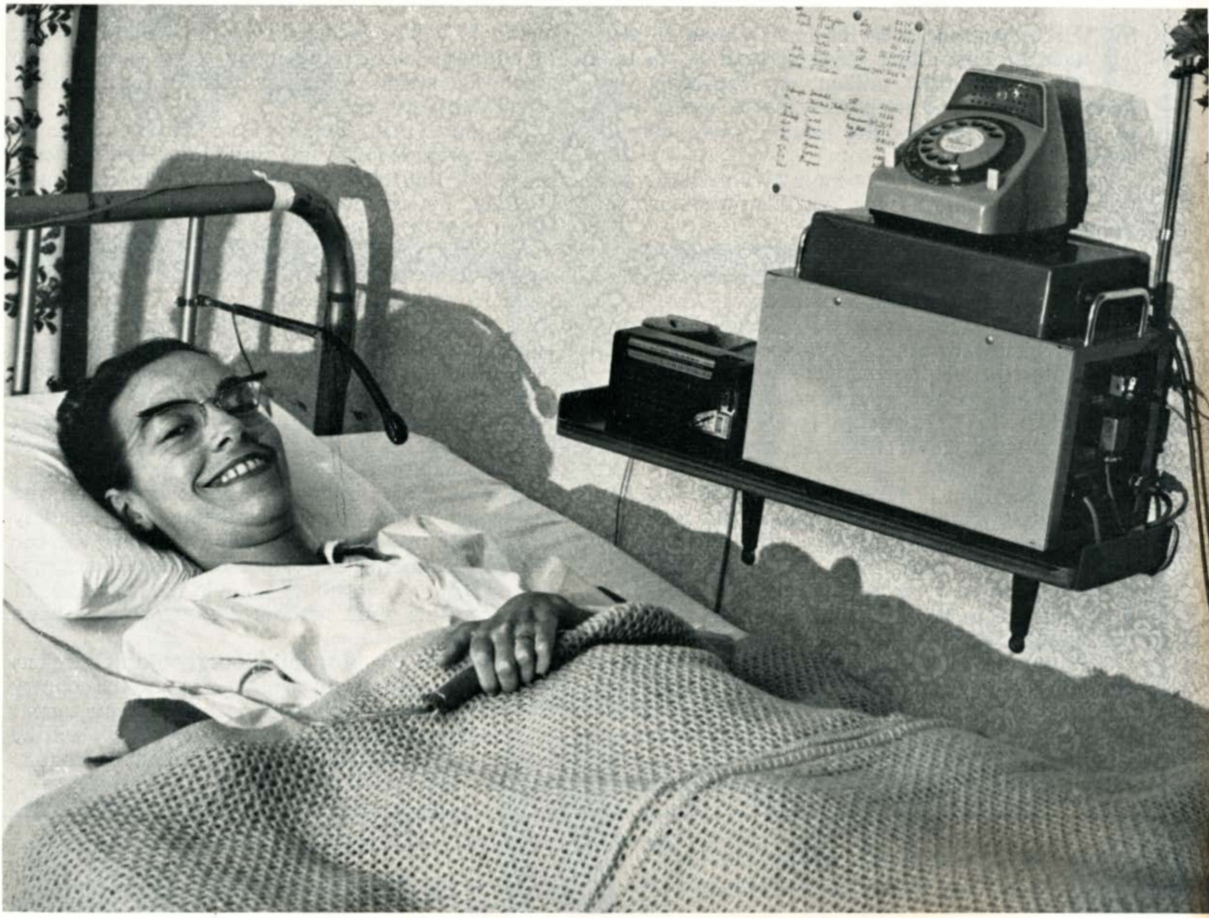
THE POST OFFICE AIDS THE HANDICAPPED

By R. G. FIDLER

The Post Office has for many years provided special telephone equipment for the blind and the deaf. Now it has developed equipment to enable the severely-handicapped to dial and receive their own calls



Mrs. June Cottingham remains cheerful in spite of her disability. Since she retains some movement in the fingers of one hand she can operate the POSM equipment by a sensitive switch. The extension microphone is shown strapped to the bed.

MRS. June Cottingham, a polio victim, has been bed-ridden for six years. She can move only her head and two fingers of her left hand very slightly. Until recently she could do nothing for herself and was completely cut off from the outside world.

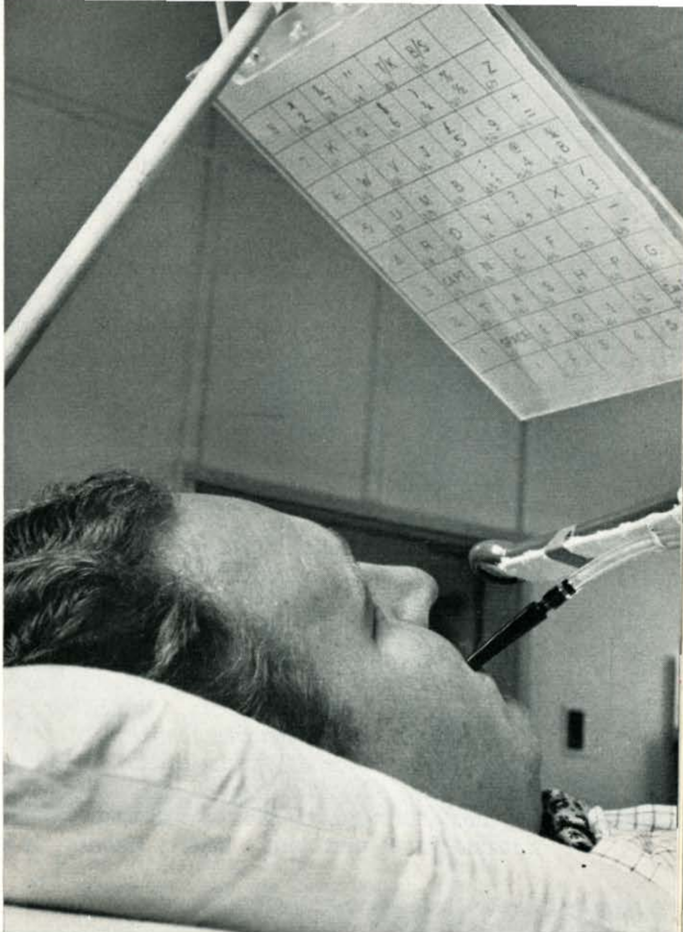
Now, however, she can perform a number of useful actions by remote control such as switching on and off the heating in her room, the lights, the radio and television set and even initiate and receive her own telephone calls.

Mrs. Cottingham, who lives in St. Mary Cray, Kent, is one of many physically-handicapped people who, thanks partly to special equipment designed and manufactured by the Post Office, can keep in touch with her friends and acquaintances through the telephone system.

Providing assistance to people who are severely handicapped and have little or no muscular control apart from some head movement is a difficult problem, but for several years research has been conducted into possible ways of harnessing and exploiting any small remaining movements so that the lost faculties can be restored as far as possible by artificial aids.

The latest advances have been made possible largely as a result of the work carried out by Mr. R. G. Maling, a research worker for the Polio Research Fund, who has designed at the National Spinal Injuries Centre at the Stoke Mandeville Hospital, near Aylesbury, a device known as the Patient Operated Selector Mechanism (POSM).

POSM is a switching mechanism controlled by the patient who, by operating a switch or sucking through a tube, can select a number of facilities such as heating, lighting, radio, television, bell circuits, book-page turning apparatus and so on. The change in air pressure produced by sucking down the tube is detected by a micro-switch which causes a uniselector to step slowly. At each step a click is heard and illuminated panels offer the facilities in a pre-determined sequence. The uniselector can be halted at any facility simply by releasing suction. The selected panel then remains illuminated and the uniselector returns to its home position in readiness for the next selection. When the patient wishes to switch the device off he merely repeats the process and the lamp in the selected panel is thus extinguished. Any combination of facilities may be put into operation simultaneously and the user can always see which facilities are in use.



POSM also provides facilities for the paralysed to operate an electric typewriter—by sucking and blowing down a tube. The chart above the man's head helps him to select the characters.

POSM can even be equipped with an electric typewriter, preloaded with a roll of 500 sheets of paper. The operation of typing is governed by a code consisting of first sucking, then blowing and finally releasing the air pressure altogether in unison with timed audible pulses.

Now the Post Office has developed and is manufacturing equipment which can be associated with one of the POSM's outlets so that the patient can initiate and receive telephone calls. One type consists of a relay set and a Sender No. 1 (both battery-operated). A lightweight headset has to be strapped into position on the patient before he can begin to telephone. This system is suitable for people who spend a lot of time telephoning, among them at least one who, although bed-ridden and completely dependent on outside aid, even to the

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AIDING THE HANDICAPPED *(Cont'd)*

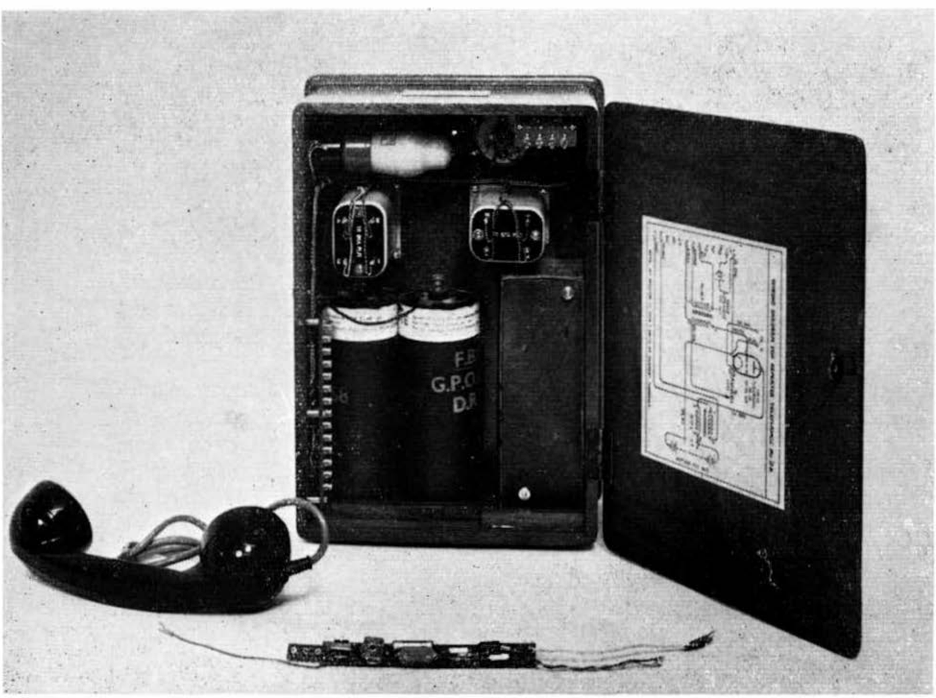
extent of having his breathing done for him by machine, controls a business.

When the Loudspeaking Telephone No. 1 made its appearance in 1962, the National Spinal Injuries Centre asked if it could be adapted to the POSM system. This loudspeaking telephone is a "hands-free" device consisting of a control unit with microphone, lamp, dial and control keys (on/off and volume), a telephone with loudspeaker fitted in place of the dial and a transistorised amplifier, powered from the exchange line current. It is of the "non-voice switched" type—that is, both directions of transmission are always open. Freedom from howling due to feedback from the loudspeaker to the microphone is achieved by careful design and separating the loudspeaker from the microphone.

The Post Office accepted the request and has now produced a successful modification, known as the Loudspeaking Telephone No. 5, which is being manufactured by the Factories Department.

LST No. 5 retains the full facilities of the No. 1, the amplifier being incorporated into a larger unit together with a Sender No. 1, a relay group and a mains power unit with a battery standby. It is easy to operate. When the subscriber selects the appropriate outlet on POSM the loudspeaking telephone is automatically switched on. The dialling tone is heard from the loudspeaker and the pilot lamp in the control unit glows to indicate that the equipment is in use. After a three-and-a-half second pause, the Sender No. 1 automatically pulses the digits 100 or 0 as appropriate to route the call to the exchange operator. An extension microphone near the subscriber's head (for convenience it is strapped to the arm carrying the POSM control tube) is automatically switched into circuit and the microphone in the control unit is switched out. The subscriber is thus able to speak freely and ask the operator to connect him with the desired number, prefixing his remarks with the phrase "Special assistance". On completing the call, the user clears down by re-selecting the telephone outlet on POSM.

On incoming calls, the subscriber brings the loudspeaking telephone into use in exactly the same way as for outgoing calls. It is necessary, of course, to arrange for the Sender to be suppressed on seizure of the equipment, otherwise the calling party would receive dialled pulses in the receiver. Suppression is achieved by detecting the ringing



This modern amplifying handset shows the transistor amplifier withdrawn from the hollow handle. This amplifier draws all the current it needs from the exchange line. Behind the handset is the older version with cumbersome batteries and valve.

A trainee at the Royal National Institute for the Blind learns to identify a calling extension on a manual switchboard by feeling for the doll's-eye indicator.

A PABX I standing on a doll's-eye plinth. The plinth converts the lamp signals of the PABX switchboard into doll's-eye movements which the blind operator is able to feel.

current through the bell and arranging for this to cause a relay to be held operated for the duration of ringing (including the inter-train pauses). A similar system is adopted for the lightweight headset equipment.

Other members of a household may set up or receive calls in the normal way, using either the handset or the loudspeaking telephone. If it is subsequently desired to transfer a call established in this way to the disabled person, it is again necessary to suppress the Sender and a "transfer" button is provided for this purpose.

The LST No. 5 can also be used on separate metering Shared Service, the equivalent condition to pressing the calling button being automatically provided on outgoing calls. Particular attention has been paid to power protection aspects to make sure that there is no possibility of mains power leaking to line or to the subscriber. As an additional safeguard, an isolating relay is interposed between the Post Office circuit and POSM. Like POSM, the Post Office equipment incorporates a nickel-cadmium re-chargeable battery connected on float charge and regulated by a Zener diode—a semiconductor device. The battery assists with some of the heavier currents—for example, the surge due to the Sender motor starting—but its prime function is to maintain service if the mains supply fails. This is a most important feature for those who are mains dependent—patients in iron lungs, for example—who need help very quickly if failure occurs. All the powered POSM facilities—such as light, heat, respiration and so on—will fail and only a battery-operated trembler bell and the telephone service will continue to operate. Normally, an attendant will be on hand all the time but the patient is re-assured to know that the telephone—the vital link between him and the outside world—will always be available to summon assistance when it is needed.

People who are less physically handicapped but have difficulty in dialling are also helped by special Post Office equipment. A service has for some time been available whereby such subscribers can be directly connected to the manual board so long as

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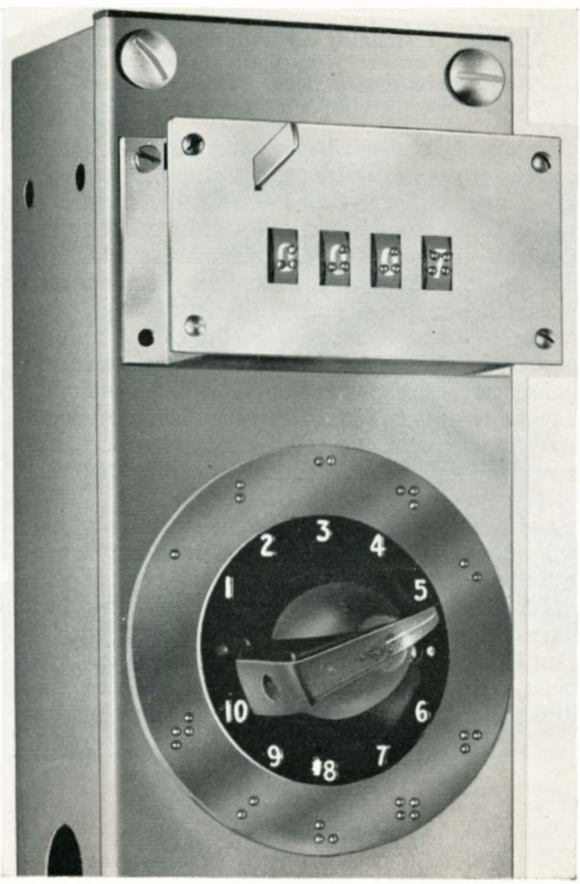
AIDING THE HANDICAPPED *(Concluded)*

the manual board and the subscriber's terminating equipment are in the same building. For various reasons this arrangement is no longer recommended. Its chief disadvantage is that the remaining members of the household are obliged to ask for manual board assistance on every call and—a very important point—they are thereby deprived of the 999 Emergency service.

The present practice is to provide for the disabled subscriber a battery-operated Sender No. 1. Normally the "start" signal is given by pressing a very lightly loaded micro-switch button on the top of the device, but it is also possible to wire a remote switch into the "start" circuit if the built-in switch is inconvenient to the subscriber.

As people grow old they often lose their keen sense of hearing and find the telephone is not quite so clear as it used to be. For such people and also for those who are moderately deaf the Post Office provides an amplifying telephone, the handset of which contains in the hollow handle a complete miniaturised transistor-amplifier. A volume control

The new type of STD meter with characters in Braille for the use of blind operators.



is set into the receiver moulding so that the output can be controlled by the user to a convenient level up to 20 db above normal. The action of the amplifier is self-limiting so that accidental damage to the ear by excessive volume is impossible. Other members of the same household, who are not deaf and would find the amplified side tone objectionable, are able to reduce the amplification to give a normal output. Power for the amplifier is usually derived from the exchange line current and if the subscriber already has a 700-type instrument, it is a simple matter to change the handset for the amplified type—the Handset No. 4. If the line current is insufficient, small mercury cells, generally lasting for 18 months, can be fitted in the telephone instrument, and Handset No. 5, similar in outward appearance to the No. 4, is provided instead.

A few subscribers suffer from defective voices—usually the vocal chords are not functioning correctly and their speech resembles a loud whisper. For them there is available the "Faint Speech Telephone". Like the amplifying telephone this device is basically a transistorised amplifier, but it is interposed between the carbon microphone and the line to ensure that the outgoing level of signal is adequate. Naturally, nothing can be done to restore the missing quality from the voice but the amplification permits the user to talk without undue strain. The amplifier is contained in a small plastic case, usually mounted on the skirting board, and it is switched in and out of circuit as required by press buttons on the telephone instrument. The gain is pre-set by the installation engineer to match the user's voice.

Blind subscribers can usually manage to manipulate the dial by feeling for the finger plate holes and memorising the positions of the figures and letters. This method is adopted by the many blind operators who successfully control switchboards. Small filed cuts can be made on the edge of the finger plate against the figures 4 and 7 but after a little practice blind operators no longer feel the need for these marker points, "doll's-eye" type indicators are sensed by the fingers.

The cord supervisory indicator conditions cannot be recognised unless the indicator is modified since in their normal form they are visual only. After World War One, when an urgent need arose to find work for war-blinded Servicemen, attention was directed to this problem. Among the early proposals was one for replacing the indicators by electric buzzers. By this means the operator could

AN ISRAELI IDEA

TECHNION, Israel's Institute of Technology, is developing an instrument which may enable deaf mutes to communicate with each other by telephone. According to the magazine *Discovery* the system consists of a single apparatus on which the "speaker" sends messages by operating sensitive vibration sending keys with his fingers. The fingers of the "listener" rest on a vibration-receiving diaphragm and the system can be reversed to allow the listener to become the speaker. The tactile vibrations may be of different frequencies and in this way a sizeable language can be built up. If three frequencies are used at each of the five finger points, for example, it would be possible to develop a language of nearly 5,000 words.

Professor Hirsch, who is in charge of the project, believes that the system could have a wide range of applications. For example, it could be used for communications during space flights in which the human voice may suffer distortion.

Professor Hirsch (right) and a colleague demonstrate the instrument for deaf-mutes.
Courtesy, New Scientist.

both hear and feel the calling signal. Present-day practice is to replace the glass fitted to the indicator by a glass which has a small metal stud set loosely into the centre so that when the indicator is energised the stud protrudes above the surface by about a quarter of an inch and can be readily sensed by the fingers.

Since a blind operator needs to take occasional notes these are prepared on a Braille tape machine. To keep the tapes under control, they are attached to the switchboard by a metal clip with a rubber grommet set into the free end. Remarkably, a trained blind operator is expected to commit to memory some 300 telephone numbers.

