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Electronic Telephone Exchanges

THE IDEA OF AN AUTOMATIC TELEPHONE exchange, in which the familiar switches and relay sets will all be replaced by electronic devices with no moving parts, has for many years fired the imagination of telephone men. Although many problems have to be solved before a public exchange of this kind will become a reality, a great deal of pioneer work has already been carried out at the Post Office Research Station at Dollis Hill. Electronic directors, for example, were tried out at Richmond Exchange four years ago, and have given good results ever since. There is also an electronic private branch exchange serving the Dollis Hill Station. In addition, the leading manufacturers of exchange equipment have been carrying out their own researches in this field.

The stage has now been reached when a joint effort by the Post Office and its manufacturers is needed to bring development to a point where electronic exchanges can be built for a field trial. An important step was taken in June when the Post Office and its five exchange equipment contractors entered into an agreement under which they will pool their ideas and carry out further research jointly with the object of devising an electronic switching system best suited to Post Office needs. The agreement provides for forming a Research Committee, and this has already begun its work under the chairmanship of the Engineer-in-Chief.

Electronic switching equipment should take up less space and require less maintenance. These are attractive prospects and it is confidently expected that the joint effort will make a notable contribution to what promises to be one of the most revolutionary developments in telephone history.

Telecommunications Power Plant

F. G. Cummings, A.M.I.E.E.

THE ELECTRICAL POWER CONSUMED BY AN ordinary 100 watt electric light bulb is about a thousand million times greater than that required to produce, in a telephone receiver held to the ear, a volume of sound which can be comfortably heard. Although a modern telegraph relay requires about 4,000 times the power necessary for audible speech, this is still a very small amount and the relay remains a very sensitive device. In spite of these frugal demands, however, power plants capable of delivering 100,000 watts or more are often required for a single installation of telecommunications equipment. Where, then, does all the power go?

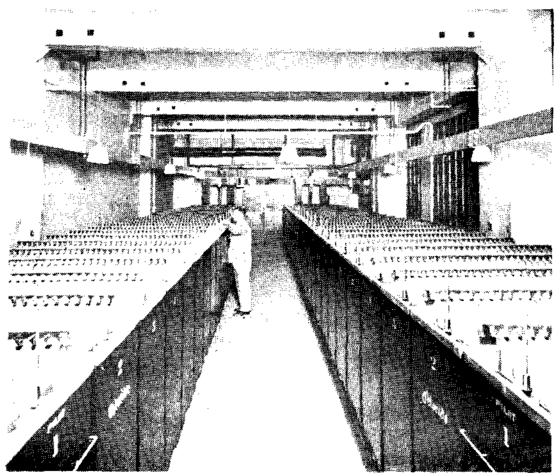
To establish a telephone connexion, apparatus is necessary to signal the various stages of the call to the operator or to automatic switching apparatus. In automatic exchanges, power is also required for moving switches into position. But signalling and switching devices are far less sensitive than the telephone receiver human ear combination and therefore considerably more power is required for signalling than for speech. Further, to ensure satisfactory operation, a supply of power far in excess of the speech power transmitted must be fed to the telephone transmitter throughout the call.

When information is transmitted by telegraph, power is used in achieving a satisfactory signal shape and, of course, the telegraph relay is only the agency through which the telegraphed information is received. Teleprinters require power for magnet and motor operation and, with modern systems, power is required to energize the apparatus used to enable a single circuit to be shared by a number of separate signalling channels and also for the automatic switching of telegraph circuits.

In all forms of electrical communication loss of power occurs in the line or other medium separating the communicating parties, and long-distance transmission on the modern scale would be quite impracticable if signals could not be restored to their original strength at regular intervals. Present techniques for achieving this purpose employ the familiar thermionic valve and while all engineers acknowledge the vast contribution made by this device in the telecommunication field, they prefer to discuss its efficacy rather than its efficiency. Consequently "repeater stations" and "relay stations" used in cable and radio links respectively, are notorious consumers of electrical power.

The earlier telephones were self-contained for their power supplies. Either wet Leclanché cells (which some readers may recall from school-days in the physics lab.) or the more familiar "dry" cells, were provided for speech purposes and the subscriber provided the power for signalling by turning the handle of a generator. Maintenance of local battery supplies presented difficulties in large exchange areas and the provision of a hand-generator for each subscriber was expensive. Both these disadvantages were overcome with the introduction of the common battery system in which power for speech and signalling was supplied from a large battery of accumulators at the exchange. Although the common battery signalling system (which dispensed with subscribers' hand generators

Fig. 1 : Telephone Exchange battery room—charge discharge working



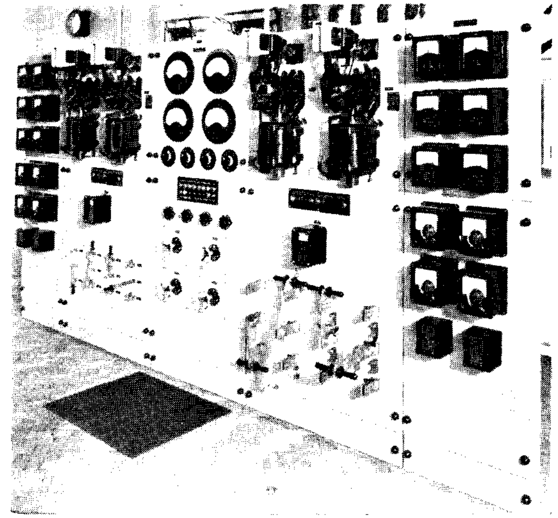


Fig. 2 : Control switchboard for repeater station automatic floating battery system

but retained the local batteries for speech purposes) was introduced later for small exchanges, the common battery system is basically the one used in modern telephone exchanges. For signalling reasons, the voltage of telephone exchange batteries gradually increased from 22 or 24 to 50 volts with the introduction of the automatic system. (Telegraph central or "universal" batteries at one time used voltages as high as 120 for line signalling but 80 volts has been standard for a number of years.)

The year 1922 witnessed an important event in the history of our telecommunications—the opening of the first telephone repeater stations at Fenny Stratford and Derby. A demand was thus created for supplies at either 6 volts or 24 volts for valve filaments (low tension or "L.T.") and 130 volts for anodes (high tension or "H.T."). In 1926 an event of even greater international importance occurred, for with the opening of Rugby Radio Station the era of long distance communication by radio began. Nine years later a new method of spanning the narrow seas separating various parts of the United Kingdom was inaugurated—the ultra-short-wave radio link. In 1949 our first micro-wave radio link paced-out its 40-mile strides between London and Birmingham. Today, micro-wave links are a normal means of inter-connecting television transmitters and compete very keenly with repeatered cables for a place in the inland trunk network. Although the power requirements of these radio stations were similar in principle to those of repeater stations, the difference in degree was sufficient to necessitate —at any rate until recently—a quite different approach to the problem.

In earlier days the lack of a public electricity supply frequently meant that electricity had to be generated locally. Gas, petrol and diesel engines and even windmills have all been used for this purpose. Nowadays, although there is still a large number of installations having no public supply, power is normally taken from the mains. Unfortunately public power supplies are liable to be interrupted, but the communication system must function nevertheless—in fact, its continuity under such conditions is vital. The emphasis in modern power plant design is therefore to safeguard service against power supply failure, and here it may be appropriate to point out that a recent three-monthly record at some 6,700 telecommunication installations listed a total of 1,095 supply failures of varying duration. In spite of these failures, it is pleasing to note that service was not interrupted.

Stand-by Plans

Because of the fluctuating loads at telephone exchanges, batteries are usually the most economical form of stand-by plant, at any rate for limited periods of cover. In general, power plants are designed to enable every exchange to withstand unaided a 24-hour interruption in the public power supply. Failures of a more protracted nature must be legislated for and usually are covered by means of a strategically located fleet of mobile engine generating sets.

Two factors have led to the practice of employing an "indefinite reserve" at repeater and radio stations: the importance of such stations to national and international communications, and the fact that battery stand-by is not normally economical for equipment which imposes a constant load. This indefinite reserve takes the form of a stationary engine-driven generating set, with fuel-oil storage capacity for not less than two weeks continuous running. This period is sufficient to enable refuelling arrangements to be brought into operation—hence the term "indefinite reserve". This form of reserve is also used at the more important trunk switching exchanges, thus permitting a reduction in the size of the batteries. Often it is possible for a common engine-set to provide stand-by for several types of communication equipment.

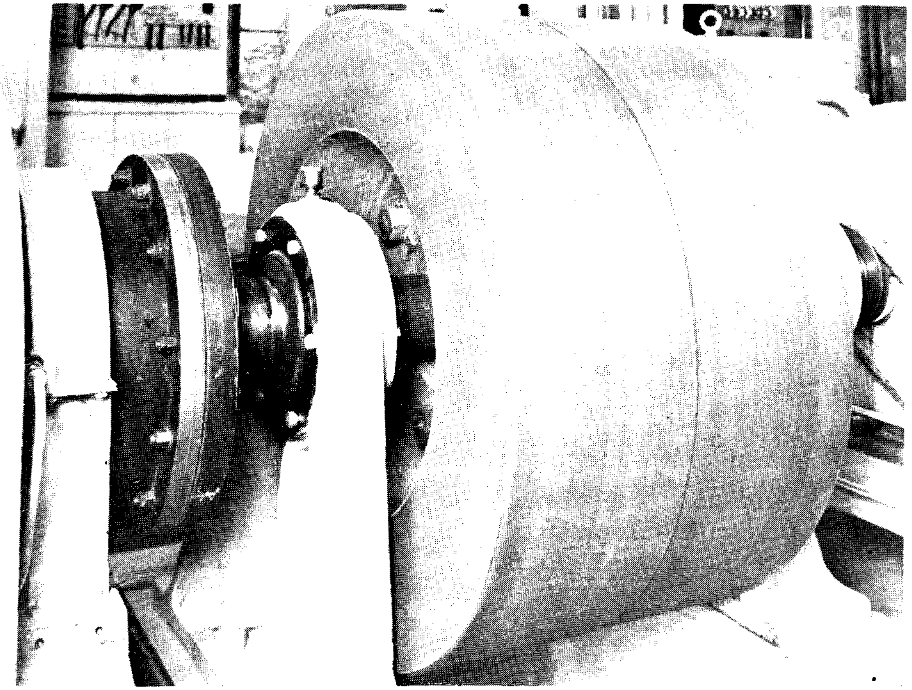


Fig. 3 : Magnetic clutch and fly-wheel for fly-wheel-start engine set

Telegraph stations are treated generally on the same lines as telephone exchanges.

In spite of the use of engine stand-by, batteries have always until recently been an important feature of repeater station power plants as, apart from other technical advantages, it was convenient to provide at least a short-term reserve in this way to allow time for engine starting. This practice was not followed for radio stations, however, where the use of voltages up to several thousands made such an arrangement unsuitable. In such stations replacement of the mains supply by engine-driven plant has usually been the practice, often augmented in larger stations by alternative mains supplies. However, in the absence of batteries a short break in supply occurred—under power failure conditions—because of the time taken for engine starting. Although this interruption was accepted in the past, future applications of radio communication will probably require a continuous supply.

The first common battery power plants were operated on what is known as the charge discharge system, two batteries being provided, charged and discharged alternately. This system required each battery to be capable of providing the minimum reserve and led to large battery rooms and considerable wear and tear of the battery plates.

Figure 1 is an illustration of a telephone exchange battery room with two batteries operating on the charge discharge system. It shows, in fact, the battery room at Holborn Exchange at the opening in 1927 of the first automatic exchange in the London area—another milestone! The charge discharge system was gradually superseded by systems—generally referred to as "floating" systems—in which power is supplied from the mains direct to the communications equipment via machines or rectifiers. In these systems, the battery, although connected to the load, does not normally supply power, but is maintained fully charged until required in an emergency. By avoiding frequent conversions of energy from the electrical to the chemical form, a higher operating efficiency with resultant saving in power costs is achieved. Also, the battery capacity is reduced by approximately 50 per cent. and plate renewal is required much less frequently. Floating systems necessitate, however, an accurate control of battery voltage for satisfactory operation (often required in any case by the equipment being supplied with power) and this, coupled with the trend towards automatic operation, has led to more complex equipment. Figure 2 shows a control panel for an automatic floating system for a large repeater station.

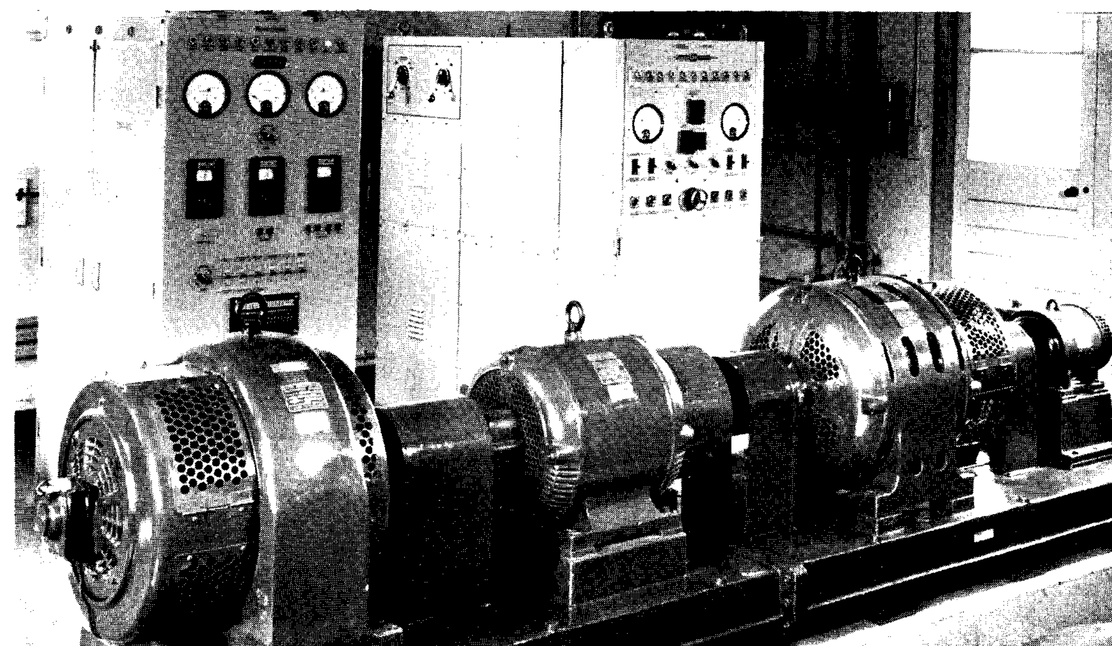
The early repeater stations were large buildings, 40 or 50 miles apart, with maintenance staffs in attendance. The introduction of "carrier" cables in 1936 reduced this spacing to 22 miles, while the first "coaxial" system in 1938 required a repeater spacing of eight miles, subsequently reduced to six miles on later routes. Economic development of the trunk system therefore required large numbers of normally unattended repeater stations and, in common with other equipment, the power plant had to be designed for automatic operation. Henceforward, the automatically started diesel engine generating set was to become a normal feature of repeater station plants.

The coaxial system required alternating current normally derived from the mains to be fed along the cable from "power feeding" to "dependent" stations on each side. Thus the power plants for these stations introduced an important change in design—the traditional batteries used hitherto on direct current plants were replaced by an engine generator capable of supplying alternating current to the communication equipment in the event of a power supply failure. Fortunately for the power engineer, a short interruption in supply was permissible and this enabled the stand-by to be introduced and mains to be re-connected without undue difficulty. A minimum period of interruption of 15 seconds was adopted to ensure that the break in transmission was brought to the notice of telegraph operators.

Effect of "N.E.P."

When repeater station and other main line equipment was re-designed after the war (New Equipment Practice or "N.E.P."), it was decided in the interests of efficiency and flexibility to abandon the common direct current supplies which had previously been used and to supply alternating current at mains voltage to the equipment racks. This practice was in fact similar to that adopted previously for coaxial line equipment except that individual "power packs" on each equipment rack were used instead of a common power rack. In view of the probable extension of

Fig. 4 : Continuity set and control gear



international working and other possible developments, it was also decided that the 15-second interruption in power supply, which had previously been accepted on A.C. operated plants following a mains failure, could no longer be tolerated. The combined effect of these two decisions on power plant design was very far-reaching.

With direct current plants employing batteries, a mains failure—unless prolonged—has no appreciable effect, power being supplied immediately from the battery. It is much more difficult to substitute a stand-by A.C. supply for the normal mains supply without an effective interruption. The problem of bridging the gap between a mains failure and stand-by becoming available has been tackled in several ways, but the alternative methods which have been employed by the Post Office are briefly as follows:—

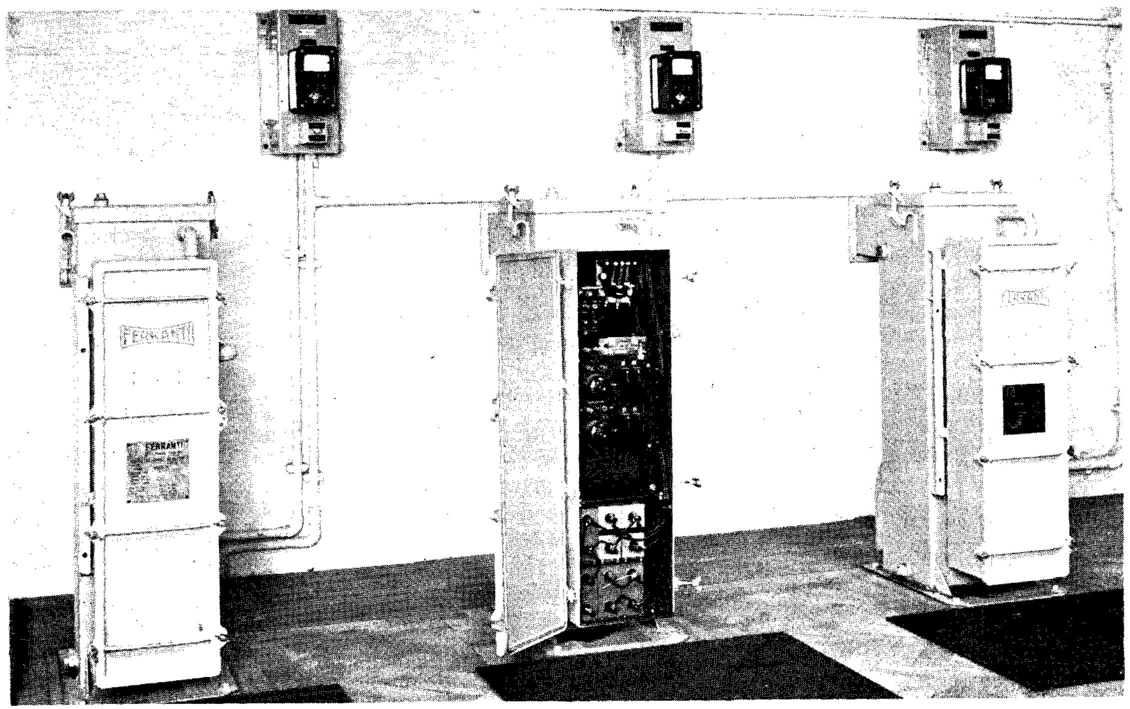
Method A: A machine capable of very rapid starting is taken into service on mains failure. This machine usually functions as a "short-term" supply until a "long-term" stand-by is available.

Method B: A switching point is interposed between the rack power pack and the communication equipment and on mains failure, appropriate battery supplies are brought into service. (This method takes advantage of the fact that direct current is just as suitable as alternating current for valve-heating while for valve anodes the output of the power pack is in any case D.C.)

Method C: A large mass (that is, a fly-wheel) is coupled to an electric generator which is big enough to supply the load. The combination is continuously rotated either by means of a separate motor or alternatively using the generator as a motor. Power for rotation and for the load is supplied from the mains. On mains failure the fly-wheel continues to rotate under its own momentum and drives the generator until an alternative source of power is available. The fly-wheel ensures that rotation will continue at sufficient speed for some seconds after failure of the mains.

