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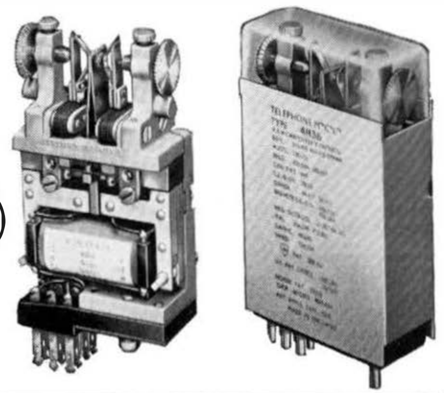

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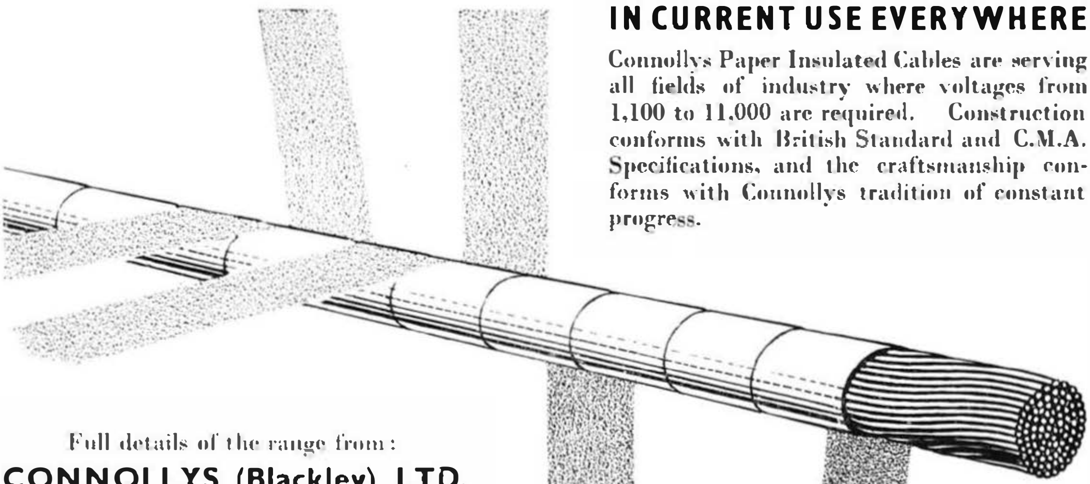

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Post Office Telecommunications Journal

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Contents

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Vol. 9 *Autumn*, 1956 *No.* 1

The New Cable is in Service

THE POSTMASTER GENERAL, DR. CHARLES HILL, opened the first Transatlantic Telephone Cable for public service on September 25.

With this issue we include a special supplement to commemorate the completion of this new instrument of international communication which is at the same time a symbol of international co-operation. Overleaf we present a pictorial record of the opening ceremonies in Britain, the United States and Canada.

The scientists and engineers of Britain and North America—and finally British seamen—have completed their task in just under three years. But, in fact, the service has a long lineage; it is the latest—but not the last—product of generations of men who have worked to harness electricity in the service of man, and particularly of those who first spanned the Atlantic with a telegraph cable a hundred years ago.

While we salute the scientists and engineers of North America who have collaborated so willingly with us, we may without boasting feel particular pride in our own people of the Post Office who have worked so magnificently, and in our own ship, Her Majesty's Telegraph Ship *Monarch*, which laid the whole 4,500 miles of cable from coast to coast.

The new cable has already proved its value in strengthening communications across the Atlantic and, as Sir Gordon Radley forecast in the paper he read to the Institution of Electrical Engineers, the extension of the principles on which it is based to other seas is being studied.

Left to right: Mr. C. J. M. ALPORT, Assistant Postmaster General, Mr. N.A. ROBERTSON, High Commissioner for Canada; Dr. CHARLES HILL, Postmaster General; United States Ambassador, Mr. WINTHROP ALDRICH, and Sir GORDON RADLEY, Director General of the British Post Office

Inaugural Ceremony—London—New York—Ottawa

IN Lancaster House, London, at precisely 4 p.m. on September 25 the new transatlantic telephone service was opened by the Postmaster General, Dr. Charles Hill, who exchanged greetings with Mr. Cleo F. Craig, until recently President and now Chairman of the Board of Directors of the American Telephone and Telegraph Company, at the headquarters of the Company in New York.

The Postmaster General also spoke to Mr. G. F. Marler, Canadian Minister of Transport, in Ottawa, and then Mr. Marler exchanged greetings with Mr. Craig.

In a speech before the opening, Mr. Aldrich described the cable as being "as fine a piece of international co-operation as has ever been seen in peace or war," and Mr. Robertson spoke of the benefits to Commonwealth communications and paid tribute to the team-work which had made it possible.

The threefold—regularity, reliability and clarity—promise of the engineers was fulfilled at the ceremony. The conversations over the new cable were heard with perfect clarity in New York, Canada and London. The new service is completely free from fading and atmospheric noise—voices across the Atlantic sounded as audible as though they were on the telephone within the London radius.

Captain Betson, Commander of H.M.T.S. Monarch, *with some of his officers, and Cable Foreman McManus representing the crew, were among the 250 guests and newspapermen at the inaugural ceremony in London, all of whom listened through individual earphones.*

Telephonists at the switchboard of the International Exchange, London

Participating in inaugural ceremonies for opening of the cable at the American Telephone & Telegraph Company headquarters in New York are Mr. GEORGE C. McCONNAUGHEY, Chairman of F.C.C., CLEO F. CRAIG, newly elected Chairman of the Board of Directors, A.T. & T. and FREDERICK R. KAPPEL, President of A.T. & T.

During the ceremony many other greetings were exchanged. Later in the evening many members of the International Exchange staff in London spoke with people in a large number of American and Canadian cities, the most distant city being Denver, Colorado—a circuit distance of some 6,000 miles.

During the first full week of operation, calls to Canada were 85 per cent. above the average week-day traffic over the radiotelephone circuits; calls from Canada were 100 per cent. higher. Full rate calls to the United States were 60 per cent., and cheap rate traffic was 50 per cent. higher. There appeared to be little "curiosity" traffic but both business and private cables (for family conversations) were quick to take advantage of the new service, many family calls being made during the night and Sunday reduced rate periods. Some calls lasted for 20 minutes or more.

London operators say they find the new service pleasanter to work; they have had to monitor all radiotelephone conversations, but now they simply connect the callers and leave the circuit as with inland calls.

A special supplement describing the inception and achievement of this first transatlantic telephone cable service is included with this issue. Extra copies are available for 1s. each.

Left to right: Mr. THOMAS W. EADIE, President, Bell Telephone Company of Canada; Mr. GEORGE C. MARLER, Canadian Minister of Transport; Mr. D. F. BOWIE, President, Canadian Overseas Telecommunication Corporation; United States Ambassador Mr. LIVINGSTONE T. MERCHANT and United Kingdom Deputy High Commissioner Mr. NEIL PRITCHARD (this picture was transmitted over the new cable)

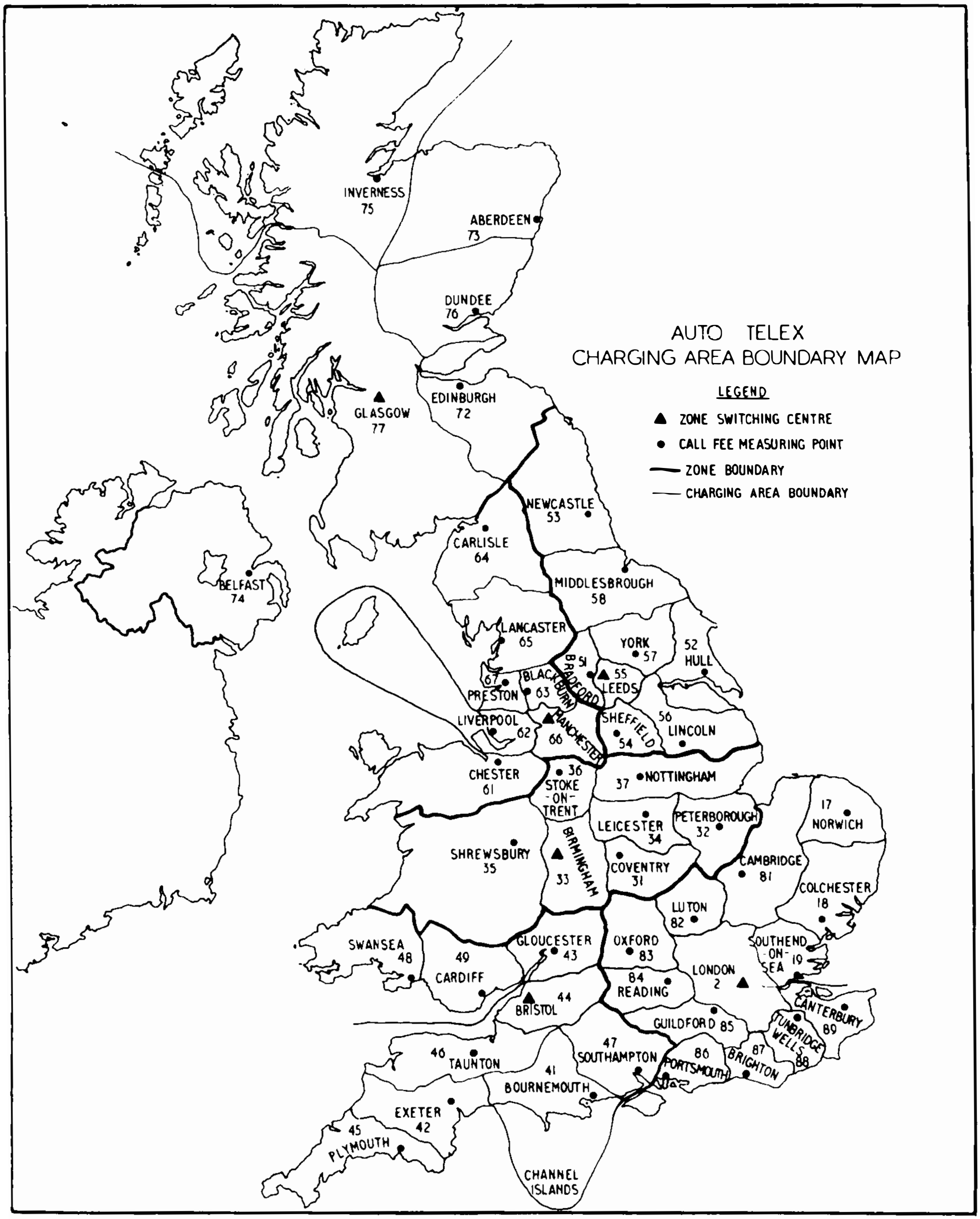


Fig. 1 : Map showing how the country has been divided into fifty telex charging areas

Automatic Dialling for Telex

R. D. Johnson and A. E. T. Forster

IN NOVEMBER, 1954, THE INLAND TELEX SERVICE was transferred from the telephone network to an independent teleprinter exchange system. At the same time it assimilated the international telex service which had developed rapidly as a separate system since the war, and was already operating on an entirely telegraphic basis.

The conversion of the public telegraph service to full automatic working had been completed earlier in 1954. The next major step to be taken in teleprinter switching was the development of full automatic working for telex, with national and international dialling by subscribers. Rapid progress has been made in this direction in Europe, and it has now become one of our most urgent tasks in the continuing process of modernizing Britain's telecommunications services.

The authority of the printed word and the speed of the telephone combine in the teleprinter to meet the quickening pace of today's affairs more effectively, for many purposes, than the older services. Modern industry tends towards increasing specialization, there is more sub-contracting and more buying-out, and fast-written intercommunication has become essential.

Although the expansion of the telephone system has led to a decline in the use of the public telegraph service, teleprinter services, by telex or private wires, are being used to an ever increasing extent and for some purposes are becoming serious competitors with the telephone. The importance of teleprinter communication for business has increased greatly in recent years, especially in the export trades.

Contacts between businesses in other countries are continually increasing and this is reflected in the growth of international telex traffic, which has more than doubled in the past two years and is now well over half the volume of overseas telephone traffic. Telex calls are set up within a minute or so, and more than 30 countries, including Honolulu and parts of Africa, can already be reached on demand.

Indeed, telex is accelerating the pace and affecting the character of certain types of business. For example, highly competitive shipping deals between agents in different countries, requiring quick decisions from the executives responsible, are often settled immediately in a teleprinter conversation. Telex, which gives a printed record and reduces language difficulties, is becoming the method of choice for a wide range of international communications.

At first the telex service in this country was established over the telephone network, using voice frequency convertors at subscribers' premises to enable teleprinter signals to be passed between subscribers over a normal telephone connexion. Apart from this, the demand for teleprinter communication within this country has been met mainly by a well-developed private-wire service, but this has limited flexibility. To make teleprinter service more generally available, particularly for international communications, a separate manual telex service with its own network of voice frequency telegraph circuits was introduced to replace the old telex service. Though this was an interim measure designed to provide a satisfactory service within a reasonable time, it prepared the way for full automatic working, and included features that would be common to a future automatic network.

Continental Systems Studied

In other European countries the emphasis has long been on telex rather than on private-wire service. Some of these countries already have automatic telex services giving country-wide dialling by subscribers; others are now changing over to this system. In May, 1955, a team of four from the Post Office went to the Continent to study some of these systems.

Three of the countries visited, Austria, Germany and Switzerland, have many years experience of a subscriber national dialling system. Their networks are variations of a basic design developed by Siemens and Halske known as the TW 39 system, the forerunner of which was introduced in Germany in 1935 as the TW 35 system. The familiar dial, as used on an automatic telephone, is fitted at subscribers' installations to select the required number by a straightforward step-by-step method without registers.

The Netherlands, the other country visited, provided a contrast. Its telex service is in process of conversion from dependence on the telephone

OCC (upé)	Line busy.
NC (no circuits)	Trunks busy.
NP (no party)	"NU" tone.
ABS(ent)	Office closed and subscriber does not wish messages to be left for attention when he returns.
MOM(ent)	"Wait" signal on calls to manual switchboard.
DER(angé)	Out-of-order.

Table I : Service Signals

service to a separate national dialling system of new design. The switching equipment uses registers to control power-driven 100-point rotary uniselectors over the forward signalling path. Register working enables the teleprinter keyboard to be used to signal the required number, eliminating the need for a dial at subscribers' stations. Other interesting features are that a full range of printed service signals is available and that the time a call is set up is printed on the subscribers' teleprinters.

In essence, the basic service provided by these systems is, however, the same—the instantaneous interchange of written information between all subscribers throughout the service. What impressed the team most were two demonstrations of subscriber international dialling in which series of calls were set up to several countries in turn, all in a matter of a few minutes. In many European countries the aim is now to provide direct international dialling by subscribers and a start has already been made between Germany, Austria, the Netherlands, Switzerland, Sweden, Belgium and Denmark.

The separate manual service in this country was planned to facilitate early conversion to full automatic operation but the Continental visit confirmed the need to accelerate the programme for its introduction, and above all to include subscriber international dialling at the earliest possible stage. In the light of the report on the visit, intensive studies were made of the main features required for the future automatic system.

The conclusion was that a comparatively straightforward non-register scheme, in which calls would be set up by direct selection, would be the most suitable for this country. A device called a routing translator, to be fitted at zone centres only, will, however, be used on a small proportion of traffic. Subscribers will dial national numbers for all inland traffic, but those connected to area centre exchanges will have to dial the prefix digit "1" before certain national numbers and will therefore need a very simple form of code list. Together, the routing translators and the code lists will, with a minimum of complication, secure all the flexibility in traffic routing likely to be required, thus obviating the shortcomings of a direct selection system using national numbers.

An important factor taken into account in choosing a relatively simple dial-control system was the advantage of using equipment conforming as closely as possible to that already in use on the telephone and teleprinter automatic switching systems, both to save development time and to simplify maintenance. The system will, however, give all the essential facilities at low cost, including such desirable features as the printed service signals given in Table 1.

Telex and TAS

During the initial planning, a study was made of the possibility of securing more efficient use of lines and plant by integrating telex with the teleprinter automatic switching (TAS) scheme already in operation for the public telegraph service. The existing TAS switching units in London are, however, some distance from the City, in which telex development is concentrated. Moreover, segregation of telex and TAS traffic on a joint system would require an extra switching stage. Coupled with these drawbacks of integration is the fact that the telex network is expected to become much larger than the TAS network in the long run. It has therefore been decided that the network will not be integrated at this stage, but the telex trunking plan is being arranged so that TAS can be assimilated later should this prove economical. The fullest possible use will, however, be made of common engineering services already provided for TAS wherever this will be advantageous.

The capital cost of the new system, catering for about 6,000 subscribers at the opening date, is expected to be about £2½ million, but about £500,000 a year will be saved on operating.

Metering will be adopted for recording amounts due from subscribers for dialled calls, both within this country and to Europe. Simplicity and low cost determined the choice; the alternative, automatic ticketing would be expensive and take much time to develop. Moreover, metering is the common practice in the other European services and since ultimately all European subscribers are likely to be dialling each other, there is much to be said for the arrangements being as nearly as possible reciprocal. Furthermore, metering leads to a form of tariff which permits very cheap short-duration calls and this feature is expected to prove attractive, especially to subscribers with considerable international traffic.

With metering, the information presented to subscribers in their accounts for dialled calls is limited to the total number of charge units recorded, but criticism on this score may be met by giving separate figures for each month, or even possibly weekly totals for heavy users. For subscribers wanting to know the charges for particular calls, check meters at subscribers' premises seem to be the real answer and will be available at an extra rental.

The method of charging for calls on the new system had to be decided, as well as the method of recording charges. The current method consists of minimum charges (which vary according to distances) for three-minute calls, further time being charged for minute by minute. The three-minute minimum charge is needed on a manual service to pay for the initial cost of setting up the connexion, since this would not otherwise be covered on short duration calls. With an automatic service the initial cost of establishing the connexion is much lower and this makes possible a simpler form of charging which reflects more accurately the cost of the service given and makes for cheaper engineering arrangements.

Single-Pulse Metering

The method of charging will be single-pulse metering which consists of applying single metering-pulses during the course of a call at a rate varying with distance. Thus, a pulse rate of one per minute is likely to be applied on local calls, one every 15 seconds on maximum rate inland trunk calls, and on a call to one of the Central European countries a pulse every two or three seconds. This assumes the value of the pulse to be 2d. A range of pulsing rates will be generated by a common source in each exchange. A typical range is shown in Table II but the design of the machine producing the pulses will enable changes in the rates to be made.

An initial pulse will be applied in addition to the timing pulses. This will be connected about three seconds after a chargeable call has been established. Thus a call to an engaged line will not be charged because it will be cleared by the forced release condition that follows immediately after the OCC (Occupé) signal and before the initial pulse is applied.

Further engineering simplifications, and therefore savings in cost, are being achieved by minimizing the number of pulsing rates and reducing the number of charging relationships to be recognized by the apparatus.

Range	Pulsing rate per minute	Charge per minute
Inland	1	2d.
	2	4d.
	3	6d.
	4	8d.
Overseas	Then by 30 steps to a maximum of	
	120	20s. od.