The type of boards most suitable for blind operators are the 3 + 9 Cordless; 5 + 20; 10 + 30; 10 + 50; and the PABX 1. In the latter case the visual signals have to be converted into audible and tactile signals. This is accomplished by providing a "Doll's-eye plinth" on which the PABX 1 stands. The doll's-eye indicators operate either fully or flash on and off at differing rates in the same way as the switchboard lamps, and the operator feels for and interprets these signals and manipulates the switchboard accordingly.

An STD meter with additional Braille characters will shortly become available. It is similar in construction to an exchange-type subscribers' meter, that is, the figures are presented through a window in the manner of a cyclometer. A re-set lever is provided. Associated with each meter is a ten-way switch with Braille identified outlets numbered 1—10 so that the meter may be brought into use with the exchange lines terminated on the board. The meters and switches are mounted on two-unit panels.

Development is also being carried out on an electronic probe for detecting light signals. Application of this device will necessarily be limited to cordless boards, since it is impracticable to search for a calling lamp through a network of intervening cords.

As the *Journal* went to press the Post Office was installing in a house in Nettlebed, Oxfordshire, for use by a completely paralysed polio victim, a Loudspeaking Telephone No. 5 which, in conjunction with a POSM equipment, will be operated by the patient sucking through a mouth-piece. This is the first time that the LST 5 has been used by a patient in this way.

* *The author is indebted to the Royal National Institute for the Blind and to the National Spinal Injuries Centre for assistance in compiling this article.*

★ **THE AUTHOR, Mr. R. G. Fidler,** who joined the Subscribers' Apparatus and Miscellaneous Services Branch in 1961 as an Executive Engineer, came into the Post Office as a Youth-in-Training in the London South-East Area in 1940. After serving with the Royal Corps of Signals from 1942 to 1946 he returned to Faraday Building and in 1947 went to the Exchange Equipment and Accommodation Branch as an Assistant Engineer, later transferring to the Main Lines Planning and Provision Branch.

CUTTING THE COSTS IN TRUNK SWITCHING

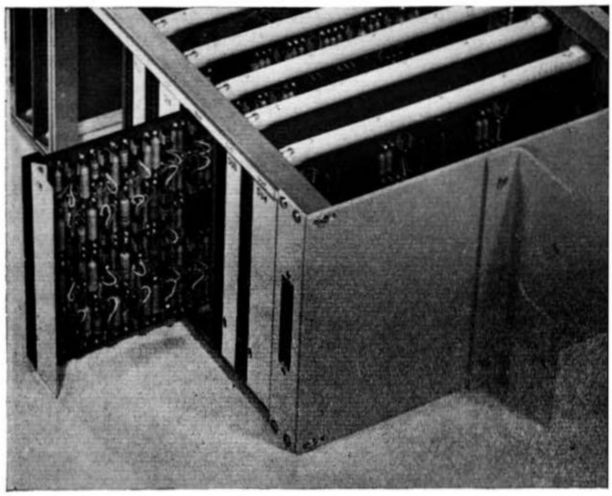
Mechanisation and improvements in signalling, switching and transmission techniques have increased the efficiency of the trunk network and at the same time reduced costs. Now, the Post Office looks ahead to other ways by which more economies and even greater efficiency can be achieved

By A. J. THOMPSON

ALTHOUGH the history of automatic telephony in Britain can be traced back through more than half a century, it was not until shortly before World War Two that the mechanisation of the trunk service began.

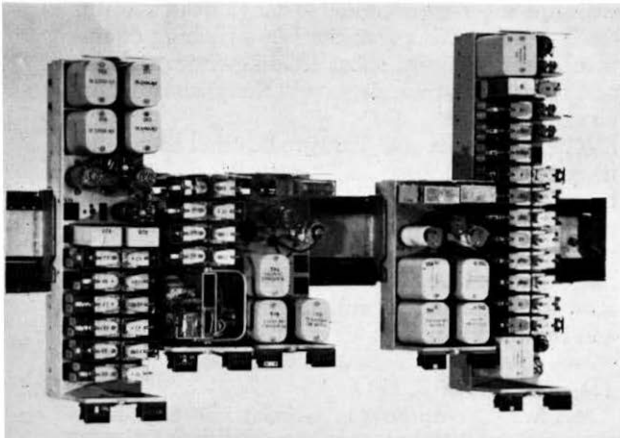
This early mechanisation, which was restricted to a few large centres, enabled operators at the originating centre to complete certain trunk connections direct to distant subscribers so long as the required subscriber was connected to an automatic exchange. The war years delayed subsequent development but shortly after the end of the war, study was revived to determine the policy for the further automation of the trunk telephone system. The initial objectives were to connect the majority of trunk calls with the assistance of only one operator and to ensure that the equipment provided would not in any way prejudice the subsequent introduction of Subscriber Trunk Dialling.

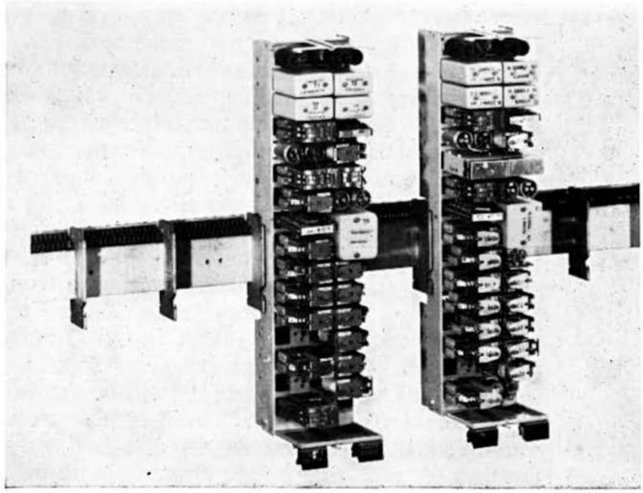
Full implementation of this policy depends on the conversion of all local manual exchanges to automatic working and the present programme is for this to be completed by the early 1970s. Provision of the trunk automatic equipment for the "one operator only" stage is almost complete and forms the framework on to which STD facilities are being added. The stage has now been reached where over 30 per cent of all trunk calls are being dialled directly by subscribers. By the time all local manual exchanges are converted to automatic working, STD facilities should be available to almost all subscribers.



A prototype of a new multi-frequency signalling system—showing a plug-in electronic sub-unit partially withdrawn—illustrates the trend towards miniaturisation. The Post Office hopes to adopt this system in 1967.
Courtesy: ST and C Ltd

This progressive mechanisation of the trunk network has already achieved considerable savings in operating costs, and, at the same time, continuing improvements in switching, signalling and transmission techniques have produced savings in the capital cost of equipment and lines. The





Old and new. Above: the equipment required for one outgoing and one incoming signalling relay set and (right) the modern equivalent.

reduction in capital costs of trunk line equipment which has followed the introduction of carrier techniques and improvements in terminal equipment are well known, but other economies in the trunk switching field have also been attained. Although not spectacular, these have kept the cost down at a critical time—when the trunk network in Britain is growing phenomenally—in the development of the system.

Since the introduction of the post-war trunk mechanisation programme, and in spite of rising labour and material costs, a 15 per cent reduction in the actual cost of trunk switching equipment has been achieved. A number of factors have contributed towards this reduction and of these the two most important have been the introduction of the new type of signalling system known as SSAC (Signalling System Alternating Current) No. 9 for use on high frequency routes and the use of two-motion selectors in certain switching stages instead of motor-uniselector group selectors and their associated digit switches. Smaller, but still important, economies have been made by adopting the changes made in local exchange installation practices, for example, the use of PVC cable, smaller gauge wires and more efficient terminations.

The new signalling system now being widely introduced into the trunk network uses a single signalling frequency (2,280 cps) compared with the two signalling frequencies (600 and 750 cps) used in the earlier system. An innovation is that the trunk circuit termination is located in the trunk exchange relay set and not, as before, in the repeater station. This permits a much simpler and cheaper method of filtering the required signalling frequency in each direction of the transmission path. To appreciate the merit of the economies achieved by the design, one can compare the number of signalling relay sets mounted on a standard equipment rack. Broadly speaking, these are 20 for the two frequency equipment and 40 for the SSAC 9. As well as in the prime cost of the relay sets considerable economies are made in power consumption. The SSAC 9 equipment dissipates approximately only half the power of that required for the 2 VF equipment.

In addition to the economies brought about by the design, other facilities are provided by the new system which add to the efficiency in the use of the trunk circuits.

Early post-war trunk exchange designs used motor-uniselector group selectors for all the switching stages in order to exploit the benefits of fast hunting and increased availability provided by this selector. To equip all trunk switching stages with these selectors has been found unnecessary, however, and modern designs provide this type of selector only on those stages which give access to large and expensive trunk routes. The remaining switching stages are equipped with two-motion selectors which are cheaper and smaller. A standard rack will accommodate 80 two-motion selectors or 50 motor-uniselector group selectors. Other economies are obtained as a result of patient study of installation techniques by the Engineering

OVER

Department and the equipment manufacturers.

Can comparable economies be achieved with the new switching and signalling systems which are now being planned? Equipment engineers are always cost-conscious, particularly when discussing new developments with their design colleagues, and have great hopes that new techniques will, at least, enable them to stabilise prices in the present rapid development of the system.

The next stage in the development of trunk mechanisation will be the introduction of the transit network which will enable the STD range to be extended for multi-link calls. New signalling systems for supervisory purposes will be entailed but economies should be achieved by the use of multi-frequency fast inter-register signalling for the transfer of digital information. This means a greater proportion of "paid for" time compared with the "over-all occupied" time per call and it is from this and the use of the fast switching equipment controlled by short holding-time registers and markers that we can expect the greatest future economies.

There are, of course, likely to be other economies in equipment designs using transistorised equipment and miniaturised components and cost studies have already indicated that, for some single link traffic between large cities, economies could be made by utilising the principles of the transit network signalling technique between controlling and terminal registers.

★

THE AUTHOR

Mr. A. J. Thompson is an Assistant Staff Engineer in the Equipment Branch of the Engineer-in-Chief's Office. He was joint author of the article *New Trunk Switching and Transmission Plan* published in the Summer, 1961, issue of the Journal.

★

A Unique Operation at Sea

When a coaxial submarine cable in the Irish Sea developed a fault, it was temporarily repaired by inserting a short length of telegraph cable. This operation is believed to be the first of its kind ever carried out

ON Monday, 24 June, 1963—only two days before the arrival in the Irish Republic of President Kennedy for a short visit—a fault occurred on one of the 60-circuit submarine cable systems between Holyhead and Dublin. Tests made from the two terminal repeater stations proved that both submerged repeaters in the cable were functioning satisfactorily but that a cable fault existed at a point 16.5 nautical miles from the Irish coast.

Action was taken immediately to provide an alternative routing for the 60 circuits which had been lost and to get a cableship on to the cable ground. It was quickly established that none of the four Post Office cableships could arrive on the cable ground to complete the repair in time. Further enquiries revealed that a Cable and Wireless Ltd. cableship *Lady Denison Pender* would be putting into Falmouth to refuel on the following day. This ship could, if the weather remained favourable, just meet the target date but, since no coaxial cable was available on board and none could be transported to Falmouth in time, telegraph cable would have to be used in the repair.

Coaxial cable consists of an insulated conductor enclosed within a tube, formed in this case by copper tapes, which acts as a screen and serves to contain the electromagnetic field within the cable. Submarine telegraph cable consists merely of an insulated conductor without screening. Both types are protected and strengthened for submarine use by a sheathing of steel wires. Consideration was given to the probable effects of this unprecedented step and to the method of jointing the two dissimilar types of cable. A brief review of the fault repair history of the cables in the vicinity of the fault encouraged the belief that only a short length of telegraph cable would need to be inserted in this repair and that the probable effects on the system transmission could be offset by adjustments to the terminal equipment. A method of jointing was devised in which the outer coaxial conductor was bonded to the armouring wires of the telegraph cable as the only available means of maintaining its continuity.

The cableship sailed from Falmouth for the Irish Sea on 25 June shortly after being joined by a Post Office representative, and arrived on the cable ground late on the following day. Meanwhile the lost circuits had been temporarily made good via Belfast and it was agreed that they should remain so routed until the end of the President's visit.

The repair was completed in the early afternoon of 27 June and overall cable tests were made followed by transmission tests with the repeaters energised. The insertion of a quarter of a nautical mile of telegraph cable had increased the attenuation of the cable by 0.75 per cent and slightly increased the distortion. After adjustments had been made to the terminal equipment the system worked satisfactorily until 19 July when the telegraph cable was replaced by HMTS *Ariel* as she was passing through the Irish Sea.

G. COTTAM, Engineering Department

THE RAY SUPERVISION AND TRAINING SCHEME

By J. D. STARK and C. HALL

★

The Ray Supervision and Training Scheme which was introduced experimentally in 1959 is now in operation at more than 100 telephone exchanges. This article discusses the Ray Scheme's merits and explains how this new training plan affects telephone operators and their supervisory staffs

IN November, 1958, Mr. F. I. Ray, then Director of Inland Telecommunications, led a party of official and staff association representatives to the United States to study the telephone system there in the light of its extensive mechanisation. The report of the Ray team—*Telephone Service and the Customer*—contained many important recommendations one of which was that the Post Office should re-examine its policies and procedures for supervising and training telephone operating staff in the light of the Bell system practice.

This recommendation gave impetus to the examination of some ideas on training and supervision which had already been discussed in some quarters in Britain, and a few weeks after the publication of the Ray Report experiments were arranged at six exchanges to see if a modified scheme involving local training could usefully be applied in this country. It was recognised from the outset that the experiments would affect the day to day work of both supervisors and telephonists and that essentially the staff should be fully associated with the development of any new arrangements. To this end, the experiments were organised through the Standing Joint Committee on Training and Education and the views of the Staff Side were sought on all points.

Early in 1961 the experiments were extended to include 29 exchanges and, following further adjustments, the scheme is being introduced progressively, for application during the day, at automanual exchanges with between 35 and 300 telephonists. It is now in operation at 125 exchanges. Further experiments are being conducted to find out if modifications are required when applying the scheme to small exchanges with fewer than 35 telephonists, or at very large exchanges.

Importance of efficient training

A sound and economic training scheme in the inland telephone operating field—with its 51,000 telephonists, 6,000 supervisors, and an annual wages bill of nearly £40 million—is of the greatest importance. Even after the effect of Subscriber Trunk Dialling has been taken into account, a need for a sizeable operating force will continue. Training requirements derive mainly from recruitment to replace resignations which are of the order of 25 per cent a year, but varying from less than ten per cent at some exchanges to more than 50 per cent at a few centres.

This continual replacement of staff produces a threefold need. First, there must be a continuous effort to train a great number of recruits. Second,

OVER

Operators at the Weybridge Exchange connecting trunk calls.

RAY SCHEME (*Cont'd*)

a continuous effort must be made to train existing staff in further aspects of telephonist work—for example, to handle exchange accounts work, enquiries and exchange clerical work. At most exchanges operators are trained first to connect calls and at a later stage to price tickets for calls (accounts work); to deal with enquiry calls and the routine clerical work associated with the running of an exchange. Third, there must also be a constant effort to develop further the skill of newly trained telephonists so as to maintain the corporate efficiency of the exchange staff at a high level.

The main feature of the previous training scheme which was introduced in 1946 (described in the August, 1949 and August, 1951 issues of the *Journal*) was an initial five weeks course of instruction at a central school where practical training was provided largely with artificial traffic. This was followed by two or three weeks training at the operator's own exchange to increase her manipulative skill. At the end of this period a qualifying test was given and, if satisfactory, the operator took up exchange duty. No further instruction was given, apart from refresher training to put over new developments and procedures and to keep experienced operators up to date (one hour a week for a telephonist at zone and group centres and one hour a month elsewhere). Specialist instructors were employed for school instruction and for the post school and refresher training in the exchange.

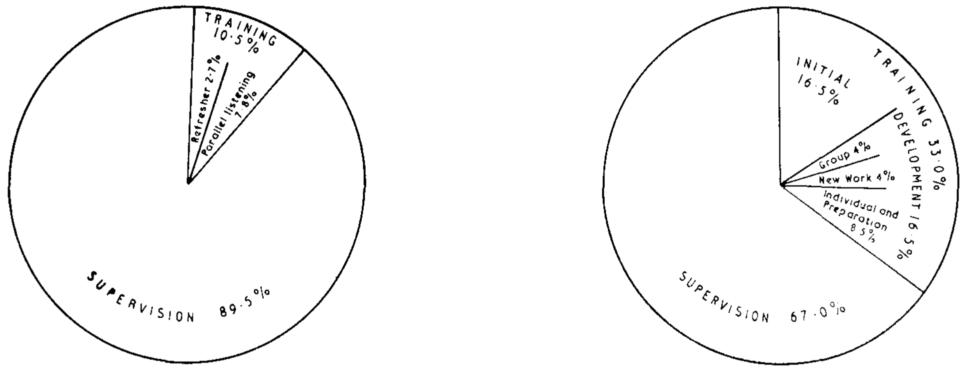
Main features of the Ray Scheme

To meet current conditions, a training plan was needed which would give the trainee, in the shortest possible time, the procedural knowledge and manipulative skill to enable her to deal with conditions she would regularly encounter. She would, of course, need further instruction to deal with all those other conditions which occur infrequently. This meant that there should be some form of instruction after the recruit had taken up effective duty. This further stage of training, which is given over a period of several months at convenient opportunities, is a particular feature of the Ray Scheme.

Each Assistant Supervisor in the exchange has about a dozen telephonists in her care, whom she trains as required in the various aspects of exchange work. From time to time new recruits are assigned to her to replace telephonists who have resigned or been promoted.

Initial training given to a new entrant is kept to a minimum consistent with operational needs. Thereafter, her operating skill is continuously developed both by experience and as a result of guidance by her own Assistant Supervisor.

When giving initial training to new recruits, the



These two diagrams illustrate how the proportion of a recruit's time spent on training has been increased more than threefold by the Ray Scheme. Left, the picture before the Ray scheme was introduced and right, the situation now.

Assistant Supervisor pays full time attention to them for three weeks and at most exchanges she has to do this not more than twice a year. For the rest of the year, her work is divided between supervision and what is called development training, that is, training to increase the efficiency of the staff under her control and to instruct them in new procedures and techniques.

At exchanges with a Chief Supervisor in charge one of the Supervisors is designated "Training Supervisor" and is responsible for the development training of Assistant Supervisors in the same way as telephonists are looked after by the Assistant Supervisors. At smaller exchanges this training is the responsibility of the officer in charge. As well as giving individual tuition the Training Supervisor holds regular meetings to co-ordinate training activities, studies the operational needs of the exchange from a training and efficiency view-point and is responsible for the training syllabus and methods to ensure that the training plan is adjusted to local needs.

In the first stage of initial training the trainee is taught enough to allow her to operate effectively at her own exchange. Training in those aspects of operating which occur infrequently—for instance, the more uncommon difficulties met in connecting calls and background knowledge such as a general understanding of the STD system which is of value in handling customers' requests for assistance —is left to stage three. Limiting the amount of material taught at the outset avoids the danger of a trainee becoming confused by too much information in a short time and allows her to graduate quickly to effective status.

The training consists of periods of instruction interspersed with practice in handling live calls. More than 50 per cent of the time in stage one is spent in such practice, the Assistant Supervisor

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	STAGE 1	STAGE 2		STAGE 3
Recruited and assigned to an Assistant Supervisor.	Regular instruction and practice, with full time attention of Assistant Supervisor. Learns sufficient to be able to operate effectively.	Consolidating by practice what was learnt in stage 1. Part time attention of Assistant Supervisor.	Qualifying Test.	Assigned to operating duties. Training given at intervals, spread over three months, dealing with items excluded from stage 1. Usually 20 to 30 items.
	← 3 weeks →	← 2 weeks →		← 3 months →

RAY SCHEME *(Cont'd)*

listening in parallel. If the trainee is asked for a particular type of call or meets a difficulty the procedure for which has not yet been explained to her, the Assistant Supervisor handles it herself. In this way, therefore, trainees learn from seeing the work done as well as from formal instruction. The local pattern of calls is taken into account in determining the order and extent of the stage one training. Stage two consolidates the work taught in stage one, gradually developing by continued practice a satisfactory level of output and skill. To qualify at the end of stage two, an output of at least 75 per cent of a full load with not more than 5 per cent of errors must be achieved—the same standard as under the pre-Ray scheme. This standard is achieved in 25 days compared with 35 to 40 days previously.