Method D: An electric generator coupled to a mains-driven motor, supplies the load normally. On mains failure, the momentum of the machines maintains rotation for a very short period and an alternative drive is rapidly made available.

Fig. 5 : Automatic voltage regulators for mains-operated repeater station equipment



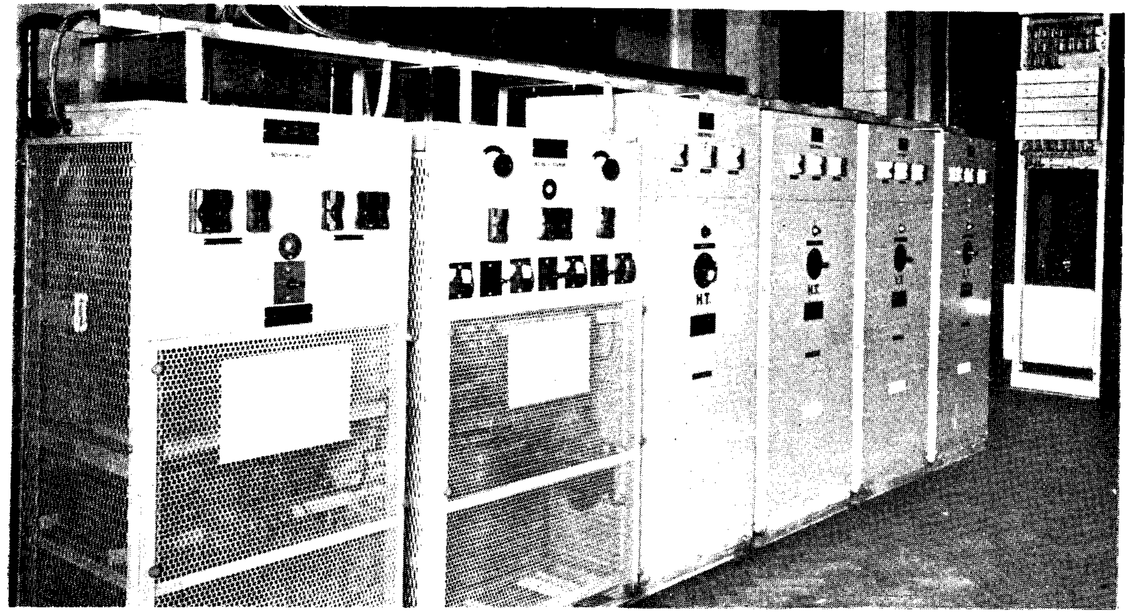


Fig. 6 : Telegraph plant employing selenium rectifiers

Methods A and B are not strictly "no-break" systems, but the interruption involved is a fraction of a second which, with most communication equipment, does not affect service. Method A has so far been used in the Post Office only for very small loads. The economic application of Method B is limited to installations where the equipment served is capable of accepting fairly wide voltage changes under mains-failure conditions.

With Method C, sufficient time is available to enable a "long-term" stand-by (that is, an engine) to be started up and coupled to the machine or, alternatively, the energy contained in the rotating fly-wheel can in some circumstances be used both to maintain rotation of the machine and to start the engine. The large rotating mass introduces mechanical problems, however, as may be gathered from Fig. 3 which shows the clutch and fly-wheel of a typical set.

With Method D the store of energy in the machine is very limited and this requires that the alternative drive shall be in the form of a second motor, driven from a battery, and capable of taking-over very rapidly. The problems involved are therefore mainly electrical. Figure 4 shows a continuity set designed for long periods of service and employing the principles of Method D.

Methods C and D have been combined in continuity sets fitted with fly-wheels. This arrangement eases the electrical switching problems but the present tendency is to prefer a clear cut distinction between the "mechanical" and the "electrical" methods.

One advantage of post-war mains-operated equipment has been that the power plant designer has been able to unify the requirements of repeater, telegraph and micro-wave radio equipment with a view to the use of a common type of power plant. In this connexion, it should perhaps be stated that the majority of so-called mains-operated main-line equipment is not designed to operate directly from the normal mains supply, but requires the use of special "voltage-regulating" plant (see Fig. 5) to maintain a much closer control of voltage. Further, the change from mains to a locally generated supply will often affect performance of the transmission equipment to such an extent as to necessitate local re-generation of power since the mains supply cannot be exactly imitated by a small machine.

A significant trend since the war has been an extension in the use of static as opposed to rotating plant for direct current supplies. Figure 6 is an example of the clean lines which can be achieved with this type of design. In this connexion, our story would not be complete without reference to two remarkable installations which well illustrate the technical achievement of the British engineering industry in this field.

The repeater station plant at Faraday Exchange (South Block), London, opened in 1953, is almost certainly the largest telecommunications plant in the world using static equipment (that is, selenium rectifiers). For those technically minded: this plant can provide closely regulated direct current supplies of 12,000 amps. at 24 volts and 980 amps. at 130 volts for valve heaters and anodes respectively.

The telephone exchange plant for the Kingsway Trunk Exchange, London, which has been in service since 1954, also employs selenium rectifiers throughout and has a maximum capacity of 4,000 amps. at 50 volts. To cater for the rise and fall of the exchange load, rectifier units are switched in and out of service entirely automatically as required, while at the same time the voltage of the supply is maintained within very close limits. This plant is one of the largest completely automatic exchange power plants in the world.

Apart from developments included under the previous heading, a very noticeable trend in the design of telephone exchange power plant has been the effort to save space by breaking down the barrier between the apparatus room and the power enclosure. With this in mind, the design of certain types of power plant has followed telephone equipment practice, rather than traditional lines. Fig. 7, which shows a rack of power equipment in line with telephone exchange apparatus, is a good illustration of this trend. This plant is also an example of the application of the system of stand-by referred to previously as Method B.

A Glance at the Future

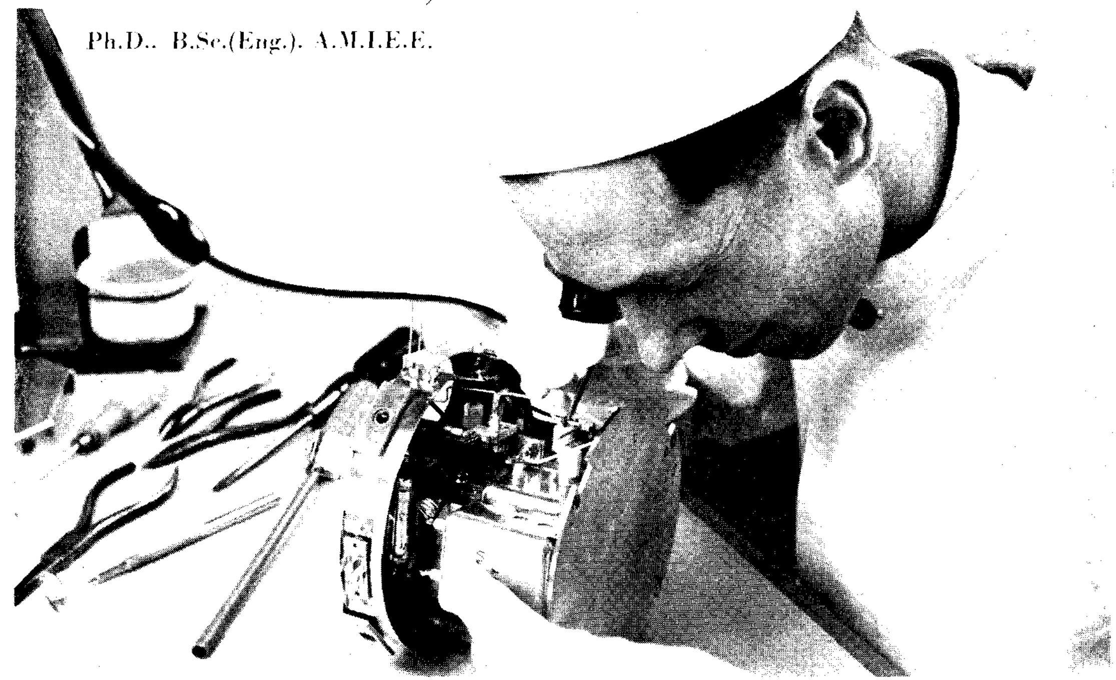
In the past, the power engineer was often tempted to regard the circuit designer as a man who was content to acknowledge the existence of some form of power plant by means of a small symbol on his diagram, and then dismiss the whole subject from his thoughts! Even if this conception were ever more than a myth, it is now generally accepted that power considerations must be taken into account at a very early stage, so that apparatus design shall not impose impracticable or uneconomic demands on the power plant. With this in mind, future requirements are now being carefully considered. Electronic switching techniques are already well advanced, and the all-electronic telephone exchange may not be very far away. There are various alternatives to conventional electro-magnetic switching and it is especially necessary to preserve a flexible attitude when considering power requirements.

The desire to avoid conversion losses on valve heater current was one of the factors leading to present day mains-operated transmission equipment. With the development of that astonishingly power-saving device, the transistor, it appears that for many purposes the days of the thermionic valve are numbered and there seems no doubt that much smaller valve-heater loads will have to be catered for in future. The research into semi-conductor materials which followed the discovery of the transistor also stimulated the development of new types of conversion equipment—germanium and silicon power rectifiers—whose application may enable the power engineer to eliminate rotating machines entirely from D.C. plants and permit the achievement of higher efficiencies and smaller bulk than ever before. These considerations, with the fact that fully automatic no-break A.C. plants are necessarily quite complex, may ultimately reverse the present trend towards mains operation and lead back to common D.C. supplies.

Fig. 7 : Rack of power plant installed in line with telephone switching equipment

British Submerged Repeaters in the Transatlantic Telephone Cable

R. A. Brockbank,
Ph.D., B.Sc.(Eng.), A.M.I.E.E.

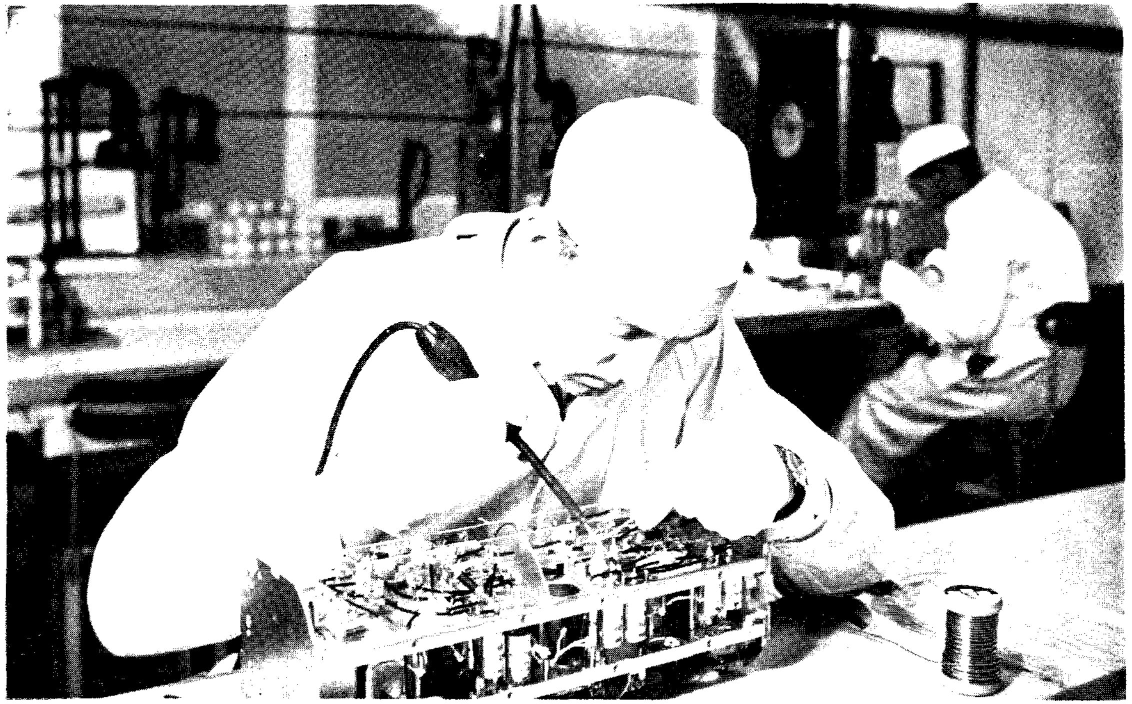


Wiring a power separating filter [Courtesy, Standard Telephones & Cables Ltd.

WHILE AMERICAN-STYLE ONE-WAY Repeaters amplify the signals in the main telephone cables between Oban, Scotland, and Clarenville, Newfoundland, the 316-mile cable from Newfoundland to Sydney Mines, Nova Scotia, contains 16 British-style two-way repeaters. In this article Dr. Brockbank outlines the problems involved in developing the British repeaters and describes how they are made and tested.

The Post Office has been working on submerged repeater systems for nearly 20 years and now has some 34 repeaters operating in the comparatively short cables in the shallow seas around these coasts. This experience is proving invaluable for the development of the more complicated long deep-sea systems which the near future now undoubtedly holds in store. Such systems present many facets and major problems often arise in metallurgy, chemistry, physics, hydrostatics and, of course, in mechanical and electrical engineering. Successful solutions, however, cannot really be fully assured until a system has operated satisfactorily for many years.

A description of a submerged repeater, and the British transatlantic telephone repeater in particular, will be better appreciated if some of the major essential differences between repeatered land and sea carrier systems are briefly discussed. The most radical differences between two such systems are probably in respect of reliability, fault localization,



(Courtesy Standard Telephones & Cables, Ltd.

Wiring a transatlantic telephone cable amplifier

compactness, watertightness, equalization and power supply.

An important reliability requirement is obviously involved when it is appreciated that repairs and electrical adjustments are extremely difficult to carry out once the system has been laid. The question of how much money to lavish on a repeater to improve its reliability is to an appreciable extent governed by the "cost" of a repair. It is estimated that a repeater fault on the Clarenville-Oban route may cost nearly £100,000 to repair and may take on an average three weeks to complete. This figure does not include loss of revenue while the system is out of service, or of any repercussion on traffic growth.

The extreme seriousness of a repeater fault on a long distance system is therefore very evident, and to prove-in such a system economically it is necessary to attain a standard of consistent long life never before attempted in comparable equipment. This overriding emphasis on ensuring the utmost possible reliability is a nightmare at every stage from the designer's first thoughts to the final act of laying. Wherever possible "belt and braces" tactics have been employed when it is evident that they are mutually independent.

Fault localization in a submerged repeater system presents quite a problem since not only must it be reliable and accurate because of the time and expense involved in breaking into the cable at an incorrect location, but it must also be capable of functioning for the many different types of faults which could degrade the system performance. For example, valve noise, intermodulation, spurious oscillation and low repeater gain, all require different treatment of fault location. Also, all this information has to be transmitted over a single core cable where frequency bandwidth is at a premium.

Compare all this with a land coaxial cable where eight interstice pairs are provided for supervisory purposes, and if there is still any doubt a journey to an adjacent station takes only a matter of minutes! Space forbids further discussion of an interesting problem, but on the British transatlantic telephone cable link two methods are

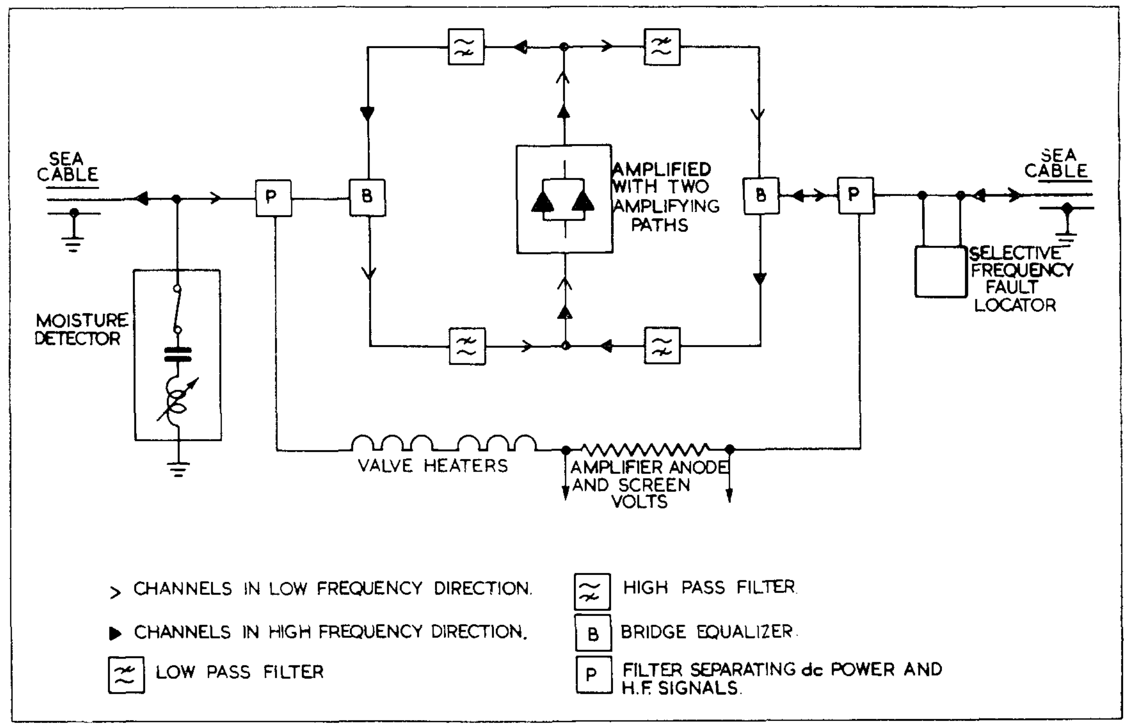
available. The first permits an accurate measurement of the loop gain to each repeater and the second primarily measures distortion and overload level of each repeater.

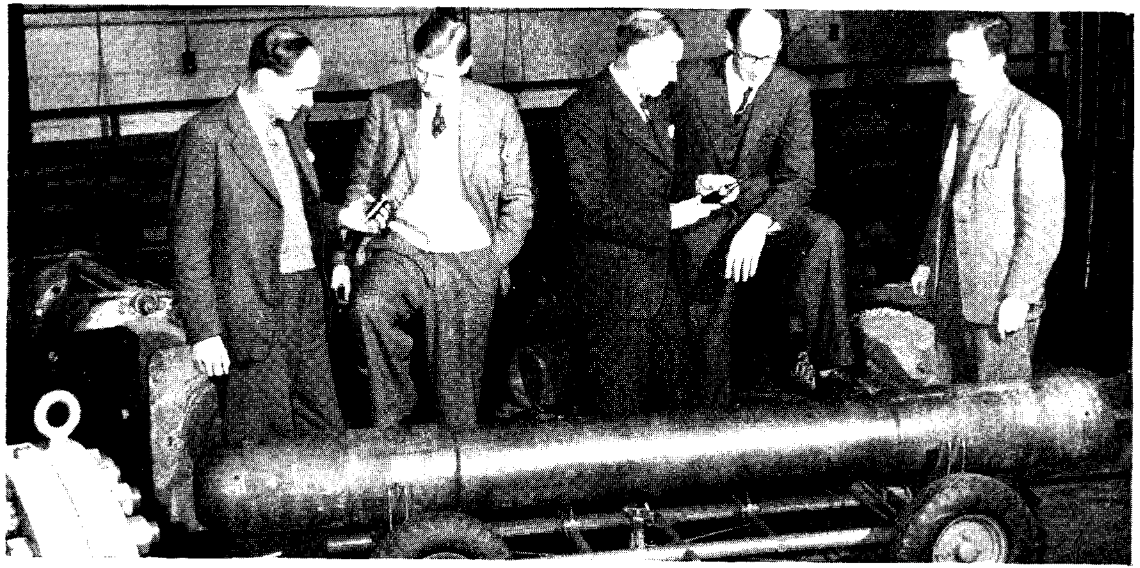
Compactness of design is essential if the housing which is to contain the electrical unit is adequately to withstand a deep sea pressure of $3\frac{1}{2}$ tons per square inch at 3,000 fathoms ($3\frac{1}{2}$ miles deep) without becoming excessively bulky and heavy. The present British housing weighs about half a ton, and inside it has been possible to provide a volume of about one cubic foot for the electrical equipment. This just about enables the 300 components to be arranged so as to (*a*) provide insulation for them to withstand a direct current power feed voltage of 2,500 volts to earth, (*b*) dissipate the heat from the six valves and (*c*) provide a layout which enables every joint to be inspected and tested at a final stage of assembly.