Table II : Pulsing Rates

The inland tariff will be limited to four distance ranges, requiring four pulsing rates probably producing charges of 2d., 4d., 6d. and 8d. per minute, the lowest rate being made for local calls which will continue to be timed as on the present manual service. The chargeable distance depends on the distance between the centres of the charging areas in which the calling and called subscribers are situated. The country has been divided into 50 telex charging areas, as shown on the map (Fig. 1). The time-zone metering equipment has therefore to identify only 50 different charging points for inland traffic.

This simplified charging-area plan has, of course, already been introduced on the manual service, the charging areas corresponding broadly with the London Telephone Region and the Telephone Managers' areas elsewhere. It enables complete charging information for all subscribers throughout the country to be included in the preface to the directory, in a table similar to that used for showing fare stages on omnibus services. This should also help to make bulk billing of call charges acceptable.

The charging areas are grouped together into zones, each zone having a distinctive initial digit; 3, for example, stands for the Birmingham zone. The second digit identifies the charging area; for the area in which the zone centre is situated, it is the same as the first digit but is, of course, different for the surrounding areas; thus, Birmingham is 33 but Nottingham, an area centre dependent on Birmingham, is 37. Areas having a forecast development of fewer than about 80 lines can therefore have subscribers' national numbers consisting of four digits, but five digits will be needed for most numbers. The estimated development is about 20,000 lines and

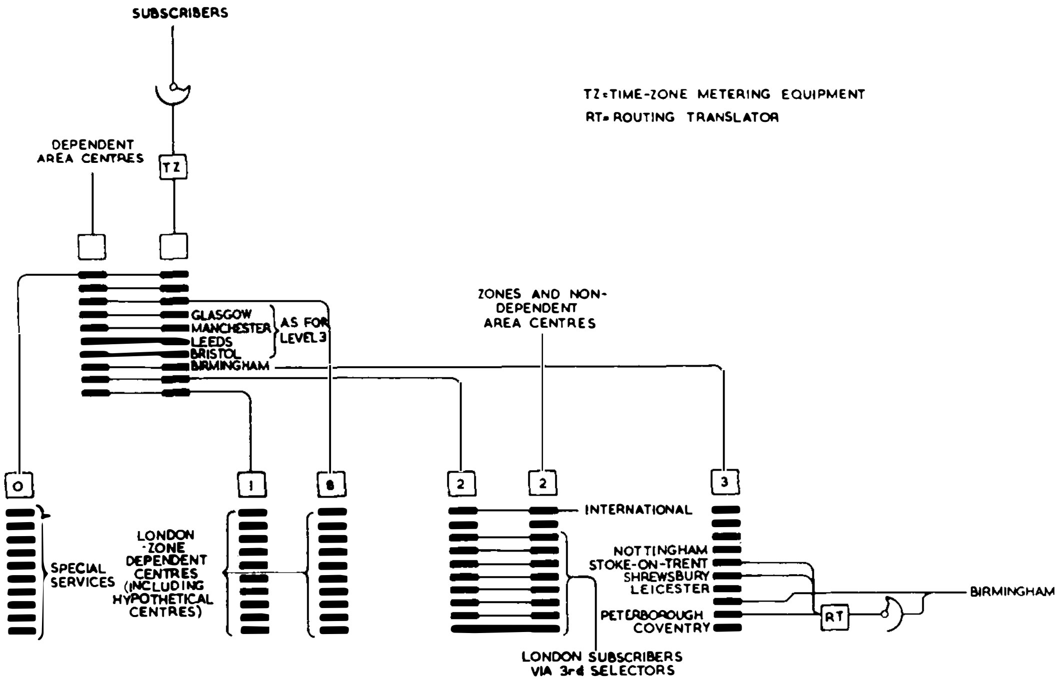


Fig. 2 : Skeleton trunking diagram of London telex centre

we expect that about half of these will be in London. Eight two-digit codes in the range 21 to 28 have therefore been allocated to the London charging area. One of these, the code 26, will be expanded into six-digit numbers if development prospects are fulfilled.

Another difference in the London zone is that it will require three initial digits, since most of the range of two-digit codes starting with 2, which is London's characteristic digit, have been reserved for ultimate development in the London charging area itself. The 12 Home Counties areas have therefore been allotted two-digit codes starting with either 1 or 8. There are six zones in all, including London, which leaves the initial digit 0 for obtaining access to various service points via second selectors, and digit 9 spare. This digit will be available to create further two-digit codes should they be required for expansion of the national numbering plan in the provinces in the event of unexpected development.

The total number of exchanges covering the country is likely to be fewer than 30 for some time to come. Areas in which development is insufficient to justify a physical exchange will be served by hypothetical units at the zone centres but will of course require their own two-digit codes so that traffic to them can be correctly charged.

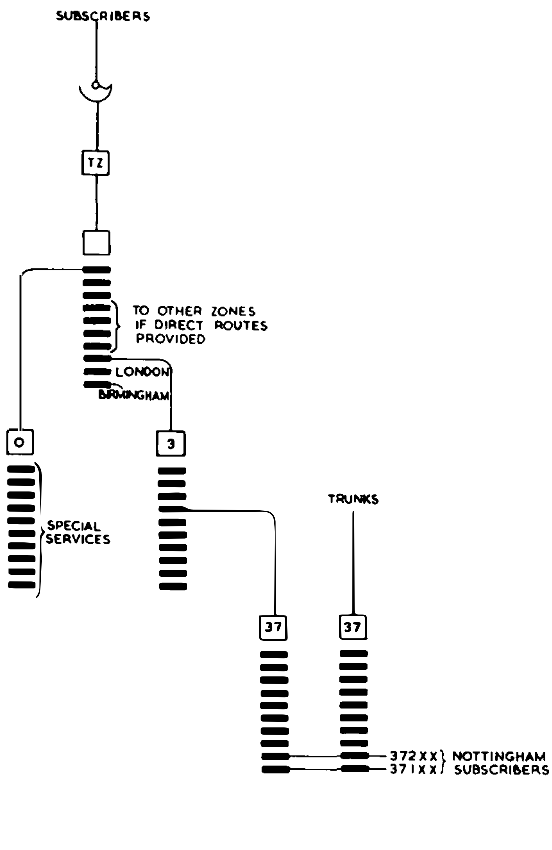
All zone centres will be connected together and will, of course, have routes to their area centres. The area centres will also have routes to London, and to other places if justified.

This network will meet the transmission limits which require that the number of links in any chain of connexions should not exceed five from end to end. Any voice frequency circuit or long physical circuit counts as one link, but the majority of subscribers' lines, which are short physical circuits, can be disregarded. Some subscribers' lines may, however, be 100 miles or more in length and may, if connected to a zone centre, include two voice frequency circuits in tandem. The transmission limits may be exceeded on some international calls, but regenerative repeaters can be included at a convenient point to ensure satisfactory transmission.

The trunking arrangements for the London centre are given in outline in Fig. 2. Time-zone metering equipment records the first two digits of the required subscriber's number to determine- the meter pulsing rate. On international calls, the digits dialled will start with the code 20 to reach the international centre and be followed by one or two digits to select the called country and then by the foreign subscriber's national number. The time-zone metering equipment will determine the appropriate pulsing rate from the dialling code for the distant country.

The function of the routing translators may be explained by considering the routing of traffic to the Shrewsbury charging area. Fig. 2 shows that a direct route to this area will not be provided. The Shrewsbury level therefore gives access to a group of routing translators which temporarily store the digits dialled and extend the call over a Birmingham trunk. The routing translator then transmits the digits needed to route the call to the Shrewsbury hypothetical unit at Birmingham. These routing translators are much simpler and cheaper devices than conventional register translators and therefore need not be released from the connexion after they have performed their function. Direct routes can be connected in place of routing translators as soon as there is sufficient traffic. Routing translators will carry only one or two per cent. of the traffic and will be required at zone centres only.

Fig. 3: Trunking diagram of Nottingham telex centre



The trunking diagram of an area switching centre is given in Fig. 3. The national number only will be dialled for local calls and calls to London, but all other calls will be prefixed by the digit 1 to route them via Birmingham, the home zone centre. It will be noted that level 3 second selectors have been provided to absorb the first digit of local subscribers' numbers. Little local traffic is expected on telex and the provision of digit absorption facilities is not therefore warranted. An alternative method of absorbing the unwanted digit on local calls by routing them in and out of the parent zone centre may be adopted where proved cheaper in particular instances.

The new system will be given a trial, starting in 1958, when a pilot network to serve about 1,000 subscribers will be set up. Automatic exchanges in London and Leeds will be connected together by an auto-to-auto trunk route, and in addition will have trunk routes to most switchboards on the present manual service to reduce tandem manual switchings.

The London pilot exchange will have capacity for about 800 lines to provide the relief needed on the manual system. It will be in temporary accommodation in Shoreditch, as the permanent building for the London unit will not be ready by then. Subscribers in the London charging area served by the "A" exchange in the C.T.O. will be transferred *en bloc* without a number change.

Leeds pilot exchange will serve its own charging area and, on a hypothetical basis, the Lincoln and York areas for an indefinite period, and Middlesbrough and Bradford charging areas until 1960 and 1962, by which time their own physical exchanges will be ready. The hypothetical units released when these physical exchanges are open will be absorbed into the equipment serving the Leeds charging area to cater for the future.

The main conversion will be started when the permanent switching equipment to be installed in the new Fleet Building in London is ready for service in the first half of 1960. This will be followed by the opening of the provincial zone centres as soon as possible afterwards and it is hoped to have the automatic network substantially completed by early 1961.

Fuller details of the pilot scheme, the conversion programme and the facilities to be given, will be described in a later article.

Wick Coast Radio Station 1920-1956

Cyril Rowlinson

AMONG THE MANY POST OFFICE SERVICES IS one which may not be quite so well-known as others—that of radio communication with ships at sea to enable them to obtain assistance in cases of distress and to keep in touch with the shore. This service is provided by 11 coast radio stations, situated at points around the coast of the United Kingdom so as to give coverage of a sea area extending to a distance of approximately 300 miles from shore. In addition, there is a long range station at Burnham-on-Sea, but in this article we are concerned with one of the most important of the coast radio stations, at Wick in Scotland.

Wick Radio, on a site of two acres in the north-east corner of Caithness, is the main station for communications with trawlers bound for fishing grounds in northern waters. The Admiralty constructed it during the first world war, and it played an important part in the operations of the Grand Fleet based on Scapa Flow. In April, 1920, the Post Office took the station over as a coast radio station. In its early years the amount of traffic handled at Wick was so small that it was in danger of being closed down for economic reasons. Today, Wick Radio is by far the busiest coast radio station in the United Kingdom.

The equipment in 1920 consisted essentially of a spark transmitter and a crystal receiver with valve amplifier, the principal frequency being 500 kilocycles per second, the International Distress and Calling Frequency. At that time the station operated on radiotelegraphy only but in the late 'twenties, with the advance of radio technique, radiotelephony was coming into use as a means of communication between ship and shore, particularly for smaller vessels such as trawlers and coasting ships. These vessels were fitted with compact radiotelephone sets and trawler skippers could, through Wick Radio, keep in touch with their owners and so regulate landings of fish. This regulation avoided glutted markets. Trawler owners were quick to realize the advantages of radio communication, with the result that they rapidly equipped whole fleets of trawlers with radio apparatus. In consequence the traffic rose proportionately. There was also the added facility for members of crews to communicate with relatives and friends.

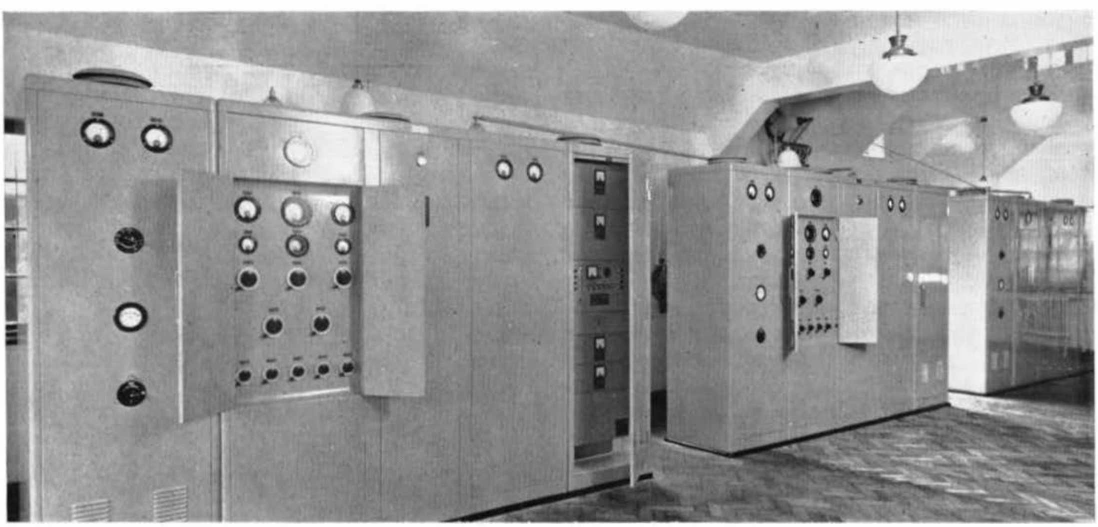
In 1930 Wick Radio was completely re-equipped for radiotelegraph and radiotelephone working with small craft. Certain frequencies in the two megacycles band were allocated for this purpose and these frequencies later became known as the "Trawler Band". With the introduction of this band, more and more trawlers were fitted with radiotelegraph and radiotelephone equipment and communications at distances exceeding 1,000 miles were common.

In 1936, more up-to-date equipment was installed at the station, including two relatively high-powered transmitters which gave yeoman service throughout the second world war. The radiotelephone link service at Wick Radio was introduced in 1939, enabling trawler skippers to be connected by telephone with their owners on shore.

To meet the expansion of services and to keep abreast with technical developments, the station building has been re-constructed, enlarged and re-equipped since the war. The transmitter room now accommodates six modern transmitters of Post Office design; three of them are capable of operating on both radiotelegraph and radiotelephone frequencies in the medium and trawler bands; one operates on radiotelegraphy only in the medium frequency band; and two high frequency (H.F.) transmitters operate in the four, six, eight and twelve megacycles bands. The H.F. transmitters cater for the increasing number of larger trawlers fitted with H.F. apparatus, thus enabling them to communicate regularly from the farthest fishing grounds in the White Sea, Bear Island and Icelandic Waters. Also in the transmitter room is a miscellany of radiotelephone apparatus designed to permit duplex working in the radiotelephone link service between ships and subscribers ashore.

A new wing is divided into operating/receiving room and landline room. The operating/receiving room contains eight operating console positions, each having a modern receiver of a type best suited for the particular service operated from the position, and appropriate control panels to select transmitters and operate radiotelephone apparatus. Two positions are fitted with radio-goniometers for direction finding (D.F.) for use when ships are in distress or when skippers desire to determine their position. The Adcock system is used, calibrated to take bearings on 410 kilocycles per second, the normal D.F. frequency; the radiotelegraph and radiotelephone distress and calling frequencies on 500 and 2,182 kilocycles per second

Transmitter Room



Operating Room

respectively. The landline room accommodates three teleprinters connected to the telegraph automatic switching system.

The transmitting aerials are on the station site, while the receiving and direction finding aerials are on remote sites and are connected to the station by balanced transmission lines and coaxial cables. The separation of transmitting and receiving aerials permits simultaneous transmission and reception.

Should a power failure occur, the station is well able to carry on normal working by switching over to the emergency power supply, which consists of a four-cylinder 38-h.p. diesel engine driving a 27.5-kilowatt ampere alternator.

The primary function of Wick Radio, in common with all coast radio stations, is its contribution to the safety of life at sea. Watch is kept on the radiotelegraphy and radiotelephony calling and distress frequencies throughout the 24 hours of every day, for calls from ships in distress. When a distress call is received, the station re-transmits particulars on full power on the International radiotelegraph and radiotelephone distress frequencies. It also advises the coastguard authorities, the appropriate naval authorities and Lloyd's, London. The coastguard advises the lifeboat as necessary and any other life-saving body, the naval authority advises warships if available and Lloyd's advises tugs. During 1955 Wick handled 55 such calls for assistance.

Navigational warnings, gale warnings and weather bulletins are broadcast to ships and a direction finding service is always available. In addition, a free medical advice service is provided for ships not carrying a doctor. Particulars of sick or injured members of crews are passed to the station, which obtains advice from a local doctor and sends it immediately to the ship. When diagnosis of the complaint may be difficult, the coast station connects the ship (if it is suitably equipped) with the doctor by radiotelephone link. In 1955 Wick dealt with 38 requests for advice.

As a typical example of a medical advice case, the trawler *Princess Anne* recently requested medical advice for a deck-hand suffering from a badly fractured leg for which it was impossible to use splints. The station telephoned the local hospital and the surgeon advised applying a tourniquet to stop bleeding and giving the patient a quarter grain of morphine. He also suggested that the skipper should make port and land the patient as quickly as possible. This information was passed to the *Princess Anne* and the man was safely landed the same day.

Early in 1956, an Israeli ship, carrying a cargo of horses, requested medical advice as several of the horses appeared to be suffering from influenza. The local veterinary surgeon was telephoned and gave the necessary advice, which was passed to the vessel; the last we heard was that the horses had arrived at their destination safely and well.

Although Wick Radio has for many years been the main radio communication station for trawlers and other fishing vessels operating in northern waters, the services it provides are used also by larger vessels and coasting vessels. Ships sailing from Scandinavian ports to North America and the North Western ports of the British Isles, as well as vessels coasting, regularly use the services.

Wick handled approximately 30,000 messages in 1938 and in 1955 this figure had increased to approximately 75,000. The increasing use of the radiotelephone link service is shown by the fact that 7,306 calls were handled in 1955, compared with only 421 in 1948. As a result of these large traffic increases, the station staff has had to be increased. In 1920, the staff consisted of an Officer-in-Charge and nine radio operators; today an Officer-in-Charge, an assistant Officer-in-Charge and 18 radio operators are needed.

The time is now fast approaching when Wick Radio will be entering its busiest period of the year. Trawlers bound for northern fishing grounds and not expected to be in port again before Christmas Day pass their greetings traffic to Wick Radio on the outward voyage. The station holds the traffic until quite near Christmas and then clears it by landline to the delivery offices for Christmas delivery. Thus it can be said that radio communication contributes to domestic bliss.

"Forward Scatter"

Marconi's Wireless Telegraph Company is producing equipment, designed for ionospheric scatter work, for the Ministry of Supply. Some of the equipment will be used to establish communications between Britain and Malta, with eventual extension to Cyprus and the Middle East. The Company has also supplied a prototype transmitter for Admiralty experiments, the signals being beamed over the Bay of Biscay for scattering over Britain.

If "Forward Scatter" (as it is popularly known) say Marconi's in a note, lives up to its present promise, it may constitute the greatest advance in radio communications since 1924, when the Marconi-Franklin Beam system was invented.

Long distance radio communications, normally carried out in the High Frequency (H.F.) band has always had to face the serious obstacle that it is impossible to transmit on one frequency for 24 hours a day, because, at certain times, the signals will fade and nothing can be received at the other end for some hours. Fortunately, different frequencies are effective for different times of the day over a given path, so that when transmission on one frequency is due to fade—and the time it will do so is reasonably predictable—the established procedure is to maintain communication whenever practicable by switching to a different frequency.