These operators at the Cunningham Exchange are engaged on directory enquiry work.

	Pre-Ray Scheme	Ray Scheme
Qualifying standard	At least 75% of full load with not more than 5% errors.	Same as pre-Ray Scheme.
Duration of training	Stage 1. 25 days at a central school. Stage 2. 10 to 15 days working experience.	Stage 1. 15 days local training. Stage 2. 10 days working experience.
Organisation	In classes of eight for Stage 1, with three Assistant Supervisors. In groups of two to five for Stage 2, with one Assistant Supervisor.	In pairs for both stages, with one Assistant Supervisor.
Assistant Supervisor's time per trainee	2½ weeks.	2 weeks.

Development Training

The telephonist later receives further training which keeps her knowledge up to date, increases her skill and enables her to deal with new kinds of work—for example, enquiries. At a typical exchange development training occupies about a sixth of each Assistant Supervisor's time in a year. This includes time spent in preparation, during which Assistant Supervisors are encouraged to study the work of their telephonists and so adjust training to meet individual needs. Assistant Supervisors are also encouraged to operate occasionally to maintain their skill so that they are able to demonstrate good operating techniques and to keep up to date on the difficulties which telephonists experience.

An important feature of the Ray Scheme is that the time made available to Assistant Supervisors for group and individual training allows them to develop a close personal relationship with their telephonists. Moreover, to train effectively, Assistant Supervisors need to keep themselves up to date on all aspects of the telephonists' work, to adjust the training to the individual and to develop a satisfactory training technique. In doing this they have a much greater opportunity than before to use effectively the first-hand knowledge and experience they gained as telephonists.

The time spent on direct supervision is reduced in favour of ensuring greater efficiency through training. As a result, the ratio of telephonists to Assistant Supervisors engaged in first-line supervision is greater than hitherto, but care is taken to ensure that sufficient supervision is available to meet practical requirements. In addition, time spent by an Assistant Supervisor in developing her telephonists results in a good standard of work which is reflected in a reduced need for assistance during normal operating.

Long before the Ray Scheme the advantage of first-line supervisors having responsibility for a team of telephonists had been recognised. Standing instructions stated that "a section supervisor is primarily a leader" and stipulated that "one of her essential aims . . . . . should be to improve the

Clerical Telephonists dealing with staff and equipment records at the Monarch Exchange.

standard of work of operators in her team by guidance and advice". The instructions also indicated that the supervisor should keep in constant touch with the operating efficiency of her team by listening in parallel and through general supervision and recognised that she could obtain the goodwill of her staff "by showing a personal interest in their welfare and tact and sympathy in their difficulties". In practice, however, there was difficulty in applying these instructions before the Ray Scheme because the Assistant Supervisor force was divided into groups with functional responsibilities but without direct responsibility for the efficiency of individual telephonists. This is now altered so that all Assistant Supervisors are concerned with both supervision and training, including a specific responsibility for the efficiency of a group of telephonists.

This new arrangement recognises that when an Assistant Supervisor is supervising she cannot at the same time give efficiency training and although required to supervise part of the operational work of the exchange from day to day, she is also allocated specific periods each week when she is free to concentrate on the training of her telephonists. When supervising, she would have telephonists from various groups—including some of her own—in the section of the exchange under her control.

Since classroom instruction (as at the Wing Schools) is generally effective in teaching a group of trainees with a minimum of instructors it may be puzzling to some to see how the Ray Scheme can be justified economically. The explanation lies in the fact that as the training of a telephonist involves developing her operating skill, considerable practice has to be arranged. This practice needs close supervision by an instructor so that operating errors can be observed. With a class of

OVER

	Group Training	Individual Training	New Work Training
Nature	Group discussion between Assistant Supervisor and her telephonists.	Individual instruction, either at switchboard or in a training room as appropriate.	Individual instruction and practice.
Object	To introduce new procedures, to follow up common failings and to give reminders about special procedures.	To further develop an operator's skill.	To enable a telephonist to deal with new kinds of work, e.g. enquiry calls.
Frequency and duration	One hour each week.	As required, at discretion of Assistant Supervisor. Mainly directed to telephonists recently trained initially or for new work. Assistant Supervisors have six hours a week for this work.	As required, i.e. when telephonist is due to move into more senior rota, covering a fresh range of work.

A Monarch Exchange operator prices tickets. ▶

RAY SCHEME *(Concluded)*

eight at a central school simultaneous practice for all trainees would have required eight instructors—four to supervise and four to act as customers making calls. Since such an arrangement could not have been justified economically it was arranged that two trainees should be given practice together, using two instructors, while the other six revised procedures under supervision of a third instructor. Even so, this arrangement was expensive in instructor time. The new arrangements dispense with "revision time" and since training is given locally practice can be with live traffic, thus avoiding the need for an instructor to act as a customer.

Although practice by handling live traffic is advantageous, care has to be taken to ensure that customers do not suffer from immature operating and that training does not deteriorate to the state in which a trainee is expected to learn merely by watching an experienced operator and then developing her skill by a process of trial and error. Customer service is safeguarded by the Assistant Supervisor being in parallel with the trainee during the early stages. The quality of training is controlled by the Training Supervisor who ensures that there is a satisfactory syllabus adjusted to local needs and that the training methods, with periods of formal instruction interspersed with live practice, are up to date. F. H. C. Brook, in his book *Personnel Management and Welfare* says that training on the job stimulates recruits to give their best and spurs them to acquire an efficient technique. The truth of this is supported by the experience already gained under the Ray Scheme. It is significant, too, that under the new arrangements telephonist trainees, many of whom are young girls, do not have to go away from home for training. Nor, after training, do they have to start all over again getting to know the staff at their exchange.

The essence of the Ray Scheme is that Assistant Supervisor effort is redeployed to give a better balance between time spent on direct supervision and that spent in ensuring efficiency through training. By redeploying effort the Assistant Supervisor can now fully meet her responsibilities and participants in the Ray Scheme have quickly recognised the opportunities open to them and the influence they can have on producing an efficient group of telephonists. They are now responsible for a specific part of the exchange complement and job satisfaction is thereby enhanced.

The co-operation of the supervising staff at the experimental centres in making use of their greater opportunities to promote operating efficiency has contributed materially to the effective operation of the Ray Scheme. Careful preparation was, of course, essential to ensure that everyone knew her part and was able to play it efficiently. As the Ray Scheme is being extended, local preparation is being augmented by short courses at Headquarters for all senior supervising and telecommunications traffic staff involved. In addition, supervising officers who have not previously been instructors are being trained in teaching techniques.

It is difficult to assess in quantitative terms the success of a scheme essentially concerned with ways in which people are organised and the parts they have to play. It can be claimed, however, that the scheme helps telephonists to settle down quickly in a friendly atmosphere, to become proficient and to develop self-reliance. For the Assistant Supervisors the benefits to be gained stem from the sense they can acquire of making a significant contribution to the efficiency and spirit of their exchanges through their skill, knowledge and enthusiasm.

THE AUTHORS

Mr. J. E. D. Stark, BSc, DPR, a Chief Telecommunications Superintendent, entered the Post Office in 1933. He became Assistant Traffic Superintendent in 1937 and from 1943 to 1946 served in the Technical (Signals) Branch of the RAF. From 1947 to 1958, when he was promoted to his present rank, he was an ATC II in the Midland Region Telecommunications Branch. Until July, 1963 he was a member of ITD Operations Branch, closely associated with the development of the Ray Scheme. He is now employed in the Defence Division of the ETE.

Mr. C. Hall is a temporary Chief Telecommunications Superintendent in charge of the Exchange Management Section of ITD's Operations Branch. He entered the Post Office in 1936 and joined North Western Region Headquarters on its inception in 1939. After helping to inaugurate Midland Region Headquarters in 1940 he moved to Coventry in 1947 and on promotion to Senior Telecommunications Superintendent in 1951 he moved to ITD where, since 1959, he has been concerned with national arrangements for operator training.

AND NOW—TAT-3

By J. F. BAMPTON
and P. T. F. KELLY

TAT-3, a new 3,500-nautical-mile trans-Atlantic submarine cable linking Britain and the United States and the longest so far laid anywhere in the world, was brought into service in early October. The capacity of the trans-Atlantic cable network has now been increased from 36 circuits in 1956 to 384. This article describes the new cable system and traces the growth of the trans-Atlantic submarine cable network

The shore-end cable, floated on balloons, is towed ashore at Widemouth Bay, Cornwall.

WHILE the telephone administrations of the United States and the British Commonwealth push ahead to span large areas of the world with high quality, multi-circuit submarine telephone cables, one problem remains: how to keep pace with the ever-growing circuit requirements across the Atlantic.

In 1953 the United States, Canada and Britain combined to provide TAT-1, the first trans-Atlantic cable system, which was opened for service in 1956. This system had a capacity of 36 circuits and the main Newfoundland to Scotland link comprised a two-cable system with flexible repeaters developed by the American Telephone and Telegraph Company (AT and T). The Newfoundland to Nova Scotia section was a single

OVER

On the foredeck of HMTS *Alert*, the cable end is secured to a tow rope before the shore-end cable is taken ashore.

TAT-3 (*Continued*)

cable system with a capacity of 60 circuits with rigid repeaters of British Post Office design.

The high quality of the circuits stimulated telephone and telegraph traffic across the Atlantic and the cable system was soon full. A second cable—TAT-2, a duplicate of TAT-1 except that it terminated in France—was laid in 1959. Both systems then had their capacities doubled by applying, at the terminals, devices for using the bandwidth more efficiently (by introducing 3 kc/s spaced channel equipment originally developed by the British Post Office) and for using spare time on the circuit even during actual conversations to carry more calls (by the use of TASI, the Time Assignment Speech Interpolation equipment developed by AT and T).

Britain and Canada then jointly provided CANTAT, the first all-British single-cable, 60-circuit system. The design of this system was more efficient and only a third of the cost per circuit of the previous systems. CANTAT was being used to full capacity soon after it was opened in December, 1961, and a year later it was converted to 3 kc/s operation to increase the number of circuits to 80. Thus the original 36 circuits available in 1956 had been increased to 256 in six years.

Meanwhile, the AT and T Company had begun a new development—a 128-channel, single-cable system using rigid repeaters—which owed much of its conception to the lightweight cable and rigid repeater techniques developed by the British Post

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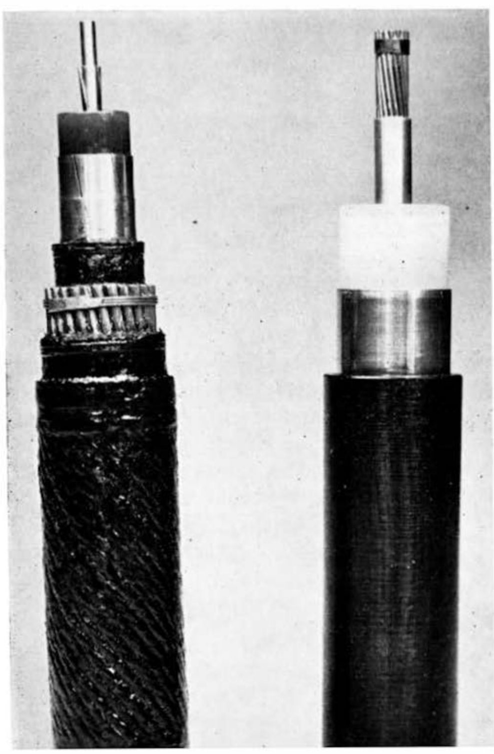
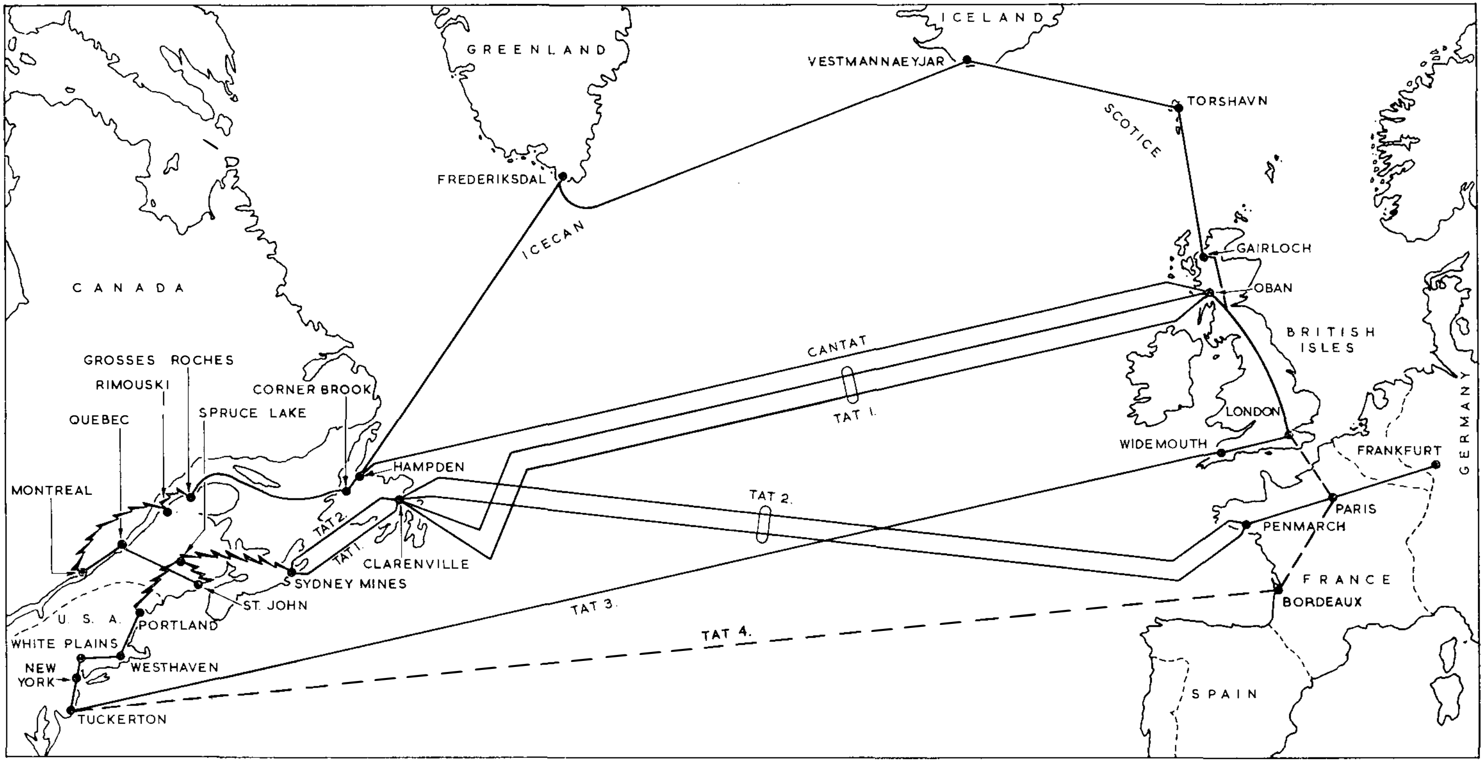


The cable used for TAT-3 (right) and that employed for TAT-1. The 41 high-tensile wires which form the strength member are surrounded by a seam-welded copper tube to form an inner conductor, then covered with extruded polythene, a single copper tube and a sheath of polythene compound. The overall diameter of the cable is 1.25 ins.



This diagram shows the trans-Atlantic cables which have been laid since 1953 when TAT-1 was provided. TAT-4 is planned for completion in 1965.

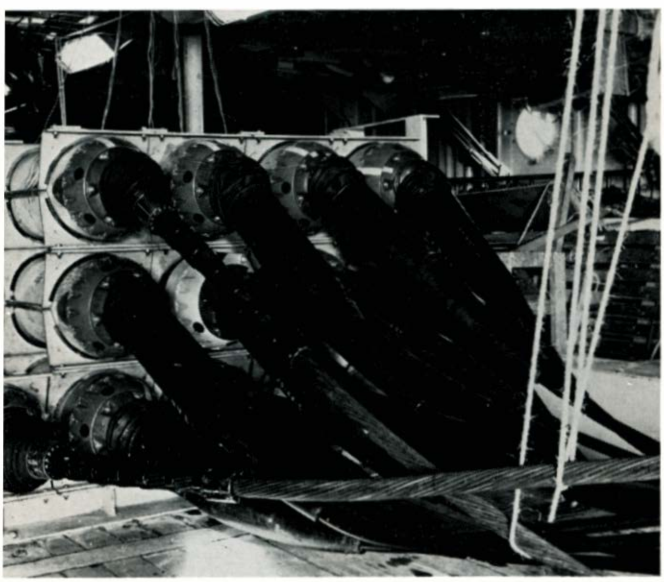
TAT-3 (*Continued*)

Office for CANTAT. The British Post Office and the AT and T Company agreed to share the cost of providing a first long-distance cable of this design—a 3,500 nautical mile long direct link between Tuckerton, New Jersey, USA and Widemouth near Bude, in Cornwall. Thus, TAT-3 was born.

Work on TAT-3 began early in 1961. Bringing large resources to bear on the project the AT and T Company built a new factory to manufacture the repeaters under clinical conditions, using automated testing processes to speed production. Then a contract for much of the cable was placed with a British contractor who, in 18 months, constructed a new factory to make it. Finally, a new AT and T cable ship—*Long Lines*—the largest in the world and incorporating many original ideas, was built to lay TAT-3.

As with all projects which break new ground, TAT-3 had its problems and difficulties. When, for instance, *Long Lines* was 90 per cent complete the firm building it went bankrupt and the ship had to be completed by another firm in Hamburg. This was a major blow because *Long Lines* was due to lay two short Caribbean cables of the new design and then proceed immediately with the TAT-3 cable.

However, so alike is the basic design of the TAT-3 system to British Post Office systems that HMTS *Alert*, one of the British Post Office cable ships, was able to help out. After minor modifications had been carried out to *Alert's* well tried 5-sheave laying gear she set off for the United States and laid some 630 nautical miles of the new cable and 33 repeaters from Tuckerton, New Jersey. *Alert* also laid the shore-end cable at Widemouth in May, 1963. Earlier *Alert* had laid the short Florida to Jamaica and Jamaica to Panama cables which were prototypes of the new design.



Finally, *Long Lines* was completed and in July, 1963, she took over from *Alert* and completed laying the remaining 2,900 nautical miles and 149 repeaters to Widemouth in two separate lays.

The cable used for TAT-3 is 1.00 inch in diameter and similar to the 0.99 inch cable used in CANTAT, although there are some constructional differences. It derives its strength from the 41 high-tensile steel wires which make up the centre strand. Unlike that in the CANTAT cable the centre strand is not torsionally balanced. Surrounding the centre strand is an inner copper conductor, somewhat thicker than that used on CANTAT, and swaged down to the required diameter, thus stiffening the inner unit against twisting under tension. Low density polythene is extruded over the centre conductor to give the desired one-inch diameter.

The return conductor consists of a copper tube 0.01 inch thick with a simple overlap longitudinal seam that withstands bending to a three-foot radius without buckling or changing its electrical characteristics. Over the return conductor a high-density black polythene jacket, one-eighth of an inch thick, protects the finished cable and grips the return conductor tightly. Under laying tensions the cable twists less than one half a turn every 100 feet. Twisting during the laying of the rigid repeaters is considerably less than that which occurs in conventional armoured cable and there is little chance of damage occurring.

For the shallow water sections, less than 400 fathoms, the centre conductor of the TAT-3 cable is replaced by one of solid copper. Armour wires covered in neoprene are added for strength and protection. Over sections of the route suspected to be subject to heavy trawling a further layer of neoprene covered armoured wires is added.

Some 1,790 nautical miles of the TAT-3 lightweight cable and 410 miles of the armoured cable

A view of the inside of *Alert's* centre castle, showing the forward end of a repeater stack with the cable ends connected to American type rigid repeaters of the TAT-3 cable.