Watertightness is a *sine qua non* and this involves not only sealing up the housing after the electrical unit has been inserted but also providing two cable entries (glands) which shall not only be watertight at $3\frac{1}{2}$ tons per square inch sea pressure but shall be sufficiently insulated for the cable to work at 2,500 volts to earth. Watertightness usually also implies that the passage of water vapour shall be such that after 20 years the relative humidity of the gas within the housing shall not be substantially increased. The British repeater glands are tested at 5 tons per square inch and with 20,000 volts to earth.

Equalization of a long submerged repeater system is incomparably more difficult than of its land counterpart. At the latest it must be done during the laying operation by selecting a suitable submerged equalizer and splicing it into the cable. This operation is inflexible and costly and to minimize its need it is essential to be able to forecast the attenuation characteristic of the laid cable with the utmost precision. Unfortunately this has not yet been possible, as various factors affect the cable—for example, coiling, tension, temperature, sea pressure and corrections—for these are not yet accurately known. Equalization for seasonal temperature changes can be carried out readily only at land based stations so that the system has to be designed initially to operate

Simplified diagram of Repeater Circuit



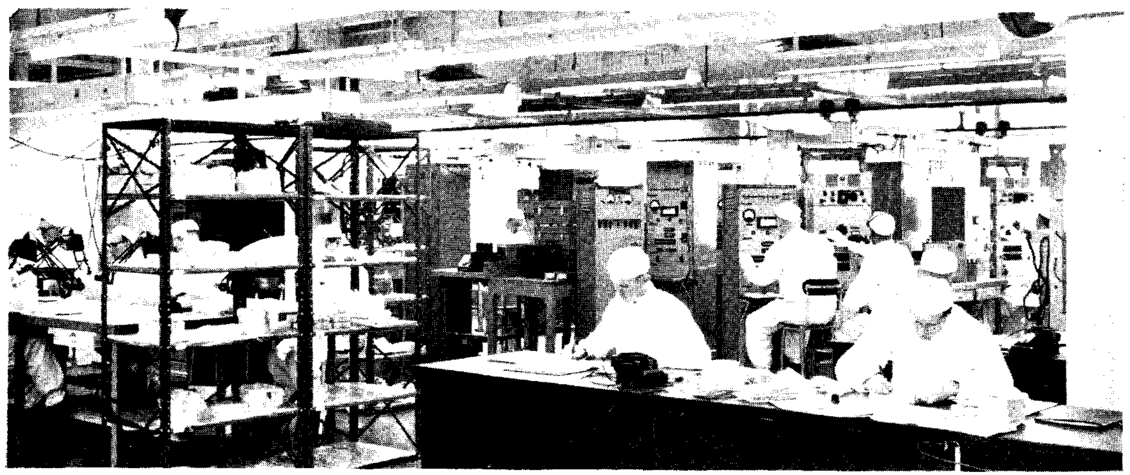


The Post Office design team—*(left to right)*: **Mr. D. C. Walker—Electrical design; Dr. G. H. Metson—Valves; Dr. R. A. Brockbank (author of this article)—Submerged Repeater systems; Dr. V. G. Welsby—Housings and laying; Mr. F. Jones—Cable and components**

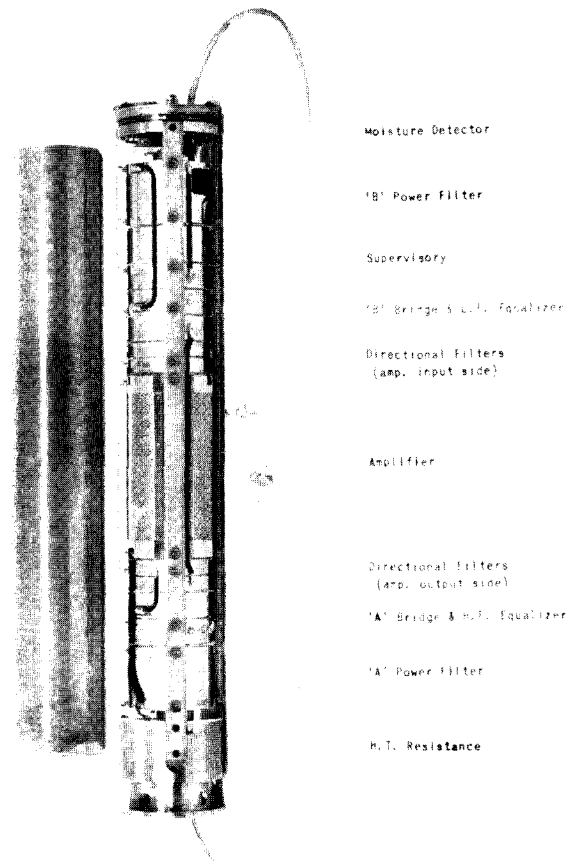
satisfactorily at all likely cable temperatures. It is fortunate that long cables usually imply long stretches at ocean depths, as at such depths a virtually constant temperature exists.

The amplifiers in a chain of submerged repeaters must be energized at land terminals. The universal method is to feed a constant direct current through the centre conductor, through the valve heaters and return through the sea. The high voltage for the amplifier valves is obtained from across a series resistance in each repeater, which may include the valve heater resistances. Long systems can readily require a total of 4,000 volts or more and this begins to present certain difficulties in the power feeding arrangements and in the repeater design. In the British section of the cable each repeater absorbs 125 volts so that a total feed voltage of about 2,200 volts is required. By feeding

A corner in the Assembly Block



[Courtesy, Standard Telephones & Cables, Ltd.



[Courtesy, Standard Telephones & Cables, Ltd.

An assembled electrical unit ready to be sealed into its brass sleeve

from one terminal at 1,100 volts and 1,100 volts at the other, the maximum working voltage to earth is halved and the centre of the system is at earth potential.

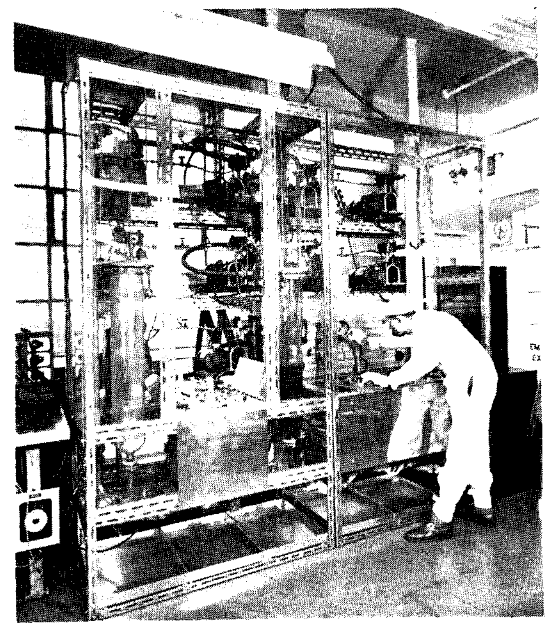
The British repeater for the transatlantic telephone cable follows transmission practices proved in an earlier system. Briefly, 60 telephone channels each 4 kilocycles per second (kc s) wide are transmitted in a carrier band 20-260 kc s and the channels in the return direction are situated in the band 312-552 kc s. Only one amplifier is necessary to transmit the signals in both these frequency bands, as this is made possible very simply by the electrical filter arrangement shown diagrammatically on page 149. In addition, other filters are required to separate the direct current feed from the high frequency signals and feed it through the valve heaters and anode supply resistor and thence to the other side of the repeater.

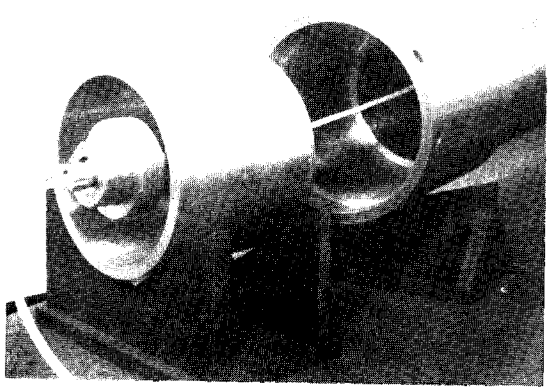
Also shown in the figure is a selective frequency circuit which enables the levels of the signals at each repeater to be monitored from the terminal, an equalizer which makes the repeater gain compensate for the cable loss in each repeater section, and a moisture detector device which will be mentioned again later. The amplifier consists of two amplifying paths in parallel and provides a repeater gain at the highest frequency of 60 decibels; that is, a power amplification of one million. A fault can occur in either of the two parallel paths without affecting the gain of the repeater.

The electrical circuit components—for example, the inductors, capacitors and resistors—are manufactured, aged and tested according to most rigorous specifications and are then assembled in gold-plated cans. These cans are then mounted and interconnected within a framework of four perspex bars which insulate the units for working at 2,500 volts to earth. The internal unit at this stage contains over 1,500 soft soldered connexions. The gold plating of metal parts eliminates the

The impregnating plant for paper capacitors

[Courtesy, Standard Telephones & Cables, Ltd





A bulkhead with gland ready for insertion into the pressure housing

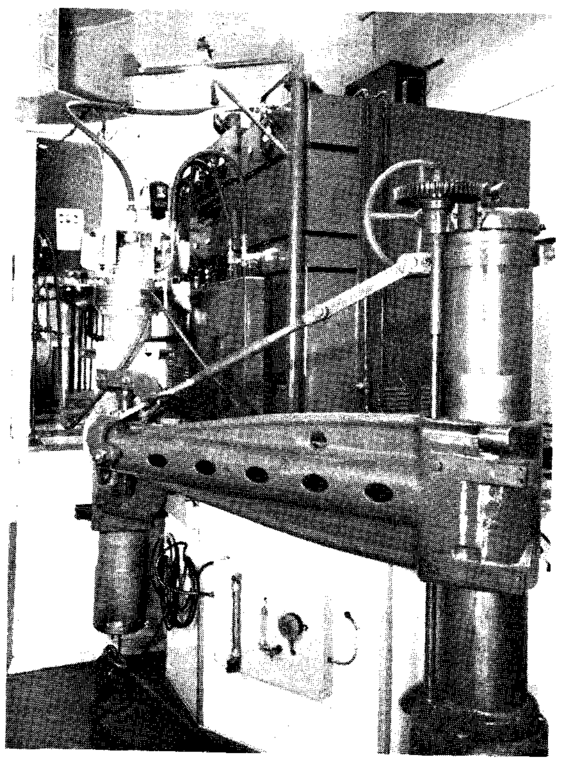
possibility of whisker growths which are known to occur on many metals, particularly tin, and which act as conductors. The whole assembled unit, after searching electrical test, is sealed in a cylindrical brass tube with two cable tails for electrical connexions. Dry nitrogen is passed through the unit through two small holes, to ensure a low stable relative humidity. The holes are then sealed off, leaving a nitrogen filling.

Up to this stage manufacture has been carried out in a building which is temperature and humidity controlled with dust-free air. This building is popularly known as the "Dairy" because of its white glazed tiles and general cleanliness. Operators are specially selected and they must change into special clean protective clothing in an ante-room before entering an assembly block in which there is no smoking, eating or "music while you work"! Only authorized visitors are allowed to enter and they also must wear full protective clothing. Rigorous and lengthy testing and inspection is carried out at all stages and the individual operators are encouraged to report or reject any condition which is abnormal or in which they have not complete confidence.

The sealed electrical unit is now ready for enclosing in its pressure housing. This consists of a steel cylinder plugged at each end by a bulkhead through the centre of which passes the electrical connexion from the submarine cable to the electrical unit. The gland developed by the Post Office is most original but it has been well proved and is simple and compact. The electrical unit is first bolted to one bulkhead and the tail connected to the low pressure side of the gland. This assembly is lowered into the cylinder until the bulkhead rests on a flange. The bulkhead is then brazed into the cylinder using a 50 kilowatt (kW) induction furnace operating at 350 kc/s. Water jackets protect the gland and limit the spread of heat away from the brazing area. The actual braze takes about 45 minutes. After cooling, the other tail from the electrical unit is connected to the second bulkhead, which is then inserted into the other end of the cylinder and brazed in position.

The moisture detector, which is used subsequently to check that the relative humidity does not increase, is now brought into use. This device consists of a series tuned circuit in series with a fuse and connected from the centre conductor at one end of the repeater to earth. The inductor of this tuned circuit has an armature fixed to an aneroid box so that gas pressure changes vary the inductance, and hence the resonant frequency, of the circuit. The inductor is mounted on the outside of the electrical unit. A glass capsule containing calcium is mounted on the inside of one of the bulkheads underneath a small "filler" tube provided in each bulkhead. Dry nitrogen is now circulated in the space between the electrical unit and the housing. When this has been satisfactorily dried out a plunger is inserted through the filler tube and the glass envelope of the capsule broken. The filler holes are then plugged and brazed. If a water leak should develop at any later stage the water vapour will react with the calcium, releasing hydrogen and thereby building up gas pressure and altering the resonant frequency as measured on the repeater tail.

Induction brazing a bulkhead into the pressure housing



[Courtesy, Submarine Cables, Ltd.

The housing is now pressure-tested and for the transatlantic telephone cable repeaters this consists of inserting the repeater in a pressure vessel and maintaining a water pressure of $1\frac{1}{2}$ tons per square inch for one week. The moisture detector checks that there has been no leakage into the repeater.

The final stages in the assembly of the repeater are then completed as follows. Each gland is enclosed in a metal cone which is filled with a soft but solid grade polythene mixture and the cone and braze then submerged in a viscous liquid (poly-iso-butylene), held in place by a poly-vinyl-chloride (P.V.C.) diaphragm. (The compounds are considered preferable to having sea water in contact with the gland and braze.) The clamps for gripping the armour of the sea cable are then fitted at each end; these operate on a locking wedge principle and are as strong as the cable. Finally the stream lined end caps are screwed on and locked in position.

To minimize corrosion, the external surface of the repeater is then treated by shot-blast, zinc spray and two coats of vinyl paint. The high frequency output end of the repeater is coloured red since the repeater must be connected correctly into the cable.

The manufacture of the repeater is now complete and the remaining requirement before acceptance is a confidence run for three months. For this the repeater is energized under water and a series of precision measurements and recorder monitor runs is carried out to establish as far as possible that the repeater is stable in all respects.

At any time during subsequent storage the relative humidity within the repeater can be measured by the moisture detector. Since the moisture detector circuit is connected between the centre conductor of the cable and earth it is desirable to remove this shunt before the repeater is inserted in a working cable. This is readily accomplished during a normal moisture test by increasing considerably the volts across the tuned circuit so that the increased resonant current blows the fuse and disconnects the shunt.

This brief description of a transatlantic telephone cable repeater is necessarily extremely condensed and does not do justice to the enormous amount of work which has gone into the design, manufacture and testing of these repeaters. The accent has been chiefly on the mechanical aspects and little reference has been made to the much more specialized problems associated with the electrical design, the circuitry and the performance of the repeaters and the system.

Experience is now indicating that the reliability of repeaters can in practice attain a standard which makes long distance submerged repeater systems an economic proposition. With such a promise a new era of underwater telecommunications can be confidently expected.

Inland T.A.T. Coaxial Completed

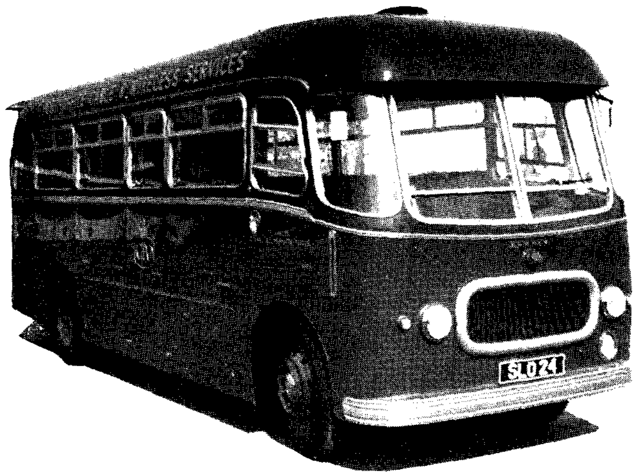
The first pair of coaxial tubes in the new cable from Oban to Glasgow, which can carry 900 inland and transatlantic circuits, are ready for service; this extends the existing inland coaxial and carrier cable network from Glasgow to the Oban terminal. Construction involved laying about 130 miles of ducts in roads.

The cable is hermetically sealed at all the 21 intermediate repeater stations between Oban and Glasgow, and dry air at a pressure of approximately 10 lb. a square inch is forced into the lead sheath. Should the sheath become slightly punctured the air pressure is sufficient to keep out moisture until repaired. Pressure devices give immediate warning should pressure fall below a prescribed level and show where the fault has occurred.

Many of the new buildings along the route, such as intermediate repeater stations, have been built of local stone to harmonize with their surroundings.

A second pair of coaxial tubes will be ready shortly as a reserve to guard against appreciable interruption of service should any fault occur in the first pair.

A special supplement on the transatlantic telephone cable will be published with our Autumn issue.



Mobile Telegraph Office for Sporting Events

L. G. Timms

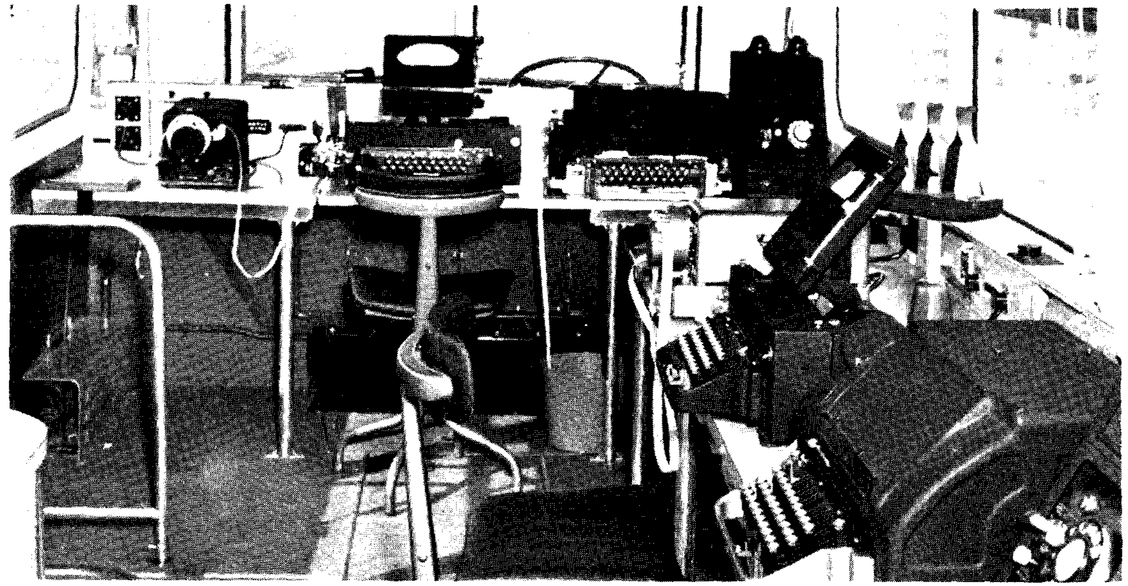
(A brief paragraph about the new Mobile Telegraph Office appeared in "Notes and News" in our Spring issue. In this article Mr. Timms gives a full description of the vehicle and its purpose.)