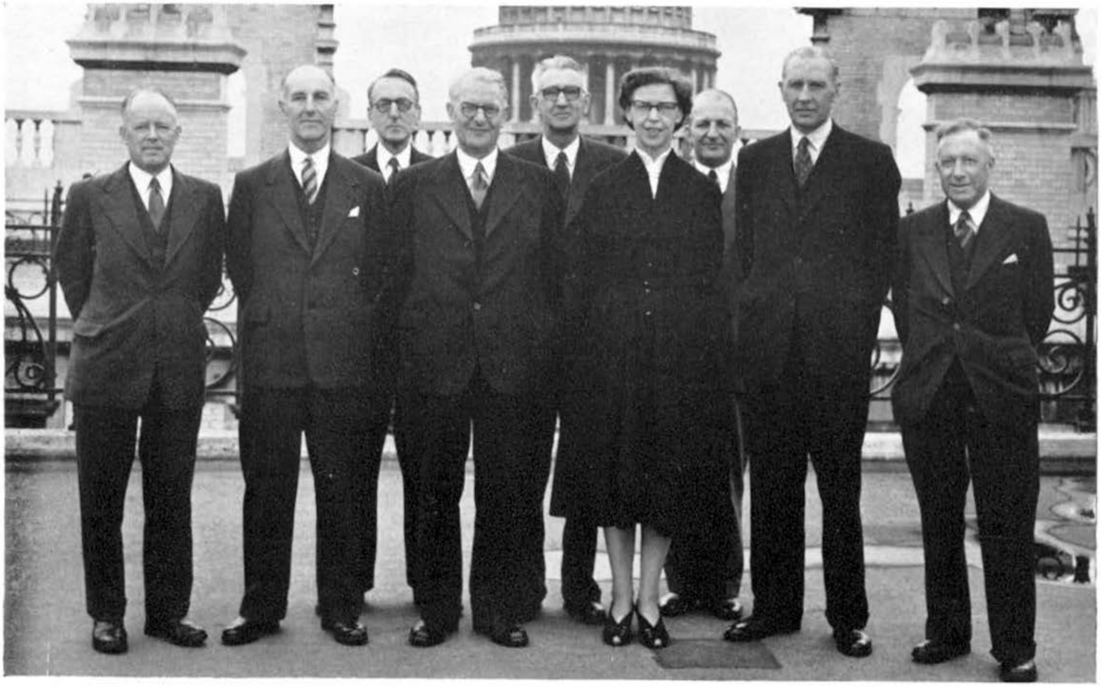
The ionospheric scatter system of propagation, which uses the Very High Frequency (V.H.F.) band, promises to overcome these difficulties. V.H.F. transmissions have been extensively used for many years, but the effective range has always been regarded as in the region of 30 miles. Now, however, it has been found that, by using the ionosphere (and particularly one ionised layer 50 to 70 miles above the earth), distances of 1,000 miles or even more can be spanned.

Transmission Skyward

Under the new system, the V.H.F. transmission, instead of being beamed in a path roughly parallel to the earth's surface (as for normal point-to-point working) is directed skyward at a critical angle until it meets the ionised layer at a height of 50 to 70 miles. Much of the radio energy is lost, but an appreciable fraction is deflected forward and downward to return to the earth at a point which may be about 1,000 miles from the transmitter. There it can be received, amplified and re-transmitted by a similar process for another "hop" and so on until the ultimate destination is reached.

A rough analogy is provided by a searchlight, which, if its beam is directed parallel to the ground, is visible for only a short distance, particularly if the country is hilly. If, however, it is directed skywards and strikes a cloud-base, the beam will be scattered but the glow will be visible for a great many miles.

The ionospheric scatter system provides a method of radio communication which can be effected with a high degree of reliability at any hour of the day or night, all the year round. It is virtually unaffected by magnetic disturbances and is therefore eminently suitable for use across Polar regions where magnetic storms frequently occur. It can be used for telegraphy, teleprinter signals or low-quality telephony, but it is not suitable for transmitting television signals, which, being extremely complex, require a bandwidth of at least three megacycles. Tropospheric scatter (using much higher frequencies but of shorter range) offers possibilities for television, but much experimental work has yet to be done.



EDITORIAL BOARD *Left to right:* Mr. A. KEMP, Mr. C. O. HORN, O.B.E., Mr. JOHN L. YOUNG, Mr. F. I. RAY, C.B.E., Mr. H. R. JONES, Miss K. F. A. McMINN, Mr. H. A. SIMMONS, Col. D. McMILLAN, O.B.E., and Mr. H. WILLIAMS

When the Post Office Public Relations Study Group recommended in 1945 that a new journal should be launched to replace the pre-war "Telegraph and Telephone Journal" they added that the Public Relations Department should be responsible for production and publication, "with the assistance of an appropriate editorial committee".

That "committee" soon developed into an editorial board to consist of three members of the Telecommunications Department (this was before it was divided into inland and overseas) the Director of which was to be Chairman, a representative from the Engineering Department, one from the Regions and two members of the Public Relations Department, one of whom was to be Editor.

At an early meeting of the Board, members decided that they should "function broadly on the lines of giving direction and advice (and not post-executive advice) on the make-up of the 'Journal'. Articles should be seen before publication by members of the Board for an appraisement of quality and urgency of publication".

With this issue the "Journal" enters its ninth year and, although it has developed considerably during its eight years of life, the constitution remains broadly the same, though membership has, naturally, changed from time to time.

The minutes of one of the preliminary meetings record that "Mr. Ray had engagements which prevented his attendance"; now, eight years later, having become Director of Inland Telecommunications, he is Chairman of the Board.

Mr. Hugh Townshend, now Secretary of the International Telecommunication Union in Geneva, was Chairman of the Board at its preliminary meetings; in June, 1948, he suggested that he should be succeeded by Mr. B. L. Barnett, who had become Director of Inland Telecommunications. Mr.—now Sir Ben—Barnett is now Chairman of the Commonwealth Telecommunications Board after some years as a Deputy Director General of the Post Office.

The first issue of the "Journal"—November, 1948—contained a photograph of the Board. Now members, for the first time since, emerge from the modesty of the editorial panel at the back of the issue, grouped on the roof of Headquarters Building, almost beneath the dome of St. Paul's.

Electro-Magnetic Announcers in the Telephone Service

J. C. Rennison

MANY READERS WHO HAVE SEEN THE RAPID development of magnetic tape recorders during the past six or seven years may be surprised to learn that the principle of magnetic recording was first patented as long ago as 1898 by a Danish experimenter, Valdemar Poulsen. Mr. Poulsen discovered that sound could be recorded on a magnetized steel tape and played back, but in the absence of suitable amplifying equipment the value of his discovery was not realized at the time. Later, the thermionic valve made it practicable to amplify the sound, and a German named Steele improved Poulsen's invention and used his equipment for recording people's voices. Similar equipment was used in the 1930's for recording radio broadcasts.

During the last war the magnetic recording principle was developed along two different lines. In America the tape was replaced by a steel wire which could be wound on comparatively small bobbins, while in Germany a method of coating paper and plastic tape with a ferromagnetic oxide was devised.

The quality of the recording depends on the molecular construction of the ferromagnetic material used and on its speed of transit through the magnetic recording and reproduction head. The molecules of the ferromagnetic oxide are held together less firmly than those of steel and for this reason it is easier to magnetize during recording and to demagnetize during erasure. Because the tape of the tape recorders, which is about ¼-inch wide, is wider than the thin wire on the wire recorders, a larger area of magnetic material on which the sound is recorded is carried under the recording head for the same speed of transit. For this reason the tape recorder can be run at a much slower speed, which means comparatively smaller storage space for the tape; it also gives a better quality of recording with a higher signal to noise ratio.

The sensitivity of the tape recorder is also very high, and when used in normal surroundings with the instrument set at the best modulation level for recording, unnoticeable extraneous noises, such as distant train whistles, motor car engines and footsteps are faithfully recorded as background noise. This unwanted noise can be eliminated either by making the recording in a sound-proofed room, which would be the ideal arrangement, or recording at a low volume and reproducing at a much higher amplification.

Other factors to be taken into account are the ease of editing the recording, the methods of driving, handling and accommodating the recording tape or wire without entanglement, and the physical and chemical properties of the materials.

The ferromagnetic oxide covered tape has proved better than the steel wire for all these qualities except the last. High atmospheric humidity and temperature may make the loops of tape stick together, but they do not seriously affect stainless steel wire. For use under certain atmospheric conditions—in the open air for example—the advantage, therefore, lies with wire recorders if a high quality of reproduction is not required, but for all other purposes the tape recorder has gained in popularity over the wire recorder.

By about 1949 tape recorders had become generally available at prices sufficiently low to attract customers who wished to use them for high quality recording and reproduction of music in the home. Although the plastic or paper tape coated with ferromagnetic oxide material was recognized as an ideal medium for lengthy recordings, it was realized that the mechanical features of the tape recorders were not so convenient as the well established rotating disc of the conventional gramophone, and by about 1950 attempts were being made to produce magnetic disc and also magnetic drum recorders.

While this development in the commercial world was going on the Post Office was confronted with a growing problem in dealing with the interception of calls to old numbers and ceased exchange dialling codes resulting from the extension of many of the larger exchanges or their conversion to modern equipment. Many of these changes were simply the addition of another digit to the number, necessitated by the addition of another rank of first or second group selectors. Edinburgh was among the cities where many numbers had to be changed as the telephone system there was being converted from non-director to director automatic working; and from this city a suggestion was made in 1949 to connect a recorded announcement to advise callers to some 6,000 subscribers on one of the exchanges that the telephone numbers had been changed.

Further Experiments

Hitherto two techniques had been used to divert wrongly routed calls to new numbers: (i), to get the controlling operators at distant exchanges, on receiving requests for calls to old numbers, to refer to enquiry operators for the appropriate new ones and, (ii), to arrange for calls to old numbers—usually by local subscribers—to be diverted by special interception equipment to an operator who would advise callers of the new numbers. At the Edinburgh conversion it was impracticable to accommodate any special changed number interception equipment and this prompted the suggestion to connect to the ceased numbers, not the number unobtainable tone, but an oral announcement, "the number you are calling has been changed. Please consult your directory for the new number".

The Post Office adopted this suggestion, but could not devote much time to designing special equipment. A commercially available tape recorder, which had the tape deck designed to carry a small continuous loop of tape, was therefore used.

The Edinburgh experiment proved an outstanding success, so the Post Office decided to provide similar machines for other cities. The choice of recording technique rested between the well-established photo-electrical method used for TIM, which required specialized equipment for recording, and one of the magnetic methods. The magnetic tape recorder was selected because it was cheaper, more compact, more readily transportable, more adaptable to give the different messages required, and easier to manipulate in the field; also, because the messages could be easily, quickly and cheaply recorded and altered at will. Although it was mechanically inferior to the glass disc recorders used on TIM, the recorder could be run continuously for about one or two weeks without serious harm, and this catered adequately for the immediate rush of wrongly dialled calls following a general change of telephone numbers. The modified tape recorders were called "Changed Number Announcers", and they were adopted to meet particular needs. Meters are now associated with the ceased levels and ceased number circuits to which a changed number announcer is connected for recording the number of calls made each day to the old numbers so that the local traffic staff can determine when the Announcer is no longer needed.

A standard relay set is being developed to facilitate connexion of circuits to the Announcer. The relay sets, in conjunction with the amplifiers used, connect the telephone lines to the Announcer in a manner which avoids cross-talk between subscribers connected to the recorded announcement. At present enough relay sets have to be made up locally to deal with the expected traffic, but eventually a standard rack will be designed to accommodate 60 relay sets, adequate to carry about 5,000 calls an hour to an announcement of about 20 seconds' duration. This equipment will also contain the control circuit which connects number-unobtainable tone in place of the recorded announcement and brings in an alarm if the equipment breaks down. It is very desirable that the recorded messages, which may be transmitted over long distance circuits, should be as short as possible, and we aim to make them less than 12 seconds' duration.

Experience with the Changed Number Announcer has revealed that, when subscribers' numbers have to be changed as the result of an extension of an automatic exchange, it is often preferable to change all numbers uniformly without any exceptions (for example, prefixing them with an additional digit). The recorded announcement can then be worded along the lines "the number you are calling has been changed. It is now (SIX) followed by the old number. Please make a fresh call". The caller is thus told how to obtain the new number without having to refer to a directory or an enquiry operator.

A disadvantage with this type of announcement, however, is that, because of its length, some difficulty is experienced in transmitting the message over old type voice frequency trunk circuits. Over these circuits the announcement must be transmitted in the "unanswered" condition so that subscribers are not charged for the call. Some equipment is fitted on the circuits themselves

Photograph of a changed number announcer published in the *Sheffield Telegraph* showing Miss P. A. Busby, winner of the "Golden Voice" contest in Sheffield, making a recording, watched by runners up and engineers

so that when they are in the "unanswered" condition silent periods are introduced to permit the transmission of signalling tones from the calling end for releasing the circuits. These enforced silent periods of one second in every five seconds occur at random in relation to the announcement and tend to make the messages unintelligible to the distant callers. Research is now being directed to overcoming this problem of random interruption but meanwhile the interrupted messages still provide a useful service so long as the calls affected are set up by operators who can be advised of the shortcomings of these circuits.

Immediately after many telephone numbers have been changed numerous calls are wrongly dialled and it is therefore necessary to run the Announcer continuously. After a week or two, however, this traffic subsides, and to minimize wear of the tape (which usually lasts from four to seven days with continuous running) and the tape driving mechanism a "start-stop" facility is being fitted which can be brought into service when the traffic has subsided sufficiently. This will permit the electronic part of the Announcer to be ready to deal with a call but the tape driving motor will be at rest until a call is connected; the motor will then start automatically and stop if no further call arrives soon after the caller restores his receiver.

Because the Changed Number Announcer is usually a novelty where it is used, it provides a topical means of attracting desirable publicity to the number changes. Very often the interest of the local newspapers can be gained by holding a competition to select the most suitable voice to make the recording. The main attraction to newspaper editors is usually the local personalities taking part in the competition, but once their interest is gained they usually accord prominent publicity to other aspects of the change-over.

As the subscribers become accustomed to the announcement the traffic subsides and usually after a few weeks the equipment can be taken out of service, at first during the less busy periods and then completely. It is often found that calls continue to be made fairly frequently to the old numbers because callers come to rely on the announcement as a substitute number unobtainable tone. For this reason the equipment is designed so that it can be easily switched in or out of service, and in the out of service condition callers dialling the old numbers will be connected either to the number unobtainable tone or to manual changed number interception circuits at the discretion of the local administration. The change-over from the recorded announcement to number unobtainable tone can be arranged to suit local conditions and the subscribers' reaction when the Announcer is withdrawn from service can be noted. This enables local staff to decide what else they need do to reduce the number of wrongly dialled calls to the old numbers, which cause both inconvenience to the subscribers and abortive work to the Post Office.

What it Costs

To give a very rough indication of the cost of using changed number announcers, the capital cost of the equipment is about £150, and the installation and maintenance cost about £30; there is also the staff cost for making the recordings which can vary from a negligible to a fairly appreciable sum, according to the amount of work which has to be done to select the most suitable voice. The total cost of using the equipment at its first assignment is usually about £200.

As each machine is, on the average, used for two assignments each year and should remain serviceable for many years, it is evident that the overall cost of providing the service is very small indeed—about £60 or £70 for each assignment. The cost of dealing with the wrongly dialled traffic by manual interception, when 6,000 subscribers' numbers were changed in Edinburgh in 1950, would have amounted to approximately £1,000 and for the 4,000 subscribers whose numbers were changed in Newport (Monmouthshire) in 1953 it would have been about £500.

Naturally, the cost of dealing with wrongly dialled traffic manually will depend on the telephone characteristics of the area, but the cost of a changed number announcer is more than covered by the saving of operational costs on its first assignment; additionally, callers get an immediate reply on each of their mis-routed calls instead of having to wait for an operator to advise them. For these reasons Post Office Headquarters now hold 11 units which are distributed wherever required; six months' notice is necessary to arrange for the requisite auxiliary relay sets and amplifiers to be obtained for use with a tape recorder.

While the Changed Number Announcer was being developed another problem was arising as a result of the trunk system being made automatic. The first fully automatic trunk switching centre at Faraday Building, London, was planned to give many operators throughout the country the facility of setting up calls through the London trunk exchange without the help of an operator there. By dialling appropriate digits they could thus obtain connexion direct to subscribers and operators at terminal exchanges in other parts of the country. We realized that some arrangements must be made to notify the controlling operator if congestion occurred on any of the distant circuits over which a particular call would be connected, so that she would know that an alternative routing must be used. For this purpose a congestion and delay announcer was developed and first brought into service in February, 1954, when the London (Faraday) Trunk Automatic Exchange was opened.

This equipment enables one of the following messages to be connected to the trunk outlet to indicate automatically the amount of delay being experienced on congested routes:

"*No lines at London*"
"*Delay ½ hour, London*"
"*Delay 1 hour, London*"
"*Delay 2 hours, London*"
"*Delay 3 hours, London*"
"*Test Call*"

The last announcement is used for automatically routine testing the circuits going out from selector levels to manual exchanges. As more of the trunk system becomes automatic these Announcers will be installed at other Trunk Switching Centres.

The congestion and delay announcing equipment need not be transportable and the messages do not have to be changed periodically. The more convenient arrangements of the tape recorder for recording and altering the messages are more than offset by the greater mechanical reliability of the photo-electrical reproduction system similar to that used on TIM and this system has been adopted. Similar advantages might, however, have been obtained more conveniently if magnetic disc or drum recorders had been available when the congestion and delay Announcer was being designed. A more detailed technical description of both the Changed Number Announcers and the Congestion and Delay Announcers appeared in two separate articles in the *Post Office Electrical Engineers' Journal* for October, 1954.

As recorded in the Spring *Journal* the Post Office introduced the Weather Service in the London area in March of this year. This enables subscribers to obtain a weather forecast for the London area by calling WEAther 2211. The announcement is connected to telephone circuits through a new type of final selector with a special relay set that does not return "busy" conditions to callers in the same way as normal final selectors do; this enables more than one call to be connected simultaneously to the recorded forecast. This new type of final selector is also fitted with meters to record the number of calls made to the announcement.

Over 200,000 calls were made to the service within a week of its inception and by June, nine weeks later, between 60,000 and 80,000 calls were being made each week.† The *Post Office Electrical Engineers' Journal* for April this year contained a detailed technical description of the new type of final selector in an article entitled "The Weather Service".

Other Possible Uses

The ease with which magnetic tapes and disc recordings can be made and transmitted to telephone subscribers suggests that they might be used for other purposes. Such possibilities as theatre programmes, recipes for the housewife, news records, sports results, advertisements, bed-time stories for the children and a Santa Claus service at Christmas time, as given by Hull Corporation and some foreign administrations, spring readily to mind as extensions to TIM and the WEAther service; indeed one such extension was made this summer—the cricket score service which was first made available for the Lords Test Match in June this year. At first this service was available by calling WEBber 8811 and calls to this number were routed the same way as calls to the weather service. Unfortunately, the immediate popularity of the cricket score service congested the telephone lines, also used to provide the weather service, and another telephone number (INFormation 2211) had to be allocated. The cricket score service was later extended to many provincial subscribers, who were connected by special automatic equipment over trunk lines to the recorded announcement in London.

There is one important limitation on such services, however, apart from the question of whether they would be profitable; special dialling codes must be used as if ordinary final selector numbers were used coin box callers could get the service free because they would not have to press button "A". This last factor also prevents the use in this country of automatic answering machines which could be used to give a caller a short message which could be readily changed. Developments in these directions must therefore be somewhat limited until a new design of coin box is available.