THIS IS LONG LINES

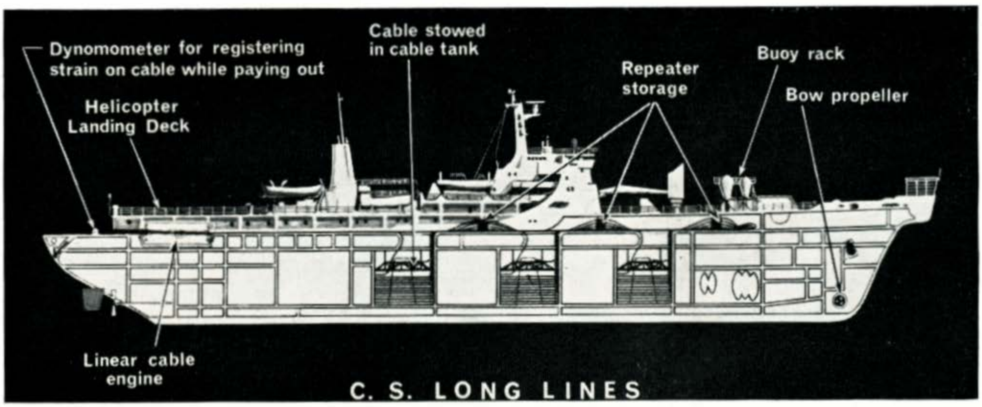
Long Lines (11,200 tons and 511 ft long) is the world's biggest cable-laying ship and was built especially for laying TAT-3 in Hamburg, Western Germany.

She cost about £6.8 million to build and is owned by the Trans-Oceanic Cable Ship Company, a subsidiary of the AT and T Company and operated by Isthmian Lines Inc. She has a cruising speed of 15 knots and can lay cable at the rate of 7-8 knots. Her cable-carrying capacity is 2,000 nautical miles of lightweight cable.

Technically, *Long Lines* is notable for her ability to lay rigid repeaters without reducing speed. This is achieved by paying out the cable through a linear cable engine at the stern of the ship. During the laying, the cable passes through the engine at a controlled speed, firmly gripped between caterpillar tracks to prevent it running away as a result of the pull of cable behind the ship. When a repeater arrives at the cable engine, the caterpillar tracks open and swallow it, but still maintain a firm grip.

The cable engine, which was developed by the AT and T Company, is 40 ft long, 15 ft high and 10 ft wide and weighs 85 tons.

Above: *Long Lines* sets out from New York Harbour. Below: A cutaway drawing of *Long Lines*.



were manufactured by Standard Telephones and Cables Ltd. at their new factory built alongside their existing submarine cable factory at Southampton and production reached the remarkably high rate of about 100 nautical miles a week. About 1,300 nautical miles of cable were also made at the Western Electric Company's factory at Baltimore, USA. Inspection was undertaken jointly by the British Post Office and Western Electric Company staff.

The terminal equipment at the Tuckerton and Widemouth terminal stations is mainly of AT and T design but the special group and supergroup translating equipment at Widemouth and the 3 kc/s spaced channel equipment at both stations were provided by the British Post Office. The power feeding equipment at the ends of the system together provide a feeding voltage of 11,000 volts—5,500 volts at each end—to energise the repeaters,

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TAT-3 (*Concluded*)

the line current being 389 milliamperes. To help maintain the system, pilots at a frequency of 96 kc/s are provided in each 60-108 kc/s group path. The complete equipment, including the power feeding equipment but excluding the channel equipment, is duplicated at each station and there is an automatic changeover if a fault occurs on any of the terminal equipment.

The repeaters and equalisers for the TAT-3 system were manufactured by the Western Electric Company at their new factory at Clark, New Jersey, which, at full capacity can produce up to 400 repeaters a year. The repeaters are made under the "dairy" technique in which the temperature and humidity in the working areas are closely controlled. Life histories of all components and sub-assemblies and the tests to which they are subjected are translated on to punch cards which are then fed into a central computer so that the complete history and trend of any component or of a complete repeater is readily available.

The repeaters, of which 182 are used in the system, are 13 inches in diameter, 36 inches long and weigh about 500 lb. Each repeater amplifies the transmission path in both directions (the band 108-504 kc/s in one direction, and 660-1052 kc/s in the other) and the amplification characteristic is shaped so that each repeater effectively cancels out the loss of about 20 nautical miles of cable. The actual amplification at 1,000 kc/s is 48 db, that is, the signals are magnified by a factor of 63,000 in each repeater.

Safeguards similar to those in the CANTAT repeaters are built into the TAT-3 repeaters. Duplicate amplifiers are arranged so that signals normally pass through both in parallel, but should one fail the other takes over the full load. The outer case of the repeater is of beryllium copper and a new feature is the flexible connection—called a gimbal—at each end which permits the cable ends to move relatively freely during laying.

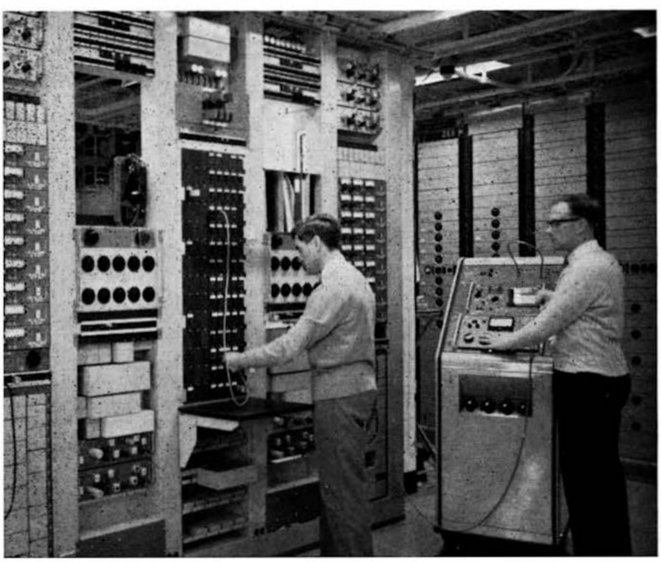
TAT-3 has cost about £16 million for its 128 circuits which means that like CANTAT, it has achieved a considerable reduction in the cost per circuit compared with TAT-1.

About half of the circuits in TAT-3 will be extended to Europe for through traffic with the USA; all these circuits will be required immediately. In the other half of the cable there will be sufficient circuits to meet immediate traffic requirements between Britain and the USA, with spares to cater for only a few months' growth of traffic, concurrently running at an annual rate of 15 per cent.

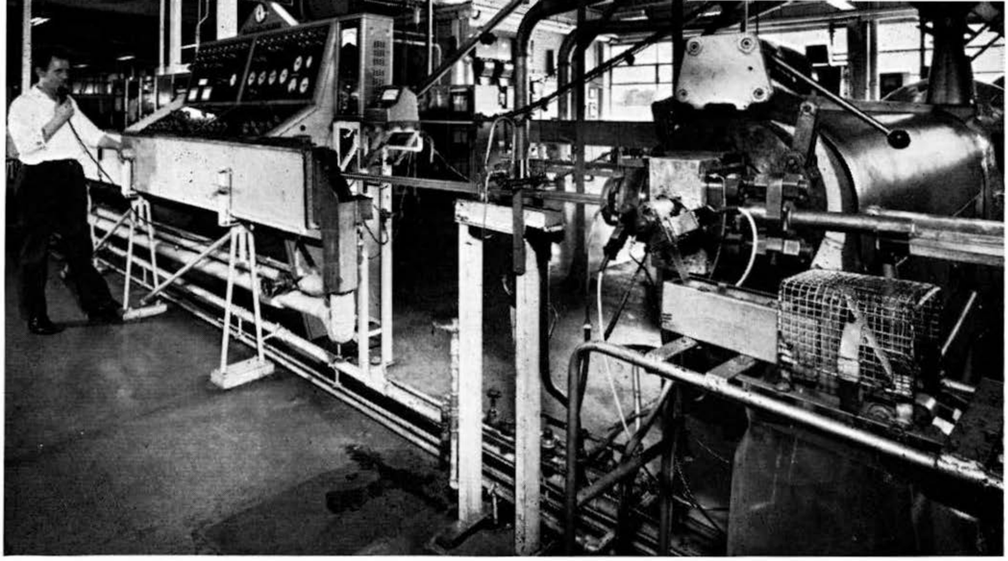
Plans are well advanced for the laying of yet another trans-Atlantic cable—this time TAT-4—linking France with the United States. TAT-4 will be a duplicate of TAT-3 and is scheduled for completion in 1965.

The British Post Office is also considering the design of a 360-channel system for route lengths of up to 3,500 nautical miles which could be available in 1966-67 and would show a ten-fold increase over the capacity of the TAT-1 system. The AT and T Company are developing a system using transistorised repeaters which will provide 720 circuits. It now seems possible that submarine cable systems suitable for the Atlantic route with capacities in the order of 1,000 channels are possible in the very near future and that they can be provided at a cost per circuit showing even greater reductions than hitherto.

The struggle to satisfy trans-Atlantic circuit demands is continuous. Only two years ago CANTAT made a 50 per cent increase in the number of available circuits. Now, with the successful completion of TAT-3 a further 50 per cent increase in the total trans-Atlantic circuit capacity has been achieved.



A view of the repeater station at Widemouth, showing some of the British and American terminal equipment. Similar equipment is installed at Tuckerton terminal station. At each end of the system power-feeding equipment provides a feeding voltage of 5,500 volts to energise repeaters.



At the Standard Telephones and Cables factory at Southampton polythene is extruded on to the inner conductor to form the core of the cable which was made in 20-n. mile lengths.

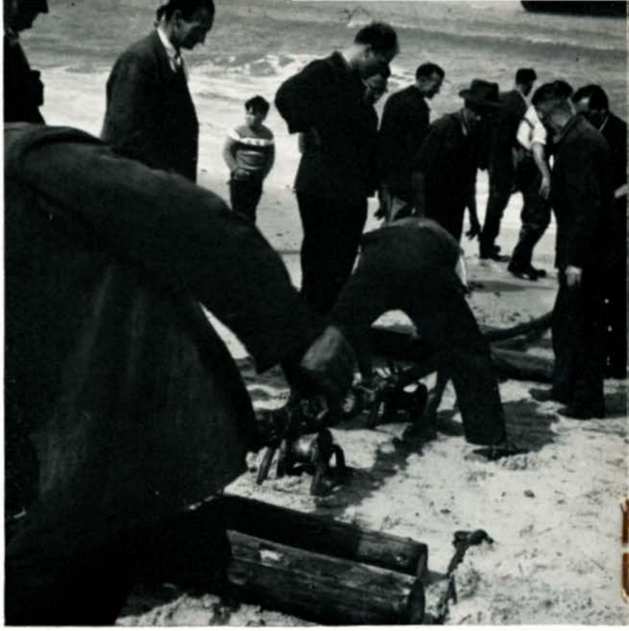
At an American factory a repeater (right) is prepared for its expoxy casing and (left) two assistants remove a completed unit. The repeaters are manufactured under clinical conditions.

★

THE AUTHORS

Mr. J. F. Bampton, an Assistant Staff Engineer in the Engineering Department, has an honours degree in Engineering and is an Associate Member of the Institution of Electrical Engineers. After early service at the Post Office Research Station he joined the Engineer-in-Chief's Office, Lines Branch, in 1942, and was concerned with the development of military communications equipment until 1944 when he was loaned to the Indian Government as a Telecommunications Engineer to the railways of Southern India. Returning to Lines Branch in 1946, he worked on carrier systems on submarine cables and has lately been concerned with trans-oceanic cable communications, including the CANTAT and COMPAC projects.

Mr. P. T. F. Kelly joined the Post Office London Telecommunications Region, South West Area, as a Youth-in-Training in 1944. After serving at the Central Training School at Stone he was appointed Assistant Engineer in 1948 in the Engineering Training Branch, transferring to the Transmission and Main Lines Branch on promotion to Executive Engineer in 1950. In 1953 he joined the project team planning the first trans-Atlantic telephone cable project and on promotion to Senior Executive Engineer in 1957 was engaged on planning and development work in connection with submarine cable systems to the Continent of Europe. Lately he has been concerned with the TAT-3 project. He has an honours degree in Engineering and is an Associate Member of the Institution of Electrical Engineers.



THREE AT C

Left: Post Office staff from Norwich Area handling a cable ashore. Above: Winching in the sea earth cables. The cables were hauled up the beach and through a trench in the sand-dunes to the anchorage manhole.

)NCE AT WINTERTON

Photographs: H. R. HOWLETT

THE pictures on these pages show better than words can tell of the scenes on the beach at Winterton, Norfolk, when the shore-end cables were recently laid for three new submarine telephone cables across the North Sea—two to Germany and the third to Denmark. All three shore-end cables were laid at the same time to save expense.

The operation began on 25 May when the Danish cable ship *Peter Faber* left Korsor, Denmark, for Southampton. Here she picked up the three shore-end cables, sea-earth plates and other equipment before sailing for Winterton on 30 May, Post Office jointers having already spliced the earth plates to the cables.

Heavy swells and near-gale-force winds held up laying operations until 5 June when a line attached to the UK-Germany No. 1 shore-end cable was fired by rocket on to the beach. Floated on balloons, the cable was then hauled ashore by tractor.

Attempts to lay the shore-end of the UK-Germany No. 2 cable by firing a line ashore, failed. So, too, did attempts by *Peter Faber's* motor launch to take the line ashore, the boat twice overturning in heavy seas. Finally, it was taken ashore in a rowing boat.

Peter Faber's motor launch carried the line ashore for the UK-Denmark shore-end cable on 8 June and by the following evening all three cables had been dug into trenches on the beach and connected to the nearby repeater station and the three sea-earth plates had been laid.

The two UK-Germany cables, which will be jointly owned by the British and West German Post Offices, will terminate at Borkum and the UK-Denmark cable, jointly owned by the British and Danish Post Offices, will be linked to shore-end cables at Esbjerg. Each new cable will provide capacity for 120 simultaneous telephone conversations. The first of the new cables to Germany is expected to be brought into service in February, 1964, and the other two later in that year. The three main cables will be laid by the British Post Office cable ship HMTS *Monarch*.

Left (above): Moving a cable into position on the beach, with *Peter Faber* in the background. Left (below): The end of the UK-Germany No. 1 Cable comes ashore at Winterton.

TRACKING DOWN THE ROT

By Miss E. M. BORROFF

BECAUSE it is now known that a small amount of decay—even in its early stages when it is invisible to the naked eye—can seriously weaken timber, the Materials Section of the Engineering Department's Test and Inspection Branch has been carrying out an unusual investigation.

How serious was this problem in the cable drums which the Post Office uses? Is sufficient protection achieved by brushing the drums with, or dipping them in, preservative—the method which has been used for many years? If not, is the extra cost of impregnating the drums with preservative under pressure justified?

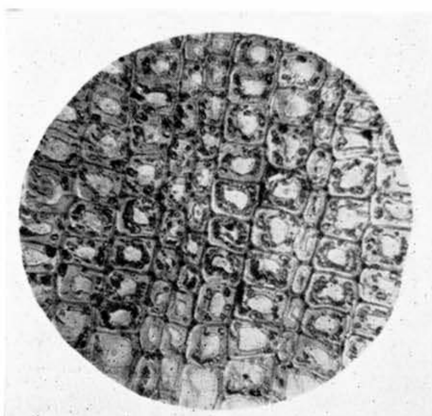
These were some of the questions to which the Materials Section, after more than a year's work on the problem, has now produced the answers.

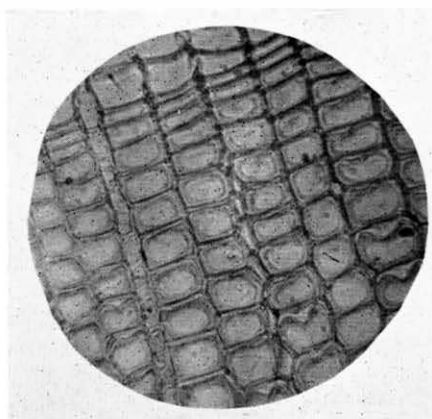
As a first step, the Materials Section collected samples of damaged timber from cable drums sent for repair during one month to both the Kidbrooke and Birmingham depots. Those pieces of wood which were visibly decayed were examined and noted. Then the remaining pieces which did not appear to be infected with decay, were brought back to the Section's laboratory in Studd Street, London, and put under close scrutiny by scientific staff.

From each piece of wood very fine slices were shaved off, stained and placed under microscopes through which they were viewed at magnifications of up to 1,000 times their actual size. The results were remarkable. Many of the apparently sound pieces of timber were found to contain brown and white rots which were seen as very fine threads or hyphae. Others were affected by soft rot which leaves tiny bore holes in the cell walls of the wood, and by the sapstain fungi which cause staining and when present in large amounts can reduce the strength of timber.

In fact, 55 per cent of the samples of drum timber which were examined were discovered to be infected with decay or excessive sapstain, proving conclusively that these organisms are much more widespread than had been thought. Since decay will always contribute to drum failures, it was obvious, too, that a much more adequate preservative treatment was needed and that the cost of pressure impregnating, which is only six per cent of the cost of a drum, was highly desirable.

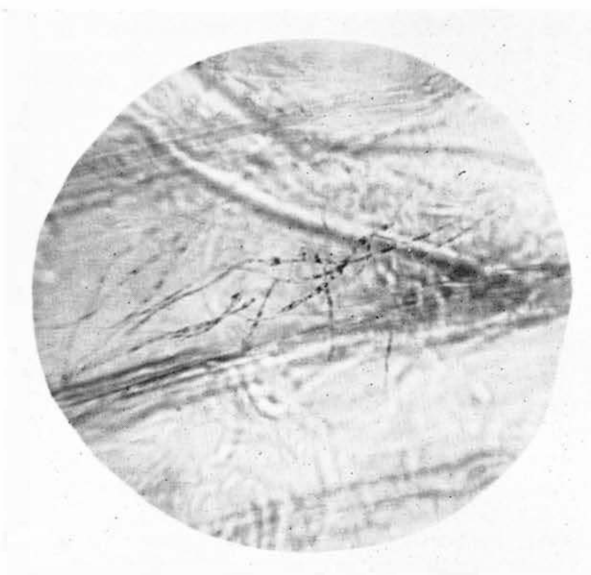
The evidence produced by the Materials Section has been accepted and in future all cable drums will be impregnated with preservative under pressure before they are delivered to the Post Office. As a result cable drums are expected to last longer before they need repair.

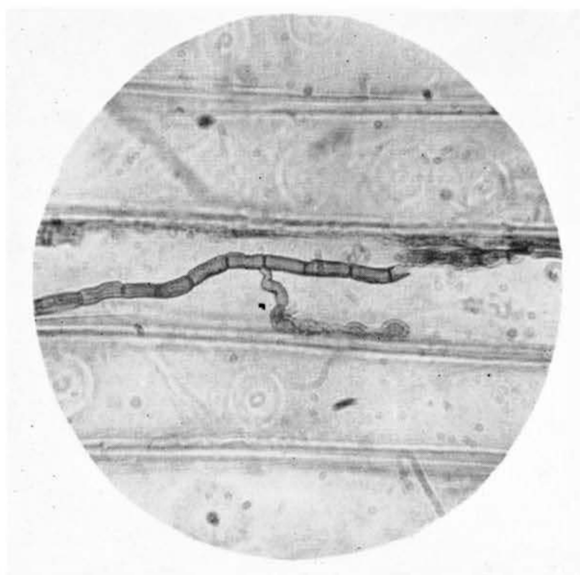




These photomicrographs of pieces of wood from cable drums show (left), bore holes in cell walls caused by soft rot fungus and above (right) sound wood.

Miss Borroff examines a piece of wood for traces of decay. The microtome, on the left of the picture, enables thin sections of wood to be cut mechanically.





These two pieces of wood from cable drums are seriously affected. Left: a wood destroying fungus and (right): a sapstain fungus. Excessive sapstain can seriously weaken timber.

★ **THE AUTHOR, Miss E. M. Borroff,** is an Experimental Officer in the London Materials Section of the Engineering Department's Test and Inspection Branch. She entered the Post Office in 1953 and since 1958 has been engaged on special investigations and development work.

★ ACROSS CANADA

When COMPAC, the Commonwealth Pacific Cable, is brought into service in December it will provide a substantial and important extension of the Commonwealth Cable system and for the first time people on opposite sides of the world will be able to speak to each other over a reliable telephone link. An essential part of this communications system will be a 3,000-mile-long microwave link which is being built across Canada to connect the CANTAT Cable which runs from Oban, in Scotland, to Montreal, and the COMPAC Cable which spans the Pacific from Australia and New Zealand to Vancouver. This article, from a report supplied by *Canadian Pacific* tells how this gigantic enterprise is being tackled

A helicopter lifts in a 40-ft long power-line pole at Marathon, Ontario, to supply electric power for a remote microwave tower—one of 136 which are being erected across Canada.