BEFORE SPECIAL RATES FOR COMMONWEALTH Press telegrams were introduced in 1939 and 1941 the daily total of overseas Press traffic originated at a cricket Test match was small in comparison with that handed in today, and we could transmit the whole of this over one or two telephone circuits to the overseas terminal. The reduction in the cost of telegraphing news—and a growing public interest—resulted at the end of World War II in a considerable increase in the Press traffic at sporting events in general, and at Test tour cricket matches in particular. Telephone circuits soon proved inadequate and teleprinter circuits were brought into use. At many cricket grounds, however, no accommodation could be offered for the telegraph instruments and, although huts and other temporary shelters were used during the 1948 visit of the Australian touring team, the answer to the problem seemed to be in the provision of some form of mobile office.

In 1952, therefore, the Engineering Department lent the External Telecommunications Executive an unequipped mobile automatic exchange (M.A.X.) 12 trailer, wired for working point-to-point teleprinter, automatic 5-unit and high-speed morse. Although from the limited choice of vehicle then available this M.A.X. most nearly met the telegraph operating requirements, it had several limitations. The original intention had been to send the mobile office to each venue completely equipped, but the springing of the trailer was such that this idea had to be abandoned. A lack of insulation resulted in an unpleasantly high noise level and made it difficult to maintain anything like an equable interior temperature despite the fitting of a fan and heaters. All ancillary equipment had to be accommodated within the vehicle, and the rectifiers under the telegraph benches became somewhat uncomfortable footstools for the telegraph operating staff.

Despite these handicaps, however, the trailer proved its value during the 1953 Australian Test series when it handled over half a million words at the 11 matches for which it was used. The whole tour produced 2½ million words of overseas cricket Press, valued at £17,000—a million words more than for the 1948 tour—and in reviewing the results of that season it was clear that with increasing traffic a properly designed mobile telegraph office would certainly be necessary before the 1956 visit of the Australian cricketers. With the experience of a year's operation of the trailer on which to work, the External Telecommunications Executive (E.T.E.) began planning a self-contained mobile telegraph office.

The first concern was the type of vehicle to be used. A coach was favoured but, before the final decision was made, a chassis which fulfilled the requirements of adequate springing and floor space was taken to the Oval where the only site available had rather awkward access. No difficulty was experienced in manœuvring the vehicle in, however, and, with the size of vehicle thus settled, the Operations and Planning Branch of the E.T.E. was



Interior—looking to front of vehicle

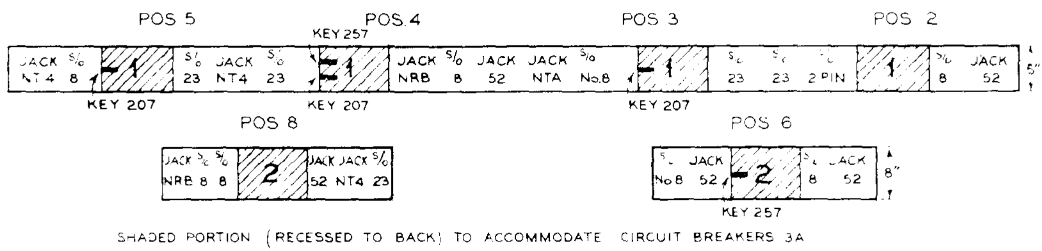
able to start planning the telegraph requirements.

Provision was made for five alternative methods of telegraph working—high-speed morse, teleprinter automatic switching with either manual or automatic transmission, 5-unit automatic transmission using perforated tape, duplex or simplex point-to-point teleprinter. The position of the telegraph instruments on the benches for each method of working was determined by practical trials, under simulated conditions, in the E.T.E.'s Telegraph Training School at Acton.

Meanwhile, the Engineering Branch of the E.T.E. and the Telegraph and Motor Transport Branches of the Engineer-in-Chief's Office had been carrying out a detailed study of the electrical and mechanical requirements, and in due course the results of the investigations of all the branches concerned were brought together and plans and a specification produced jointly. The effort was directed throughout at producing a practical instrument room layout with clear floor space, reasonable operating conditions and neat yet accessible wiring and equipment.

The specification provided for the mobile office to be built by Harrington's of Hove on a Commer "Avenger" chassis powered by a new Rootes diesel engine developing 105 b.h.p. The completed vehicle is 27 feet long and weighs just over six tons. The outside of the aluminium body is finished in Post Office red with the window frames, mouldings and other exterior metal fittings gold anodised. Inside, the walls and doors are lined with light

Back-board jacks and sockets lay-out

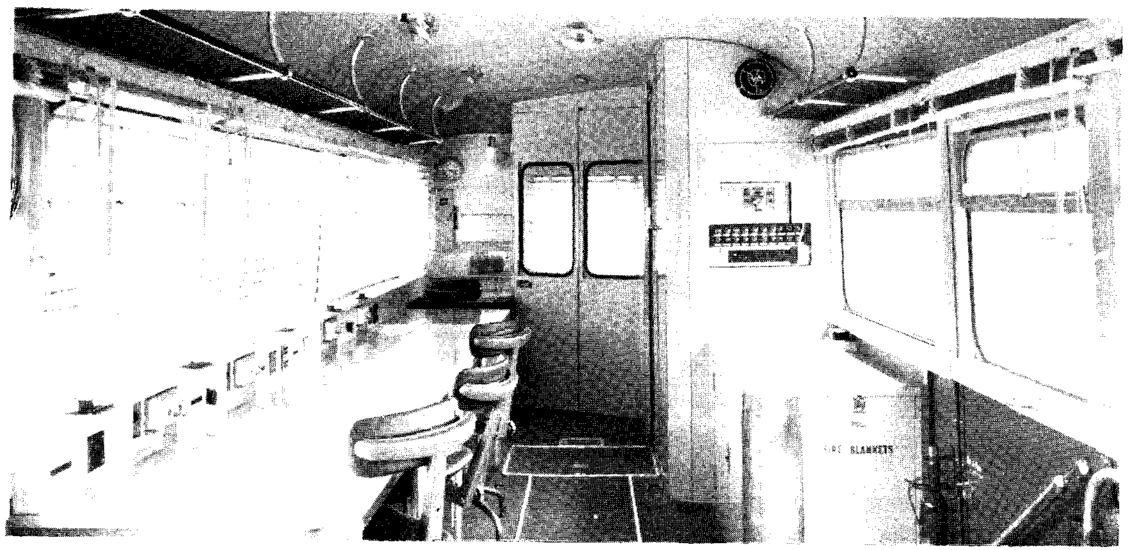


The Postmaster General, Dr. Charles Hill, viewing the interior at the inaugural ceremony on April 26

mottled brown "linette" Formica, and the same material, in green, covers the telegraph benches and table tops. Cream venetian blinds at each window pass the maximum amount of light into the vehicle without glare, and a green rubber floor and green covered adjustable chairs conform to the general colour scheme. The sound and heat insulation provided by three inches of fibre-glass behind the grey Bedford cord roof lining keeps the noise down to a reasonable level and greatly facilitates the control of interior temperature by means of large intake extract fans and tubular electric heating.

Built into the vehicle are a miniature toilet containing a hand-basin, with running water, and a mirror; a small telephone silence cabinet which can be used for phonogram working should the need arise; adequate cupboards for the paper

Interior—looking to rear of vehicle



supplies, angle-poise lamps, coats and the inevitable tea-making equipment. Eight rectifiers are contained in a large under-floor locker as are the cable masts, spare wheel, cleaning utensils, towing ropes, a ladder, lengths of perforated metal for use on soft ground and other similar articles. Fire precautions include three extinguishers and two asbestos blankets in easily accessible positions.

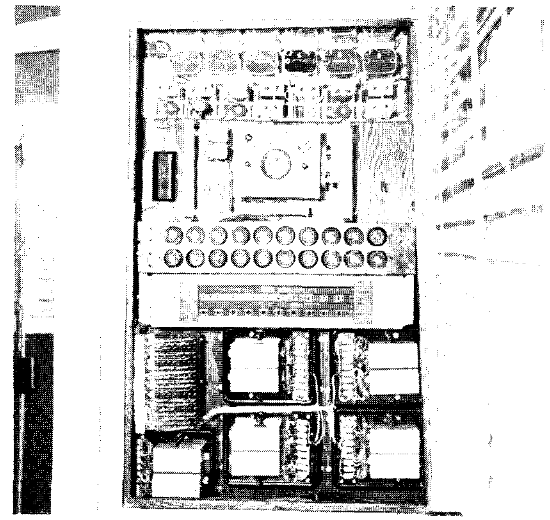
The use of special packs has enabled the original idea to be put into practice and the full telegraph equipment for a particular event is carried in the vehicle. The only requirement at a site now is the provision of the telephone and telegraph line terminations and a power supply of six kilowatts. The driver of the mobile office maintains the telegraph instruments and carries out minor servicing on the vehicle.

The telegraph wiring was installed by engineers from the Brighton Telephone Manager's staff while the vehicle was under construction at Hove. The wiring is run in channels at the rear of the telegraph benches behind a vertical panel on which are mounted the various switches and socket outlet terminations.

Although designed primarily for working wholly one or other of the five alternative methods previously mentioned, a certain degree of flexibility is possible in that, where the physical space permits, a combination of methods can be used—for example, a high-speed morse circuit could be worked from positions 2 to 5 on the main table and a T.A.S. circuit from positions 6 to 8 on the cross table, or the morse circuit control audio oscillator and undulator on position 2 could be replaced by a point-to-point teleprinter or T.A.S. manual circuit.

The new mobile office was formally declared "in service" by the Postmaster General at an inaugural ceremony, when representatives of the Press inspected and photographed the vehicle. Two days later it was on its first assignment—the opening match of the 1956 Australian Test series which was being played on the Duke of Norfolk's private ground at Arundel.

We are sure that we now have a vehicle that reflects credit on all concerned with its design and building. By August it had attended 10 cricket matches and cleared 578,000 words with an average transmission on urgent traffic of about 8 minutes from handing in at the ground to reception in Sydney. The mobile office has proved eminently suitable for the job, and both the operating staff and



Jack-field with cover removed

the driver-mechanics are satisfied that they have a vehicle that enables them to maintain the very high quality of service that the overseas Press expect of us.

"Journal's" New Chairman

The Editorial Board learned with regret that Mr. J. F. Greenwood, C.B., who, as Director of Inland Telecommunications, has been Chairman since Spring, 1954, had retired from the Post Office because of ill-health.

Mr. F. I. Ray, C.B.E., Director of London Telecommunications Region since April, 1948, has been appointed Director of the Inland Telecommunications Department, and becomes Chairman of the Board. Mr. Ray joined the Engineering Department in 1922 and during his career has been Telephone Manager in the Scotland West Area, Telecommunications Controller in the North Western and London Regions, and was for several years an Assistant Secretary in his new Department. He has recently visited a number of continental countries to study their telephone systems.

Col. H. B. Somerville, C.B.E., T.D., Director of the North Eastern Region, has succeeded Mr. Ray as Director of the London Telecommunications Region.

Cricket Scores by Telephone

"Argus"

WEBBER 8811, THE TIM EQUIVALENT FOR learning the latest Test scores, was introduced for the first London (Lords) match in June, and proved so popular that the Post Office decided to open a similar service during each of the provincial Tests this summer, as well as to follow the original plan of repeating it during the second London match at the Oval in August.

It is estimated that during the five days of the Lords match (June 21-26) about 1,000,000 calls were completed but the total traffic probably included some 200,000 attempted calls an hour. The records are incomplete because the call counting equipment, being overloaded, did not work accurately.

Test messages

Although when announcing the service on May 16 the Postmaster General said it would be opened only for the two London Tests, the probability that some people would call WEBber 8811 during the first match at Nottingham early in June was prepared for by having a preliminary message, recorded by Jim Laker, the England bowler, connected as soon as the equipment was ready on June 8. Mr. Laker said, "This is Jim Laker of Surrey and England making a Test announcement for the Post Office in their London Test Match Service. Greetings to all cricket followers. I hope you will find this service useful. Call this number, WEBber 8811, to hear score details of the Lords Test starting on 21st June and of the Oval Test starting on 23rd August". Johnny Wardle (Yorkshire) and John Warr (Middlesex) recorded later preliminary messages.

Before play began on the first day of the Lords Test, the message heard by callers was, "Test Match Information Service. Play between England and Australia in the second Test will commence at 11.30 this morning". During the match a Post Office representative passed the score details from the ground direct to Holborn Exchange by private wire.

The information was then edited and recorded as brief messages in the form, "Test Match Score—Australia two hundred and sixty-nine for eight. Johnson 1 not out, Langley 4 not out". The last message on the fifth and final day was, "Second Test Match result—Australia won by 185 runs. Australia 285 and 257—England 171 and 186. The first Test was drawn".

The new service in London uses spare capacity on the London Telephone Weather service equipment, described in our Spring issue, which was designed to cater also for similar new services which might be developed in the future. As the service this summer, as originally planned, would be for two periods of six days only, however, the Post Office found that it could become a practical and economic proposition only by using the same director code and routings as for WEAther 2211; hence the adoption of the name WEBber. Roy Webber, incidentally, has written numerous books on cricket and contributes to the *News Chronicle*.

Many calls during the first Test match failed because of lack of switching equipment at the local and in the tandem exchanges, as well as at the weather unit. This was remedied on the first day at the bad spots and although congestion did occur afterwards, surprisingly few complaints were received. On the second day of the match a local scores information service was provided at a number of the big central exchanges so that operators could give the information to call office users who had to dial "O" for this service, and to ordinary subscribers who failed to get through to WEBber because the number was engaged. All such calls were, of course, chargeable.

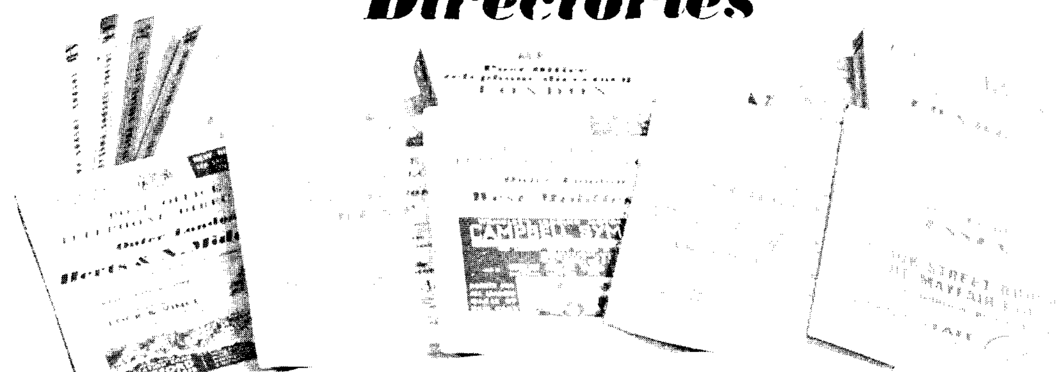
The Post Office's ability to provide this service depends, in addition to the skill of the engineers, on the fullest co-operation willingly given by the host clubs—in London, the Marylebone and Surrey cricket clubs.

4½ million calls

Post Office Cable & Wireless broke all records on July 12 for the number of words transmitted overseas reporting any Test match in this country. Some 47,000 words were received from the cricket ground at Headingley, Leeds, and 30,000 were received from Fleet Street—a total of 77,000 words.

The popularity of the service is shown by the increasing figures: second Test with which the service began one million; third, a million and a half; fourth, two million 4½ million in all on the three matches.

Typography and Telephone Directories



K. F. A. McMinn

"IT *must of necessity be", said Sir Joshua Reynolds, "that even works of genius, like every other effect, as they must have their cause, they must also have their rules; it cannot be by chance that excellencies are produced with any constancy or any certainty, for this is not the nature of chance: but the rules by which men of extraordinary parts—and such as are called men of genius—work, are either such as they discover by their own peculiar observations, or of such a nice texture as not easily to admit being expressed in words. Unsubstantial, however, as these rules may seem, and difficult as it may be to convey them in writing, they are still seen and felt in the mind of the artist; and he works from them with as much certainty as if they were embodied upon paper. It is true these refined principles cannot always be made palpable, as the more gross rules of art; yet it does not follow but that the mind may be put in such a train that it still perceives by a kind of scientific sense that propriety which words . . . can but very feebly suggest*".

Sir Joshua said this about painting, an art in which he was a genius, but, as Updike* says, if we substitute "art" for "genius" we have a quotation applicable even to the task of designing satisfactory pieces of typography. Although rules for designing suitable printing may seem insubstantial, and difficult to convey in words, it is still true that they are seen and felt in the mind of the worker. They are illusive rules; none the less a man works from them with as much certainty as if they were set down on paper. It is because they are so illusive that many persons believe that, in designing printing, there are no rules at all; because they commonly think of rules as matters of precise measurement and definite proportion. In fact, the best rules for planning work are general rules, and rules for the mind rather than for the hand—no less real because applying to what may be called, in a sense, a spiritual matter. So in properly laying out printing (which is nothing more than successfully designing it for a given object) it is necessary to have a certain mental equipment, which is, to tell the truth, where most designers of printing fail.

Typography, therefore, is not just the art of type design; it is the art of presenting reading matter to attract the reader and enable him to read as easily as possible. This is true whether the matter to be read is a literary work, a newspaper, or a telephone directory. Ease of reading depends mainly on the simplicity of the type design, the length of the type lines and their leading, the spacing of words and the right choice of type for the paper on which it is to be printed.

Telephone directories are functional in that they are primarily reference books—Charles Lamb's "biblia a-biblia"—and not works of artistic typography. Their first function is to give information quickly, so that clarity and legibility must be the first typographic consideration. The factor of legibility, accepting the principle that "legible" means the quality of being distinct enough to read, is fraught with difficulties. First you have to compare type faces and sizes, since the smaller

* *Daniel Berkeley Updike, author of "Printing Types: Their History, Form and Use".*

Smith Albert H,205 Wadham rd E.17...**LAR**kswd. 2498
Smith Albert H,Contr,105 Foulden rd N.16**CLI**ssold 1508
Smith Albert J,
30 Kneller gardens Isleworth.........**POP**esgve 5154
Smith Albert J,93 Lime grove Nw Malden**MAL**den.. 5043
Smith Albert J,50 Marlpit la Coulsdon..Downland 107
Smith Rev. Albert J,
St Pauls vcge St Stephens rd E.3......**ADV**ance. 1626
Smith Albert J,8 Yew grove N.W.2......**GLA**dstne 8349
Smith Albert J,Bldr,Almavedon Main rd.Romford. 858
Smith Albert J,Buyer,19 Russell st W.C.2**TEM**pl Br 1700
Smith Albert J,Plmbr,63 Queens rd SW14**PRO**spect 3879
Smith Albert J. & Sons (Hornchurch) Ltd,Bldrs,
213 Station lane....................Hornchch 349
Smith Albert L,18 Blunts rd S.E.9......**ELT**ham.. 8676
Smith Albert M,107A Victoria rd........Ruislip. 6546
Smith Albert P,76 Salisbury rd.........**HAR**row.. 7073
Smith Albert R,3 St Andrews mans NW9.**COL**ndale 2901
Smith Albert R,
4 Sipson lane Harlington............**HAY**es... 1376
Smith Albert S,77 Connaught av...........**ENF**ield. 1039

The type—6 point Modern—in the present directory

your type the relatively thicker are the hairlines, which decreases legibility; very many type faces lose their clarity in the small sizes. You have also to consider other variables such as eyesight, health and illumination, and the blackness of the ink for contrast. Paper, too, is important; you need the right "colour"—a term which applies to the almost infinitely varying shades of white as well as to "colour" in its common meaning—so that you get the right degree of contrast to throw your type in relief, and you need to consider the quality of the paper to ensure that the type face clarity is not diminished by absorption. Last, but by no means least, in printing telephone directories is the factor of economics.