The Post Office would undoubtedly give a valuable service if it could transmit a recorded message to advise people making calls to subscribers whose lines are out of order approximately how soon the fault may be cleared; such a service would be particularly useful when many subscribers' lines are affected by cable faults or storm damage.

Another field of service is as an aid for training the different grades of staff employed in the Post Office, particularly telephonists. A telephonists' approach to subscribers should always be pleasant, and magnetic tape recorders can be used in two fundamentally different ways in their training. First, by recording and reproducing a particular voice, the enunciation, phrasing and the general intonation can be shown to each girl, so helping her to recognize and eradicate undesirable characteristics. Secondly, a sequence of operations carried out by the girl herself can be recorded and on reproduction any defects in operating procedure can be recognized. It is, however, necessary to consider the cost of the recording equipment, and its use in the training field is at present exploratory.

About twenty years ago the Post Office was proudly giving publicity to "the Girl with the Golden Voice" who had made the recordings for the speaking clock; in the next few years, after wider experience has been gained with magnetic recorders for training telephonists, we may be justifiably proclaiming that we do not employ any telephonist who has not a golden voice.

† *By October 31 a total of more than 2½ million calls had been reached for the seven months since the service began on March 5.*

Telephone Managers' Anniversary.—The Post Office appointed the first Telephone Managers 21 years ago on December 15. They succeeded the District Managers who had controlled the telephone service since the Post Office took over in 1911. The Telephone Managers held a celebration dinner on October 16 at which the Postmaster General was the principal guest. The Director General, the three Deputy Directors General, the Engineer-in-Chief and Sir Ben Barnett were also present. About 90 past and present Telephone Managers—there are 57 throughout the Kingdom —were present.

President: Brig. L. H. Harris, C.B.E., T.D., M.Sc., F.C.G.I., M.I.E.E.

The Institution of Post Office Electrical Engineers 1906 - 1956

Chairman: D. A. Barron, M.Sc. (Eng.), M.I.E.E.

THE INSTITUTION OF POST OFFICE ELECTRICAL Engineers which is celebrating its fiftieth anniversary during the current 1956-57 session was founded in 1906. The first formally-constituted Council meeting was held on June 6, 1906, when the first President of the Institution, Sir John Gavey, C.B., Engineer-in-Chief to the Post Office, took the Chair. The first local centre meeting (of the Metropolitan Centre) was held on October 8, 1906. At these local centre meetings papers are presented, mainly by members of the Institution on scientific, technical and allied matters associated with the activities of the Post Office Engineering Department, and 40 such meetings were held during the inaugural session. In recent sessions the number of meetings held at the 15 main centres and six sub-centres now throughout the country has averaged about 120.

Membership of the Institution is principally for the major engineering and scientific staff of the Post Office Engineering, Factories and Contracts departments, and its objects are "to promote the general advance of electrical and telecommunications science and their application and to facilitate the exchange of information and ideas on these and allied subjects amongst the members of the Institution". To achieve this, not only are meetings held thereby providing a forum for the interchange of ideas and experience, but the more important papers are selected for printing. Over 200 of these printed papers have been issued to the membership—and to subscribers from industry and oversea administrations—in the last fifty years. A central lending library is also available of some 2,500 volumes on scientific, technological and administrative subjects. A wide range of technical periodicals are also circulated to the membership.

The Post Office Electrical Engineers' Journal was established by the Institution in April, 1908, as a quarterly technical magazine mainly for the engineering staff of the Post Office, but with, it was hoped, an appeal to a wider circle of readers. In the event this hope has been more than realized, for the circulation of the Journal is world-wide and more than 15,500 copies of each quarterly issue are printed and distributed.

The membership is now over 6,000 compared with 2,500 in 1931 and 750 in 1906.

The Institution celebrated its fiftieth anniversary by a commemorative meeting in London on October 8, 1956, at which the President, Brigadier L. H. Harris, gave an address on "Fifty years of Telecommunications". A comprehensive historical exhibition of telecommunications equipment was shown. On the following evening a Jubilee dinner-dance was held for a reunion of past and present members of the Institution and also to mark the happy relationship between the Institution and all those associated with telecommunications in this country. The Postmaster General, Dr. Charles Hill, was the Guest of Honour and representatives of professional and public bodies, industry and the Post Office directorate were present. At the various provincial centres of the Institution similar Jubilee celebrations were held.

The October issue of the Institution's Journal is a special Jubilee number reviewing the development and growth of the British Post Office telecommunications services and the mechanization of postal services. The articles cover the history of development in each of the main branches of telecommunications engineering with particular reference to technical advances in recent years.

Cable rolling mill and drawing machine

Cable Materials and Manufacture

L. G. Dunford, M.I.E.E.

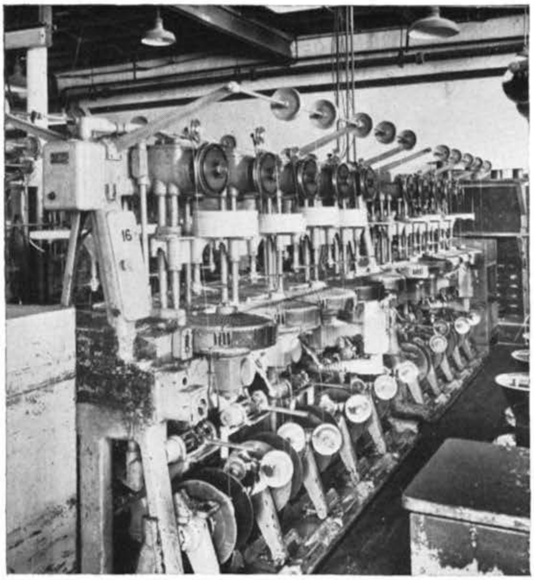
A CABLE CONSISTS ESSENTIALLY OF THREE components: a conductor, an insulant, and a sheath or protection. Cable making in general involves four basic processes: drawing the wire for the conductor, applying the insulant to the conductor, stranding together the insulated conductors and protecting the whole with a sheath.

Conductor

The conductor is normally a copper wire (or a strand of wires). Copper is used because it is an excellent conductor of electricity—second only to silver which, of course, is too expensive. Copper's only economic competitor is aluminium, which may be used if weight is an important consideration or if the copper-aluminium price ratio becomes large as it has tended to do recently.

The conductors in most Post Office telecommunication cables are small-gauge single wires as they carry only small currents. Power cable conductors usually consist of a number of wires stranded together, to give flexibility with heavy current-carrying capacity.

Copper for cables, which is electrically refined and 99.9 per cent. pure, is imported in 54 inch bars, four inches square, each weighing about 250 lb. The bars are converted into wire by being passed through rolls and drawing machines. A rolling mill is a spectacular part of the factory. Furnace ovens heat the bars to about 1600°F, between red and white heat. The bars are then disgorged and passed through a succession of rolls until the 54 inch bar is 1,450 feet long and a quarter of an inch in diameter. The speed of movement of the copper increases as the diameter diminishes, and some of the "passes" are still manually operated. It is fascinating to watch the operator seize the snake-like end of red hot metal as it emerges rapidly from one pair of rolls, and guide it into an adjacent pair. The whole



Lapping machine

operation of converting the bar to quarter-inch rod takes about one minute from the time the bar leaves the furnace.

The quarter-inch rod, after being annealed and cleaned in dilute sulphuric acid ("pickling") is drawn down to conductor size in drawing machines, each containing a number of tungsten carbide and diamond dies which successively reduce the diameter, so that finally the 54 inch 250-lb. bar becomes 25 miles of wire weighing 10 lb. a mile.

The insulating material, as well as having good electrical qualities, must be capable of being applied to the wire by one of the four standard methods: longitudinal application, lapping, extrusion, enamelling.

Longitudinal Application

The first method (longitudinal) is practically restricted to rubber; it consists in folding two rubber tapes round the wire by polished steel rollers which pressure-seam the edges. The rubber is then vulcanised. This method is simple and economical, in that up to 36 wires can be insulated together in one machine.

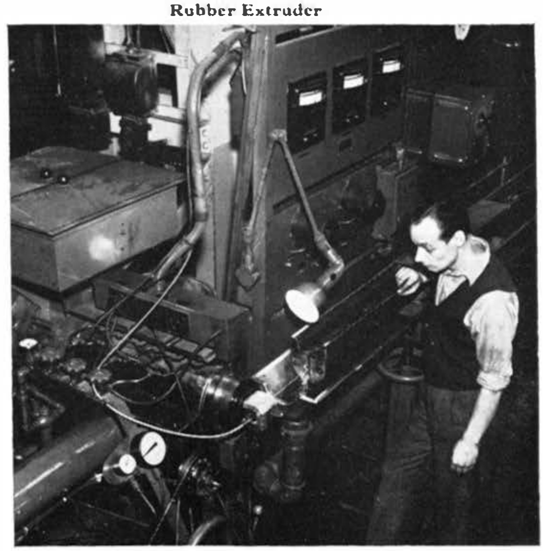
Lapping is the application to the conductor of threads or tapes in a close spiral, the lapping head revolving round the conductor as it moves through the machine. Post Office cables are insulated by lapping with paper tapes, applied loosely to enclose as much air as possible. The inclusion of air reduces the capacitance and thus helps the cable to carry speech over longer distances. Power cables, on the other hand, are lapped tightly with paper and thoroughly impregnated with an insulating compound under vacuum. It is very important with these to get rid of all air inclusions, as they tend to cause premature breakdown under electrical stress.

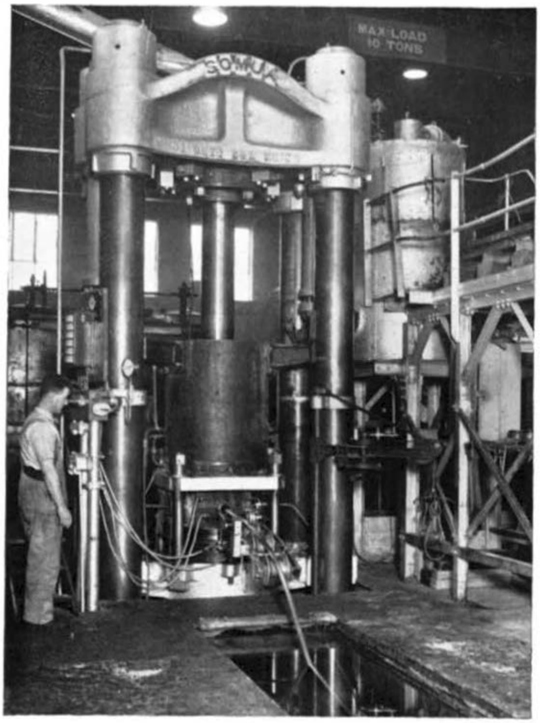
By the extrusion method the insulant, in a plastic state, is forced round the wire as it passes through a die. The die is in the head of the machine; at right angles to the head is the barrel. The insulant is fed into the barrel and forced up to the head and to the die by a screw or worm. Obviously the material must be thermoplastic; that is, softened by heat but otherwise unaffected, and the method is very largely used with modern plastics such as polythene, polyvinylchloride (PVC) and nylon.

Rubber also is extruded, but requires vulcanising after extrusion, and modern practice is to use a "continuous vulcaniser". This is an extrusion machine with a long tube (100 feet or more) at the outlet, which is steam heated. The rubber mix contains the sulphur required for vulcanisation, and the steam-heated tube provides the heat, so that the vulcanisation is done continuously during the haul-off of the cable from the extruder.

Extrusion is simple in principle, but careful attention to design and operation are necessary to avoid pinholes, eccentricity, irregular diameter, and internal stress in the insulating material.

Rubber Extruder





Lead extruder

Enamelling consists in passing the conductor through a bath of the material which adheres to the wire and is smoothed off by a wiper as it leaves the bath. Several passes are necessary, depending on the wire size and the required thickness of enamel. Between each pass the wire is taken through a heated tube to dry the previous coat. Enamel was formerly used, in conjunction with lapped silk and cotton, to insulate switchboard wires and cables, but this composite dielectric is now being replaced by extruded PVC.

Stranding and laying-up

A cable may consist of only a single conductor—it is still a cable if it has a sheath or other mechanical protection round the insulated core. Power cables do not normally have more than three conductors (with perhaps a fourth for earth continuity) required for three-phase working, since what is supplied to each consumer, that is, electric current alternating at 50 cycles a second, can be tapped off the same main; and more consumers simply means heavier conductors to carry the current. For telephone purposes, however, each consumer (or subscriber) requires a separate pair of wires to connect him with the equipment at the exchange which is individual to his line. More subscribers therefore mean more pairs in the cable. Subscribers' cables are made containing as many as 1,800 pairs and the conductors may be of wire weighing only 4 lbs. to the mile. Audio type trunk and junction cables are made with up to 542 pairs of 20lb. conductors, and tie cables, which are used, for example, to connect a repeater station with an exchange, may have up to 1,040 pairs of 10lb. conductors.

The process of combining a number of conductors together in the cable core is called stranding or laying-up. With power cables this simply amounts to twisting the two or three cores together, with the addition of jute "wormings" in the interstices to form a reasonably circular core over which the sheath is extruded. With telephone cables the process is more complicated, and is preceded by either twinning or quadding. Twinning is twisting together two wires to form a pair; in quadding, four wires are twisted round a centre string, the diagonally opposite wires forming a pair. The great advantage of quadding is economy in space. The twins or quads are then applied helically in layers, the direction of lay usually alternating with successive layers. The actual lengths of lay chosen for twinning, quadding and stranding are important in that they have a big influence on the electrical interference (crosstalk) between pairs. The laid-up core is lapped with paper or cotton tape to prevent damage and to preserve the formation until the sheath is applied.

Sheathing

The commonest sheathing material is lead, although among metals aluminium is challenging it. Plastic-insulated cables are normally plastic sheathed.

Lead is extruded in what is called a press, similar in principle to the extrusion machine referred to above, but requiring much greater pressure, which is supplied by a hydraulic ram instead of a screw. Molten lead is poured into a container, and allowed to cool just below its melting point. The ram then descends (or the ram may be fixed and the container raised) and forces the now plastic lead out through a die as a tube over the cable core. When the container is empty the ram is withdrawn, the container recharged, and the process repeated. A later type of press uses a screw instead of hydraulic pressure. Here

Stranding or laying-up—combining a number of conductors together

the lead is fed in continuously and the halt in the proceedings necessary with the old type of press for recharging is eliminated. There is, however, no sign yet of the ram type of press being superseded by this continuous extrusion press.

Power cables are in general laid direct in the ground; hence the lead sheath itself needs protection from laying hazards, rock, chemicals in the soil, electrolytic corrosion and other dangers. This protection is provided by steel wires or tapes, wound over the lead on a bed of jute or hessian, impregnated with preservative compound. Telephone cables are normally laid in ducts, so that armour is unnecessary, but compounded hessian is frequently applied to prevent corrosion. Submarine cables and some trunk cables for laying directly in the ground are armoured with layers of steel wires.

Cable Development

Cables, and the processes of cable making, have been developed in accordance with the technical advances of recent years, and progress may be considered under the broad heads of materials, methods and types of cable.

The most notable new materials are the plastic insulants, polythene, polyvinylchloride (PVC), nylon, synthetic rubbers, polytetrafluorethylene (PTFE). The first two in particular are now widely used, polythene for its outstanding electrical qualities, and PVC for adequate electrical merit for many purposes combined with mechanical toughness and excellent ageing properties. Polythene has now entirely replaced gutta-percha and its derivatives as the insulant for submarine cables, with greatly improved electrical performance and considerable savings in cost. The use of nylon is extending as a sheath or braid because of its remarkable resistance to abrasion. PTFE combines electrical qualities equal to those of polythene, and can withstand temperatures up to 250° C. or so, as against polythene's 60° C; but both nylon and PTFE are expensive.

Impregnated paper still holds the field as the insulant for high voltage and super-tension power cables; the impregnating oils have been improved, allowing higher voltages with lower losses. The high hopes once entertained for polythene in power cables have not been realized so far, largely because of the difficulty of entirely eliminating air, and of troubles associated with the high thermal expansion of the material.

New types of synthetic enamel coverings for wires have been developed, but these in general give mechanical, not electrical, improvement and are used for coil, motor and instrument windings.

Aluminium is being increasingly used instead of lead as a sheathing material.

New Methods

By far the greatest development effort in ordinary cable making methods has been devoted to perfecting the technique of extrusion. Temperatures, and speeds of conductor and screw, are very closely controlled to give optimum conditions, and methods of controlling the diameter of the insulated conductor automatically are making rapid progress. Basically, this is done by passing the extruded core between electrodes which respond to diameter changes (or to capacitance changes which are essentially the same thing) and produce unbalance in an electrical circuit. The unbalance current is then used to control the screw speed (or the haul-off speed) in a manner which corrects the original change. Thus the core of the transatlantic telephone cable, with a normal diameter of 0.620 inch, was held to approximately ± 0.003 inch of that figure throughout its length.

Post Office coaxial cable for land use consists of a centre conductor which is threaded with polythene discs at intervals of about 1.3 inch; over these is folded the outer conductor of copper tape. Several ingenious machines have been developed to produce this type in continuous lengths.

The use of aluminium instead of lead as the cable sheath has followed developments in methods of applying it. Direct extrusion is being energetically attempted, but the dominant process at present is the swaging down of an over-size tube on to the cable core. Another method consists in folding aluminium strip over the core and welding the seam.

Super tension power cables are made to work at still higher voltages (and thus greater efficiencies) by improvements in the methods of excluding voids. The methods used are oil filling, gas filling and gas pressure. A recent Swedish oil filled cable operates at 380 kV. A.C. and cables have thus caught up with overhead transmission lines.

New Types of Cable

The development of new materials and methods obviously enables cable requirements to be met in different ways, and it is often difficult to decide between a number of alternatives. But while it is useful to experiment with different types, standardization is important in achieving economy and efficiency. Thus, with many considerations to balance, new types make their way slowly. In the Post Office, polythene insulated and sheathed cable is partially replacing paper core lead sheathed cable for subscribers lines, and PVC insulation is gradually superseding textile for switchboard and other internal cables. Trials are being made with aluminium sheathing, and also with polythene sheathing over paper core. For power and lighting, the old rubber insulated cables of BS7 are being challenged by PVC and polythene.

For submarine telephone cables the solid polythene coaxial type is now the standard for all but quite short distances (for which paper core cables are used), with 0.62 inch diameter over the polythene as the favoured size. Further experiments are being made with an unarmoured submarine cable, the necessary strength for laying and picking up being obtained by incorporating steel with copper in the centre conductor. This project, if successful, will reduce the cost of both manufacture and maintenance, and taken together with submarine repeaters, should open up new possibilities for submarine telephone links.

P.O.T. & T. Society Programme, 1956-57.—The Post Office Telephone and Telegraph Society of London opened its autumn programme on October 10 with an address on "The WEAther Service" by Mr. P. S. Russell, Post Office Engineering Department, and Mr. W. R. Hanson, Meteorological Office.

On November 7 Mr. P. J. Mapplebeck, Post Office Contracts Department, spoke on "The Contractual Relationship between the G.P.O. and Industry". Mr. L. F. Scantlebury, Post Office Engineering Department, will talk on "Developments in Engineering Construction" on December 10. Miss H. M. Trenerry, Long Distance Area, London Telecommunications Region, will speak on "A Supervisor's Log Book" on January 9 and on February 11 Col. F. A. Hough will talk on "The Transatlantic Cable". The programme closes on March 13 with an address by Captain C. F. Booth, Assistant Engineer-in-Chief of the Post Office, on "Colour Television".