A SMALL army of men and machines is blazing a new trail across Canada. When they have finished, probably early in 1964, Canada will have a new 3,000-mile long microwave system which will play a vital part in world communications and at the same time expand and improve Canada's civil and defence communications system.

This giant project, which is being constructed and will be operated jointly by Canadian Pacific and Canadian National Telecommunications, will cost 36 million dollars (about £12 million)—or £4,000 a mile. Stretching from Montreal to Vancouver, the new system will provide up to 3,600 voice channels and contain 136 microwave stations. The system will also be tied in with existing Canadian Pacific and Canadian National microwave and ultra high frequency routes serving the Atlantic provinces, central Canada, the Yukon, the North-west territories and Vancouver Island as well as landline circuits operated by the two companies elsewhere in Canada.

For strategic defence reasons the route of the new microwave system is generally well away from existing communications facilities and spur lines or "drop outs" from the main system will feed major centres of population across Canada.

Work on this gigantic task began in the summer of 1962 and many of the 130 test stations which have to be built first are now being replaced by permanent structures. One of the first signs of construction of the system appeared in west-end Montreal in August, 1962, when a 300-ft high tower sprang up almost overnight. Three days later it disappeared.

This "here-today-gone-tomorrow" tower was a temporary microwave tower, built to test radio paths on the first link of the cross-Canada system. Today, a permanent 200-ft high self-supporting galvanised steel tower stands in its place.

A leapfrog technique was used by the project

BY MICROWAVE ★

engineers to determine radio paths and tower sites. Three towers, all of which could be raised and dismantled quickly, were used. The one in west-end Montreal was tested with a second tower at St. Lazare, Quebec, about 40 miles to the west. Meanwhile, the third tower was being erected at Alexandria, Ontario, another 40-miles westwards.

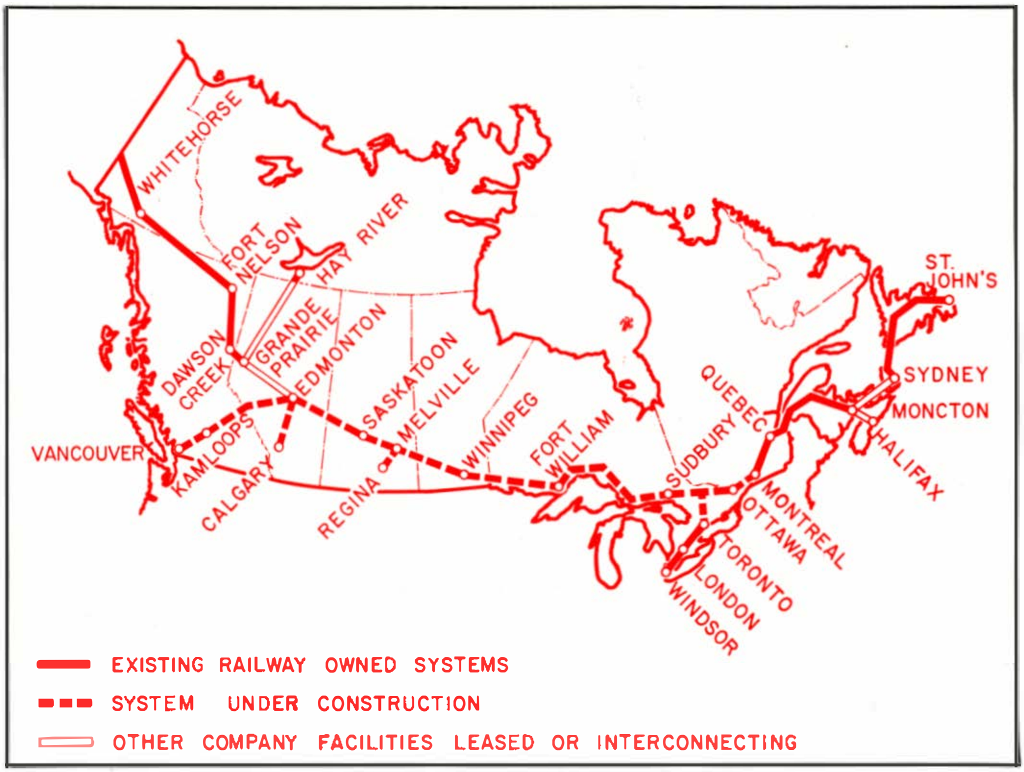
When the Montreal-St. Lazare tests were satisfactorily concluded, a second set of tests, this time between St. Lazare and Alexandria, was carried out. Number one tower at Montreal was dismantled in the meantime and erected again at site number four, yet another 40 odd miles to the west.

To meet the rapidly approaching construction date, simultaneous tests and early construction work took place in all areas along the 136 station route—in Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia.

The basic route of the new microwave system by-passes built-up areas that might suffer in the event of hostilities, thus ensuring as far as possible a continuing line of communications. The system is also equipped to provide automatic remote control, monitoring and warning systems. In areas where accessibility to the permanent towers will be difficult because of their location, radio equipment and power facilities, capable of operating unattended for long periods, have been specified.

From Montreal, the system heads west through rolling farmlands to a point in Ontario about 30 miles south-east of the national capital, Ottawa, where a branch line connects it to the cities. From there the line extends westward again towards Huntsville, Ontario, from where a spur line feeds Toronto. At Huntsville, the system juts north

OVER



Map showing the route of the new microwave system from Montreal to Vancouver. The system is scheduled to come into service early in 1964.

◀ **This is No. 1 Tower at Montreal, showing the huge dish-shape transmitting and receiving antenna surmounting the structure.**

ACROSS CANADA *(Concluded)*

towards Sudbury and follows the rugged, forbidding country north of the Great Lakes close to the route of the recently-completed Trans-Canada highway to the Fort William-Port Arthur region.

Winnipeg, in Manitoba, is served from a spur line moving south from the main system, and then the line of towers continues west again to Melville, Saskatchewan from where another "drop out" feeds Regina, the province's capital city.

From Melville, the system heads west once more to Saskatoon, then carries on to a point about 35 miles south of Edmonton, from where spur lines serve both that city and Calgary to the south. From here it follows a route through the Rockies, down the North Thompson River valley with a pause for a branch line to Kamloops, then finally on to the Pacific coast terminal at Vancouver.

The first link in the Commonwealth submarine cable system—the CANTAT cable between Britain and Canada—was completed in December, 1961. It connects London and Montreal and provides 80 trans-Atlantic telephone circuits.

COMPAC, the trans-Pacific cable which connects Canada with Australia and New Zealand by way of Hawaii and Fiji, was due to be opened for service on 2 December, 1963. The Australia to New Zealand section was opened for service in July, 1962 and the New Zealand to Fiji section in December, 1962.

The third link in the system will be SEACOM which will link Malaysia (Jesselton and Singapore) and Hong Kong and is due for completion in 1964. By 1966, it will be extended to Australia to join COMPAC.

Construction problems have been formidable. High in the Rockies drilling crews have clambered up mountain sides to set the bases for towers. Last March in Northern Ontario, not far from White River, a helicopter had to be used to set in poles and erect the lines so that power could be supplied to an almost inaccessible tower a mile and a half away from the nearest outlet.

Where possible, commercial power supplies are being used. However, the stations, whether manned or unmanned are all equipped with standby power generators which contain no-break systems providing continuous operation in the case of a commercial power failure.

In the main, the towers along the network are of the guyed type and built of prefabricated steel. Station structures at each location house both the microwave equipment and the standby power facilities. However, in the urban areas served by the spurs, towers are self-supporting and made of galvanized steel and capable of supporting eight 10 ft diameter microwave antennae. This design is dictated by space limitations and these towers, even the 200 ft high one now completed in Montreal, are less than 30 ft square at ground level.

Initially, the new microwave system will consist of two channels (one working and the other standby) each capable of providing 600 voice circuits. The latest engineering techniques have been embodied in the standby facilities so that no significant interruption will be experienced when switching from the main circuit to the standby channel. Provision has been made for additional channels to be superimposed on the system as needed. The ultimate capacity of the system, when fully loaded, will be 3,600 voice channels.

The travelling wave tubes used in the system are the most up-to-date for microwave amplification and four of them, each costing 450 dollars (£150) are provided at each of the 136 stations. Although sharply-focused antennae of the parabolic type are used for transmitting and receiving the radio frequency signals as they pass from station to station along the link, less than one-millionth of the energy transmitted at one station is picked up at the next.

To make up for this loss as the signal crosses the gap, tremendous amplification is required at each repeater. This is the task of the travelling wave tube—it boosts the power of the signal at least one million times before it is relayed to the next station.

KEEPING THE PRESS IN THE PICTURE

By L. A. G. PARNELL
(who also took the pictures)

In the Picture Room at Electra House Post Office staff receive and transmit more than 13,000 pictures a year over nearly 100 separate phototelegraph services covering most parts of the world

At work on the board for switching overseas picture circuits through to Fleet Street offices of newspapers and agencies.

FEW people are surprised today when a picture illustrating an event abroad, sometimes on the other side of the world, appears in a newspaper only a few hours after it has happened.

That this is so is largely due to the work of the Post Office's London Public Picture Station at Electra House where a staff of overseas telegraph operators and engineers maintain the phototelegraph services between Britain and many foreign countries. In 1953 the Station handled 7,420 pictures. Last year the total rose to 13,400.

Not all the pictures the Station handles are for newspapers, however. In addition, it receives and transmits pictures of documents, machine drawings, fashion designs and even finger prints. On one occasion a Swedish firm holding its 50th anniversary dinner sent the front page of the menu to its South American branch where a similar dinner was being held.

The story of phototelegraphy goes back to over a century ago when Alexander Bain, a Scot, had the idea of transmitting pictures by a method involving the use of pendulums swinging in synchronism. Lack of suitable equipment hampered his early experiments but with the invention and development at the turn of the century of cells with photo-sensitive properties facsimile transmission over wire circuits seemed to be a commercial proposition.

Far-sighted engineers then visualised using facsimile over radio circuits and set their sights accordingly, with the result that in May, 1926, the first radio circuit for facsimile working was opened between the London Office of the Marconi Wireless Telegraph Company and the New York Office of the Radio Corporation of America.

The picture to be transmitted was prepared in a negative form and wrapped round a glass cylinder in the centre of which was a powerful electric light focused down to a very small point. As the cylinder rotated, the light point scanned a very narrow line

OVER

A general view of the picture transmitting and receiving equipment at Electra House.

KEEPING THE PRESS IN THE PICTURE (*Cont'd*)

width of the negative, moving over the whole picture as the cylinder moved along on a lead screw and picking out the values of all parts of the picture by penetrating the light areas and shining not at all or only dimly through the dark portions. The varying degrees of light penetrating the film were passed to a photo-electric cell which automatically changed the amount of current it conducted according to the intensity of the light received through the film. The radio transmitter responded to these light variations by transmitting a series of dots—very few and very short for light parts of the picture and in increasing numbers and lengths for the darker parts.

Recording the picture was done literally with hot air. As a roll of sensitised paper unwound slowly from the receiver a hot-air gun travelled back and forth across it, blowing out a stream of electrically-heated air. To construct the picture, the hot air was allowed to strike the paper directly or was blown aside by a cold air stream from the side of the gun. The cold air was controlled by a valve which conducted according to the incoming signal, either shutting off the cold air completely—in which case the hot air stream made a dark mark on the paper—or blowing so much cold air across the hot air stream that the paper was left white. Varying signals caused different degrees of hot air to record the tonal shades of the picture which was produced as a positive.

The introduction of short-wave circuits in the late 1920s provided an increased band-width and led to the development of a new system—the Constant Frequency Variable Dot—in which synchronous dots, varying in length according to the tonal values of the picture, were transmitted. Although the system produced a great improvement in the quality of pictures it was very slow, the drum revolving at only 20 revolutions a minute and taking about half an hour to transmit the average picture.

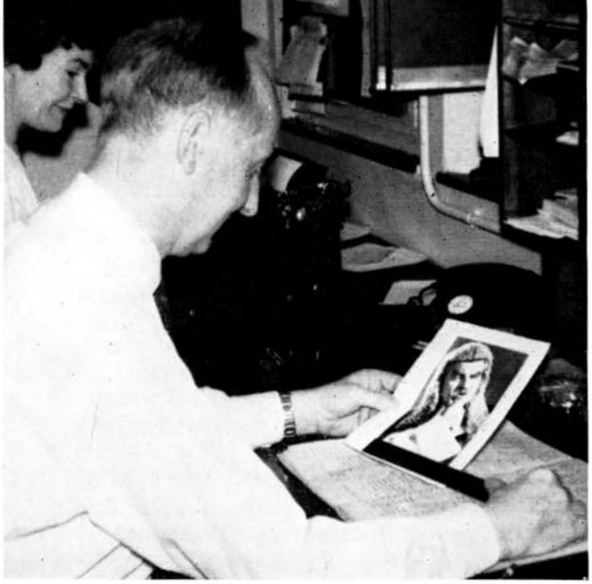
Then, in the late 1930s, came the Sub-Carrier Frequency Modulation system, which is still used on most radio photo-telegraph circuits. Drum speeds were increased to 60, and sometimes 90, revolutions a minute and reduced the average time to send a picture to ten minutes.

Today, the Picture Room at Electra House has eleven picture machines—six transmitters and five receivers—and operates services to and from 56 European zone and 38 extra-European terminals. In the extra-European zone, the services to and from New York, Bermuda, Jamaica and Montreal are carried by the TAT-I and CANTAT cables while all others are worked by radio. In the European zone, the Malta, Athens, Moscow, Lisbon and Berne services go over radio circuits, although wireline facilities are available to Moscow and Athens. The rest operate over telephone circuits by way of the Continental Telephone Exchange in Faraday House.

All the services are organised on an "on-demand" basis and circuits are operated only when pictures are being sent or received. Charges are calculated by the size of the picture, those sent throughout the Commonwealth costing £5 for up to 150 square centimetres and £1 10s. for every additional 100 square centimetres.

When a picture is handed in to the Picture Room for radio outward transmission, the distant terminal is alerted by a service telegraph message or by radio telephone through the radio telephone at Brent Building. The distant terminal is told of the radio frequency the London Station intends to use and is asked to nominate its own frequency for control purposes after satisfactory contact has been made. Then the picture is transmitted. A serial number is given to each picture and accounting instructions are conveyed by means of a preamble affixed to the picture. The preamble is similar to that used on an overseas telegram, the number of words being replaced by the number of square centimetres.

A picture sent on one of the Picture Room's machines is transmitted by signals generated by the different reflections of light from the picture itself. It is mounted on a metal cylinder which is placed



OTO T. Sheehan measures the width of a picture to be transmitted before making up the preamble. Charges are calculated by size.

on a movable platform some 12 inches long. Two lamps shine on the drum and are focussed down to give a bright spot of light on a tiny area. The reflection from the spot, which is greatest when the light shines on a white part of the picture, decreases in intensity as the tonal shades darken until, from a deep black part, there is almost no reflection.

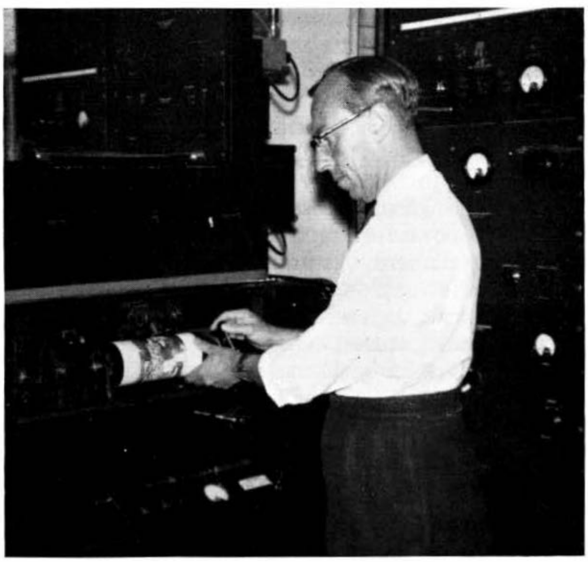
The reflected light passes through an aperture one-hundredth of an inch wide and then through a chopper disc on to a photo-electric cell. A chopper disc breaks up the beam of light to form a signal with a frequency of 7,100 cycles a second, modulated by the varying intensity of light reflected from the picture (modern systems use an electronic modulator). This is mixed with an oscillator working at a fixed frequency of 8,400 cps and the resultant difference frequency (1,300 cps or 1,900 cps in some instances) is extracted from the circuitry to form the amplitude modulated signal, with white adjusted to zero and black to minus 34 db. Almost all European terminals worked over telephone circuits via the Continental Telephone Exchange use this method but some—all radio circuits and those carried over the TAT-I and CANTAT Cables—use the Sub-Carrier Frequency Modulation system. To obtain this mode the 1,300 cps amplitude signal is rectified and applied to a reactance modulator which changes the frequency of an oscillator so that an output of 1,500 cps is generated for white and 2,300 cps for black. This is the signal which is passed to the radio transmitter for transmission to the receiver station.

The incoming signals from the radio receiver are fed into the equipment, filtered, limited, discriminated and then applied to a final amplifier, from which the output operates a mirror galvanometer. A light is reflected by the mirror on to the film on the receiving machine drum and exposed according to the variations of the incoming signals, thus reproducing a facsimile of the original picture. The copy received can be either a positive or a negative but in Electra House all pictures are received in the latter form.

Although the diameter of drums varies on different machines, pictures can be sent from one size drum to another without becoming distorted. A picture sent from a large drum to a small one is reduced in size at the receiving end by about one third and one sent from a small to a large drum is reproduced about one-third larger than the original, so long as the "Index of Co-operation" is the same.

After a picture is received in the London Station it is taken to a darkroom, developed and fixed and prints made from the negative. Usually, newspapers need only the negative since they have their own printing facilities, but commercial users, such as banks, receive one print as well as the negative. Pictures from a distant terminal can also be automatically relayed to any newspaper which has its own picture machine. This is done by using broadcast equipment which can relay one picture to as many as 20 newspapers simultaneously.

Technical Officer A. W. Kenison places the drum on the transmitting machine carriage before sending a picture to Australia.



★ THE AUTHOR—Mr. L. A. G. Parnell joined Imperial Communications (later Cable and Wireless) in 1929. He served with the Royal Signals in World War Two and in 1946 returned to Electra House Control Room as a Technical Assistant. On integration of Cable and Wireless with the Post Office in 1950 Mr. Parnell was graded Technical Officer and in 1956 became Leading Technical Officer and Picture Room Supervisor.

After years of research and experiment a new telephone cable is soon to come into service. It is cheaper to make and install and, because of its paper-polythene construction, more resistant to corrosion

THE DOVER to DEAL EXPERIMENT

By H. C. S. HAYES

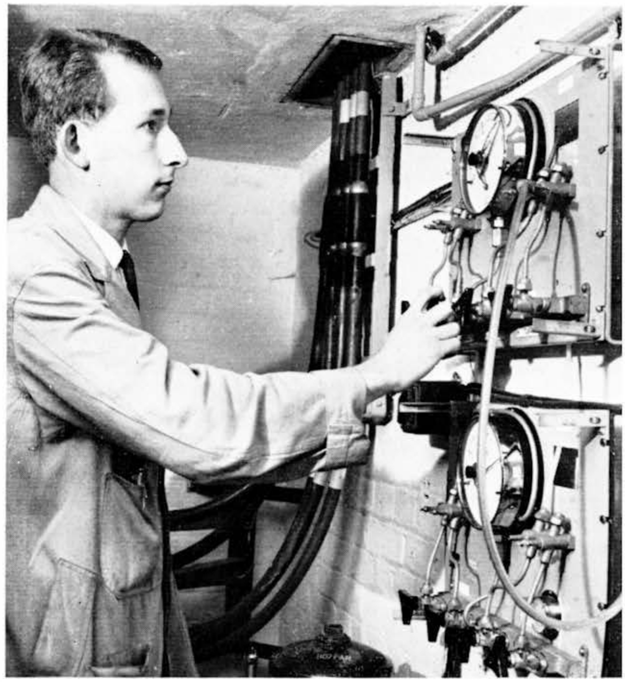
FROM April next year a new type of paper-polythene sheathed telephone cable which will be lighter, less prone to corrosion and less costly to manufacture and install, will be coming into service in subscribers' networks ranging from about 100 to 2,000 and possibly 3,000 pairs.