The opportunity for considering a change of the type used for telephone directories in this country arose when the London Directory had to be split and reorganized (the London Directory being

Bell Gothic in the first "pilot" (York) directory

Briars Arthur J,20 Eastward av Fulford............York 77121
Brice W,11 Burn bdge Oval.....................Harrogate 81775
Brick R.C,Felindre Stockton-on-Forest...............York 8328
Briddon I.H,42 Heslington la Fulford..............York 77279
Bridge D,Chemst,Opt,116 Newbegin..............Hornsea 242
Bridge Hotel,Huntington rd...........................York 523711
Bridge H.H,16 Pannal Ash cres.................Harrogate 5909
Bridge W,Yewcourt Stockton la.........................York 3455
Bridge W.Ltd,Haul,Fetter la...........................York 4674
Bridge W.H,Denmark cott Malton rd.................York 2489
Bridge Rev. W.H,21 Londesborough rd......Scarborough 1488
Bridgens Francis H,Poult Frmr,
Hazeldene Thorpe Wd...Selby 402
Bridgewater J.C,27 Green la Newby..............Scalby 356
Brid. Autolectrics,Auto Elecns,
75a New Burlington rd...Bridlington 2203
Bridlington Car Renovators Ltd,
35 St John st...Bridlington 2421
Bridlington Chronicle,10 Manor st...........Bridlington 2569
Bridlington Conservative & Unionist Assn.
Conservative Club...Bridlington 4074

limited to telephone numbers in the London Postal Area, the Outer London districts having separate directories), particularly as the Stationery Office were changing over from Monotype (single letters) to Intertype (letters in solid lines, or "slugs") machines for type-setting. For some time efforts had been made to secure greater clarity by using blacker ink and whiter paper, but there were limits to which these measures could be exploited because of the very high cost of better quality paper, the difficulties of high-speed printing with certain types of ink, and the fact that the blacker ink tended to show through the paper.

With the change in the London directories, proofs of three type-settings (produced on the Intertype machine) were considered: 5½ point* solid, 5½ point on 6 point body—thus showing slightly more white between the lines—and 6 point solid. Variations on these settings using different kinds of type were considered as follows:

5½ point No. 14 with Doric No. 1 on 5½ point body.
6 point Bell Gothic with Bold No. 3012.
6 point Kenntonian with Cloister Bold.
6 point Period Old Style with Cloister Bold.
5½ point No. 14 Doric No. 1 on 6 point body.
6 point Old Style No. 1 with Cheltonian Bold.
6 point Garamond with Garamond Bold.
6 point No. 7 with No. 1.
6 point Baskerville with Bold No. 1595.

Although Bell Gothic—the type which was specially developed for telephone directories and used extensively in the United States of America—was considered at this stage, the founts† available were not acceptable. One criticism was that they gave insufficient contrast between light and bold lettering. This was shown later when the first "pilot" (York) directory in Bell Gothic was published, although the public accepted it without comment.

Eventually, Period Old Style was used temporarily for the new Outer London directories, as they were needed urgently. This gave greater clarity but unfortunately took more space and estimates showed that if it were used for directories throughout the country it would increase paper costs by about £35,000.

The need for urgency having passed, the Stationery Office obtained from America a limited quantity of matrices for casting Bell Gothic and these were used to re-set a complete directory, the York directory being chosen. Bell Gothic proved

* *Point: unit of type measurement; there are approximately 72 points to one inch.*

† *Fount: complete set of type of the same face and size, containing proportionate quantities of the individual characters.*

to take much less space than the other type faces, using seven per cent. less paper than the present type (6 point Modern, with heavy entries in 6 point San Serif) and 13 per cent. less than Period Old Style. For the whole country, the comparative annual paper costs of printing directories were, in fact, present type £530,000; Period Old Style £565,000; Bell Gothic £493,000. The Bell Gothic type used for the York directory, although taking the same space vertically as the old type, had a narrower face; it was thus possible to print more characters in a line and so to reduce the number of entries requiring more than one line.

Because of the lack of contrast in the York directory the Post Office decided that heavy type entries should be printed in a bolder fount. This was done in the Swansea directory, Gothic No. 12 being used for the heavy type entries and Bell Gothic for the ordinary entries. There was, however, still insufficient contrast between the light type used for subscribers' names and addresses and the bold type used for exchange names. The use of other types for the exchange names was then considered, but these took more space and offset the economies resulting from the use of Bell Gothic for the main part of the entries. Finally, the bold type previously used for the exchange names was adopted for the subscribers' names and addresses, with Gothic No. 6 for the heavy entries and the exchange names. This has been done, with very satisfactory results, in reprinting the Brighton directory and is likely to set the pattern for all future directories.

The re-setting of directories is, however, a slow process and it will take many years to change over to Bell Gothic. A start has been made in re-setting the London Classified directory in this type and the July, 1957, issue will appear with its new face. The re-setting of one of the parts of the London Postal Area directory will probably follow and the sooner this can be completed the better, because it is growing so rapidly.

By the courtesy of Colonel A. H. Read, a former member of the *Journal's* Editorial Board and now Telecommunications Attaché at the British Embassy, Washington, we were able to obtain a description of the development of Bell Gothic from Mr. C. H. Griffiths, Consultant Typographic Engineer of the Bell Telephone Company, who developed Bell Gothic and under whose direction it was produced.

The production of telephone directories for the metropolitan area of New York City, and other

Dazzo Antelina 1708 N Mohawk --------**MI** chgn **2-9706**
Dazzo Chas Mrs 4011 W Grenshaw-----**NE** vada **2-0146**
Dazzo Chas Vincent 7846 S May-----**ST** ewrt **3-3060**
Dazzo Frank 402 N Trumbull----------**KE** dze **3-3512**
Dazzo Henry 3843 W Lexington----**SA** crmnto **2-5088**
Dazzo Joe 4013 W Grenshaw-----**SA** crmnto **2-7486**
Dazzo John 2611 W Armitage--------**DI** ckns **2-6783**
Dazzo Jos A 2338 N Janssen----------**LI** ncln **9-2289**
Dazzo Paul 829 S Paulina----------**CH** esapk **3-7032**
Dazzo Paul 3534 W Pierce----------**SP** aldng **2-3086**
Dea Jerry A 1431 W Balmoral-------**SU** nysid **4-1768**
Dea Jos C 723 W Melrose----------**WE** lngtn **5-1913**
Dea Mow Haw 250 W 22 Pl---------**DA** nube **6-2158**
Dea Tillie 3913 S Ellis---------------**OA** klnd **4-1745**
Deabel Harry A 1849 W Wellington--**WE** lngtn **5-6002**
Deabel Paul 1803 W Cuyler---------**EA** stgat **7-5540**
Deacetis Anthony A 2424 S Oakley-----**YA** rds **7-0763**
Deacey Gilbert 7425 S Dante---------**FA** irfx **4-6833**

Bell Gothic as it appears in the Manhattan directory

cities, where individual entries are numbered in millions, had become a stupendous printing project. The publication of two complete issues annually required thousands of pages of standing formes to be corrected for each edition. This involved mixing new type with the old and the resultant printed inequalities had become a serious problem. The complete re-setting of the directory for each issue was physically and economically impossible, and the detection and re-setting of the worn individual lines was equally impracticable.

The directories had hitherto been set in a conventional Modern Roman letter, characterized by contrasting thick stems and hairlines, sharp serifs and small counters, which made the face vulnerable to the peculiar and rigorously exacting conditions of directory printing. Various attempts had been made to modify the design without success.

The Brighton directory . . . pattern for the future

Allaway R.E,33 Woodbourne av,6..............**Brighton** 56853
Allbright W.J,91 Greenfield cres,6..............**Brighton** 55119
Allbuary C.A,The Gate Inn Ifield Crawley.........**Rusper** 271
Allbury Frederick J,9 Old Orchard rd.........**Eastbourne** 4133
Allchild Rita,3 The Droveway Hove,4...........**Brighton** 52627
Allchin Capt. H,St Christopher's Chapel hl.........**Lewes** 1317
Allchin J.M,42 Claremont rd.......................**Seaford** 2392
Allchin V.S,145 Freshfield rd,7..................**Brighton** 20633
Allchorn A.C,71 Wannock la.......................**Polegate** 494
Allchorn A.W,Grngro,67 Leslie st..............**Eastbourne** 5590
Allchorn Bros,Pleasure Boats,
56 St Phillips av...**Eastbourne** 3667
Allchorn E.C,High Reach Wannock av...........**Polegate** 549
Allchorn T,39 Ringwood rd.........................**Eastbourne** 4836
Allchorne Miss E,1 Coombe rse Worthing.........**Findon** 3174
Allcock Mrs. A,307 Seaside.......................**Eastbourne** 5329
Allcock Bros,291 Seaside.........................**Eastbourne** 2654
Allcock Flora B,43 Goldstone vls,3..................**Hove** 37402
Allcock Mrs. J.C,70 Wilmington wy,6..........**Brighton** 58075
Allcock J.D,120 Eastern av.............**Shoreham-by-Sea** 2449
Allcock R.J.D,Garden Strs,The Gardens....**Southwick** 2842

In 1937 the Bell Telephone Company decided to develop a type specifically adapted to the fundamental requirements of directories, solving the closely interrelated problems of durability, legibility and spatial economy, and on the basis of these simple specifications the Mergenthaler Linotype Company was commissioned.

This concept of functional simplicity immediately ruled out all the traditional influences on letter anatomy. For long-wearing qualities and durability, delicate hairlines in contrast to heavy strokes had to be eliminated; legibility was enhanced by proportioned distribution of white space within and around individual characters; spatial economy was effected by eliminating serifs, which permitted greater freedom in forming the shapes of letters. The integration of these basic elements of design produced a slender version of the sans serif letter of moderate weight of line that proved highly legible, and not devoid of aesthetic feeling. The combination of comparatively large counters, uniform weight of line and attention to the important detail of letter-fitting, contributed to the printing clarity of stereotype and electrotype plates and their durability, as well as to the type formes from which the plates were moulded.

The same basic principles were used in developing the design for the lighter companion face for secondary references in the entries—street addresses and so on linked with the subject entries. The weight of line in this face was calculated to avoid too marked contrast with the primary (dark) face, and at the same time be visibly different. This was achieved by drawing the alphabetical characters the equivalent of one half point (.007 inch) less in height than correspondent primary characters, and the numerals one full point (.014 inch) less—as in setting material and directional symbols of street addresses without

300E106

word spacing; for example, 222E121, where height differential gives white space.

Bell Gothic has proved a satisfactory solution of the difficult problems involved in type composition of telephone directories in the United States and elsewhere. The Post Office believes that it will prove acceptable in this country also, enabling quick reference, easy legibility and acceptable on aesthetic grounds. A celebrated typographer has laid down the dictum that "type shall not be seen"—it is what it is used to say that counts. The Post Office hopes that Bell Gothic will be accepted as performing a sound function without itself being obtrusive.

Commonwealth Telegrams on Namesake Greetings Day

Dr. Charles Hill, Postmaster General, inaugurated "Namesake Greetings Day" on June 18 to draw attention to the Commonwealth overseas telegraph services, particularly Commonwealth Greetings Letter Telegrams (G.L.Ts.).

The Lord Mayors, Mayors and Chairmen of Urban District Councils of some 400 places in the United Kingdom exchanged free Greetings telegrams with the civic heads of about 500 places bearing the same names in other parts of the Commonwealth.

The Postmaster General personally exchanged greetings with the Postmasters General or their equivalents in 48 other Commonwealth countries. Altogether, the Central Telegraph Station at Electra House, London, handled some 10,000 words.

The United Kingdom Post Office suggested the event and it was held with the co-operation of Cable and Wireless Ltd. and of the overseas telegraph administration in most Commonwealth countries. It is hoped to make the day an annual event.

The New Cable

The Postmaster General used the opportunity of a preliminary Press conference, at which he announced namesake greetings day, to give a brief outline of developments in overseas telecommunications. He emphasized that the new transatlantic cable, when opened towards the end of this year, would provide not only stable circuits for 35 simultaneous telephone conversations between Britain, Canada and the United States, but also at least 11 additional cable channels for telegraphy between Britain and Canada; these, by trans-Canadian landline links with the Pacific cable (Vancouver - Fanning Island - Fiji - Norfolk Island-Auckland-Sydney) would strengthen the telegraphic links between Britain, New Zealand and Australia.

He added that all the new transmitters at Rugby Radio Station extension, which he opened last year, would be in service within a few months, half of them are already operating. Twenty-three more transmitters have been ordered; 12 of these will be installed in a new building at Leafield Radio Station, Oxfordshire, and the remainder at other stations, all of which are being modernized.

Cable & Wireless Engineering School at Porthcurno: single staff quarters and new instructional block in left foreground

Training Technical Staff for Overseas Service

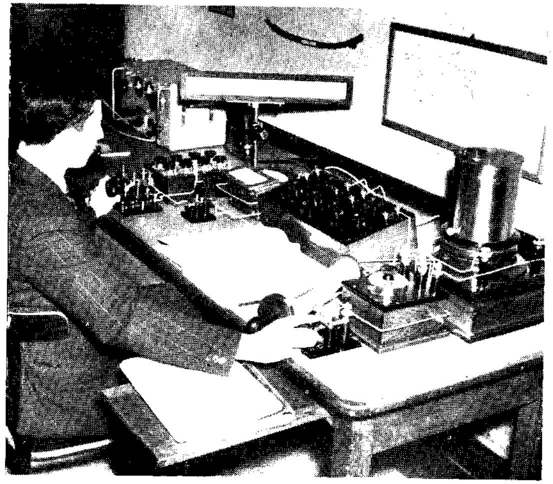
Edward Mockett, O.B.E., A.M.I.E.E.

THE TRAINING SCHEME IN ANY ORGANIZATION must be built up from the history and the special requirements of that concern. While a given technical syllabus may be covered in a similar way in different schools, the background and atmosphere associated with this syllabus will naturally be adjusted to the particular emphasis the organization requires to bring out in the staff undergoing training.

The demands made on the foreign service staff of Cable & Wireless Ltd. are perhaps novel in the breadth of interests in which they become involved. Basically, the individual must be trained in telecommunications, but he must also be able to undertake intelligent supervision of activities normally associated with civil and mechanical engineering. Additionally, he is liable, in the fullness of time, to undertake executive or administrative work and, throughout his service, take his place in the community in which he serves overseas.

It follows that the Company seeks basically a man suitable for training as a technician and engineer, but also one who has common sense developed to a marked degree so that he can tackle a variety of problems. This need in the Company is perhaps greater than elsewhere because its business involves having a number of large and small branches overseas, in many of which it would not be economically practicable to employ a variety of specialists. Moreover, the remoteness of many places necessitates the individual being able to carry out work which elsewhere could properly be dealt with by outside authorities.

The recruitment and training policy of the Company for its foreign service staff therefore takes account of this background, and its school at Porthcurno, in Cornwall, is designed to promote



Cable testing

the needs of the service. In the very early days of the Company's history the school was opened at Porthcurno; later it was transferred to London, but in 1950 the Company felt that a residential school had become once again necessary. The reason can be found in that, until mechanization drastically reduced the numbers of expatriate staff, there was a communal and corporate life at each branch, which had the beneficial effects of training men in a general, as distinct from a technical, sense. When, however, this feature ceased to exist the absence of a residential school in this country became more marked, and the obvious corrective was taken to reconstitute a residential school at Porthcurno; this happened to offer certain facilities which would be difficult to provide elsewhere, and it had the added value of a traditional link with the past.

The present number of expatriate staff is roundly 750, and assuming a perfect balance in age analysis the Company would require to recruit 25 men a year. This nice adjustment is no more present in Cable & Wireless Ltd. than elsewhere and, with other variables, has led the Company to recruit and train between 48 and 60 students a year at Porthcurno for the past few years; this rate will persist for a few years yet. The aim is to attract from school the right type of boy who has a good general education and has passed the General Certificate of Education at ordinary level in five subjects; the young man who has left school and completed his National Service is also a welcome candidate.

To obtain the necessary numbers is no easy matter since great competition exists for these people, but careful development of contacts with the public schools and grammar schools has provided an answer to this problem and selection panels operate three times a year to choose the 20 students who will start at Porthcurno each term.

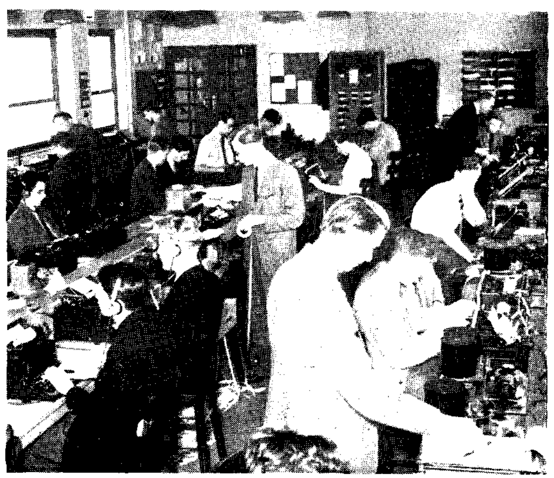
From what has already been stated it is clear that the selection procedure is aimed at finding the candidate with the necessary aptitude to train as a technician and who also has the right personality to fulfil the requirements of living overseas, where his social and recreational habits will play an all important part in his overall performance as a member of the staff.

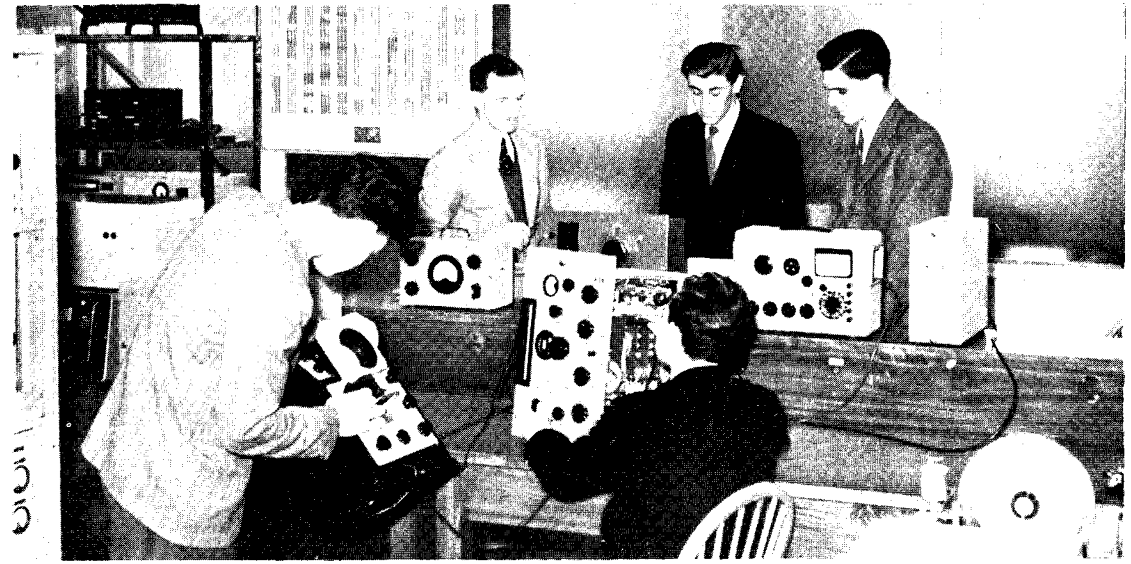
The training school, therefore, is designed primarily to teach the student the knowledge requisite to operate and maintain the Company's wireless and cable system overseas. A parallel and equally important aim is, through communal life at a residential school, to create an attitude of mind whereby a sense of belonging to a service, with its tradition of loyalty and team-work, is developed.

The basic course of training lasts 18 months, all of which are spent at Porthcurno. This is followed by a four months' period of consolidation at a near-by branch overseas, after which the technician is posted as an active member of the staff to any branch in the system, where he will at first take over the duties of routine watch-keeping technician and be responsible for the day-to-day running of the telegraph system at that branch.

The syllabus for the course begins with six months on fundamental principles, and includes

Part of the operating section





Radio receiver section

workshop training with special reference to telegraph mechanisms.

At the end of this primary period students are selected according to their aptitudes and interests for more specialized training in either wireless or cable work. The cable training syllabus includes submarine cable testing for detecting and localising faults or breaks in the operational cables; training in the design, use and operation of the primary and associated relays used for reception on cable circuits, with the complementary inductive and capacitative circuits to correct the effects of distortion and attenuation over lengths of cable of 1,000 miles or more; and finally training in the specialized regenerator equipment in use on the cable system, which provides synchronous working with the resultant facility of regenerating a distorted received signal into a perfect signal for onward transmission. In addition to its basic regenerative function the design naturally lends itself to "channelling" on a time division basis and, in the course of years, development has enabled the addition of various facilities to provide maximum flexibility in the art of working cable chain circuits.