In addition, the Society hopes that arrangements will be made for visits to Lime Grove and other places of interest to members. Mr. G. R. Clayton of the London Telecommunications Region, Telephone Branch, Waterloo Bridge House, Waterloo Road, London, is the Honorary Secretary.

Some Problems of Shared Service

W. L. Hall

THE TERM "SHARED SERVICE" IS APPLIED TO the arrangement under which two subscribers, each with a separate telephone and his own number, share the same line to the telephone exchange. In manual exchanges and a few automatic exchanges part of the exchange equipment is also shared. Shared service in its present form has been developed because of the serious shortage of lines in the local underground cables which developed during the second world war and which still persists. During the war, plans to expand the telephone system to meet normal development had to be suspended, and when the war was over there were heavy arrears. In the post-war period the demand for telephones far exceeded expectations and the difficulty of satisfying it was aggravated by restrictions on capital expenditure which the Post Office then had to endure.

New Plant Limited

The amount of new plant which the Post Office, like other public bodies and business concerns, could buy and bring into use was limited. The state of the country's finances would not allow the large scale spending needed if everyone who asked for a telephone were to have it without delay. In particular, new cables, in both towns and country districts, could not be put in as quickly as they were needed and spare wires in existing cables soon became scarce or non-existent. As business and industrial areas were to be given priority for the provision of new plant it was clear that it would be a very long time before there would be enough cables for every residential telephone connected to a public exchange to have its own pair of wires.

Shared service is by no means new. When the Post Office took over the National Telephone Company on January 1, 1912, a subscriber in the provinces had a choice of an exclusive line, sharing a line with one other person or sharing with three other people. In rural areas there were Rural Party Lines on which even more subscribers were connected to the exchange by means of one main pair of wires, and the different subscribers had to be called by different numbers of rings. These arrangements were, of course, intended for use in areas served by manual switchboards and their appeal lay in their cheapness to the subscriber compared with the cost of exclusive lines. In those early days any ordinary subscriber who was not within a two miles radius of the exchange had to pay an additional rental for each quarter of a mile beyond two miles.

As the standard rental for an exclusive line was reduced and the radius from the exchange increased to three miles before extra mileage rentals were charged, the "party-line" service lost its popularity. The Post Office welcomed this because manual exchanges were being converted in ever increasing numbers to automatic working and the party line system of that day was meant for manual exchanges only. Party lines were therefore officially discouraged so that by the year 1941 only 108 subscribers were sharing lines other than those on Rural Party Lines.

By this time the country was at war and only a minimum of work could be allowed for connecting new telephones which were not directly concerned with the war effort. The Post Office continued to put in essential telephones, but the provision of service for many people who badly needed telephones could not be regarded as essential in the national interest. Such a small amount of construction work could be allowed for these people that even if spare wires were available in the cables many of them stood little chance of having a telephone installed by normal means, and the only hope lay in connecting them with an existing telephone line serving a neighbour.

The usual procedure was to give an applicant who could prove his need for a telephone a list of existing near by subscribers with whom he could share and to ask him to approach them to see whether one of them would agree to share his line. In manual exchange areas there was no difficulty in continuing the old party line method, but there were now very many automatic exchanges and special measures had to be adopted to permit party line working in areas which they served. Party lines connected to manual exchanges were given the name "Two-Party Line" and those on automatic exchanges were called "Joint User" lines. By the end of the war some 3,000 subscribers were sharing lines.

When the war ended the Services released a large number of lines, but these were quickly swallowed up in giving telephones to those who were waiting for them. Cables could not be laid quickly enough to cope with the growing demand for telephones. The Post Office decided in 1946 that sharing lines would have to continue for some time and efforts were made to make "Shared Service" (the name by then given to both manual Two-Party Lines and automatic Joint User Lines) more attractive.

Separate Accounts

A big objection to shared service in automatic exchange areas was that one of the parties had to be responsible for paying for local calls which were dialled directly. This difficulty arose because the subscribers shared not only the same line to the exchange, but also the same calling equipment at the exchange. This meant that only one meter was connected to a shared line and all dialled calls were recorded on this meter, whichever party dialled them. It was left to the subscribers to keep a record and settle between themselves for the payment of the charges for dialled calls, but one of them was required to accept liability. Equipment was eventually developed, first for the standard types of automatic exchanges and later for nearly all types, which gave each subscriber on a shared line his own calling equipment and meter and so allowed the presentation of separate accounts for dialled calls. Calls made with the assistance of an operator could always be recorded, of course, against the appropriate calling subscriber, so it is now possible, with a few exceptions, to make completely separate accounts for shared service subscribers. From July 1, 1946, shared service subscribers were allowed a rebate of rental of 10s. a year, plus the 15 per cent. war surcharge; this was increased to 30s. on July 1, 1952.

Until 1948 shared service was optional, but the Post Office realized not only that it was necessary to retain this service, but also that it would have to be even more widely used. Thus it was that in December, 1947, the then Postmaster General announced in the House of Commons that all new and removing residential subscribers would in future be required to accept liability to share their lines when called on to do so. This policy has been very rigidly followed since then, because the success of the sharing scheme depends so much on the impartiality with which it is applied. Exemptions from sharing are very rare; they are virtually restricted to telephones in the homes of Judges of the High Court and Members of Parliament. The effect of this policy has been to increase the number of shared lines from the modest 100 in 1941, to over a million at the present time. Of this number some 150,000 business subscribers have agreed to accept shared service in areas where line plant is short. Possibly not far short of half these subscribers would still be waiting for telephones were it not for shared service, so that there is no doubt of the value of the service to the Post Office and to the community. Although shared service has grown so much in recent years, the number of exclusive line residence subscribers is now higher than when sharing service was made compulsory for them in 1948.

	Total residence lines	*Shared lines*
1941	945,000	108
1945	1,096,000	3,169
1949	1,533,803	92,675
1950	1,588,120	156,346
1951	1,671,009	247,635
1952	1,778,368	361,636
1953	1,879,803	474,232
1954	2,011,248	610,961
1955	2,197,733	773,376
1956	2,402,766	935,360

Growth of residence and shared lines

Modern shared service is not the rather crude arrangement inherited in 1912, or even that used during the war and immediately afterwards. Apart from the disadvantage of common metering, which is now used only where there is shortage of equipment, there were other disadvantages in the earlier forms of shared service which have been put right by modifications of various kinds.

First, there was the annoyance of tinkling on one party's telephone bell when the other subscriber was making or receiving a call. From the Post Office viewpoint this was most unwelcome, because one of the advantages claimed for the present form of shared service is that a sharing subscriber will not be aware of inward or outward calls on the other telephone unless he happens to try to use his telephone at the same time as his partner. This difficulty was overcome by adding special apparatus to the bell sets.

Secondly, there was the danger in automatic exchange areas that if both parties happened to lift their receivers at precisely the same moment the equipment in the exchange would "lock up" and both telephones would then become unusable until the equipment was released by hand. This disability resulted from the circuit modifications carried out to give each party a separate meter and had to be overcome by a further circuit change. A shared service telephone connected to an automatic exchange now has a button marked "Call Exchange" which has to be pressed before the receiver is lifted off the rest to make a call. In this way the danger of locking up the equipment is avoided.

Thirdly, in manual exchange areas, if the called party lifted his receiver while the bell was still ringing his partner's bell would also ring. This difficulty did not arise on automatic telephones because the ringing current is automatically cut off when the call is answered; it was found possible to arrange that many manual exchanges could also have this automatic ringing cut off.

Optional Sharing

These improvements have undoubtedly helped to make modern shared telephone service very efficient. It is safe to say that the majority of people who today use shared telephones are satisfied with the service they get, for complaints are few. Sometimes people are doubtful about sharing a telephone line when they are about to be given one, but after they have experienced shared service, they find their fears are groundless. How groundless those fears can be is illustrated by the story of the subscriber who, when he was officially approached to share, strongly objected until he was told that because of an error he had, in fact, already been sharing for six months !

There is, however, one serious objection to shared service at present; the liability to share is compulsory for all new and removing residential subscribers. No one likes compulsion in any form and Ministers have stated several times that the Post Office intends to abolish compulsory sharing as soon as circumstances permit. Subscribers will then be allowed a choice of exclusive or shared service. When adequate cables are available, it will be possible to allow subscribers to exercise this choice freely. It must be remembered, however, that not only have new subscribers to be considered, but also the million or so existing shared service subscribers who would also have the choice.

Until recently, it was the policy to share lines as soon as possible, even if spare cable wires existed, the spares being left for future subscribers. As a first step towards optional sharing residential subscribers, although still being asked to accept the liability to share, are not normally required to share at the outset where there are adequate spare wires in the cables. When the choice of sharing or of having an exclusive line can be offered to everyone, the major objection to the service will have been removed. The extent to which shared service continues to be used will depend on the appeal it makes to the public; this, in turn, will no doubt be influenced by the tariffs in force at the time. After all, shared service is cheaper than an exclusive line.

Although a million and a half pairs of wires have been added to the local underground cable network since the war ended, 185,000 people are still awaiting telephones (because there are no spare wires in the underground cable serving their locality) and about a million subscribers are now sharing lines. About two-fifths of our residential subscribers are sharing—in the United States of America the proportion is about two-thirds—and approximately 50 per cent. of new residential lines are connected on a sharing basis at the outset. This percentage is showing a tendency to decrease as more cables are added to the network, but it is bound to be some time before applicants for service, or existing shared service subscribers, can be given free choice between an exclusive or a shared line. In fact, we must now regard shared service as a quasi-permanent feature of the telephone service in this country.

Telephone Answerer.—The item under this heading in our Summer issue in "Notes and News" was unfortunately liable to give the impression that the device described could be used on Post Office telephones. We are asked to explain that under the Telephone Regulations the Postmaster General's consent is necessary for any attachment to subscribers' telephones, that the device referred to in this item had not, in fact, been submitted for approval, and that, moreover, some of the principles apparently employed have been previously found unacceptable.

The London Television Network Switching Centre

W. L. Newman

IT IS NOT GENERALLY REALIZED, EVEN BY POST Office people, that the television programmes of both the British Broadcasting Corporation and the Independent Television Authority are carried between the various studios and transmitting stations throughout the country over Post Office circuits.

The London Television Network Switching Centre in the Museum Telephone Exchange building was opened in December, 1949, after the decision to extend the Television Service of the B.B.C. to the provinces. The function of the Network Switching Centre (N.S.C.) is to operate and control the cable and radio links which are used for collecting and distributing the television programmes. Circuits are provided to interconnect the studios, programme switching centres and transmitting stations of the B.B.C., I.T.A. and the companies which supply the programmes for I.T.A. service. The programme switching centres are used to pre-view and distribute the programme material between the various studios and transmitting stations.

The links are divided into two groups, main lines and short ties. The main line systems usually comprise two channels, one channel being used for each direction of transmission, the outgoing being known as the distribution circuit, and the incoming as the contribution circuit. Some of the main line systems feed direct to the provincial transmitting stations, others are routed through subsidiary N.S.C's at Birmingham and Manchester. These systems have intermediate amplifying stations at varying distances between the terminal points. The short ties are usually operated without intermediate amplifiers, to and from stations in the London area.

The programmes from the B.B.C. studios at Lime Grove and Alexandra Palace are fed into the Centre and from there into the Programme Switching Centre at Broadcasting House, where they are connected to the outgoing links feeding the transmitting stations. More than 20 vision circuits are provided between the N.S.C. and Broadcasting House.

The studios for the I.T.A. service are situated in various parts of London, and programmes may come from one or more of ten points into the

Centre. The Programme Switching Centre for Associated Rediffusion and Independent Television News is at Television House, and twelve vision circuits are provided to feed these companies. The Programme Switching Centre of Associated Television is at Britalian House, and eight vision circuits are provided to carry their programmes.

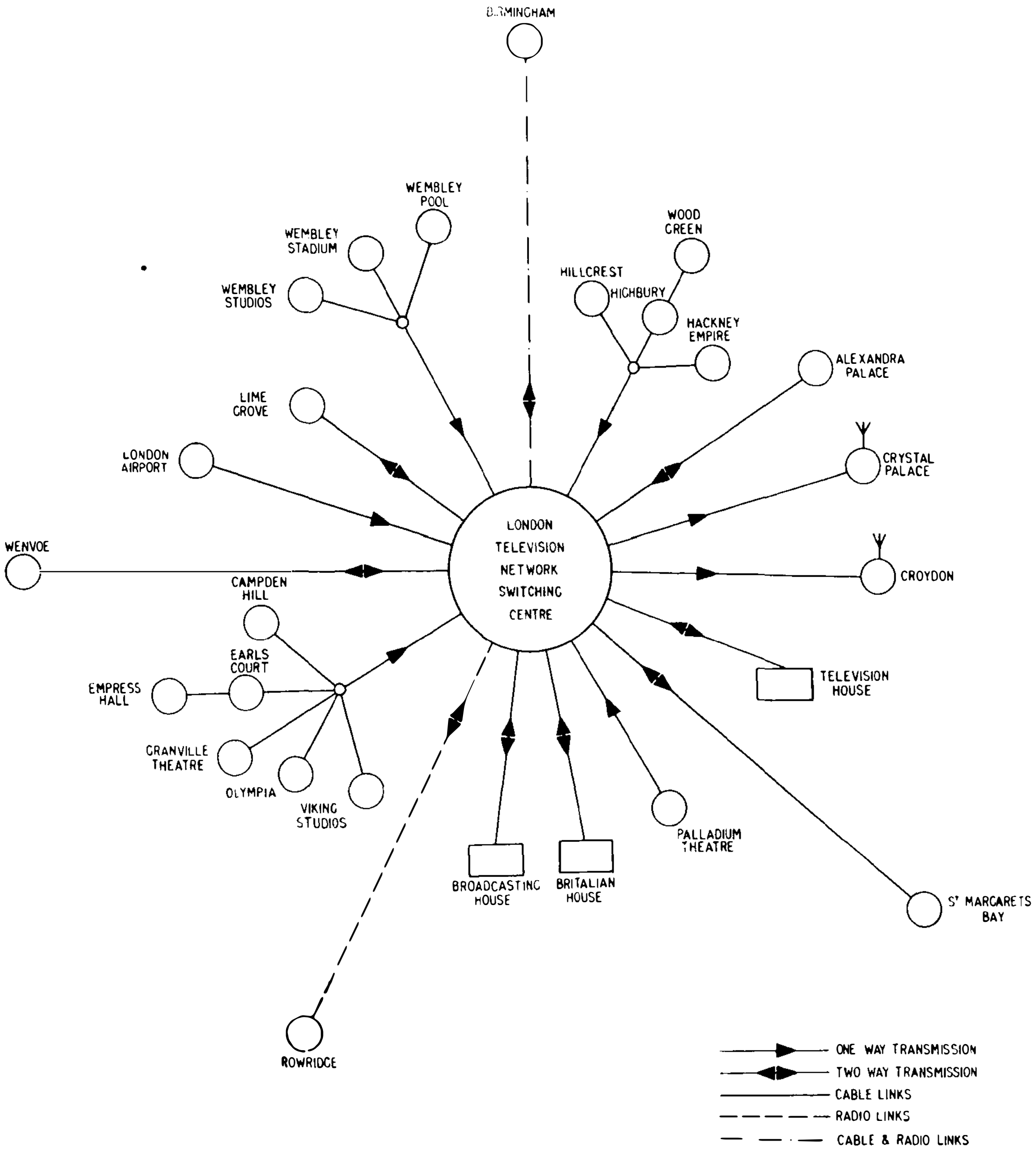
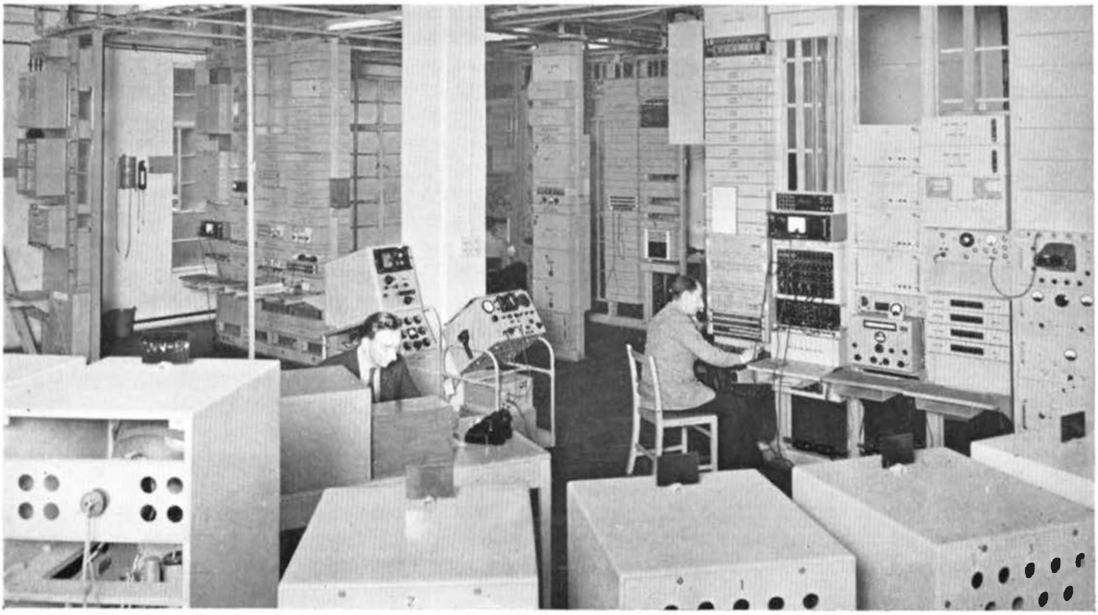


Diagram showing main connexions



General view of London Television control

The outgoing main line links form the distribution network feeding the provincial transmitters, while the incoming contribution portion carries outside broadcast (O.B.)† signals to the B.B.C. and the programme companies. These links can also be used to inter-connect the studios of the companies operating in their respective London and Provincial areas.

Two main types of cable, balanced pair and coaxial, are used for television transmission. Balanced pair cables are formed from a pair of wires critically spaced with respect to each other, enclosed in a copper screen, but insulated from it. Coaxial cable consists of a metal tube, usually ⅜ or one inch in diameter, with a wire insulated from the tube placed concentrically down its length. Balanced pair cables are used between the N.S.C. and Television House and in some instances two coaxial tubes are combined to form a balanced pair. This system is used on the circuit from London Airport.

The signals from the television cameras are in a frequency range (0-3.0 Mc/s) known as the video band, and these signals can be transmitted over balanced pair cables up to a distance of five or six miles.

Video signals are sometimes transmitted over single coaxial tubes, but this type of transmission is limited to short distances, because of interference from unwanted signals. For longer distance cable transmission the video signals cannot be used, and they are therefore stepped up to a higher frequency band, by a process known as frequency translation. The signals to and from Wenvoe in South Wales, Lime Grove and St. Margaret's Bay near Dover, are translated to the frequency range 0.5-4.0 Mc/s for transmission over the cable, with intermediate amplifying stations provided at intervals of six miles. The signals for Sutton Coldfield and Alexandra Palace are translated to the 3.0-7.0 Mc/s range, the intermediate amplifying stations on these systems being at spacing of 12 miles.