This very important development is the result of 15 years careful and continuous research and experiment carried out by Post Office engineers and cable manufacturers.

The laying of the Dover to Deal experimental junction cable in 1954-55 was a major step in the evolution of paper-polythene construction, but the story really began in 1933 when scientists experimenting with ethylene gas at high pressures discovered polythene. Until then, lead had been used for sheathing telephone cables. It formed a complete barrier against water and water vapour entering the cable core and was ductile enough to allow bending and strong enough to resist abrasion. On the other hand it was very heavy and under certain conditions subject to damage by corrosion.

Polythene was soon found to have excellent electrical properties as an insulator in structures carrying high frequency currents with a minimum loss of power. Its application as a dielectric in coaxial submarine cables was rapid. For example, some of the single-core cables laid across the Channel towards the end of World War Two to serve the invading armies were insulated with polythene.

It was soon realised that polythene—flexible, reasonably strong, highly resistant to corrosion, clean to handle, 12 times lighter than lead and highly resistant to water and water vapour—might also be used as a cable sheathing. This was an opportune discovery for at that time lead was in short supply and it became prudent to consider what could be used in its place.



In the cable chamber at Dover an engineer measures the pressure of the Dover half of the cable—about 10 lb a square inch.

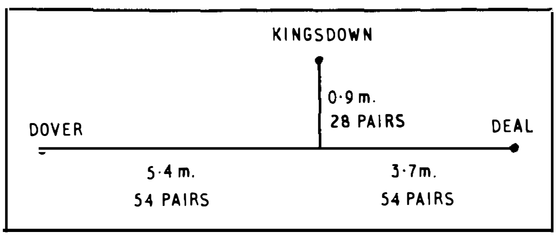
Calculations based on available water permeability figures indicated that paper insulation around the wires of a cable core sheathed with polythene would very gradually absorb some moisture but that the corresponding fall in the value of insulation resistance would not be serious—at least for some years. Trials carried out in 1948 and 1949 with four short lengths of paper-insulated and polythene sheathed cable under working conditions tended to confirm this view.

In about 1949 parallel trials began using polythene for sheathing small multi-pair plastic-insulated subscribers' cable and also as a protective covering over a thin lead sheath. Neither experiment tested the resistance of polythene against permeation by moisture to the degree that a paper core protected solely by a polythene sheath would have done but each provided valuable information about the behaviour of extruded polythene and its suitability for use as cable sheathing.

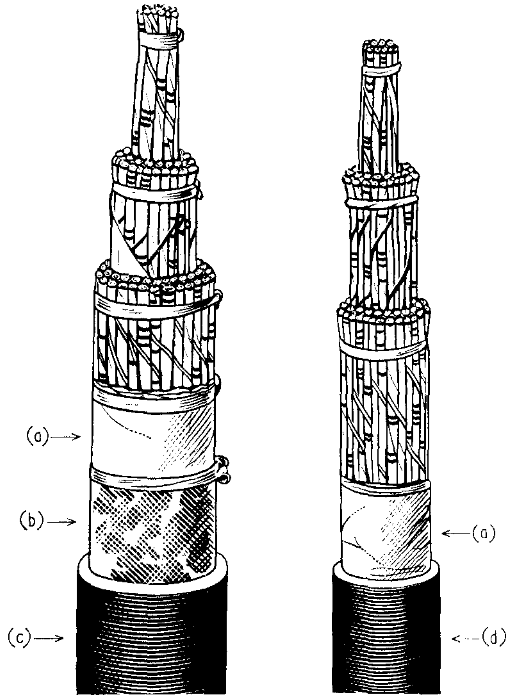
In 1951 it was decided to carry out an extended trial with a paper-polythene, gas-pressurised cable about ten miles long and on a junction route where a cable was required but at a date sufficiently distant to allow time for development and experiment. The Dover to Deal route was finally chosen and the cable was manufactured by United Telephones and Cables Ltd (Southern)—now Telephone Cables Ltd—and installed by the Post Office in 1954-55.

The experimental cable, balanced in the normal way to minimise overhearing between the pairs and loaded with standard coils, is a little over nine miles long. There are 54 pairs between its main terminals and 28 pairs in the spur cable to Kingsdown. The conductors are of aluminium and, although larger, they are much lighter, weighing about 10 lb per mile as against 20 lb for the copper equivalent. The polythene sheath is about 0.1 inch thick. Around the paper core are two thin aluminium tapes which are comparatively loose and open and form an electric screen. They provide no effective barrier to water vapour.

The main advantages of the experimental cable are its light weight—about one third of a conventional copper-paper-lead cable—and its freedom from corrosion. Its disadvantages are a 35 per cent increase in diameter, mainly because of the aluminium conductors, and a slight lowering of its insulation resistance with time. The larger diameter is perhaps not so serious as it would first



Cable diagram showing the spur to Kingsdown.



The Dover to Deal cable (left,) with aluminium conductors and polythene sheath, compared with an equivalent cable with copper conductors and lead sheath. Though thicker, the paper-polythene cable weighs much less.

(a) 2 paper tapes
(b) 2 aluminium tapes
(c) Polythene sheath
(d) Lead sheath

seem since it is the practice to guard many cables against corrosion by giving them hessian protection over the lead. The diameter of the Dover-Deal is about 11 per cent greater than that of a lead cable protected by hessian.

The Cable's Performance

Investigations into the condition of the dielectric have been made since the cable was installed to determine the adverse effect of the slow diffusion of water vapour through the polythene sheath into the paper. Possibly the most informative measurement is that of insulation resistance, tested with 500 volts DC after one minute's electrification, at or near maximum summer temperature, on representative pairs between Dover and Deal.

There is a difference of some 12°C (54°F) between the winter and summer cable temperatures and the insulation resistance figures at minimum winter temperature are about three times greater

OVER

DOVER to DEAL *(Cont'd)*

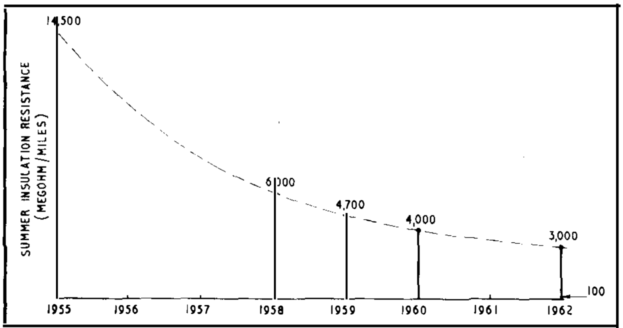
than those for maximum summer temperature. It is questionable whether the circuits and the equipment connected to the cable pairs would function reliably if the cable insulation fell substantially below 100 megohm/miles. The pattern of the curve suggests that the insulation resistance is unlikely to drop to this limiting figure within the economic life of the cable, if, in fact, it ever would.

Since the experimental Dover to Deal cable was commissioned for service in June, 1955, its performance has been very good. Although there have been some minor air leaks it has given interruption-free service.

When the cable was installed two identical sets of air compressing and drying equipment were provided—one at Dover and the other at Deal—to keep the cable under a pressure of dry air at 10 lb a square inch above that of the atmosphere so that any defects in the sheath, or sheath joints, could be detected and cleared.

The equipment was also intended to provide facilities for "gassing", (that is, to pass dry air continuously through the cable for dessication and so to counter the fall in insulation resulting from diffusion of moisture through the sheath into the core). The insulation fall has, in fact, been so small that from the service point of view there has been no need to resort to "gassing".

However, for research purposes, it is desirable to know if the insulation resistance can be restored to its original level and to this end the cable has been divided into two approximately equal lengths for experimentation. One of these is maintained without "gassing" at a constant pressure of 10 lb a square inch throughout while the other has 10 lb pressure at one end and zero at the other end where it is open to the atmosphere. From the open end air issues continuously at the rate, determined by the pneumatic resistance of the cable, of about 100 cu ft per month. The gassing began in December, 1960, and to date, because of the very slow rate of flow, there is little difference between the insulation figures of the two halves.

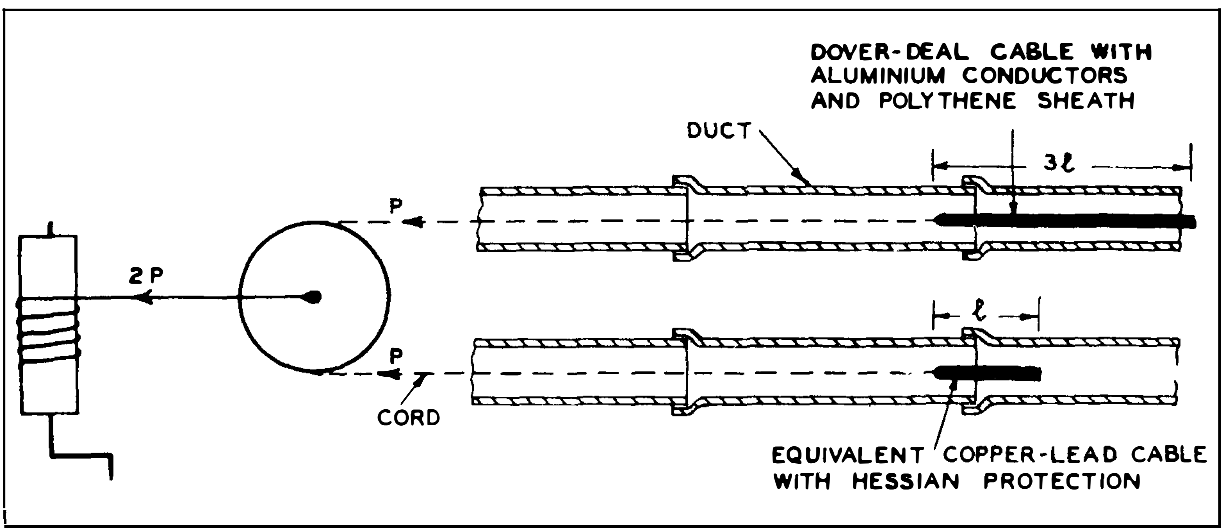


The variation of summer resistance for seven years after completion in 1955. The arrow against the pillar on the extreme right indicates the somewhat arbitrary minimum insulation resistance limit of 100 megohm miles.

The jointing of the sheath posed a difficult problem because polythene is chemically very stable and other materials do not readily combine with or adhere to it. Polythene is a very good thermal insulator and any open flame technique for melting and merging two masses of it into one is impossible since it would char the polythene in one place and leave it virtually cold in another.

A mechanical joint devised by Mr. W. R. N. Moody of the South Western Region of the Post

This diagram shows how a length of the Dover-Deal cable three times as long as that of an equivalent copper paper-lead protected cable can be moved with a given pull.



Office, in the very early stages of polythene cable development, was therefore used. At each end of the joint a circular rubber bung, sandwiched between two metal compression plates, is forced radially inwards against the sheath and radially outwards against a tubular sleeve, thus effectively sealing the joint, when the plates are brought together by tightening nuts and bolts.

What of the Future?

The Dover to Deal cable is the first of any considerable length in Britain to have aluminium conductors and they have performed very satisfactorily. The engineering experience gained from their use has been well worth having. So far there is no clear economic justification for the adoption of aluminium conductors in place of copper, but there is some evidence that technical improvements in equipment will permit the ever increasing use of finer wires of higher resistance in subscribers' and other symmetrical pair cables. It may be that the limit of "fineness" in future will no longer be set by resistance but by man's ability to handle and joint the wire. If and when this point is reached aluminium would be in straight competition with copper on a basis of wire diameter equality and would have considerable economic advantages.

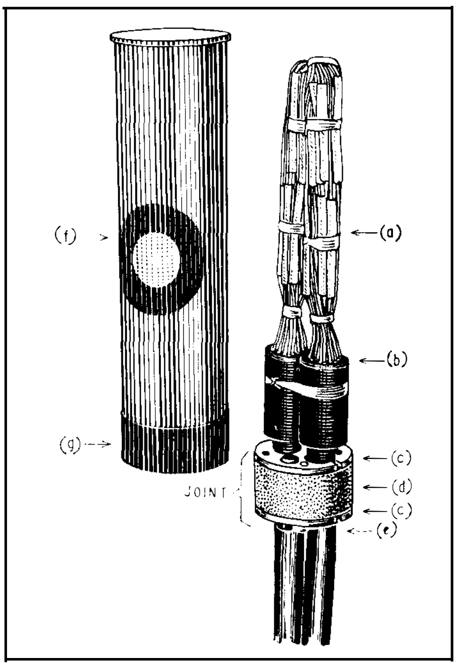
In 1959 a notable advance was made which enabled a polythene sheath during manufacture to be sealed substantially against the ingress of water vapour. A thin aluminium foil tape, pre-coated on one side with a strongly adherent film

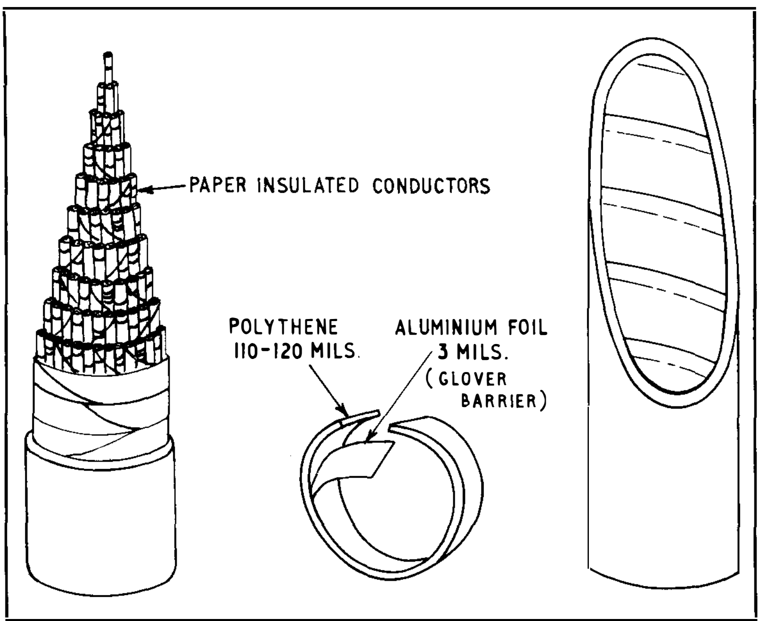
OVER

THE AUTHOR

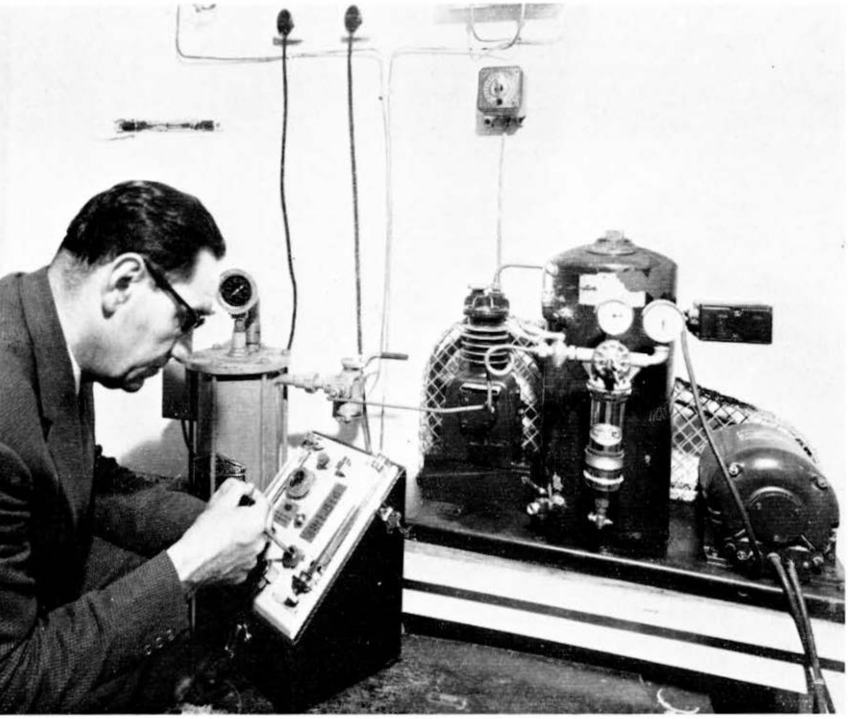
Mr. H. C. S. Hayes is an Assistant Staff Engineer in the External Plant and Protection Branch of the Engineering Department. He entered that department as a Youth-in-Training at Gloucester in 1924 and in 1927 was transferred to the Research Branch at Dollis Hill, later serving at Preston and Manchester. He returned to Research Branch in 1936, joined the Lines Branch in 1937 and was promoted to Assistant Staff Engineer in 1948. Mr. Hayes is a member of the Institution of Electrical Engineers and holds the City and Guilds of London Institute's Insignia Award in Technology. He wrote *Mechanical Aids* for the Spring, 1956 issue.

Below: The Moody Mechanical Joint—a sheath closure between two small all-polythene cables with expanding rubber bung joint. Below (right): The Slough to Staines 542 pr/20 lb junction cable with bonded aluminium foil, water and water vapour barrier.





(a) Insulated wire joints (b) Compound filled rubber sleeves (c) Brass compression plates (d) Rubber bung (e) Tightening bolts (f) Cap-ended lead sleeve (g) Brass reinforcing collar



An engineer checks the dryness of the air in the cable at the Deal end by extracting a small part of the air and measuring the dew point. On the right of the picture is the compressor equipment.

of polythene, is helically wrapped over the paper core of the cable before sheathing, the polythene surface of the tape being outermost. Hot polythene from the extruder welds to the polythene surface of the tape and firmly bonds the aluminium to the inside surface of the sheath. This conception—often referred to in the Post Office as the "Glover Barrier"—was the subject of a joint patent by Mr. D. W. Glover, late of the Post Office Research Station, Dollis Hill, and Dr. E. J. Hooker, late of Telephone Cables Limited.

This barrier reduces the effective area over which water vapour can diffuse into the paper core by at least 20 times. A cable similar to the Dover to Deal one, but incorporating such a barrier and laid in the same environment, would therefore, take 20 times as long to suffer a given fall of insulation. It should, for example, take, not seven but 140 years to reach a summer insulation resistance of 3,000 megohm miles. In practice, such a slow rate of water vapour permeation could be entirely disregarded.

The arrival of the Glover Barrier added greatly to a growing confidence in paper-polythene construction and the trial laying of a number of further junction cables followed.

In the exchange network, connecting subscribers' telephone instruments to their local exchange cables with a polythene-sheath and polythene insulation around the wires have been in use for the small fringe cables for some years. This small all-polythene cable has been generally so successful that in April, 1960, it became the standard, supplanting entirely paper-lead cable for all new work in sizes up to 100 pairs. About 80,000 sheath miles have been installed and there has been a real capital saving. In the larger exchange cables the cost pattern differs and all-polythene cable is more expensive than paper-lead. It is here that the paper-polythene construction, including the Glover Barrier, is about to come into its own. From April, 1964, it is planned to use it for all sizes of subscribers' cable ranging from above 100 to 3,000 pairs.

NEW MOBILE EXCHANGES

By A. H. HUNT

TWO new types of mobile exchange—designed and developed by Post Office engineers and equipped in the Factories Department—are being brought into service. They are of the non-director type, giving a greater capacity for lines and traffic than the previous mobile exchanges which were of the UAX type.

These new mobile exchanges are designed primarily for the relief of manual exchanges where existing equipment and multiple have become exhausted or where increased traffic has overloaded the operating staff. They can also be used to relieve automatic exchanges, subject to certain limitations.