The wireless training syllabus includes study of synchronous equipment basically the same as the regenerator system; a comprehensive course on wireless receiving and transmission practice is given with additional study of Very High Frequency working since this is becoming more common in certain telegraph telephone requirements overseas.

Having training facilities for both wireless and cable at the same school is an important advantage since the Company's service is unique in its highly integrated use of both media for communication; this has become possible only by the use of much equipment common to both, and by employment of staff with experience of both media and a common source of training and approach to overseas telegraphy.

After completing this course and his period of consolidation at a branch the student becomes available for watch-keeping duties overseas. The watch-keeper will normally be limited to routine operational and maintenance work, but at smaller branches he may well be faced with a wide range of duties ranging from property maintenance to local repair of cables and workshop overhaul work.

At the end of a four-year tour overseas the technician returns for furlough and is released to do his National Service, if he has not already done it. After this he returns to continue his service overseas, which thereafter is by means of tours of three years' duration, or shorter if posted to branches in trying climates.

The basic course of training is supplemented by further courses on advanced work to enable the technician to qualify as an engineer and assume more responsible work. Selective machinery exists by means of external City & Guilds examinations, supplemented by examinations designed and set by the Company.

Success in these examinations is followed by a six months advanced course at Porthcurno, which has special application to the field of communication engineering covered by the Company. Additionally, examinations are set on a syllabus comprising telegraph convention, traffic handling, administration and branch accounting, which are a pre-requisite for promotion to the higher grades in the Company's service bearing in mind the wide range of supervision and control which Managers of the Company's branches overseas must exercise.

Training local men

The Company has naturally taken note of the possibilities of training national staff from countries overseas, and its policy has been shaped in recent years to recruit and train locally engaged staff for technical work. Facilities for technical training cannot readily be brought together at numerous points abroad, and there is clearly an advantage in training staff at a central school, which gives men of different countries the opportunity to meet each other while pursuing a common aim. For these reasons the Company has set aside a proportion of places each year at Porthcurno for staff sent to this country from branches abroad. This bringing together of different nationalities at Porthcurno has proved successful, and a good thing for the school, and it is gratifying to see the way in which the visitors take a keen interest both in study and in the recreational facilities provided.

This article has endeavoured to set out broadly the recruitment and training policy of Cable & Wireless Ltd. in respect of its technical staff overseas, but it would be incomplete without reference to the specialist requirement of the engineering staff employed on administration, executive and development work in London. The Engineer-in-Chief needs men who are professional engineers by both training and by experience. The Company has therefore provided special facilities to ensure that certain staff receive the wider engineering training essential for this work, and suitable technicians are chosen to undergo a four years "sandwich" course, while a small special entry avenue exists for men with a university degree. The addition of men with long experience overseas on practical work provides a co-ordinated team to develop the Company's system in a progressive way, taking full advantage of technological progress in overseas telecommunications.

Equally important in the training for technical staff are the facilities provided for training and experience in general management, and appropriate arrangements exist in the Company to achieve this, since many of the technicians and engineers, later in their careers, will be called on to undertake branch management and other posts in the administration. Short courses are arranged in Head Office which give an introduction to, and short training in, the various functions of the telegraph business other than engineering, such as traffic production and circulation, accounting, work study, staff control and public relations. In addition, the Company sends specially selected staff to the courses provided at Henley Administrative Staff College and the Work Study School at Cranfield. This sphere of training, added to the main technical training, is aimed to produce the all-round experience needed in business today.

P.M.G. Presents 7,000,000th Telephone

The 7,000,000th telephone in the United Kingdom was installed in Wales during July. The Postmaster General presented it in Cardiff on July 23 to Sir Godfrey Llewellyn, Chairman of the Organizing Committee of the VIth Empire and Commonwealth Games, which are to be held in Cardiff in 1958.

The Post Office achieved the 7,000,000th installation just short of three years after the 6,000,000th was achieved in August, 1953, when, at a symbolic ceremony, the Secretary of State for Scotland opened a new radio link connecting the island of Stroma, through Wick, Caithness, with the inland telephone network.

By March 31, 1939, there were 3,235,498 telephone stations in Great Britain; by the end of March, 1946, there were 3,936,995. The 4,000,000th was installed during 1946-47 and by March 31, 1950, the total had reached 5,171,491. In the circumstances of the day it took nearly three years to reach the 6,000,000th. By March, 1955, there were just under 6,500,000.

Installation of the 7,000,000th in July, 1956, means, therefore, that more than 3,000,000 telephones have been installed during the past 10 years.

Planning for Telephone Service in New Buildings

C. W. Arnold, A.M.I.E.E.

TWENTY-FIVE YEARS HAVE PASSED SINCE the Post Office issued a booklet, *Facilities for Telephones in New Buildings*, to enlist the co-operation of architects, surveyors, consulting engineers and builders towards providing for the telephone needs of owners or tenants with the minimum of inconvenience.

Today, not only are a great many new buildings being erected but "the modern concept of design is tending more and more towards the combination of aesthetic appearance with utilitarian principles and architects today are aware of the advantage to be gained by treating the telephone services on principles accorded to the other utility services . . . with regard to distribution throughout a building".

This quotation is from the opening of a new edition of the booklet which the Post Office has recently published. The new issue provides a useful opportunity for surveying the problem and how it is tackled.

The Post Office has aimed for many years to enlist the full co-operation of the architectural profession and the building industry in providing ample accommodation for telephones in all classes of building and has achieved a substantial measure of success. Judging by the number of enquiries from many sources concerned with post-war building, there is a clear resurgence of interest in this subject, which should be stimulated. Isolated instances of apparent non-co-operation do occasionally come to notice, but these are very rare and the Post Office hopes that in time they will be eliminated altogether.

Twenty-five years or so ago, when it was first suggested that some documentation of Post Office requirements should be circulated, the public were becoming more telephone-minded and beginning to consider the telephone, hitherto regarded as something of a luxury, to be an everyday necessity.

This raised the question of the best form of installation, particularly of the wiring which might have to be taken into or through several rooms in houses. It is of prime importance to be able to get wires into each building without having to cut through a wall, window-frame or doorway and to ensure that their run within the building shall be as inconspicuous as possible and made without damage to the existing fabric or decoration.

In the 1930's a good deal of building was going on; many new business premises were being erected and the trend was towards larger and larger buildings. Large blocks of flats were also being built and quite extensive "estates" of private houses were being laid out. The Royal Institute of British Architects very willingly agreed to co-operate in preparing the first edition of *Facilities for Telephones in New Buildings*. About 10,000 copies were printed and circulated to architects, surveyors, builders and others engaged in planning and erecting buildings.

In 1942 the Government, looking forward to the post-war years when our damaged towns would have to be rebuilt, thousands of damaged buildings repaired and the backlog of new construction tackled, wisely formed various committees under the Ministry of Works to make a comprehensive and co-ordinated review of building technique for the guidance of those who would be responsible. The Institution of Electrical Engineers undertook the study from the electrical point of view which, of course, included all telecommunication services. The recommendations for all electrical services were contained in a post-war Ministry of Works booklet, one of the Building Study Series (No. 11). During the period of this study on telecommunications, the original Post Office booklet was frequently referred to and the importance of revising this document, to bring it into line with modern building practice, was realized.

Almost immediately after the war requests started coming in from architects for copies of the 1931 booklet and any up-to-date information on Post Office requirements in post-war buildings. The edition was by this time practically exhausted and the Post Office was confronted with the unfortunate position of having to lend copies to certain organizations for short periods only.

In 1949 the position became more acute. The Institution of Electrical Engineers had issued various Codes of Practice on electrical installations, including separate codes for telecommunications. These, however, were not considered to be in a form best suited for architects and builders, as they contained technical detail which was not relevant to the actual building. The Post Office realized at this stage that something more attractive and pleasing in lay-out and presentation would be more likely to appeal to architects. Something on the lines of the 1931 booklet brought up-to-date would, it was thought, be far better than all the Codes of Practice.

Accordingly, in 1949, the Post Office began to prepare a revised edition but, in the circumstances, on a far less lavish scale than the 1931 booklet. The R.I.B.A. enthusiastically agreed to co-operate in preparing a document which would be of the greatest value to all those concerned with building construction. A small committee of representatives of the R.I.B.A. and the Post Office was formed to consider the drafting of a suitable document, on the basis of the 1931 edition.

In a review of the whole field of this operation the committee agreed on the following points:—

(1) The type and style of the document: it should be complete in itself without the reader having to refer to other publications such as Codes of Practice, British Standards Specifications and so on.

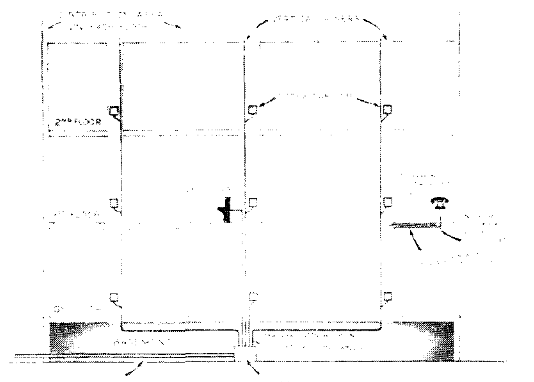
(2) The President of the R.I.B.A. would be asked to write a foreword and the booklet would be reviewed in the R.I.B.A. *Journal*.

(3) The Post Office would prepare the draft.

(4) The probable demand, and who should receive the booklet; in the event 10,000 copies were published but a further 5,000 soon became necessary, and the booklet was issued free on request to all concerned.

The drafting was completed in 1954 and after a slight delay in the production arrangements (which were outside Post Office control) the first issue was ready for distribution early in 1956.

The book has been distributed through Post Office Headquarters departments, Directorate and Regional headquarters and Telephone Managers' offices. Telephone Managers have distributed copies to the public at discretion, as widely as possible. The new edition should also be made available to schools and colleges which teach

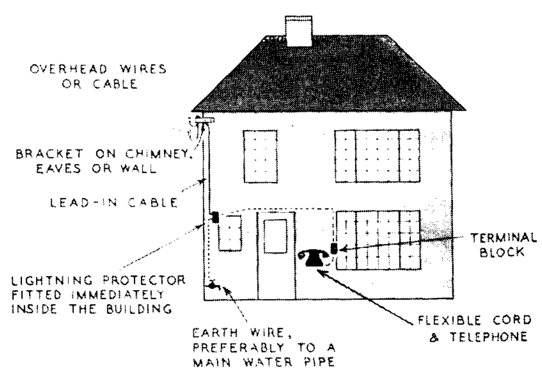


Diagrammatic arrangement of cables and apparatus in a large building

architecture and building design. The chapter dealing with needs in private dwelling houses is being separately published in pamphlet form for distribution to estate surveyors and local builders.

The problems of telephone requirements in all classes of buildings are virtually the same as in 1931, but the growth of the telephone service has to be kept in mind in allocating accommodation. The booklet shows that the basic requirements are that the Post Office should be able to take wires or cables into any building with the least interference to the fabric. Adequate duct space, ranging from a small diameter conduit for a dwelling house to a large multi-way duct for a multi-user building, should be provided through an outside wall of the building. Inside a large building there should be

Diagram of a typical telephone installation in a dwelling house



accommodation for a main frame or distribution case and for running cable to all the floors by way of risers and so on, and thence on each floor to the various points where telephones may be required. To run cables to the various parts of the building would require making holes through ceilings, cutting through walls and fixing cables on the surfaces, if no duct space or similar facility were provided. Changes in the run of cables and in the size and number of the cables would be inconvenient because of disturbance to the decoration.

In certain types of building, accommodation is needed for a complete switchboard and its associated apparatus and space may be required for certain power plant.

When considering the amount of accommodation required for telephones in any type of building, the architect and builder must bear in mind the possible requirements for other telecommunication services. In flats and houses a wire broadcasting service, such as the radio relay companies provide may be taken; possibly, in the future, wired television as well. Bell and service indicator and other systems also have to be thought of. All these services need low voltages and are generally accommodated in the same duct or chases as the Post Office cables. The Post Office would always prefer to have separate duct space because of the difficulties that sometimes arise with a joint user arrangement, but this is not always practicable and a joint user scheme should not cause trouble if generous allowance of space is provided in the beginning for all services.

It is necessary, of course, to ensure that the accommodation provided is of the right type in size and construction. For example, the inside of the duct or chase must be reasonably smooth so that cables can be easily drawn in without damage. Ample access points must be provided so that service can be maintained and augmented with the minimum of trouble, and they must also be arranged to give the maximum flexibility without resorting to surface wiring. The proximity of other services such as electric power, gas and water must also be borne in mind.

If architects and builders make ample provision in the first instance for telephone cables, wiring accessories, switchboards and apparatus, the Post Office is not greatly concerned about the materials used in the building. But a change in building practice which has greatly affected the installation of telephones since 1931 is the reduction in the amount of timber used for such purposes as floors, skirting boards and picture rails. From the telecommunication engineer's point of view the use of wood inside buildings makes life very easy; it is ideal for fixing cables, it can be easily drilled to take a cable through and it will readily take adhesive when required. Timber joists for the floor are also admirable for fixing both cables and conduit thereto. Picture rails and hollow skirtings are very good for concealing the cables to be taken round a room.

Today, concrete and composition floors are used almost exclusively in large buildings, skirtings are tending to disappear and picture rails are rarely seen. The majority of modern floors are of semi-solid construction, built up with hollow porous tiles or blocks laid down in lane formation, the intermediate spaces between the lines of tiles or blocks being filled and surfaced with concrete.

Duct provision during construction

With floors of this type it is very necessary to provide during construction the necessary ducts or channels required for the various services, unless they can be conveniently accommodated in the screed laid on the top of the structural floor. Sometimes, however, the screed is not deep enough to take all the services required and therefore some space must be provided in the structural floor. It would be difficult and indeed undesirable to channel out or break into the floor after completion. Some buildings are provided with a false or dummy ceiling, which makes a convenient run for our cables.

A rather novel type of flooring recently introduced in this country is made of steel channelling. This provides an ideal form of natural ducting for cables and so on, with ample facilities for access.

One other big change in building construction is the greater use of reinforced concrete pillars and pre-stressed concrete floor joists instead of the steel frames used before 1939. This does not materially affect the problem, but the concrete construction is rather more convenient for fixing cables than steel construction.

With smaller buildings and houses, techniques have not changed a great deal, except in the amount of timber used in houses. Plastics are being used to a greater extent for fittings these days. Greater use of steel window-frames has made entry into a house rather more difficult, unless due thought is given during erection of the building.

Changes in the materials used in the provision of telephone service in buildings, excluding the telephone instrument, have in the main been limited to the type of cable and connexion boxes used. Lead covered cables with paper insulation or textile insulation on the conductors has given place to poly-vinyl-chloride (P.V.C.) sheathed cable having insulated conductors of the same material. The size of the conductors has also been reduced. These changes have cut costs and the smaller conductors enable a larger number of circuits to be accommodated in the duct space provided. This alone tends to make life easier for the telephone engineer.

In recent years, architects have often criticized Post Office standard cable and wiring accessories, such as distribution cases and terminal blocks. Post Office engineers have been very conscious of the antiquated appearance of some of the apparatus and have realized that this criticism is justified. They considered redesigning the distribution cases as early as 1937, but had to put this aside because of the war. This work has now, however, been started again. Satisfactory progress has been made with the design of a new distribution case and terminal block which may be available soon.

This is only a brief résumé of the problems of providing telephone service in post-war buildings, but it should be enough to emphasize the need to consult such documents as are available on this subject—in particular, the new edition of *Facilities for Telephones in New Buildings*.

The Story of the Civil Engineer

EXCAVATIONS FOR CABLE LAYING, AN underground cable chamber at Faraday Building, ductworks for a repeater station, and the postal London Underground Railway are among Post Office works illustrated in *The British Civil Engineering Contracting Industry*, a lavish history of some 200 years, issued at 3 guineas by the Federation of Civil Engineering Contractors.

The introduction gives a reminder of the meaning of the term "civil engineering" which is only about 200 years old. Until the middle of the 18th century engineering was "associated almost exclusively with military ends". We can walk for pleasure today over ancient Roman roads but they were engineered by the military occupants; a Roman bridge over the Tagus in Spain still stands after 2,000 years.

Contractors were employed in constructing docks in Britain in the 17th century but it was the industrial revolution that gave rise to the need for "large-scale, continuous and diverse demands for civil engineering works". Oddly enough, among the latest work of civil engineers has been the uncovering, in the City of London, of the Temple of Mithras, which the Romans built about 2,000 years ago.

The story begins with canals, continues through railways, docks and harbours to roads and airports and ends with atomic factories. Until the civil engineers developed steam tugs, barges were "legged" through tunnels, men lying on planks reaching out transversely on either side of the barge and pushing it along by pressing their feet against the tunnel walls. Horse runs, or "horse gins" were used, when cutting the first railway routes, to carry the earth to the top of the bank.

The straw- and silk-hatted passers by who stood to watch a telephone cable route being excavated in Queen Victoria Street, London, in 1901, saw no bulldozers; the leisured-looking drivers of hansom cabs looked down on sheer spadework. One of the latest pictures in the book is of the "cathedral"—the tunnel-terminal of the first transatlantic telephone cable at Oban, built last year.

Television masts, and a fine picture showing the television cable relay link being laid across the South Downs in wintry weather, 1951, show the civil engineer's contribution to the latest form of communication.

The book closes with an epilogue by Mr. Robin McAlpine, Chairman of the Federation Council 1955–56: "Those engaged in works of a civil engineering character have from time immemorial, like farmers and fisherman, worked close to nature. They have gained some knowledge of and a profound respect for the elements and have thereby had an opportunity of acquiring patience, tolerance and understanding". The many electrical engineers in the Post Office have, in this book, an opportunity of seeing something of the traditions behind the work of their comparatively few civil engineer colleagues.

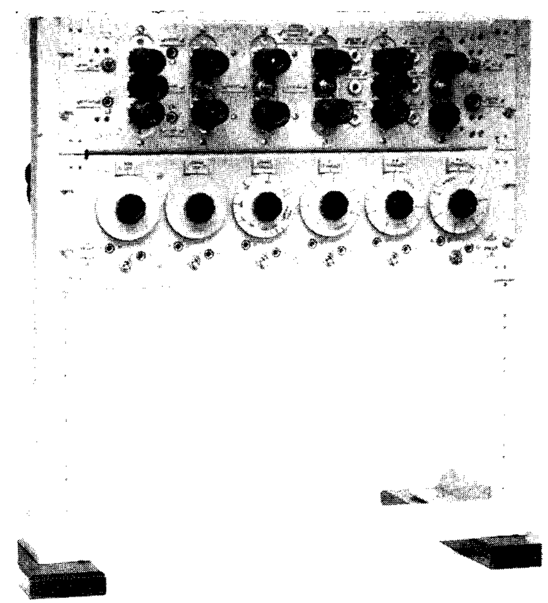


Fig. 1: Speech Synthesizer

New Ideas in the Transmission of Speech

Eric W. Ayers, B.Sc.(Eng.), A.M.I.E.E.

EVER SINCE THE FIRST FAINT, DISTORTED sounds emerged from Bell's new telephone, communication engineers have been striving to improve the electrical transmission of speech. When faintness was overcome with the invention of the thermionic valve, better quality became the next goal. For some time now any desired standard of fidelity has been technically possible, and its attainment in a practical system has been hindered only by such considerations as cost or portability of apparatus. Effort has therefore been directed towards discovering more economical ways of transmitting spoken messages.

The theoretical limit has very nearly been reached in devising systems—Pulse Code Modulation, for example—for sending a given set of signals over a channel of the smallest carrying capacity, with the least risk of error. Great progress may still be expected in instrumentation, especially now that transistors are available, but this alone will not reduce the channel capacity required. For further savings in this direction we must look beyond the microphone and ask whether we really need to send out all the signals the microphone presents to us. This is the sort of question that calls for a little delving into the new "Information Theory" which has developed so rapidly in recent years.