Radio links are used for some main line circuits; two are provided between London and Birmingham, using carrier frequencies of 900 and 2,000 Mc/s, and, in addition, a 900 Mc/s link provides a Birmingham-London circuit. The intermediate amplifying stations on these systems are spaced at intervals varying from six to 40 miles. Links working at a carrier frequency of 4,000 Mc/s are

† *An article on the "Post Office Outside Television Broadcast Service" was published in the Autumn 1955, Journal.*

provided between London and Rowridge in the Isle of Wight, with an intermediate station near Alton in Hampshire.

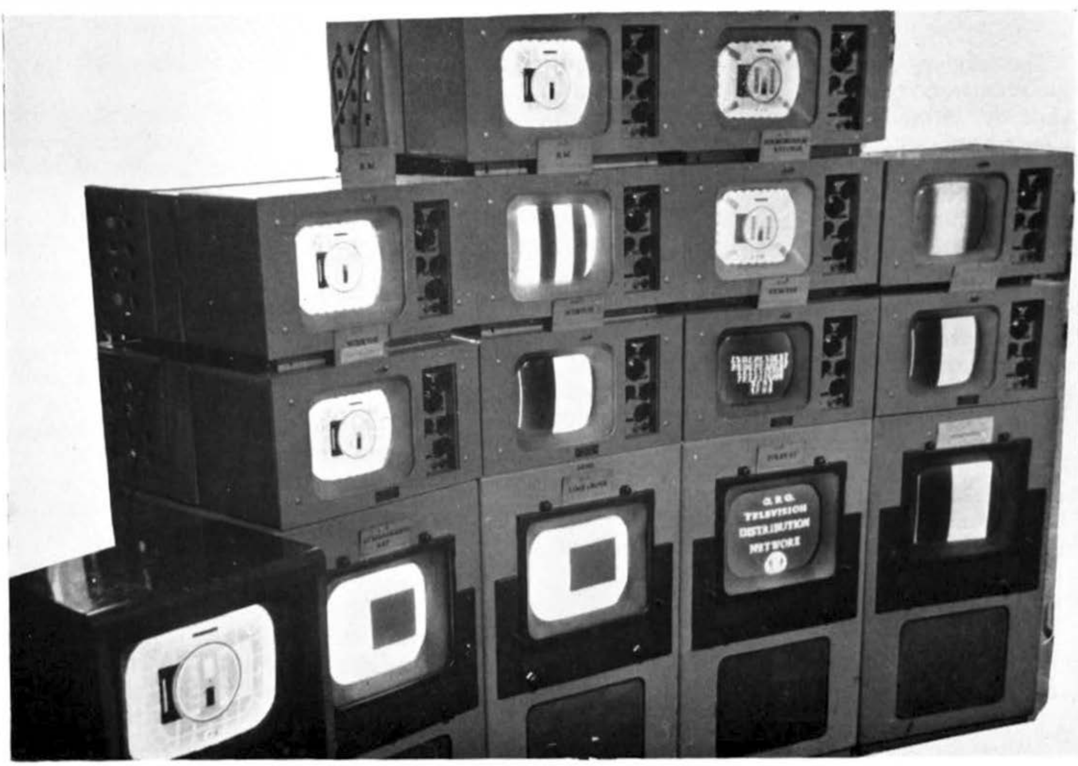
In addition to the cables for permanent links, other coaxial and balanced pair cables are used for relaying outside broadcast signals from points of interest, such as Lords Cricket Ground, Wembley Stadium, Wimbledon and Victoria Station. These points are connected as required and, in general, are in use for a few days only. The contribution portion of the main line network can be cut at any of the intermediate stations, so that O.B. pictures can be fed from these points to the Centre. For example, the pictures from Newbury race-course are fed into an intermediate amplifying station, Aldermaston, on the Wenvoe-London system.

The Centre and the intermediate amplifying stations on both cable and radio link systems, are provided with spare amplifiers which are automatically connected when a failure occurs in a working unit. This change-over is indicated at the N.S.C. by lamps on the terminal equipment. In an emergency, remote switching circuits are available between the Centre and the intermediate stations, which allow the engineers at the N.S.C. to change the amplifiers if the automatic equipment fails. To provide immediate indication of a failure of working apparatus in any part of the system, all links are continuously monitored by supervisory equipment which gives visual and audible alarms at the Centre.

The performance of each link is checked every day, by transmitting special test signals, and adjustments are made, if necessary, to give the best overall performance, before it is offered to the renter, either B.B.C. or I.T.A.

A number of picture monitors are provided to enable the quality of the signals to be readily checked during a programme. Each link in the Centre is provided with a number of test points at which the picture can be observed during the passage of signals through the complicated amplifying and frequency translation stages. This facility of being able to connect a picture monitor

Extensive vision monitoring facilities for Post Office technicians to maintain constant watch on the vast television distribution network



at will, to different points, is very important, as on some outside broadcast circuits, the picture may pass through the N.S.C. four times before being radiated from a transmitting station. Television pictures from the Continent, which are received through the St. Margaret's Bay system, can be examined at seven different points on the transmission equipment in the N.S.C.

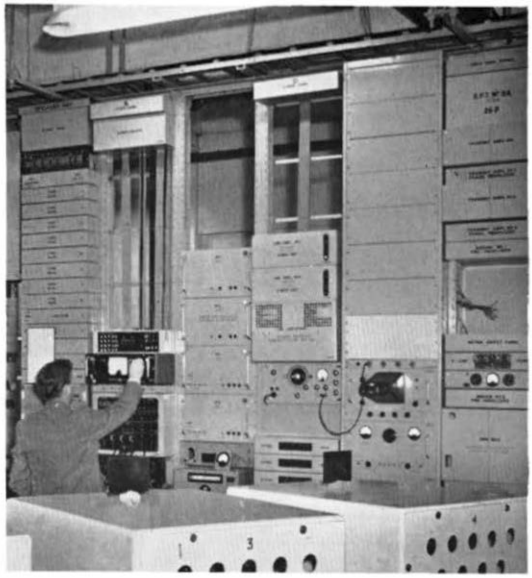
In addition to the work on the vision systems, the Centre has to deal with the large number of music and control circuits used by the programme companies. Music circuits are rented to carry the sound programme between the studios, O.B. points, programme switching centres and transmitting stations. Where possible, they are routed in the same cable as the vision circuit. These circuits are dealt with in the same way as the vision circuits, amplifiers being provided where necessary and regular tests being made to ensure the highest quality circuit. Control circuits are provided to link the presentation staff, who are responsible for the overall programme requirements, with the producers at the studios and O.B. points. Other control circuits are used to connect the programme companies engineering staff in the same way.

A P.B.X., with over 50 extensions in use, is provided in the Centre with direct lines to all the main points from which programmes are produced or transmitted.

To prevent breakdowns in the service because of failure of the public mains supply, diesel generators are provided with an output of 100 kW. which start automatically to maintain the power supply to the Centre. At the intermediate amplifying stations on both the cable and radio systems, similar equipment, but of smaller capacity is fitted, to restore service within ten seconds of a breakdown.

To guard against breaks in programmes due to cable faults, all cables are continually being tested. This is done on the older cables by an insulation tester, which tests alarm pairs provided in all the main line cables at ten-minute intervals. The latest cables are filled with dry air under pressure, with pressure indicators fitted at fixed intervals to operate an alarm if the cable becomes damaged and the pressure falls. The location of the fault can be found by equipment provided in the Centre.

To ensure rapid restoration of service in the event of a cable breakdown in the London Telecommunications Region, the cable engineers are able to talk direct to the Centre by means of a two-way radio circuit working at a carrier frequency of 80 Mc/s. Mobile radio equipment is provided in the vehicles used and the main transmitter is located at Harrow Weald, on the mast of the first intermediate amplifying station, on the London-Birmingham radio links.



Part of London television control

The introduction of the I.T.A. service has meant a considerable amount of additional work to the staff in the Centre, as the use of the transmitter stations is shared by the various programme companies. One company is responsible for the programmes from Monday to Friday, and another for Saturday and Sunday. At the close of transmission on Friday and Sunday nights the connexions to the various vision, music and control circuits have to be rearranged to cater for the different sources from which the programmes originate.

Another service provided for the I.T.A. and the associated programme companies is the switching of programmes at set times. A schedule is provided showing which studios and Programme Switching Centres should be interconnected at a given time, and switching positions have been set up at the N.S.C. where simultaneous vision and sound switching can be carried out. The switching is done at the precise time given in the schedule and a circuit from TIM is used, to ensure that the operation is carried out to the second.

"Electronics in the Post Office" —Radio Show, 1956

F. E. Williams, M.Sc.(Eng.), A.C.G.I., D.I.C., A.M.I.E.E.

A NOTABLE FEATURE OF THIS YEAR'S RADIO Show, held at Earls Court from August 21 to September 1, 1956, was the emphasis on "careers in electronics". The ground floor of the vast exhibition building was, as in previous years, covered with the brightly illuminated stands of the radio manufacturers, displaying a profusion of television and radio receiving sets of all shapes and sizes, tape recorders, gramophone disc players, and radio components. Upstairs, sharing the spacious gallery with the B.B.C. Studio, the television control room and the I.T.A. stand, were the more serious exhibits illustrating modern developments in electronics.

The primary aim of these displays was to interest the technically-minded young man in the possibilities of a career in the technical branches of the services and the communication industry. One of the larger and more striking of the displays was that of the General Post Office. Covering a floor space some 50 feet by 58 feet, this was the most ambitious display undertaken by the Post Office in recent years, and, as most of the exhibits were "live" working items, some capable of operation by the public, it proved to be a very popular stand—even competing successfully with the rival attractions of the glamorous television celebrities on the neighbouring I.T.A. stand.

Designed for the Post Office by the Central Office of Information, the G.P.O. stand was essentially of "open" construction, slightly reminiscent of a fair ground, with each of the principal exhibits surrounded by a waist-high white railing, beneath red and yellow canopies. On the side walls large photographic murals portrayed features of the work of Post Office engineers, and captions extolled the attractions of careers in electronics in the Department. At the information centre at the heart of the stand, staff from Headquarters Branches answered questions about employment,

Prototype of a new Speaking Clock

gave away leaflets and brochures, and noted the names and addresses of interested applicants.

The main theme of the display was the application of modern electronic techniques in the Post Office, and the principal exhibits were supplied by the research and development laboratories of the Engineer-in-Chief's Office. From Dollis Hill came the pilot model of "ERNIE", the Electronic Random Number Indicating Equipment which is to be used to select Premium Bond numbers. The complete machine will generate nine-digit numbers, but the model exhibited indicates two digits only. The "noise" from a neon gas tube is amplified and used to drive an electronic counter at an irregular speed; the counter is stopped at regular intervals by means of an electronic clock and the score displayed.

Another popular exhibit was "ESME", the Electronic Speaking MachinE, based on the fundamental work on the analysis and synthesis of speech described in the Summer number ("New ideas in the transmission of speech", by E. W. Ayers). The continuous demonstration of the complete analysis-synthesis process for 11 hours a day for 11 days would have been a formidable task, and so for the exhibition the synthesiser only was shown, coupled to a pair of control handles

Section of the G.P.O. stand: (left to right) testing teleprinters; ERNIE; ESME; Electronic Dart-board

with which the public were invited to create synthetic speech sounds. With a little practice it was possible to produce simple sentences such as "Where are you ?" in wholly synthetic speech with a wide variety of intonation. It is only fair to add that all too frequently in untutored schoolboy hands the machine was to be heard emitting raucous noises more appropriate to the farmyard than to human speech!

From the Switching Division of the Research Branch came a working model demonstrating the principals of an electronic telephone exchange, using time-division transmission, by means of which twenty conversations could take place simultaneously over one pair of wires without the need of amplifiers or filters. By lifting a telephone handset and dialling a number, visitors were able to talk over the circuit or listen to TIM, WEA or (on the test match days) WEB. The use of a transistor to accomplish the ringing of the subscriber's bell was a novel feature of this demonstration.

The prototype of a new Speaking Clock was on show. Although similar in mechanical design to the present TIM machines, the new mechanism is driven from an oscillator controlled by a quartz crystal, and keeps much more accurate time than the present pendulum-controlled equipment. Listeners were surprised to hear the time announcements in a male voice instead of the familiar "Golden Voice" of TIM; the recordings on the new machine were in fact a set prepared at

Another view, showing the Letter Sorting Machine on the left

Dollis Hill for the Australian Post Office Speaking Clock, and the voice was that of Gordon Gow, the well-known broadcaster.

The Transatlantic Telephone Cable project, recently completed, was represented by a sectioned model of a submerged repeater, and an exhibit showing stages in the making of a water-tight seal between the repeater and the cable.

A major undertaking was the displaying of the Letter Sorting Machine. This experimental machine, operated by a keyboard and sorting mail into 120 boxes, has been on trial at the sorting office at Bath, Somerset, for some months, and a team of sorters was brought specially from Bath to operate the machine at the Radio Show. Thousands of dummy letters had been specially prepared, and spectators pressed three deep around the railing to watch the machine sort the mail deftly into the correct boxes.

An ingenious novelty from the Engineer-in-Chief's Telephone Branch was the Electronic Dart-Board, using cold cathode tube counters constructed on "printed circuit" units. Each of three groups of lights travelling around the dart-board could be halted in turn by pressing a key, and to ring the bell all three had to be correctly halted on the "twenty". This required a good eye and quick judgement, and the exhibit naturally proved a magnet to the many schoolboys at the Show!

Other displays showed the passage of a call through an automatic telephone exchange when a number was dialled, the sending of dialling impulses over trunk circuits by means of voice-frequency tones, and the operation of a Telegraph Distortion Analyser.

The practical side of engineering work in the Regions was represented in a display by a team of Technical Officers from the London Telecommunications Region, who were to be seen carrying out maintenance adjustments on teleprinters and uniselectors. Many of the spectators were heard to comment on the skill and fine sense of touch which was being displayed at this bench.

Throughout the Show the stand was staffed continuously by a team of well-qualified demonstrators drawn from the Engineer-in-Chief's City and Dollis Hill Branches, and from the headquarters staff of the Personnel Department.

The photographs in this article are by courtesy of the Central Office of Information

Two-Stage Plan for Inland Telephones

Sir Gordon Radley Speaks as I.E.E. President

The Post Office has a two-stage plan for developing the inland telephone system, said Sir Gordon Radley, Director General, on October 4, in his inaugural address as President of the Institution of Electrical Engineers.

"The first stage is to install enough additional plant, chiefly local cables and exchange equipment, to satisfy the outstanding demand for telephone service. . . . The second stage comprises the progressive mechanisation of the system with the introduction of new facilities."

The coaxial cables, capable of transmitting 600 speech channels within a single tube and, with appropriate repeaters to transmit a slightly wider band of frequencies, used for television links could, with little modification, cater for 1,000 telephone channels plus a 405-line television channel, on each tube.

"Alternatively, the tube could carry 2,000 telephone channels, but it is doubtful whether the risk of losing such a large number due to a single fault would make this arrangement attractive."

Another Atlantic Cable?

Discussing the new transatlantic telephone cable, Sir Gordon said that the impetus it has given to the growth of communication between Western Europe and North America "may well call for the laying of a second cable across the North Atlantic at no distant date of the greatest capacity technically possible. Eighty circuits in a single cable, or 200 in a twin-cable system, would be an objective only just outside the present limits of repeater spacing and cable diameter. If reasonably loaded with traffic at present call rates, either system would be profitable".

The technique and economics of a repeatered cable from the United Kingdom to Gibraltar are being studied; traffic to the Iberian Peninsula alone might not justify this investment but the cable would have potentialities for further extension—to West Africa and South America via the Azores.

The type of cable used for the new transatlantic service, and laid without difficulty at 2,400 fathoms, will be used next year in the American cable to be laid across the Pacific to Hawaii, where the depth will approach 3,000 fathoms (three miles).

Printing Aids Electronics

An illustrated description of a process which is fast becoming a major factor in the production of electronic equipment

J. A. Lawrence, A.M.I.E.E.

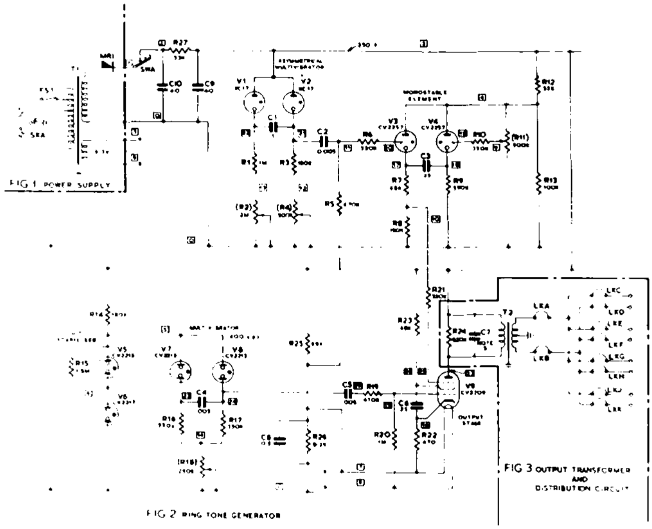


Fig. 1: Original schematic drawing

PROCESSES LONG ESTABLISHED IN ONE TRADE sometimes find an unexpected application in another totally unrelated industry, making possible new advances in technique and thus leading to new developments and reduced costs. For many years the production of intricate designs by etching on a metal sheet has been widely understood in practice in the printing world. Until recently this technique had no obvious application in electronics, but the plastics industry has now developed the art of bonding metal foil to insulating material to the stage where it is economically practicable to produce sheets of insulating material to which copper foil has been firmly bonded. This has opened up entirely new possibilities.

Meanwhile, the trend of development in the electronics industry has been in the direction of producing smaller and cheaper components while the equipments and circuits in which they are used have become more and more complex, calling for the use of components in much greater numbers. Traditional methods of assembling and wiring large numbers of tiny components are costly, while the mounting and wiring make the completed unit unnecessarily bulky. These have been limiting factors in the production of the large numbers of elementary electronic units, all identical, which are used in constructing complex equipments like computers and electronic telephone exchanges.

Faced with these problems someone must have eventually asked "Why not print the circuit?"—and a new technique was born. All that was needed was to combine the printer's skill in etching with the use of the new metal clad insulants. The new technique was not, of course, developed over-night, but during the past two or three years development has been rapid and diverse, and today several processes are available; some are already in mass production. In what follows the various stages in the production of a typical electronic unit are illustrated. Fig. 1 shows a typical electronic circuit. This is the first stage. The function of the circuit is not important; it illustrates the intricacy of the wiring required even for a simple device.

The second stage is to assemble the components and decide on a layout, the trial assembly being made on a stiff card or in any other convenient manner. This trial assembly completed, the interconnexions—the wiring—between the components must next be worked out, the objective being as compact a lay-out as possible with a minimum number of connexions crossing each other.

The result is shown in Fig. 2, in which the black areas represent the connexions required; this is prepared on stiff card or paper either by ordinary drawing office methods or by some equivalent process. For ease of handling it is often made twice or even four times full size.