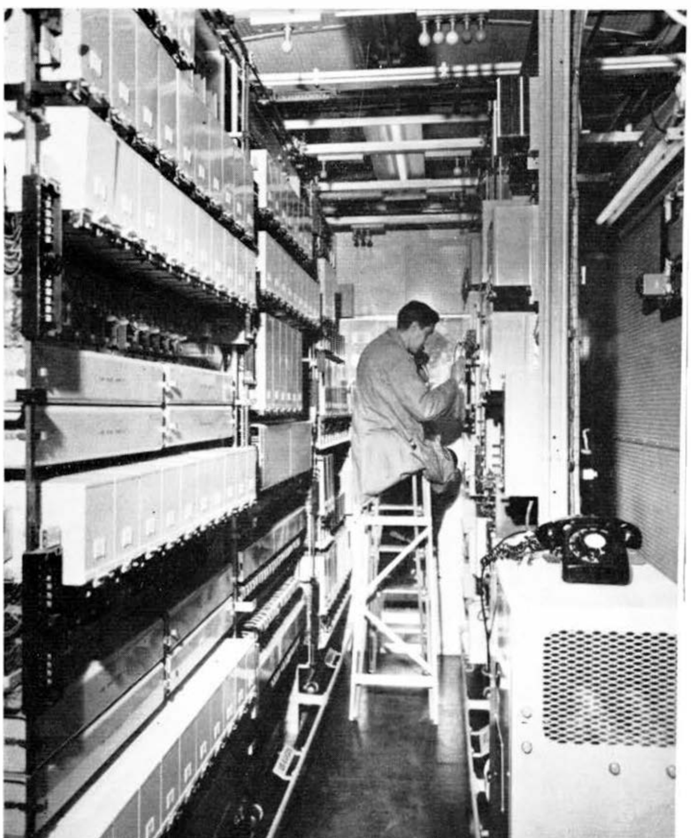
The first new mobile non-director exchange—called *Crompton*—was brought into use last February to relieve the Shaw (Lancashire) automatic exchange and another, named *Mayford*, which consists of two subscribers' units and a tandem unit and provides 800 extra lines, was opened recently to relieve the Woking manual exchange. In all, 30 of the new units have been allocated to Regions and more are on order.

The new exchanges are a subscribers' unit—called an MNDX (Mobile Non-Director Exchange), which gives multiple relief, and a tandem unit—MTX (Mobile Tandem Exchange) which off-loads some of the through junction traffic from a manual exchange. Only a single trailer, similar to that used for the emergency mobile teleprinter automatic switching units, is needed for each unit compared with the two required for the MAX 13, but some facilities provided by the latter are not available in the MNDXs. Each vehicle is 21 ft. 8 ins long, 7 ft 6 ins wide and 13 ft high.

So that the new mobile exchanges can be produced as quickly as possible and also to avoid new development work, they are fitted with 2,000 type equipment on 8 ft 6½ ins high racks and standard non-director exchange practice is employed.

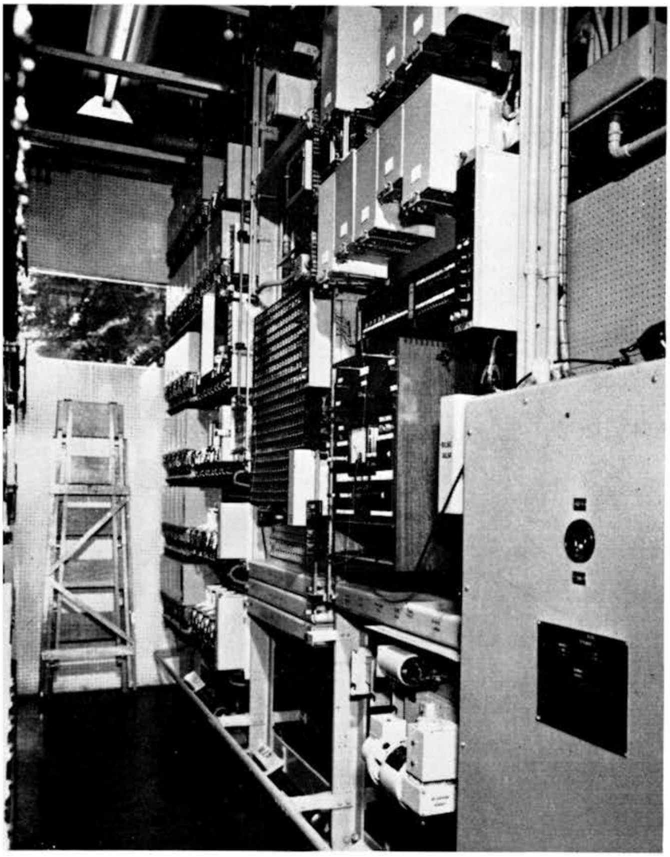
To enable the maximum number of subscribers' lines to be accommodated within the available space, it was decided to exclude Subscriber Trunk Dialling, local call timing and certain other facilities, such as changed number interception, service interception and service observations which are normally provided in a non-director exchange. Since coin collecting boxes using standard equipment would have been uneconomical and have severely restricted the number of ordinary lines, a small group of coin-box calling equipments and 1st selectors has been designed to go into the only

OVER



A general view of the interior of the new MNDX which has been introduced to relieve the manual exchange at Woking, in Surrey. ▶

★ **THE AUTHOR, Mr. A. H. Hunt, AMIEE,** is a Senior Executive Engineer in the Exchange Equipment and Accommodation Branch of the Engineering Department. He joined the Post Office in 1936 in Lincoln Telephone Area, becoming a Probationary Inspector in 1937. After serving with the Royal Signals from 1943 to 1947, he returned to Linco'n as an Assistant Engineer (New Style) and in 1955 was promoted to the Engineer-in-Chief's Office where he has been actively concerned with the design and planning of exchange systems.



Another view of the interior of the MNDX at Woking showing the power equipment, subscribers' meters and group selection rack.

NEW MOBILE EXCHANGES (*Cont'd*)

available spare space above the power rectifier cubicle.

All subscribers' units have racks, cabling, power plant and batteries for serving 400 exchange connections. A few are being provided initially with sufficient equipment to serve only 200 subscribers but these could be fully equipped should the need arise. When used to relieve a manual exchange ordinary subscribers connected to a mobile exchange will obtain operator assistance by dialling 100, thus avoiding any change of practice when they are later served by an automatic exchange with STD facilities. In other instances, the assistance code 'O' may be used if required or if more suitable. Coin-box subscribers and call office users will dial 'O' for assistance.

Provision is also made for dialling access to and from adjacent automatic exchanges and from the manual board but the number of routes and junctions is limited and depends on the particular arrangement adopted. High calling rate subscribers will normally be connected to uniselector type subscribers' calling equipment, 70 of which are available. The remainder of the lines will be connected to 50-point line finder calling equipment.

The tandem units (MTXs) accommodate switching equipment and junction signalling equipment for handling through traffic between a number of adjacent UAXs and automatic exchanges. Dependent UAXs which are connected will be given access via the tandem exchange to the manual exchange by dialling 'O'. Because of limited accommodation the tandem unit uses certain items of equipment in the subscribers' unit and cannot therefore be used alone.

The equipment design for both new exchanges is very flexible. A single subscribers' unit will be used, for instance, to provide service for up to 400 subscribers and two will be connected to give service for up to 700 subscribers. From one to four units can be used in conjunction with a tandem unit to serve up to 1,600 subscribers and provide tandem switching facilities between a number of adjacent exchanges.

A three-digit numbering scheme will normally be used when the subscribers' units are used either singly or in pairs. However, where traffic loading permits, a four-digit numbering scheme will be provided so as to avoid subsequently changing subscribers' numbers. Where an integrated numbering scheme can be used for both the MNDX and the manual exchange, the MNDX will be parented on the latter. Where clashes between subscribers' numbers on the manual and mobile automatic exchanges cannot be avoided or where confusion would arise because of the different methods of obtaining access to the MNDX, a name different from that of the manual exchanges will be assigned to the relief exchange. If this happens the MNDX will become a separate temporary exchange and need not be parented on the manual exchange it relieves. However, if it is advantageous it can be parented on an adjacent automanual assistance centre.

When fully equipped, each subscribers' unit can have 20 outgoing and 20 incoming circuits to and from the manual exchange plus ten outgoing and ten incoming circuits from adjacent automanual

25 YEARS AGO

The world's first mobile telephone exchange—designed and constructed by the Post Office—was brought into service just 25 years ago.

The inaugural ceremony was performed at Post Office Headquarters by the then Postmaster General, Major G. C. Tryon, MP, who made the first call to the chairman of the Essex County Council at Chelmsford. After the ceremony the exchange was sent to Essex and brought into service at North Weald where it replaced a small manual exchange.

The Postmaster General of 1938 makes the first telephone call from the world's first mobile exchange. On his left is the then Engineer-in-Chief, Sir George Lee.

exchanges which are within range of loop disconnect pulsing limits. If the subscribers' numbering range is 200 to 599 then the digit 6, 7 or 8 can be used for code dialling access to adjacent automatic exchanges. Two outgoing circuits are provided to the manual exchange for '999' emergency service.

If two subscribers' units are used together the numbering range would be 200 to 899 to give service to 700 subscribers. Up to 40 outgoing and 40 incoming circuits could also be provided to the manual exchange, but in this instance it would be impossible to provide any outgoing junctions to adjacent automatic exchanges since no access codes would be available.

A fully-equipped tandem unit can give inter-switching facilities for a group of up to 14 automatic exchanges or UAXs and from one to four mobile subscribers' units. With this arrangement, subscribers connected to local MNDX units will be allocated four digit numbers in the ranges 2100-2899 and 3100-3899. The digits 4 to 7 can be used to give access to four of the larger automatic exchanges in the group while codes 80 to 89 can give access to other automatic exchanges or UAXs in the tandem switching area.

The number of junctions to adjacent exchanges which can be accommodated depends on whether unidirectional or bothway working is employed and whether dependent UAXs are involved. Typically, a relief installation comprising a tandem vehicle and two subscribers' units could have 60 bothway junctions to dependent UAXs, 60 outgoing and 60 incoming junctions from adjacent automatic exchanges in addition to the normal complement of circuits to and from the manual exchange. Considerable flexibility in the equipment arrangement is possible and on each occasion when it is proposed to use mobile exchanges a careful examination will be made so that the maximum advantage can be gained.

Providing a mobile exchange for subscribers' multiple relief for an automatic exchange presents a different and more difficult problem. For the relief exchange to have the same name as the relieved exchange, for example, it would have to be designed so that it could be integrated with the existing equipment and numbering scheme. Moreover, it would be better to provide subscribers connected to the relief exchange with the same facilities as those enjoyed by subscribers on the main exchange. Different types of exchange would have to be catered for and different ages and types of equipments would be encountered. In addition, any design for universal application would have to be satisfactory for use at exchanges with or without STD. All these factors impose severe limitations on the design of a mobile automatic relief exchange which, ideally, should be capable of being integrated into an existing automatic system and of giving service in as many different circumstances as possible. Since, in many instances, relief could be given more easily by other means, no detailed

OVER

This is one of the new trailers in which the new mobile exchanges are housed. The vehicle is 13 ft high and 21 ft 8 ins long.

NEW MOBILE EXCHANGES *(Concluded)*

investigation for designing such a mobile exchange has so far been undertaken. An automatic exchange can, of course, be relieved by the MNDX so long as a name different from that of the auto exchange is used for the MNDX. Inter-dialling access between the two exchanges would be available in both directions on a code dialling basis and assistance traffic could be handled at the same assistance centre as that serving the automatic exchange or at any other suitable automanual switchboard.

The largest self-contained mobile exchange at present in service is the MAX No. 13 which, in an emergency, can restore service for up to 200 subscribers' lines. In face of the increasing number of UAX 13s with more than 200 multiple lines, there is an urgent need to restore service quickly in the event of serious breakdown at any of these exchanges. An MNDX could be used in an emergency to give service to a maximum of 400 subscribers while combinations of two, three or four units with a mobile tandem exchange could provide emergency service for 800, 1,200 or 1,600 subscribers.

★

A New Watch Receiver

The new watch receiver attached to its hook.

The Post Office has recently introduced a new-style watch receiver, or additional earpiece, to match the modern telephone. It is available in black, grey and light ivory.

The earpiece is connected to the telephone by a matching PVC cord of the same length as the handset cord and has an internal switch to disconnect it when replaced on a hook screwed to the right-hand shoulder of the telephone.

The additional earpiece cuts out noise and at the same time improves the subjective volume of the received speech. Customers with defective hearing—who can be supplied with the new watch receiver free of charge at the discretion of their telephone manager—will often be able to derive benefit from using the additional receiver in normal conditions. When the watch receiver is required merely to allow a second person to listen to a telephone conversation a rental of 2s. 3d. a quarter is charged.

The Post Office Helps to Produce . . .

A NEW CALL-OUT SYSTEM FOR FIREMEN

From a battery of ladders firemen fight a blaze at a cabinet maker's shop in Sandshaw Street, London.
Courtesy: London County Council—London Fire Brigade.

By G. M. BLAIR
and E. C. C. STEVENS

Production is soon to begin of a new voice frequency remote control call-out system for fire brigades which will speed communications and save both staff and money

THE Post Office, on whose telephone network the Fire Service largely depends for its operational efficiency, has, in conjunction with the Home Office Communications Branch, designed, developed and satisfactorily tested in the field a new call-out system which will be more efficient than the present ones and save both money and staff.

The new system—known generally as System A, or to give it its full title: The Voice Frequency Remote Control System for the Fire Service—will enable large county fire brigades to centralise their communications systems on one or a very small number of points from which all stations in a brigade can be rapidly mobilised.

At present the system adopted by most county authorities to mobilise their fire stations is based on receiving at whole-time stations (those manned by day and night) fire calls connected from the nearest automanual (and larger manual) exchanges and from automatic fire alarms, fire telephones and

OVER

The new Voice Frequency Remote Control equipment (extreme left) on field trials at the Control Room of Kent County Fire Brigade HQ in Maidstone. Alongside the equipment is one of the cordless PMBXs which have been developed for the Fire Service by the Post Office.

NEW CALL-OUT SYSTEM *(Cont'd)*

"running call" telephones (those outside fire stations on which emergency calls can be made). The remote retained stations (those which are staffed by part-time firemen and therefore unmanned) and those stations which are manned only by day are then brought into action through various Post Office remote control systems.

These arrangements, especially in counties with large rural areas, are often expensive in manpower and communications costs. This is because watch rooms need to be continuously manned and because in many counties considerable distances are involved between exchanges and whole-time stations where fire calls are received, and between these stations and other dependent retained stations. If private circuits are used in the communications links, costs are high with the result that reliance is often placed on the public network both for receiving fire calls and for mobilising stations. Under certain conditions this can lead to delay and lower standards of reliability. In addition, most present systems do not offer all the facilities needed for centralisation and those worked over private circuits cannot operate satisfactorily over the longer distances.

The new call-out system has many advantages over any other. It is economic because the same line network is used both for receiving fire calls and mobilising stations. It is simple and quick to operate and does not require specialist operators either at the control or at the remote stations. Stations can be called individually or collectively and mobilising instructions can be passed by word of mouth to a fireman in the watch-room or to all parts of the stations by a public address system. The techniques employed achieve a considerable saving in private circuits.

The new system consists mainly of two alternatively-routed omnibus circuits linking a group of five stations to the control equipment. One circuit carries a multi-channel voice frequency system for signalling and the other is used for speech. Two frequencies are allotted to each of the five stations —one for control to station, the other in the reverse direction.

The signalling paths between control and the remote stations are continuously monitored in both directions so that line and certain equipment faults are immediately indicated at both main and sub stations. If a line fault occurs the signalling equipment can be switched to the speech circuit—a vitally important facility which permits fire call signals to continue to be received and the call-out to be completed. A speech link can be established by any convenient emergency method, for example, by a fire flash call or by radio.

The call-out signals are originated by the operator at the control switching two keys. This causes the monitor tone of the required stations to be replaced by two tones sent either individually or together to produce a total of three remote control signals at the required station. These three signals can be used by the Chief Fire Officer as he wishes, for example, to operate the station bell; to operate the whole-time men's night bells; and to operate the sirens and retained firemen's bells.

The call-out signal to remote stations lasts for one minute during which time the return monitor tone of the station is interrupted to cause a lamp to flash as an acknowledgement signal at control. If the call is answered during this time, lifting the telephone off the switch hook at the remote station causes the monitor tone to become continuous, thus extinguishing the flashing lamp. Lifting the telephone off the hook at the remote station after the end of the call-out period calls the control with a slow lamp flash.

Under the new system a fire call can be received through the station nearest the automanual exchange where 999 calls are received or from fire telephones and from "running" call telephones. These are indicated at control by a fast-flashing lamp signal. The precise location of the fire is established by the control operator when the call is

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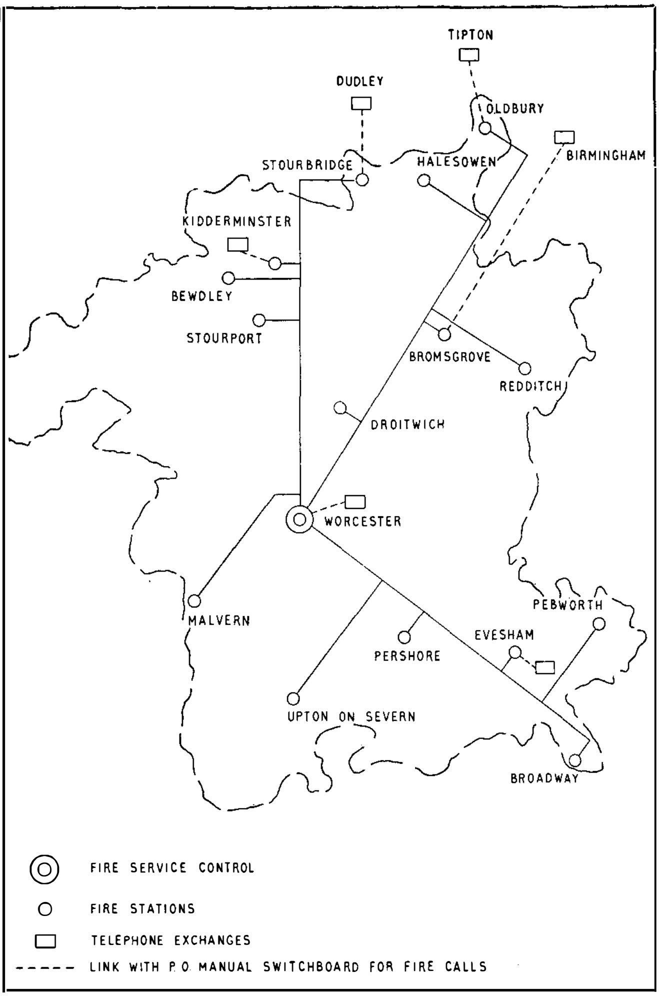
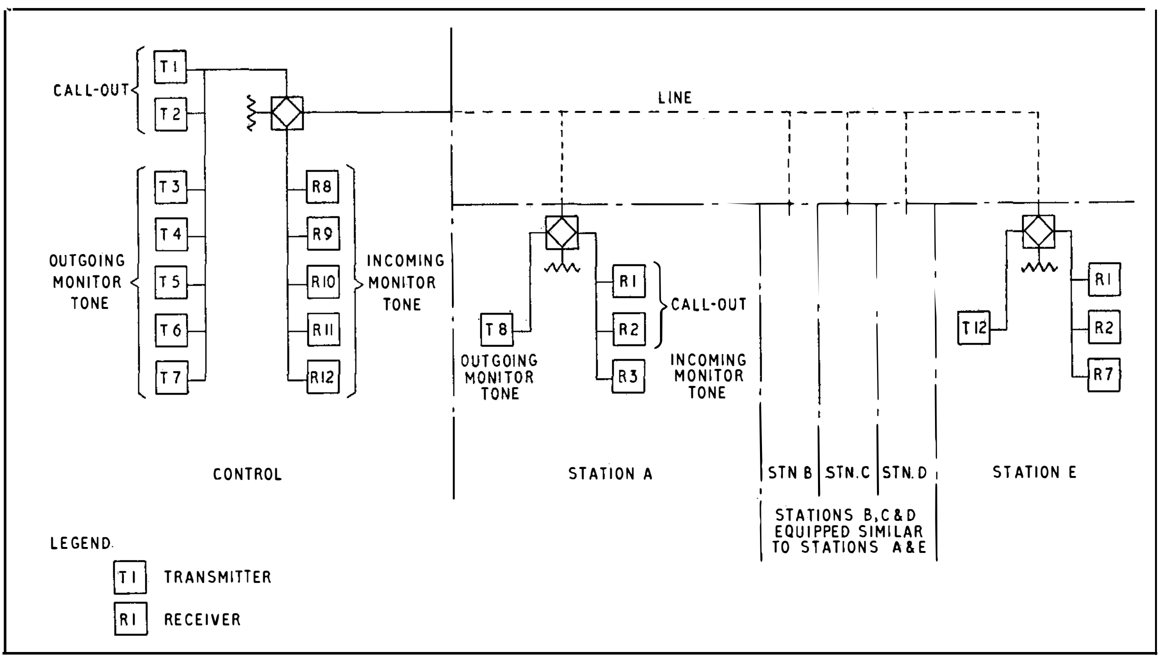
Right: This map shows the proposed grouping of fire stations in Worcestershire under the new system. Below: The simplified diagram shows the signalling arrangement layout.