One of the more startling results of doing this is the discovery that conventional telephone channels are used, even during the busy hour, with an efficiency of less than one tenth of one per cent. Information is measured in "bits" (a contraction of "binary digits"), and a telephone channel can transmit about 30,000 of them every second. Yet it has been calculated that the message content of a telephone conversation is less than 30 "bits" per second: it can in fact be written down and sent by teleprinter at little more than this rate.

It is obvious therefore that if by, say, electromechanical means the essential parts of a telephone conversation could be extracted and transmitted solely by themselves the speech carrying potentiality of telephone circuits could be greatly increased. To this end research work is already being carried out at the Post Office Research Station at Dollis Hill, and will be described later in this article.

A large channel capacity is demanded if many different transmitted signals must be distinguishable at the receiver, and if successive signals are liable to follow one another very rapidly. A telegraph channel makes one type of distinction only—mark or space—at a rate of only, say, fifty times a second. To transmit with reasonable accuracy the complex electrical waveform resulting from the impact of speech on a microphone it may be necessary to recognize one out of 30 possible values for the voltage at any instant, and to allow for the value changing as often as 6,000 times in a second.

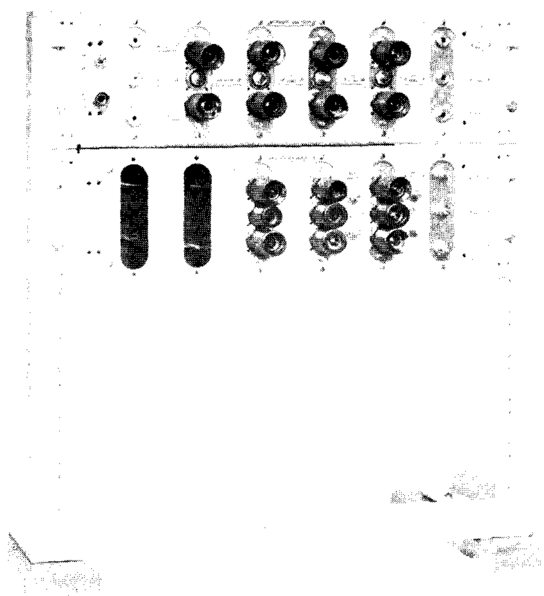


Fig. 2 : Formant Analyser

A message is put into speech by the talker's voluntary muscular actions, and there is good reason to believe that a human being is unable either to generate or to appreciate information at a greater rate than 50 "bits" a second. The enormously greater complexity of natural speech signals arises from two main causes: the representation of the message in a multiplicity of ways, and the introduction of random characteristics which are not subject to the detailed voluntary control of the talker. For example, the waveform corresponding to an "S" sound is very complicated, and every S sound differs slightly from every other. A normal telephone channel indicates to the listener that an S has been spoken by reproducing a faithful copy of the waveform of one particular S sound—the original. If it can do this, it can also distinguish between other possible S waveforms, though the distinction is quite unnecessary to the message. A teleprinter channel is less extravagant; it selects S from the 26 letters of the alphabet with just five mark or space signal elements.

The human ear and brain must somehow be able to extract the relatively simple message, and discard the irrelevant detail in a complex speech signal. If a "listening machine" could be devised to perform this function the extracted message, in suitably coded form, could be sent over a slow telegraph channel. At the receiving end the coded message would have to be presented in a suitable way to the senses. It could perhaps be typed on a piece of paper, but to allow normal conversation the received signals could be used to operate a "talking machine", which would emit speech sounds resembling the original in meaning and, so far as possible, in character.

These ideas are by no means so unpractical as they may seem: they have already been realized to some extent in the "Vocoder". The listening machine, or Analyser, splits the speech signal into narrow frequency bands by means of a bank of electrical filters. The amount of energy in each band is measured continuously and signalled over the communication channel to the talking machine, or Synthesizer. Here the signals for the various bands are sorted out, and each controls the flow of energy from an artificial voice generator through a filter similar to the corresponding filter in the analyser. Other signals control the artificial voice so that it produces a buzzing sound of appropriate pitch if the original sounds are voiced, or a hiss for unvoiced sounds. Quite good intelligibility has been achieved from the Vocoder with about one fifth of a telephone channel capacity.

The predictions of information theory have thus received some verification. The full reduction in channel capacity would probably require an analyser, possessed of a memory and reasoning ability, approaching the human brain in complexity, though the synthesizer might still be quite simple. As more knowledge is gained there seems to be a good prospect that a much more effective analyser than the Vocoder should be practicable, however. The cost of the transatlantic telephone cable, for example, is so great that quite elaborate terminal equipment to increase its traffic capacity may be economically justifiable.

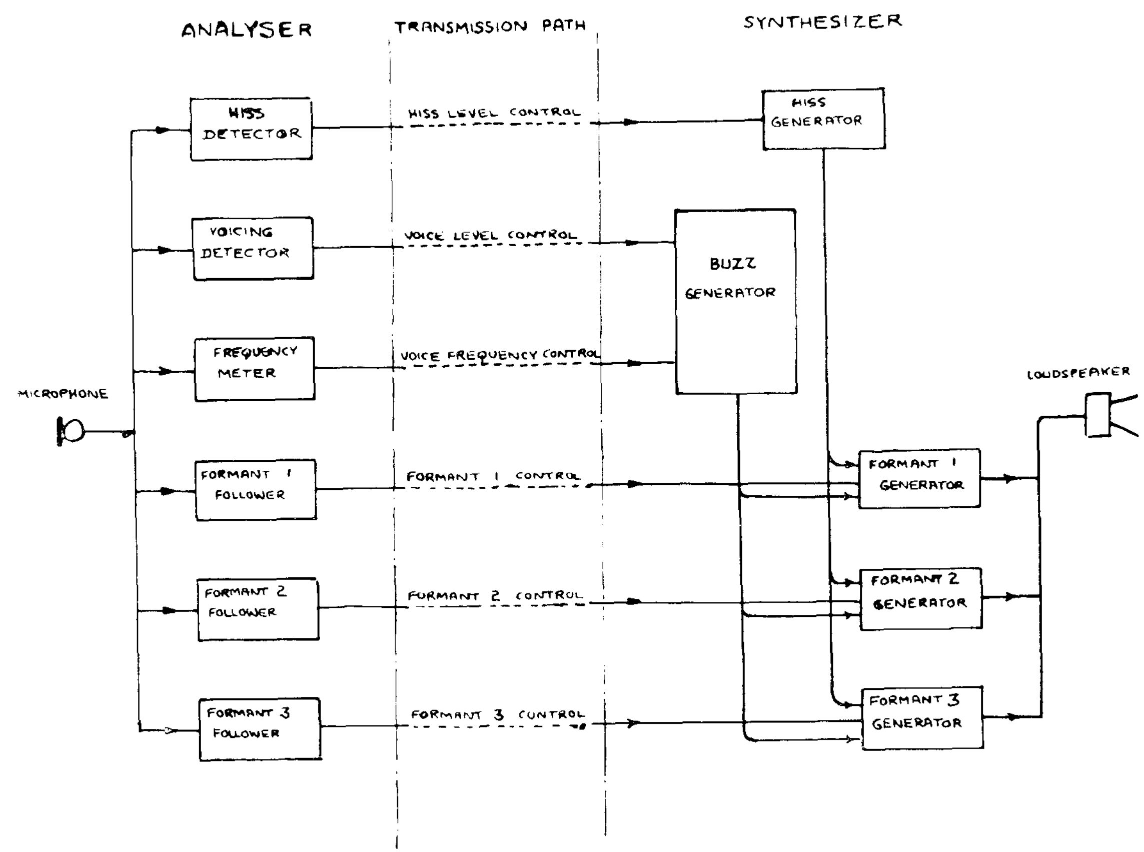
The precursors of human speech in the evolutionary scale are inarticulate whistles, growls, clicks and hissing noises. Not only have such noises remained in the repertoire of the human vocal organs, but they actually form the basis of articulate speech. In Western languages the whistle does not perhaps play a very large part, but growling or humming noises develop into voiced speech, especially the vowels, and the explosive and fricative consonants are descended from clicks and hiss sounds. The moulding of these noises into articulate speech is performed by

voluntary movements of the mouth, lips, tongue and other vocal organs. It is evident on reflection that a given speech sound has some constant features by which it is recognized, whether it is spoken at a high or low pitch or only whispered. The original exciting noises differ in these three examples, but the common factor is the configuration of the vocal tract and the pattern of its changes in time.

Since a speech sound is recognized by ear, however, it must have some acoustical property which derives from the vocal tract configuration. It is found that the vocal tract acts as an acoustical resonator, reinforcing the energy of the exciting noise at frequencies near to its resonances, and attenuating the energy elsewhere. There are normally three major resonances, called formants, which move up and down the frequency scale as the position of the tongue and size of the mouth opening are varied. The frequencies of these formants and their movements seem to be the principal acoustic features distinguishing the elementary sounds of speech from one another. Thoughts such as these on the mode of production and on the perception of speech have guided the search for more efficient analysers and synthesizers for a speech transmission system.

A new system of this type, based on formant concepts, is under development at the Post Office Research Station at Dollis Hill, London. Fig. 3 shows the principles on which it works. The Synthesizer (Fig. 1) incorporates a hiss generator and a buzz generator of adjustable pitch to represent the voice. The electrical outputs of these two sources are fed to three electrical resonant circuits which impose formant character-

Fig. 3 : Analysis-synthesis telephony based on formant parameters



istics on them. Six electrical control voltages are needed to operate the synthesizer, one each for the intensities of the hiss and buzz excitations, one for the pitch of the buzz, and three for the formant frequencies. By varying these quantities in the appropriate way, and feeding the output signals to a loudspeaker, sounds of wholly synthetic origin may be produced, which are nevertheless recognizable as speech.

The function of the analyser (Fig. 2) is, of course, to extract information about these six quantities from speech, and to generate the required control signals. The voice pitch control is generated in a circuit which measures the rate of arrival of the bursts of energy emitted at each opening of the talker's vocal cords. The intensities of hiss and buzz sounds are controlled by measuring the energy in the high-frequency and low-frequency components of the incoming speech. The formant frequencies are controlled by three tracking circuits which operate in a similar way to the automatic tuning control fitted to some of the more expensive radio sets. One tracker is allotted to each of the three formants. As soon as a formant appears in a particular frequency range, the appropriate tracker fastens on to it, and follows subsequent movements by automatically tuning itself to the formant frequency.

The new analyser and synthesizer have been connected together in the laboratory with a microphone at the input and a loudspeaker at the output. At the present stage of development conversation is possible over this system, but difficult with some voices. The synthesized speech, though distorted, has quite a natural quality, and conveys much of the individual character of the original talker's voice. Some listeners have in fact unconsciously attributed imperfections in the machine to the talker, and offered such comments as "he sounds as though he has a cleft palate". The experimental system at present occupies only one hundredth of the capacity of a normal telephone channel, and there is reason to hope that it may eventually be possible to achieve a transmission of commercially usable quality without substantially exceeding this figure.

Some Statistics of the Inland Telecommunications Service

	31st March, 1954	31st March, 1955	31st March, 1956
The Telephone Service at the end of the Year			
Total telephones in service	6,146,800	6,491,100	6,887,400
Exclusive exchange connexions	3,027,200	3,089,600	3,176,700
Shared service connexions	742,400	917,500	1,088,500
Total exchange connexions	3,769,600	4,007,100	4,265,200
Call offices	65,100	66,200	68,200
Automatic exchanges	4,494	4,576	4,662
Manual exchanges	1,419	1,351	1,282
Orders on hand for exchange connexions	376,100	371,600	343,600
Work completed during the Year			
Net increase in telephones	*269,000	*355,000	396,300
New exchange connexions provided	464,000	419,000	436,603
Net increase in exchange connexions	178,700	237,500	258,100
Traffic	*Millions*	*Millions*	*Millions*
Inland telephone trunk calls	278	306	333
Cheap rate telephone trunk calls	70	77	87
Inland telegrams (excluding Press and Railway) ...	33	25	20
Greetings telegrams	6	5	4

*This is the difference between gross new and gross ceased. The difference between the telephones in service at 31st March, 1953, and 31st March, 1954, and between 31st March, 1954, and 31st March, 1955, does not equal the net increase because the number in service at 31st March, 1954, and 31st March, 1955, has been adjusted as a result of a special check of working telephones. This is the result of a change in statistical procedure.

Echo Suppressors

H. Williams, A.C.G.I., M.I.E.E.

We are all aware how strange a conversation may sound in a bare room and how difficult it can become. This is due to the sound waves being reflected back from the walls and ceiling of the room; a similar effect is met whenever other types of wave motion meet an irregularity or obstruction. For instance, in tracking aircraft by radar a pulse of electromagnetic energy is sent out from an aerial. When this meets any obstruction—for instance, an aircraft or church steeple—an echo is returned which is picked up on a receiving aerial. The speed of the radio wave being known, the difference in time between the emission of the original pulse and the echo can be used to settle how far the echo has travelled. A somewhat similar effect may be observed on your television screen when a "ghost" appears, usually to the right of a sharp vertical edge. This is due to an echo caused by an irregularity, which results in a second image arriving slightly after the real picture.

It may come as a surprise to readers to know that speech currents travel at a measurable speed in the wires carrying them. This is important because it results in a very definite limit to the standards we may adopt in long distance telephone transmission. To help us to appreciate this let us consider how a modern long distance circuit is constructed.

Fig. 1 illustrates this in outline. Such a circuit is constructed on the "four wire" principle, to avoid the difficulties of amplifying signals in both directions on one pair of wires. The "go" and "return" directions are combined in a special transformer (H), which is provided with a "balance" (B). If the balance matches perfectly the subscriber's line, there is no irregularity to current entering from the "go" channel and no echo results. Since all manner of circuits may be connected to the long distance circuit the balance can only be a compromise and therefore in practice there is always an element of echo returned. Under the worst conditions about one-quarter of the power sent on the "go" channel is "reflected" at the receiving end, and this means that practically all the echo power—that is, one-quarter of that of the main speech signal—is returned to the sending end.

Before proceeding further it is necessary to consider the effects of transmission time and echo.

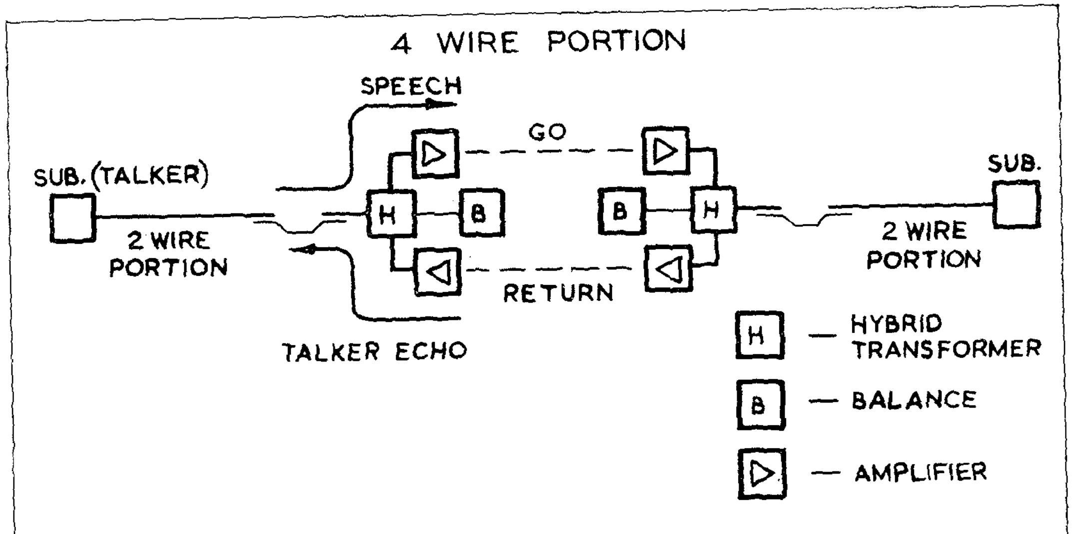


FIG. 1

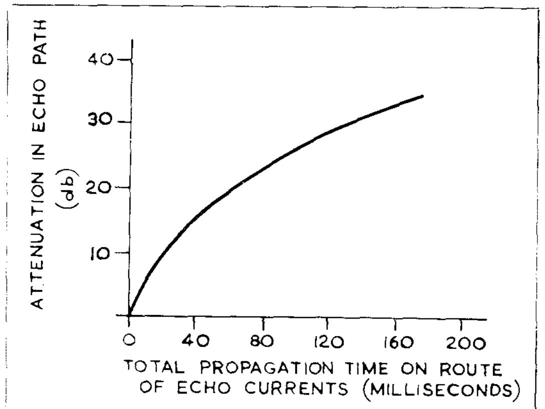


FIG. 2

Forgetting echo for the moment, it will obviously be a nuisance if speech currents take a long time to travel from one end of the circuit to the other, because the talker, having said something and received no reply for a while will naturally assume that the person at the other end wishes him to continue, so he starts talking again and confusion inevitably results. The limit is reached when the transmission time of the circuit is about quarter second, and an international agreement limits the amount of transmission time which each country may permit on an international call. The table shows the transmission times of various types of plant in common use.

Considering echo now, and referring to Fig. 1, we note two possibilities. The most obvious is the talker's speech echo returned to the talker and confusing him. The second possibility is that the echo is further echoed at the talker end and returned to the listener with the original speech.

The first effect is found to be the most important; it is dependent on the size of the echo relative to

TYPE OF PLANT	TIME TO TRAVEL 1,000 MILES	ECHO TIME ON A 1,000 MILE CIRCUIT
Loaded audio cable	1 14th second	1 7th second
Carrier	1 150th second	1 75th second
Radio	1 180th second	1 90th second

Transmission times of various types of plant

the talker's speech and the extent of the delay. A large echo sufficiently delayed is found to cause apparent stuttering in the talker but less severe conditions affect the talker's articulation to varying extents. A curve which has been used for design purposes is shown in Fig. 2 and relates the maximum transmission time which may be permitted without an echo suppressor to the attenuation in the echo path, and is based on what is considered to be the allowable effect on articulation.

If the limits set by this curve are exceeded it is necessary to equip the circuit with an echo suppressor. Before describing this device it is important to note the advantage of modern carrier plant over the older loaded audio cable, since it enables one to go about ten times as far before reaching a distance at which the echo time calls for an echo suppressor.

Fig. 3 shows a long distance circuit equipped with an echo suppressor (E). Various methods are used but in this instance the unit is placed at one end of the circuit and it can be combined with terminal amplifiers. The principle of operation is very simple. While one caller is speaking, speech currents on the channel he is using are amplified and used to block transmission in the opposite direction, thus preventing echo currents reaching the talker. In some countries the amplified speech currents are used to operate a mechanical relay

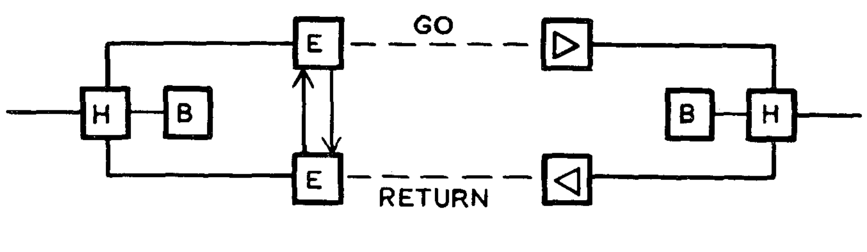


FIG. 3

which short circuits the other directions of transmission. In the Post Office a purely static device is used, made up of copper oxide rectifiers. Although the echo suppressor is simple in principle, in practice it must obey certain timing requirements, since it must hold over natural gaps in speech but must not be so sluggish that the circuit in the opposite direction is still closed to transmission when the caller at the other end starts to speak, as this would clip off the first part of what he says.