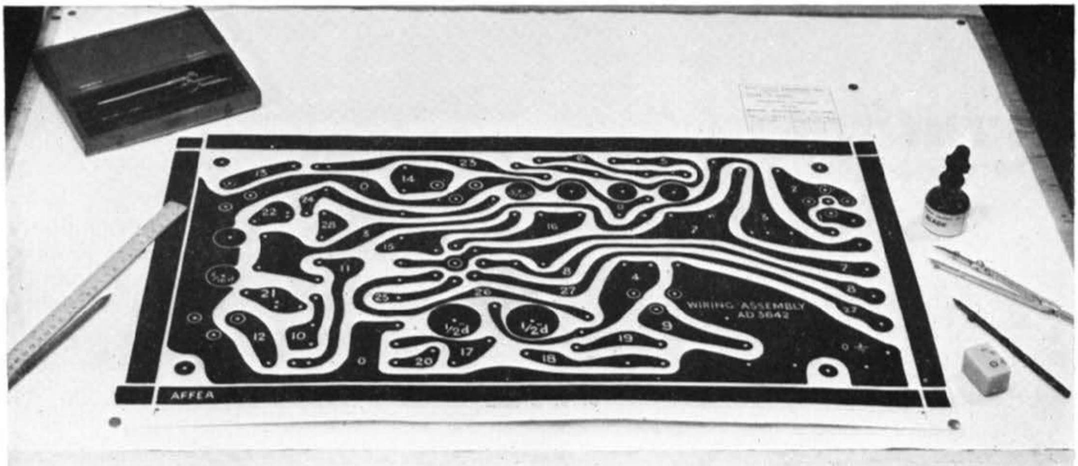


Fig. 2: Drawing of printed circuit on the drawing board

The photographer now enters the picture. First he obtains by ordinary photographic methods a true-to-size negative of the wiring lay-out (Fig. 3) the black parts of the negative now representing the spaces between connexions instead of the connexions themselves. One or more negatives are made, depending on the number of units required, and production may begin.

The basic material used in this particular instance is a copper-faced insulated laminated sheeting. The copper face has a thickness of between one and two thousandths of an inch. The sheeting is a few millimetres thick; it is cut into suitably sized pieces, cleaned on the copper face, and coated with a light-sensitive preparation (Fig. 4). The negative or negatives are then placed on the prepared copper surface and exposed to ultra-violet light for several minutes. After exposure the sheets are dipped into a solution which removes the light-sensitive coating from those parts of the surface that have not been exposed; in other words, from areas which ultimately will become spaces between connexions (Fig. 5). The process is equivalent to that of development in ordinary photography. To assist in development a dye is added to the developing solution; this stains the areas ultimately to become connexions.

The developed sheets are then placed in an etching bath containing a solution which attacks and dissolves all of the copper not dyed. The

Fig. 3: Glass negative being inspected

Fig. 4: Copper laminate being cut to size

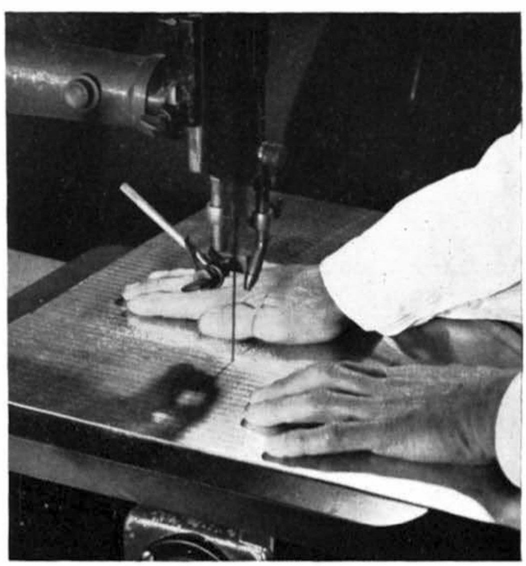
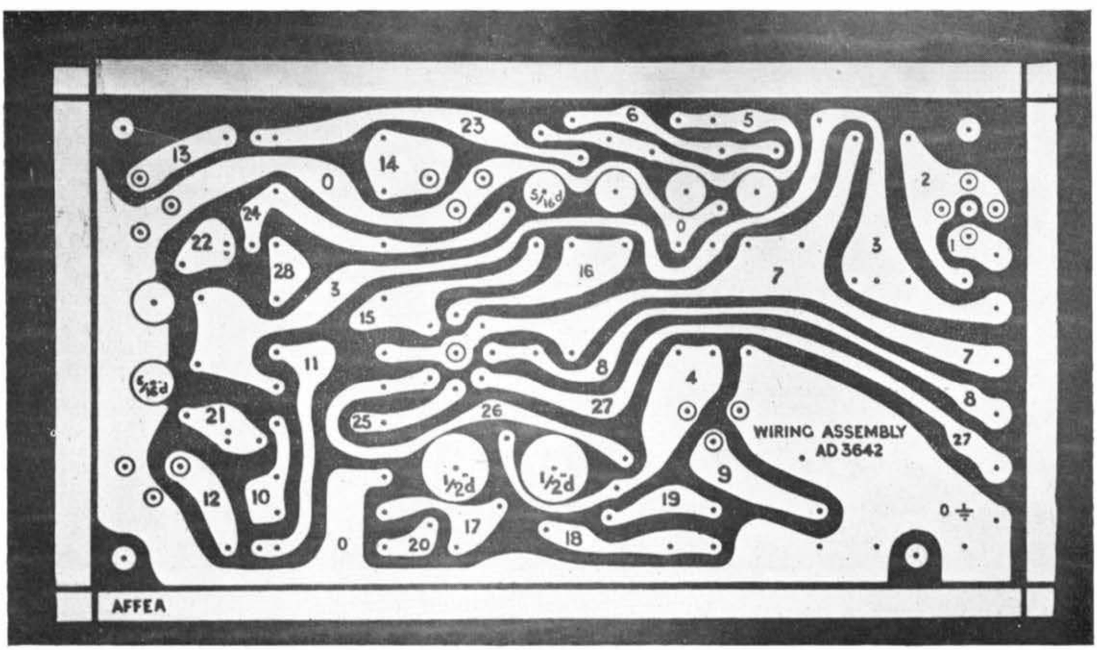


Fig. 5: Checking the developed image on the copper laminate against the negative

process is now nearly complete. After the sheets have been cleaned and dried, the remaining copper—now the actual connexions—is thoroughly cleaned and finally coated with a soldering flux ready for assembly (Fig. 6). The flux is to prevent corrosion of the copper surface and to assist soldering at a later stage. All that remains is for the sheets to be cut and trimmed to final size and drilled and punched as necessary for the assembly of the components. The final result is shown in Fig. 7.

Since the process described is basically a

Fig. 6: Etched copper image coated with flux also showing bakelite backing



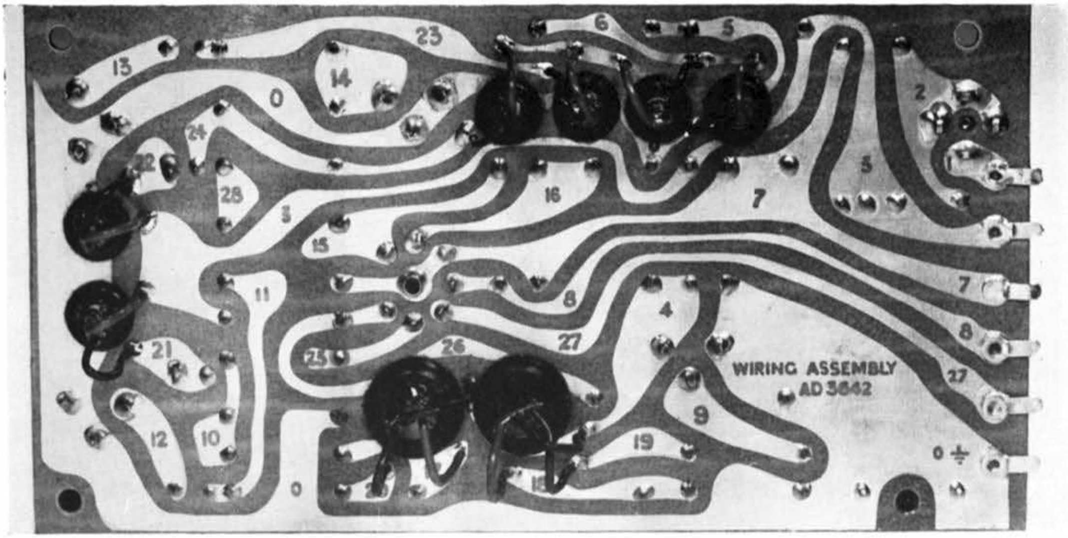
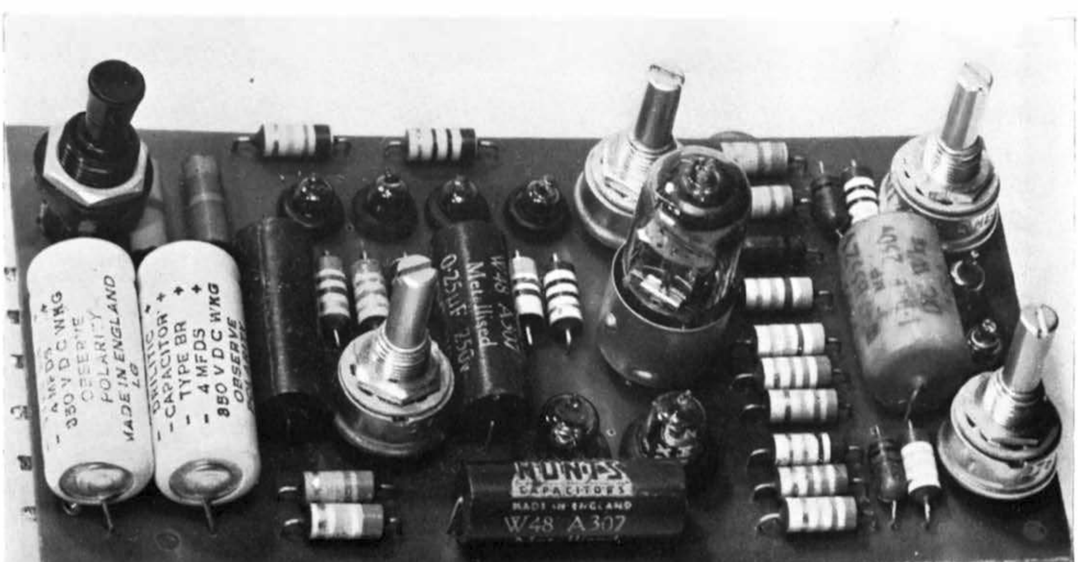


Fig. 7: Circuit complete showing components soldered to printed wiring

technique common in the printing trade it follows that words, numbers, signs and so on may also be printed in copper on the cards and assist in assembly.

From experience so far obtained the etching process appears likely to have an important effect on the design of electronic equipments. The wiring cards not only simplify assembly, but also provide a cheap and convenient mounting for the components—itself an important advantage. Moreover, since all similar units have an identical layout it is easier to produce identical circuit elements than with any other method of assembly—a fact of considerable importance in the construction of large equipments. In addition, of course, wiring errors are eliminated. The need to solder the component wires to the connexions by hand is a limitation, but considerable progress is being made with automatic mass soldering by dipping the assembled units into a bath of molten solder under

Fig. 8: The placing of the components on the printed circuit panel



suitably controlled conditions. The development of this process should lead to a further reduction in costs with improved reliability.

In conclusion it should perhaps be made clear that the process described in this article is only one of several now commercially available, and that for radio and television equipment some of the components themselves can be printed. The range of materials to which copper can be bonded is also extensive and both rigid and flexible base materials are available.

Our Contributors

L. G. DUNFORD ("Cable Materials and Manufacture") is an Assistant Staff Engineer in the Test and Inspection Branch of the Post Office Engineering Department. He entered the Department in 1922 by the Inspectors' examination, and has worked in Research and Test Branches, with war service in the Royal Signals and Ministry of Supply. He is a Member of the Institution of Electrical Engineers.

A. E. T. FORSTER (joint author of "Automatic Dialling for Telex") is a Senior Executive Engineer in the Telegraph Branch of the Engineering Department responsible for the design of automatic switching systems for teleprinter services.

He entered the Post Office as a Youth-in-Training in the Bournemouth section in 1935 and was transferred to the Engineer-in-Chief's Office in 1938 on promotion to Inspector. Served with R.E.M.E. in Persia, Iraq and Italy during the war. He joined the Telegraph Branch on return to the Post Office in 1946 and was appointed Probationary Engineer in 1947.

W. L. HALL ("Some Problems of Shared Service") is an Assistant Telecommunications Controller, Class II, at Directorate Headquarters, Wales and Border Counties. He entered the Engineering Department as a Youth-in-Training in 1933 and became an Inspector in 1937. Four years later he transferred to the traffic side as an Assistant Traffic Superintendent and shortly afterwards joined the Royal Corps of Signals. His military service was with War Office Signals, Lines of Communications Signals in North West Europe and with 1 Corps Signals. He went to Cardiff as an Assistant Telecommunications Controller at the end of 1948.

R. D. JOHNSON (joint author of "Automatic Dialling for Telex") is a Senior Inspector in the Inland Telecommunications Department. He has spent several years on development of the telegraph services, including the introduction of Teleprinter Automatic Switching for public telegraphs, and trials of facsimile equipment.

He entered the Post Office in 1932 from Messrs. Ericssons Telephones Ltd. and after experience in telephone areas, he joined Headquarters in 1938, in the then "Traffic Section" of the Telecommunications Department. He has remained at Headquarters since, apart from five years' service with the Forces.

J. A. LAWRENCE ("Printing Aids Electronics") is an Associate Member of the Institution of Electrical Engineers and is now Senior Executive Engineer in charge of Electronics in the Telephone Development and Maintenance Branch of the Engineer-in-Chief's Office. He began his career in the Post Office as a Youth-in-Training in 1927. Transferring subsequently to the Engineer-in-Chief's Circuit Laboratory he became a Probationary Inspector in 1933 and a Probationary Assistant Engineer in 1937. He served with the Royal Signals and Royal Air Force during the war, being promoted to his present rank in 1950. Since the war he has specialized in the study of foreign and automatic telephone systems and the development of new switching systems, particularly in the application of electronic techniques to the present system in this country.

W. L. NEWMANN ("The London Television Network Switching Centre") entered the Post Office in 1934 and served in the South East Section of the London Engineering District until 1939, on exchange construction and radio interference duties. He was then transferred to the Radio Branch, Experimental and Development laboratories at Dollis Hill, working on transmission equipment for multi-channel telephony and television. In 1951 he went as an Assistant Engineer to the Centre Area, London Telecommunications Region, and has worked since in the National Switching Centre. He is a temporary Executive Engineer.

J. C. RENNISON ("Electro-magnetic Announcers in the Telephone Service") is a Senior Telecommunications Superintendent in the Operations and Organization Branch of the Inland Telecommunications Department. He was an electrical engineering apprentice in the Portsmouth Dockyard before entering the Post Office as an Assistant Traffic Superintendent in 1936, in which capacity he was employed in the Glasgow, Middlesbrough and Southend-on-Sea telephone areas. During the war he was an R.A.F. Signals officer.

CYRIL ROWLINSON ("Wick Coast Radio Station 1920-1956") entered the Post Office at Ashton-under-Lyne in 1930, and transferred to Wireless Telegraph Section as Wireless Operator in 1938. He served at Humber, Wick, North Foreland and Seaforth Radio Stations as an operator. He was lent to the Foreign Office as a Radio Overseer from 1942 to 1945. Officer in Charge Seaforth Radio Station 1945, Radio Surveyor at Liverpool 1945 to 1950, when he was promoted Radio Assistant Superintendent at Headquarters. He was at the Admiralty from 1952 to 1954 as W.T.S. liaison officer to Signal Division.

F. E. WILLIAMS (" 'Electronics in the Post Office'—Radio Show, 1956") is a Devonian and was educated at Plymouth College and the Imperial College of Science, London, where he obtained B.Sc. in Electrical Engineering with 1st class honours in 1931, and after, post-graduate research on electro-acoustics, the M.Sc. (Eng.). He entered the Post Office as a Probationary Engineer in 1933, and has spent his career in the Research Branch at Dollis Hill, mainly on electro-acoustics and sound recording. From 1946 to 1951 was in charge of the newly-formed Postal Engineering group, and was responsible for initiating the development of the single-position letter sorting machine. Since 1951 he has been Assistant Staff Engineer in charge of the Electro-acoustics section of the Research Branch.

Notes and News

The Mobile Telegraph Office.—Despite the frequent interruption of play because of bad weather the present Test series has produced over three million words of cricket press, of which 149,000 words of urgent and 1,570,000 words of ordinary press were accepted at the grounds. The Mobile Telegraph Office attended at 16 of the 35 matches, played including three of the five Tests, and handled 84,000 words of urgent and 818,000 words of ordinary press. An excellent service has been maintained throughout with urgent press deliveries in Australia within eight minutes of handing-in at the cricket ground. Letters commending all concerned have been received from Australian Press Agencies and from the O.T.C. (A).

★ ★ ★

London's New Controller.—At one time the youngest Telephone Manager in Britain—City Area, 1939—Mr. H. M. Turner, Centre Area Telephone Manager since 1950, has been appointed Controller of Telecommunications for the London Telecommunications Region.

★ ★ ★

From Outer Space.—"Peterborough", in the *Daily Telegraph*, recalled that the conversation between their New York and Fleet Street correspondents over the new telephone cable on September 25 was much less terrifying than its radio-telephone predecessor 30 years ago.

At that inauguration a member of the staff was startled, on answering a normal ring, to hear a noise like a machine-gun barrage and an enormous voice. "St. Paul speaking!" it thundered.

Fearing that Judgment Day was at hand and uncertain how to address an Apostle, he asked feebly: "Where from, sir?" "Minnesota!" roared the voice. It then dawned on him that nothing more catastrophic was in being than an inaugural call from an enterprising American newspaper.

Telex on TV.—Telex was televised in the B.B.C.'s "Mainly for Women" programme in September. Miss Verrall Dunlop showed the installation and discussed the service with Mr. R. M. Watson of the Subscribers' Services Branch (Sales Division) of the Post Office Inland Telecommunications Department and a London telegraphist, Miss Jean Wrighton (see photograph above). Greetings were received on behalf of British families in Germany.

★ ★ ★

Money in Scrap.—Scrap and condemned materials sold by the Post Office during the year 1955-56 realized £3,925,300. Some 25,000 tons of metal including lead covered cable, copper wire, cable sheathing, lead seals and battery plates constituted the bulk of the material. Precious metals realized the sum of £33,000 and, among other items, timber (old poles) £7,200.

★ ★ ★

Guide to Broadcasting Stations.—Nearly 50 per cent. of the medium wave broadcasting stations in Europe are operating on frequencies not allocated to them at Copenhagen in 1948, Iliffe and Sons point out in a note with the ninth edition, 1956-57, of the *Guide to Broadcasting Stations* (2s. 6d.) compiled by the *Wireless World*; these are marked in the *Guide*, which gives operating details of more than 3,000 stations.

Iliffe's have also published the fifth edition of

Radio Valve Data (4s. 6d.) in which the *Wireless World* have compiled characteristics of 2,500 valves and cathode ray tubes. Nineteen British manufacturers have co-operated.

Marconi's new surveillance radar equipment mounted on a tower overlooking the sea; the transmitting and receiving aerials are on the adjacent pole mast

Radar Development.—Marconi's Wireless Telegraph Company have carried out functional tests on a coastal site of their new 20 kW. X-band surveillance radar type SNW.44, as illustrated; this is one of a complete range of 3 cm. equipments designed to cope with control and surveillance problems in maritime and aeronautical work.