NEW CALL-OUT SYSTEM *(Concluded)*

answered. If two or more calls are received simultaneously the control operator can select the station or stations to which he wishes to speak. When an alarm call from a "running" call, or fire telephone is answered at control a bell rings automatically at the remote station to alert the staff. (It is hoped soon to transmit automatic fire alarms over the system. Calling arrangements will be similar to those for a fire telephone and the call will be identified by means of a recorded announcement.) The control operator can forcibly release or hold off a call from a fire telephone which does not clear down after the details are received, either because of a fault caused by the fire or because a fire telephone has been left off in error. In the latter event the lock-out condition is removed and another call can be made from the fire telephone when the remote station operator replaces his telephone. It will also be possible to disconnect from the system the recorded announcement associated with automatic fire alarms when the essential details have been obtained.

The control operator can make administrative calls to any station and the remote station operator can call control simply by lifting the station telephone from its switch hook. This causes the monitor frequency of the station to be pulsed slowly and produce a slow flashing on the alarm lamp of the control equipment. The remote stations can also be connected to extensions on the Brigade Headquarters' administrative PMBX or PABX. The connection is broken down by the control operator if a fire call is received.

Automanual exchanges (if the transmission level is satisfactory) and circuits terminating fire and "running call" telephones and automatic fire alarm detection devices can be connected to the system at any station. An alarm call from any of these sources causes the monitor frequency of the station to be pulsed rapidly and produce a rapid flashing of the alarm lamp on the control equipment. The call is accepted by control in the same manner as from a station telephone. When a 999 call is received by control a 150 milli-second disconnection of the outgoing monitor causes a supervisory signal to be sent from the remote station to the 999 exchange operator. When the caller clears the apparatus is disconnected at the remote station, causing a clear signal to be sent back to the 999 exchange operator.

The control panel of the new equipment has keys which couple left and right to other panels to provide flexibility in staffing. For example, an operator will control, say, eight systems, each of five stations, in slack periods, four at normal times but perhaps only two or even one system during the summer when there is a greater danger of fires.

The voice frequency equipment is fully-transistorised. In the event of a main failure, power

Officers on watch in the Control H Q of the West Riding Fire Brigade where the new remote control equipment will soon be introduced.

★ **THE AUTHORS. Mr. G. M. Blair,** CGIA, AMIEE, AMBrit.IRE, joined the Post Office in 1934 as a Youth-in-Training at Brighton. In 1938 he passed the Probationary Inspector competition and trained in Scotland West Telephone Area, later transferring to the Engineer-in-Chief's Office where he was engaged in the design and provision of equipment for Royal Air Force operation rooms. He joined the Royal Signals in 1943, serving in Europe, Ceylon and India and reaching the rank of lieutenant-colonel. After demobilisation he joined Tunbridge Wells Telephone Area and remained there until his present appointment to the Engineering Department's Telephone Branch as an Executive Engineer. During the Suez crisis he was recalled to the Army and served at Port Said. Since early 1958 he has been seconded to the Home Office Communications Branch as a Senior Communications Officer.

The Post Office is to install a pilot teleprinter scheme into the London Fire Brigade Headquarters communications system which, if successful, will be extended to the Brigade's entire communications network.

Under the pilot scheme a teleprinter will be installed at each of five fire stations and connected to a standard teleprinter with a special control panel at the Brigade's Headquarters. When a fire call is received the control operator will actuate the keys to the appropriate fire station or stations, thus causing the firemen's call-out bells to ring and enabling the operator to broadcast a teleprinter message giving details of the fire and the type of appliance which will be needed. The equipment in Headquarters will include a fire alarm unit to indicate power failure at distant fire stations and the presence of a fault on any line.

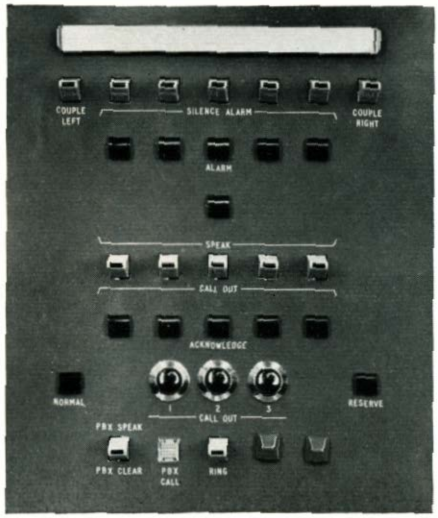
The new teleprinter scheme will, it is hoped, dispense with the need for continuous watch room staffing, save time in recording messages and obviate mistakes in telephone instructions.

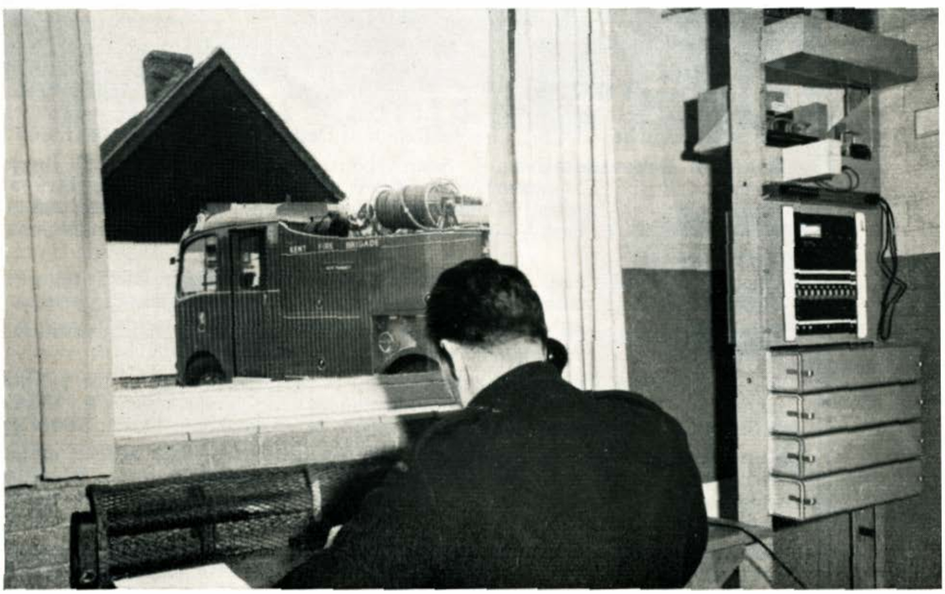
is supplied by float charged batteries which enable the system to continue to operate for up to 48 hours.

This new call-out system has been in field trials in Worcestershire since April, 1962, and further trials began this year in Lancashire and Kent. The trial in Kent includes an automatic fire alarm detection device at the Folkestone Fire Station. The possibility of passing call-out instructions by teleprinter or facsimile transmission is also being investigated.

The trials have already established that the system fully meets the operational requirements of the Fire Service. It is hoped to begin production of the new equipment, which has already been ordered by a number of county fire brigades, in the near future.

The authors acknowledge the help and co-operation they have received during the development of the system from the Chief Fire Officers of Worcestershire, West Riding, Kent and Lancashire.





Right (above): Close-up of the control panel of the new equipment. Right: Dealing with a fire call at the Kent Brigade HQ. Note the new equipment.

Mr. E. C. C. Stevens, Senior Executive Engineer in the Subscribers' Apparatus and Miscellaneous Service Branch, Engineering Department, joined the Research Branch in 1918. In 1937 he transferred to the Equipment Branch and in 1940 was promoted to Chief Inspector in charge of exchange and subscribers' apparatus, maintenance and so on. In 1946 he was promoted to Assistant Engineer and to his present rank in 1957 since when he has been concerned with the provision of facilities for the Fire Service and the development of cordless-type PMBX switchboards.

Telecommunications Statistics

	Quarter ended 30 *June*, 1962	*Quarter ended* 31 *March*, 1963	**Quarter ended 30 June, 1963**
Telegraph Service			
Inland telegrams (excluding Press and Railway)	2,895,000	2,664,000	**2,435,000**
Greetings telegrams	714,000	719,000	**615,000**
Overseas telegrams:			
Originating U.K. messages	1,570,000	1,531,000	**1,560,000**
Terminating U.K. messages	1,583,000	1,560,000	**1,573,000**
Transit messages	1,320,000	1,309,000	**1,239,000**
Telephone Service			
Inland			
Gross demand	117,000	139,000	**140,000**
Connections supplied	102,000	108,000	**117,000**
Outstanding applications	146,000	161,000	**167,000**
Total working connections	5,241,000	5,354,000	**5,402,000**
Shared service connections	1,117,000	1,099,000	**1,097,000**
Total inland trunk calls	129,034,000	139,440,000	**147,978,000**
Cheap rate trunk calls	30,334,000	30,120,000	**33,909,000**
Overseas			
European: Outward	953,000	1,046,000	**1,140,000**
Inward	888,000	958,000	**1,010,000***
Transit	9,000	9,000	**11,000***
Extra-European: Outward	88,000	90,000	**94,000**
Inward	105,000	109,000	**115,000**
Transit	15,000	16,000	**17,000**
Telex Service			
Inland			
Total working lines	9,000	10,000	**11,000**
Metered units	23,572,000	26,784,000	**29,777,000**
Manual calls from automatic exchanges (Assistance and Multelex)	3,000	3,000	**4,000**
Calls to Irish Republic	20,000	24,000	**26,000**
Overseas			
Originating (U.K. and Irish Republic) ...	1,251,000	1,585,000	**1,641,000**

Figures rounded to nearest thousand. * Includes estimated element.

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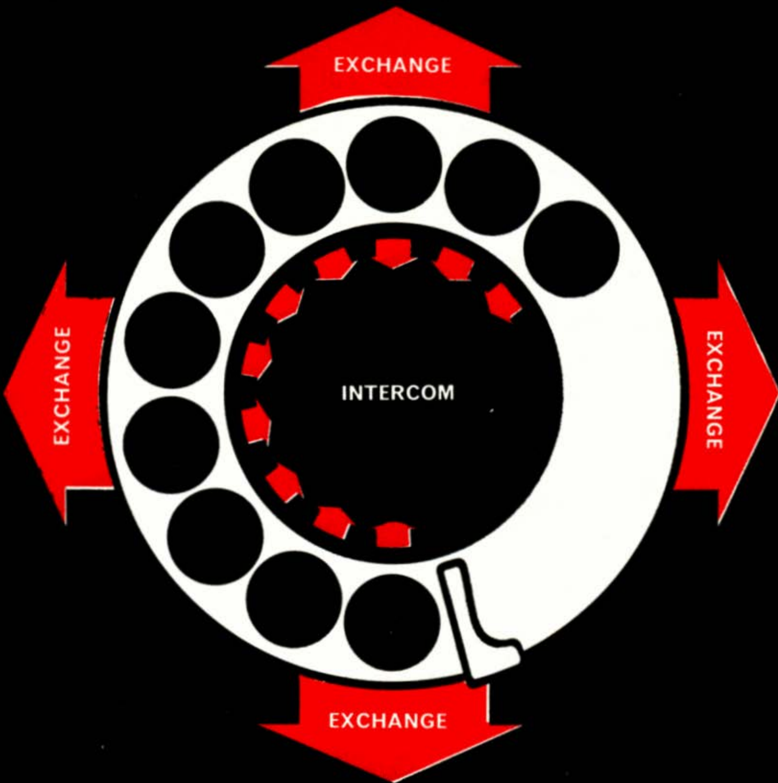
Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board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

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Headquarters, G.P.O., London, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

GPO



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POST OFFICE TELECOMMUNICATIONS JOURNAL

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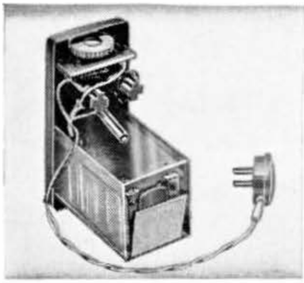
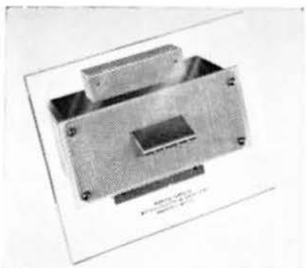
WHITELEY

electronic equipment and components

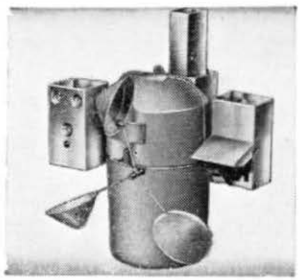


Potted components and assemblies in epoxy, Polyester resins and Polythene.

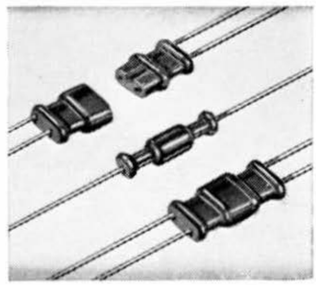
This fixed frequency oscillator is constructed on a standard octal base and encapsulated in epoxy resin.



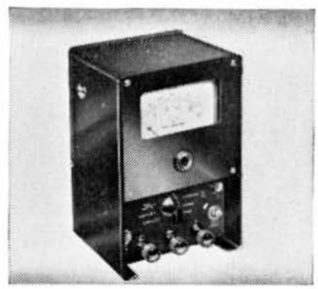
An astatic wound AF screened line transformer. Insulation of the line winding provides isolation against voltages of 30KV R.M.S.



Radio Sonde Transmitter, supplied to British Meteorological Office and foreign governments.



Waterproof plugs and sockets moulded in Polythene for underwater or outdoor installation.



The Post Office Tester is a multi-range meter used for making tests on subscribers' apparatus and lines.

P.O. Tester, AT5422 representative of the many types manufactured for the G.P.O.

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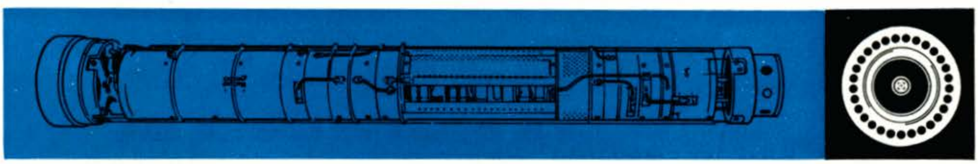

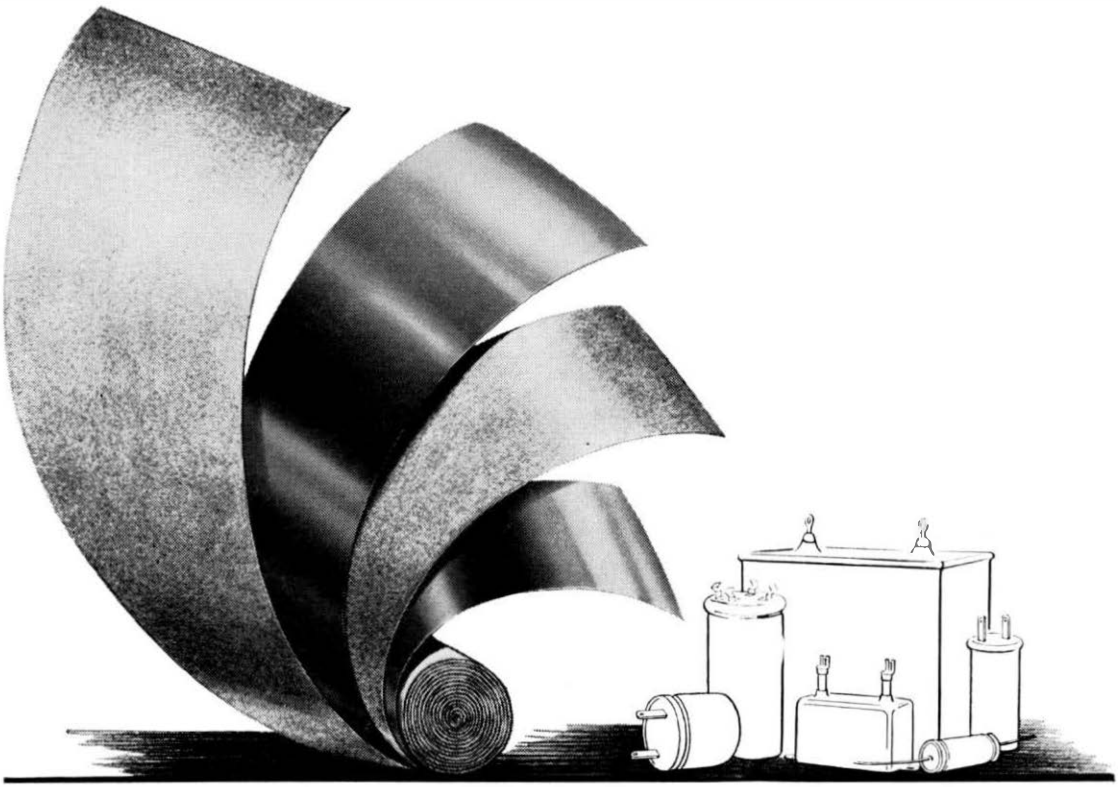

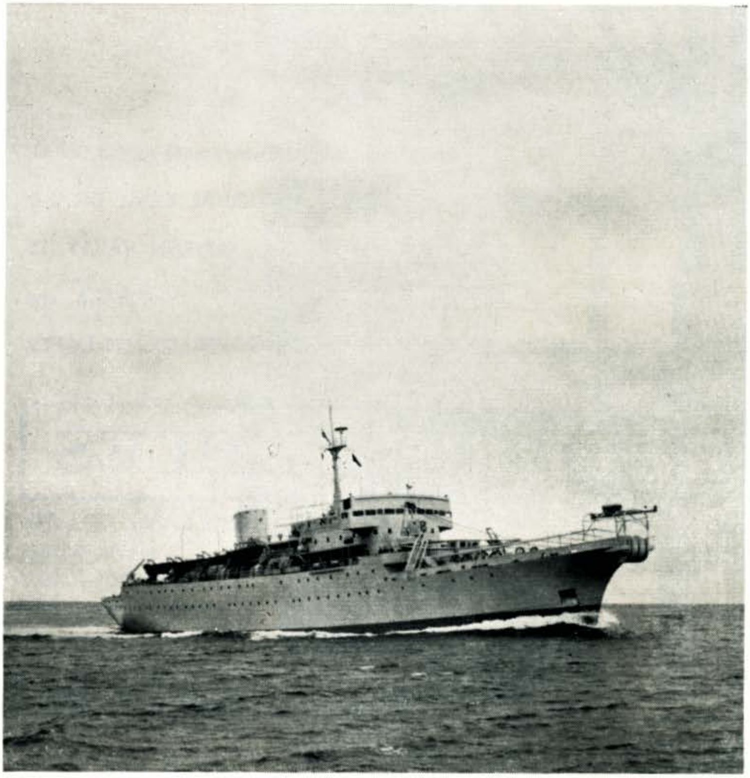

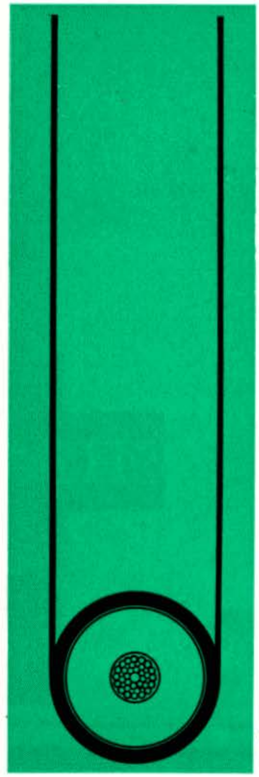

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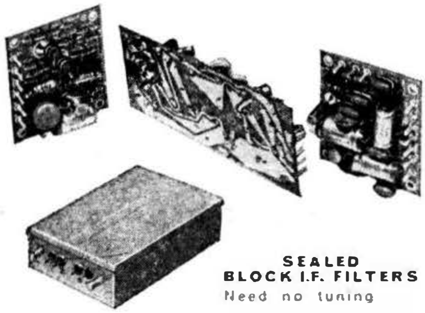

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