It is fortunate that modern communication systems allow us to do without echo suppressors except on very long circuits, because, apart from the speech problems, the fitting of echo suppressors lends to complications in the signalling (that is, calling and clearing) arrangements. It may also be remarked that even when a suppressor is fitted the speech transmission time must still be kept within limits for any given line attenuation, but greater latitude is possible than without an echo suppressor.

Our Contributors

C. W. ARNOLD, A.M.I.E.E. ("Planning for Telephone Service in New Buildings"), is a Senior Executive Engineer in the Subscribers' and Miscellaneous Services (S) Branch of the Engineer-in-Chief's Office; he is in charge of the group dealing with coin collecting box equipment, kiosks, cabinet design, wiring of buildings, advice note procedure, non-standard facilities and so on.

He joined the Post Office in 1920 as a youth in training and after serving in the London Telecommunications Region, the Radio and S branches of the Engineering Department and Glasgow Telephone Area, he reached his present rank in 1951. Mr. Arnold and Mr. Dennison contributed to the *Journal* (November, 1951) on "How Coin Collecting Boxes work".

ERIC W. AYERS ("New Ideas in the Transmission of Speech") has been a Principal Scientific Officer at the Post Office Research Station, Dollis Hill, London, since 1951, studying the properties of speech and hearing with a special interest in the possibilities of bandwidth compression.

A Londoner, he was educated at Dulwich College and London University, gaining a B.Sc. degree in Engineering with 1st Class Honours. He entered the Post Office by open competition in 1936 as a Probationary Inspector. In 1938 he took the open competition for Probationary Assistant Engineers and went to the Radio Branch at Dollis Hill where he worked on the first coaxial cable systems. From 1948 to 1951 he was a Senior Executive Engineer in the Research Branch in charge of the development of the national Medresco hearing aid.

R. A. BROCKBANK, Ph.D., B.Sc.(Eng.), A.M.I.E.E. ("British Submerged Repeaters in the Transatlantic Telephone Cable"), is Staff Engineer in charge of Submarine Transmission Systems. He entered the Post Office in 1933 after useful experience with several telephone companies. Between 1934 and 1938 he designed, engineered and installed the repeater equipment for the first coaxial system in this country (London to Birmingham). During the war he was engaged on special coaxial developments including high power wideband transmitters. As an Assistant Staff Engineer in 1947 he was associated with television on coaxial cable and submerged repeater systems and the important developments in submerged repeater systems led to his further promotion in 1953.

F. G. CUMMINGS ("Telecommunications Power Plant") is an Executive Engineer in the Power Branch of the Engineering Department. He entered the Post Office in 1930 as a Youth-in-Training in the London Test Section and was successful in the 1935 limited competition for Probationary Inspectors. After serving for three years in the Glasgow Telephone Area, he joined the Engineering Department, where he has been employed in the Editorial, Telephone and Power Branches. He is an Associate Member of the Institution of Electrical Engineers.

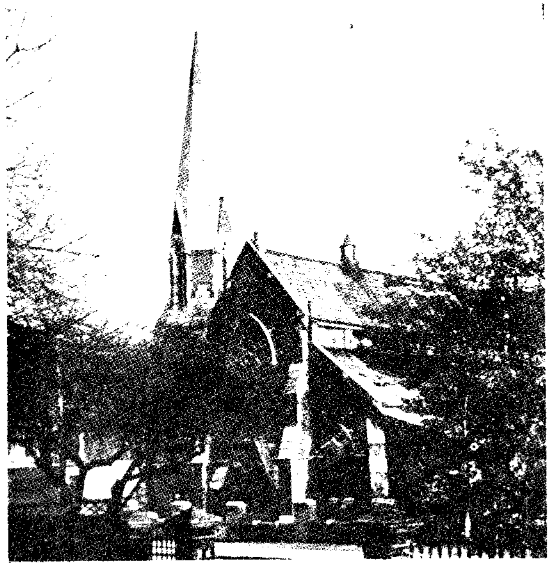
EDWARD MOCKETT, O.B.E., A.M.I.E.E. ("Training Technical Staff for Overseas Service"), joined the Eastern Telegraph Company, now merged in Cable & Wireless Ltd., in 1918. After 20 years in the Foreign Service, at Gibraltar, Egypt, Port Sudan, Aden, Mauritius, Rodrigues, Bermuda and Jamaica, he served for three years in the Engineer-in-Chief's Department at Head Office in London. Later, he joined the Staff Department and has been Staff Manager since 1947.

L. G. TIMMS ("Mobile Telegraph Office for Sporting Events"), who is a Telecommunications Traffic Superintendent in the Operations and Planning Branch of the External Telecommunications Executive, joined Marconi's Wireless Telegraph Company in 1923, and transferred to Cable & Wireless Ltd. in the communications merger of 1929 and to the Post Office in 1950.

He completed the final section of the Company's supervisory examination in 1936 and, in 1943, was appointed to the Telcom Mobile Unit ("The Blue Train") in charge of arrangements for handling the war correspondents' Press copy. After service in Italy and Austria he was posted to Rome at the end of the war to assist in re-establishing the public telegraph service.

H. WILLIAMS, A.C.G.I., M.I.E.E. ("Echo Suppressors"), is a Staff Engineer in charge of the Line Transmission Division of the Research Branch. He entered the Engineering Department in 1926 as an old style Assistant Engineer and for twelve years worked in the Signalling Group of the Research Branch concerned with the standardization of the 3000 type relay, D.C. dialling problems and voice frequency signalling. He joined the Main Lines Branch of the Engineering Department in 1938 as Assistant Staff Engineer, taking charge of the Branch in 1947. In 1953 he transferred to the Research Branch where he is concerned with all aspects of research on line transmission for telephony and television.

Church into Exchange



THE PRIMROSE EXCHANGE (NORTH-WEST London) record says:—

"Opened on March 29, 1926, as hypothetical on Hampstead Exchange (then C.B.1 with partial multiple) at College Crescent, N.W.3, and named originally Primrose Hill. Opened as physical exchange with C.B.1 type of equipment May 13, 1926, at Greville Place, Kilburn, in a disused and adapted Congregational Chapel and was from thence on known as Primrose. Converted to automatic working at 41-43, Townshend Road, on February 15, 1930. Primrose was entirely out of service due to enemy action from October 10 to November 23, 1940".

Then—

The church's history began in 1855, when a few gentlemen, members of different churches "took very eligible premises" in the neighbourhood capable of holding 200 to 300 people. Presumably these premises proved inadequate, because in 1858 a site was secured and the church, with seating for 800 people, was opened in 1859.

A woman, the Rev. Constance Coltman, was at first joint pastor with her husband. She married couples with a marriage service compiled by herself, in which the word "obey" was omitted.

In 1926, while the London Telephone Service were negotiating to take over the building as an exchange for the district, Peter the caretaker, truly the keeper of the keys, usually had to be dug out of a local resort before anyone could gain access. His reminiscences were somewhat vague about names and dates, but he explained that "he had kept the place clean and tidy for eleven year, and the parsons were good men. Oh, yes; they often give him a shillin' and let no one see".

In the early days there was a persistent rumour that the church was haunted. Birds flew in and built their nests in the hand-carved rafters, doors opened quietly and then closed quietly, no one to be seen. It is said that at 7 o'clock every night the air grew cold and still, and a nocturnal visitor walked down the robing room stairs and into the exchange. Once, in the middle of the night, a sudden and loud rapping made the solitary night telephonist leap to his feet. When his trembling body reached the door, there stood a truculent policeman, who fiercely demanded "what he was doing there, at this time of night".

The former church was fitted with all the equipment for an up-to-date manual exchange and accommodated a staff of sixty to seventy people.

—and Now

The present Primrose Exchange, which is automatic, was opened on February 15, 1930, at 41-43, Townshend Road, St. John's Wood, N.W.8. The number of staff employed is 76 and, at the moment, the number of lines working is 8,775.

Notes and News

Radio in "the Place for Crows".—The East African Posts and Telecommunications Administration has augmented its radio-telephone service with an alternative Very High Frequency link between Dar es Salaam and Moshi, Tanganyika. Fourteen 75-foot towers, and one of 50 feet, have been erected on hills, including Bondwa ("the place for crows") which has to receive signals direct from the coast 95 miles distant. Five hundred feet had to be added to the existing road, which goes to within 2,500 feet of the summit, to take the tower sections in, but it had to be manhandled up the steep path to the summit. (An article on telecommunications in East Africa appeared in the February-April, 1953, *Journal*.)

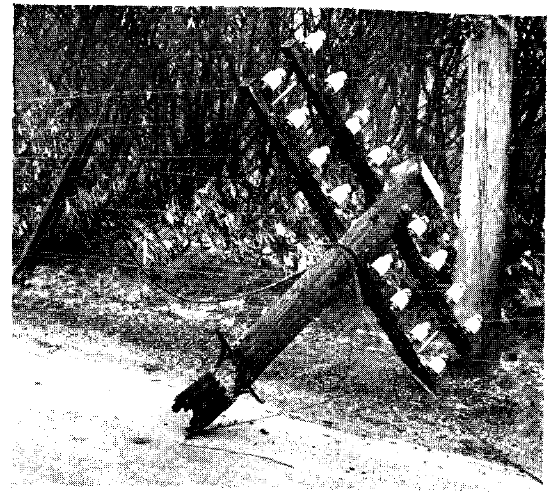
★ ★ ★

TV Progress.—There are now more television than sound licences in the London Postal District: by the end of May, 1,315,921 compared with 1,301,508. Throughout the country nearly 6,000,000 television licences are held.

The B.B.C. has bought a site at Sheriff's Mountain, Londonderry, Northern Ireland, 570 feet above sea level, for a new station which, by the end of next year, will take television to 130,000 additional people.

★ ★ ★

Speeding Transatlantic Calls.—The intervention of the operator at the incoming exchange of radio-telephone calls between the United Kingdom and the United States is no longer necessary; as a result of experiments by the British Post Office and the American telephone authorities, the operator in the outgoing exchange speaks direct to the distant subscriber. The scheme is to be extended to calls between Britain and Canada.



Repairs Under Heat.—The forest fire at Wareham in Dorset towards the end of May damaged only seven poles, five were burnt through and two so badly that they had to be replaced. The route carried five junctions, three subscribers, and one line to the Forestry Commission Fire Look-Out Hut, but it was a pretty big job restoring service. The poles were burnt about two or three feet below the arms, which indicates the height of the fire—at that height the heat of the burning rhododendron bushes was at its maximum. The telephone engineers had to work in great discomfort and difficulty because of the smouldering peat left after the fire belt had passed. The fire began at half past five in the evening; by half past nine the engineers had replaced two junctions at the U.A.X. and the line to the Look-Out. They got two more junctions working by next morning.

★ ★ ★

When the Power Went.—When electricity workers in Northern Ireland supply stations went on strike suddenly at 8.20 one morning earlier this year and the emergency plant for the telephone service was inadequate to carry the load, service to non-essential subscribers had to be withdrawn quickly so that service to essential subscribers could be maintained. By 6 o'clock in the evening nearly 60,000 subscribers had service suspended by inserting lengths of sash-line in the arrester springs at the larger exchanges, and by the withdrawal of the heat-coils or fuses at the smaller exchanges. Altogether this had to be done at 193 exchanges, more than half of them being small U.A.Xs., involving a good deal of travelling for the engineers. The strike was called off the same evening; power supplies were restored piecemeal during the night; and in the morning the engineers retraced their steps, undoing their previous day's work, between 6 o'clock and 11 o'clock. But the withdrawal of electricity supply had put the Venner switches (which control the lighting in kiosks) out of adjustment and it was three days before they were all working again.

★ ★ ★

J.P.C. for Engineers.—Six panels have been formed to assist the Post Office Joint Production Council for Engineering and Allied Services, which the Postmaster General formally inaugurated last February. The panels deal respectively with External and Internal work, Organization and Procedure, Motor Transport, Supplies and Internal Relations. Other panels will be formed if necessary.

Joint production in engineering began in 1928, when the Experimental Changes of Practice Committee was formed, and Joint Production committees have been working throughout the country since 1947; they were introduced concurrently with the shorter working week for engineering staff. The new Council has been established to co-ordinate the work of the regional committees, provide joint consultation machinery, and to stimulate and encourage the Engineering Joint Production movement.

★ ★ ★

"Two-Way Switch".—The Postmaster General has launched a campaign to increase the number of local Post Office Advisory Committees and to enliven moribund committees. These committees, when alive, meet the Telephone Manager (and Head Postmaster) from time to time to discuss local services: the Postmaster General has described them as a "two-way" switch, helping the Post Office and the public to understand one another's problems and needs in telephone service. Post Office Advisory Committees have developed out of the Telegraph and Telephone Advisory Committees which were working early in this century.

★ ★ ★

"Shooting a Line".—A new telephone line was shot by rocket apparatus to Beachy Head lighthouse in June. Previously, when a new line has been needed, it was attached to a sand-filled barrel and lowered over the cliffs to the lighthouse on the rocks 546 feet below, but this operation was dangerous as it meant that men had to work from the crumbling cliff head. This time the head of the village volunteer rocket life-saving company, after calculating the strength of the wind—a sou'wester was blowing—landed the line within a few yards of the lighthouse steps in one shot.

★ ★ ★

One in a Million.—Having learnt from the London telephone weather service (WEA 2211) that prolonged sunny periods were expected, a housewife hung out her washing. A local shower drenched it. She remonstrated with WEA and then complained to the supervisor that the "forecaster" had been quite indifferent to her protests. The supervisor explained the recording system. This was the first complaint in more than a million calls.

★ ★ ★

Anglo-American Liaison.—Earlier this year representatives of the British Post Office and the American telegraph companies discussed ways and means of using telecommunications facilities to serve the close mutual interests of their two countries. Mr. R. J. P. Harvey, Deputy Director General of the Post Office (and a former Chairman of the *Journal's* Editorial Board) headed the United Kingdom delegation. Interested private companies in both countries attended.

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Helping Iran.—The British Post Office is giving the Iranian P.T.T. Administration advice with its telecommunications development programme and is training a number of technicians. His Excellency Amir Ghassom Eshraghi, Minister of Posts and Telegraphs, has visited Britain and toured Post Office radio and other telecommunications installations, and consulted with technical experts.

★ ★ ★

Broadcast Receiving Licences.—By the end of June there were 14,332,856 broadcast receiving licences in Great Britain and Northern Ireland, 5,922,020 of which were for sound and television and 8,410,836 for sound only. In the Post Office London Postal Region, and the Midland Region, there were more combined sound and television licences than sound only: London, 1,326,068 against 1,300,254, and Midland, 1,021,171 against 1,011,463. In the Home Counties Region, however, there were 1,292,236 sound only against 680,096 combined.

RADIO SHOW

Current engineering activities are featured in the large Post Office exhibit at this year's Radio Show at Earls Court, London. On show for the first time will be: the speech synthesizer (described in Mr. Ayer's article on page 163); a demonstration model of ERNIE (the Electronic Random Number Indicator Equipment) to be used for selecting Premium Savings Bonds; the latest type of letter-sorting machine, which is partially electronic; and the telegraph distortion analyser.

One of the more light-hearted displays is the electronic dartboard, using printed wiring, fast pulse counting and pattern registration and shifting techniques.

Half-price tickets are available to Post Office staff through supervising officers up to August 29. The show is open from August 22 to September 1.

Telephone Answerer.—H. G. M. Spratt, B.Sc., M.I.E.E., described in the July *Wireless World* "a simple telephone answering machine" which, he said, "takes the form of comparatively simple adjuncts to any normal type of magnetic recording machine and, as regards its respect for the sanctity of Post Office equipment, is virtually superhuman."

It consists of three adjuncts: a relay and coupling coil attached to a normal telephone receiver, and a coupling unit connected by leads to the relay and coupling coil and to the tape recorder. The coupling coil is attached to the side of the telephone receiver by a rubber sucker; the foot of the relay unit is slipped under the receiver so that, with the hand-set removed, the relay armature holds down the cradle switch.

The machine allows one minute for a message to be passed—" in practice . . . long enough to record a message of surprising length—but by a simple modification, the line can be extended. It has operated infallibly in hundreds of tests and, Mr. Spratt suggests, should be particularly useful to people running one-man businesses.

Memorial to Baird.—While in Glasgow in July, the Postmaster General unveiled a plaque to John Logie Baird (1888-1946), television inventor, at the Royal Technical College, where Mr. Baird was a student between leaving school and going to Glasgow University. The fixing of the plaque was associated with the establishment of a Baird Memorial prize for the most distinguished student in the final year of the associateship in the Electrical Engineering Department.

"Baird was an experimenter rather than a scientist, a visionary rather than a man of business, a man who turned fantasy into fact", said Dr. Hill; "a man who was determined to invent and who did in the end light on an invention of great influence in our material and social life".

★ ★ ★

Radio-telephone for Clyde ships.—Radio-telephone communication between suitably equipped ships in the Firth of Clyde and telephone subscribers in the United Kingdom will be introduced by about the end of the year. The service is expected to be of particular value for ships undergoing trials in the Firth of Clyde. The shore station will be in the Isle of Bute. The service will operate on very high frequencies (V.H.F.), and will use frequency modulated equipment; the frequencies to be used will probably be standardized internationally for radio services of this kind.

★ ★ ★

Post Office Exhibit in Soho Fair.—A Post Office telecommunications exhibition in Gerrard Exchange, London, was opened on July 8 by the "Mayor of Montmartre". This was the Mayor's first duty when with his fellow Parisians, the Guarde Champêtre and the Chef de Pompiers, he officiated at the Soho Fair; he was connected to WEAther 2211 to hear whether the Fair's opening Parade would be blessed with sunshine or not.

In the Parade the Post Office had a float featuring British Telecommunications throughout the World; the exhibition was open during the week of the Fair and its general theme was modern telecommunications.

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Time Everlasting?—By July 24—twenty years since the service was inaugurated—London's TIM had answered 549,638,000 calls for the correct time. When the service was introduced on July 24, 1936, the Post Office said "the Golden Voice should be practically everlasting".

Dodging "Dodgem" spots.—Post Office radio interference experts have designed suppressors which reduce interference radiation from fair-ground "Dodgem" cars by at least 90 per cent. The Showmen's Guild of Great Britain called the Post Office in because the sparks visible at the top of the trolley poles and wheels of the cars can cause rows of white spots on neighbouring television screens.

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Jubilee Address.—Brigadier L. H. Harris, Engineer-in-Chief of the Post Office, and President of the Institution of Post Office Electrical Engineers, will speak on "Fifty Years of Telecommunications" at the Jubilee meeting to commemorate the Institution's 50th anniversary. The meeting will be on October 8 at the Institution of Electrical Engineers.

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Essay Competition Results.—E. F. Taunton, Technical Officer, Perth, has won the 5-guinea prize and an Institution Certificate in the Essay Competition, 1955-56, held by the Institution of Post Office Electrical Engineers.

The following (with the titles of their essays) have won prizes of 3 guineas each, and Institution Certificates:—

H. F. Bentley, Technical Officer, Edenbridge (Home Counties Region), *The Long Arm of Dual Maintenance.*

J. R. Haggart, Technical Officer, Edinburgh, *The Development of the Telephone.*

J. O. Rogers, Technical Officer, Rugby Radio Station (External Telecommunications Executive), *How far is Automation a good idea?*

J. L. Care, Technical Officer, Eltham (London Telecommunications Region), *Conducting the Public around a Telephone Exchange.*

Institution Certificates of Merit have been awarded to:—

R. L. Wood, Technical Officer, Reading (Home Counties Region), *Observations on the Larger Size of the P.A.B.X. No. 3.*

A. H. Strange, Technical Officer, Engineering Department (Long Lines Branch), *An Appreciation of High Quality Sound.*

J. R. Greenfield, Technician I (London Postal Region Power Section), *Generating and Metering (E.H.T.).*

A. L. Deighton, Technical Officer, Lincoln (North Eastern Region), *Why do Accidents occur and what should be done to prevent them?*

The essays were judged by W. S. Proctor, S. Welch and E. W. Anderson.

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Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunication 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.

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