★ ★ ★

Communications for Royal Tours abroad.—Whenever a member of the Royal Family makes an official visit abroad much detailed planning is necessary to provide rapid communication facilities. The additional requirements of the Press are alone quite considerable, and call for special provision.

During 1956 the Royal Yacht has been almost continuously in service and has created a traffic demand in points as far removed from each other as Scotland, Sweden and Zanzibar. As H.R.H. Princess Margaret's East African tour was nearing its end, *Britannia* sailed from Mombasa with the Duke of Edinburgh on his way to open the Olympic Games. This journey formed the first part of a world tour which will later take the Duke into the Antarctic and other remote places not normally in contact with the rest of the world by telegraph or telephone.

★ ★ ★

The U.A.X. Line!—The following is an extract from the *Rathfriland Outlook* (Northern Ireland):—

"For some months during my light-hearted journeyings round the Loughbrickland and Glascar districts I have noticed a tidy little wooden hut (not a caravan!) at McAllister's Hill just off the main Rathfriland—Loughbrickland [Co. Down] road. It looked to me like a very neat and superior type of hen-house, and in my ignorance I have

Inland Telecommunications Statistics

	Quarter ended 30th June, 1956	*Quarter ended 31st March, 1956*	*Quarter ended 30th June, 1955*
Telephone Service			
Gross demand	94,703	107,436	129,803
Connexions supplied	100,560	101,633	108,615
Outstanding applications	317,626	343,633	377,240
Total working connexions	4,313,170	4,265,150	4,075,676
Shared service connexions	1,113,542	1,087,628	965,110
Traffic			
Total inland trunk calls	82,650,000	80,099,000	84,164,000
Cheap rate	21,380,000	19,974,000	22,071,000
Inland telegrams (excluding Press and Railway) ...	4,092,000	4,107,000	5,393,000
Greetings telegrams	887,000	931,000	1,028,000
Staff			
No. of telephonists	49,495	49,774	48,001
No. of telegraphists	6,559	6,744	7,376
No. of engineering workmen	63,235	62,886	59,932

been imagining that the McAllisters, or their neighbours, were keeping a very select and aristocratic type of hens when they were housing them in such a comfortable wee residence.

Imagine my surprise, therefore, to learn this week that the house holds, not laying hens, but telephone equipment. Cackles of another sort!

★ ★ ★

Communication "Olympics".—Wherever the Olympic Games are held tremendous communication problems are created by Press correspondents anxious to transmit results to their native countries in the shortest possible time. Because of Australia's geographical position, additional international communications for the 1956 Games have to depend entirely upon radio circuits. The direct radio route from Australia to Europe is normally workable only for about 14 hours each day, and at the time when the main events are taking place direct communication is not at all reliable. Relay stations in many parts of the Commonwealth will therefore be used.

Much of the increased Games traffic will flow via the Post Office London Station, Electra House, to which a maximum of some 30 radiotelegraph channels will be specially provided either direct or via automatic relays in the West Indies, Kenya and Canada. In addition there will be four submarine cable channels.

Some of these telegraph channels will be leased by Press agencies and will provide direct teleprinter communication between Press offices in the Stadium and the renters' premises in London and other European capitals.

Electra House also expects to receive up to 150 radio pictures each day and to retransmit many of them to other parts of the world.

Radio telephone facilities are being augmented and will be used extensively by the B.B.C. for reports from Melbourne.

★ ★ ★

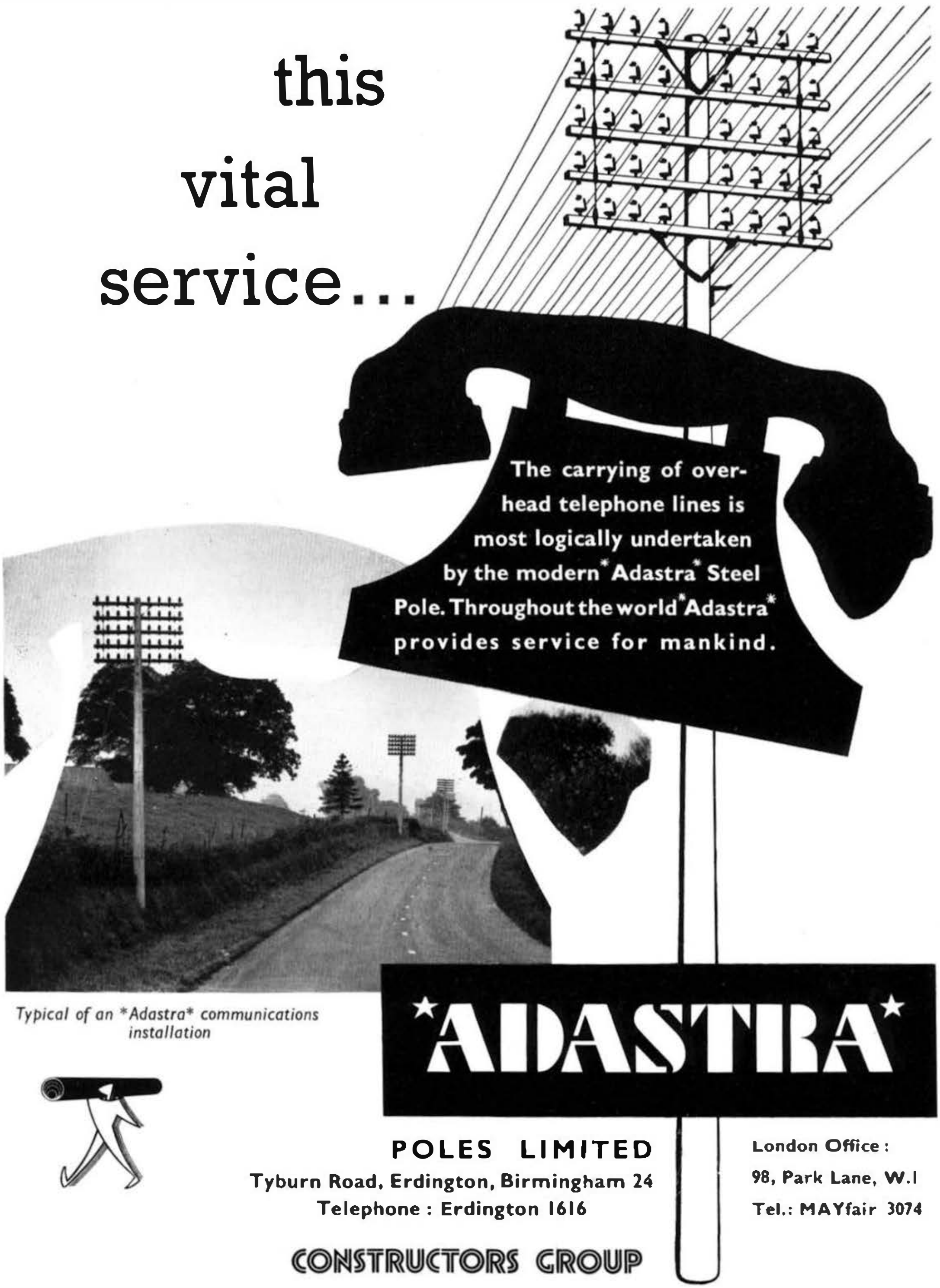
Acknowledgment.—The Editor wishes to thank all who contributed articles to the supplement on the transatlantic telephone cable, and to acknowledge the ready co-operation of the contributors and others in helping him to assemble the material. A letter from Mr. Harold M. Botkin of the American Telephone and Telegraph Company, offering "compliments . . . for a fine job in telling the story" is typical of the many tributes received to their work.

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

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.

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

GPO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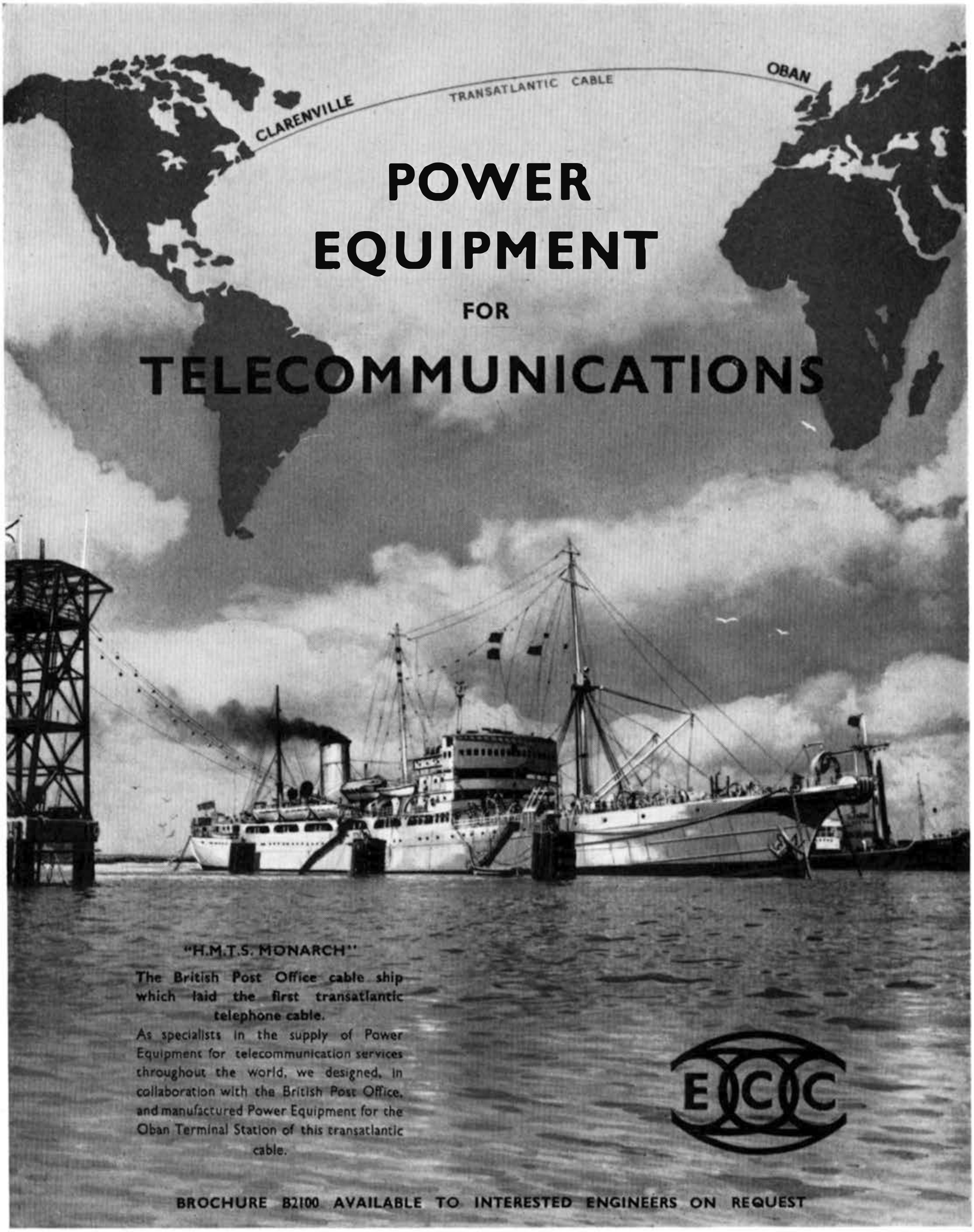
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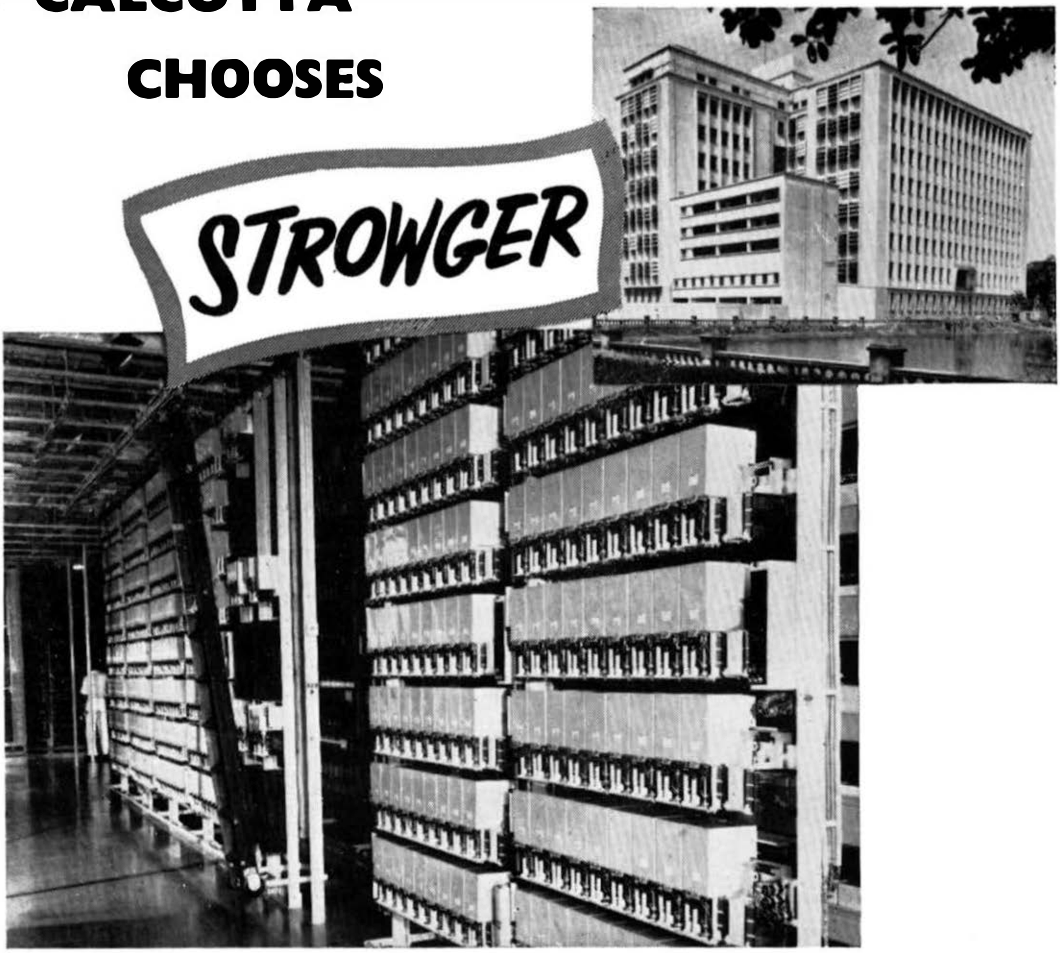
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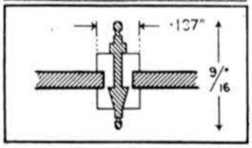

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The polytetrafluorethylene bush, which is supplied with the heavily silver-plated brass barb partly inserted is positioned in a hole ·156" in diameter. Firmly pressing the barb through the assembly expands the P.T.F.E. bush on the far side of the chassis and locks it firmly in position.

VOLTAGE 3kV working voltage for laboratory use.

1 kV under tropical conditions.

CAPACITY less than ·75 mm. F.

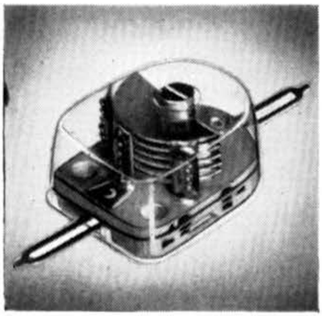
TEMPERATURE −55° C. to + 200° C.

RESISTANCE TO PULL in either direction 20 pounds.

CHASSIS THICKNESS, recommended for 1/16".

CHASSIS HOLE, ·187" diameter.

Enquiries invited for other dimensions and types.



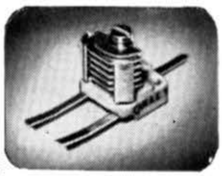
AIR DIELECTRIC TRIMMER

Type approved to RCL 141

Base ·875 in. × ·670 in. max. with fixing holes ·125 in. dia. ·437 in apart.

Capacities up to 70 pF in. ·007 in. gap and up to 30 pF in. ·015 in. gap.

Acetate dust cover optional.



STAND OFF INSULATOR

Type approved to RCL 141.

Base ¾ in. square with fixing holes for 10 B.A. ½ in. apart.

Capacities up to 13 pF in. ·007 in. gap and 8 pF in. ·011 in. gap.

Acetate dust cover optional.

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Over chassis ·86 in.
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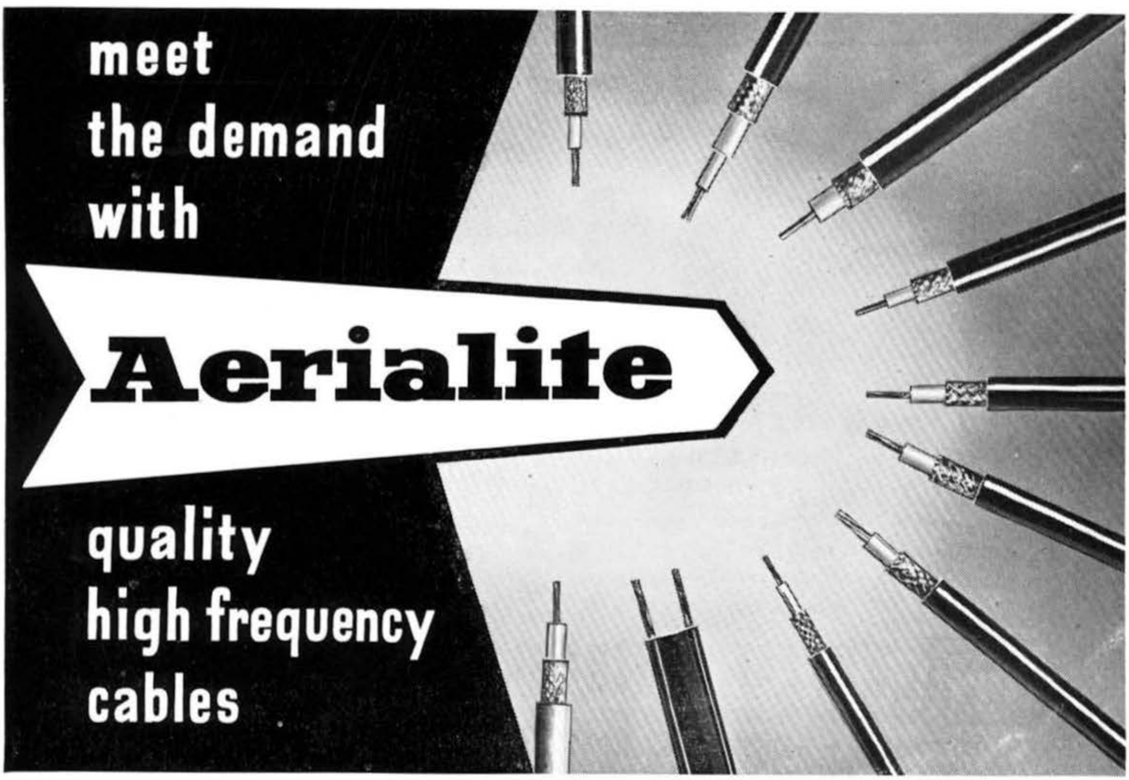

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