THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

VOL. 19 PART 3

OCT: 1926

Price 1/6 net.

ADVERTISEMENT INDEX
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The Post Office Electrical Engineers' Journal.

A QUARTERLY JOURNAL.

CONTENTS FOR OCTOBER, 1926.

All communications with regard to advertisements to be addressed to:

The Advertisement Manager,
Post Office Electrical Engineers' Journal,
4, Ludgate Hill, London, E.C.4.

PUBLISHERS:

THE ELECTRICAL REVIEW, LTD., 4, LUDGATE HILL, E.C.

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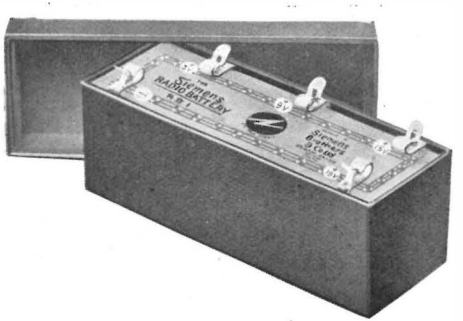

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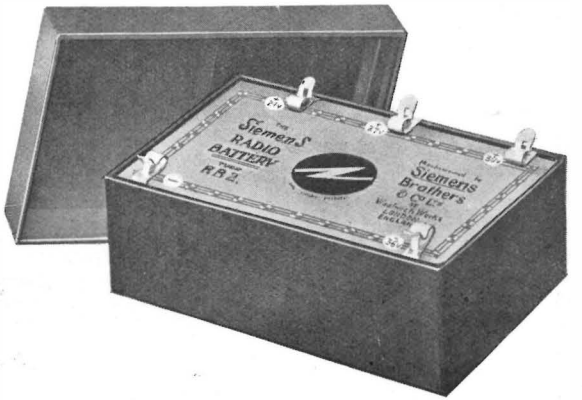

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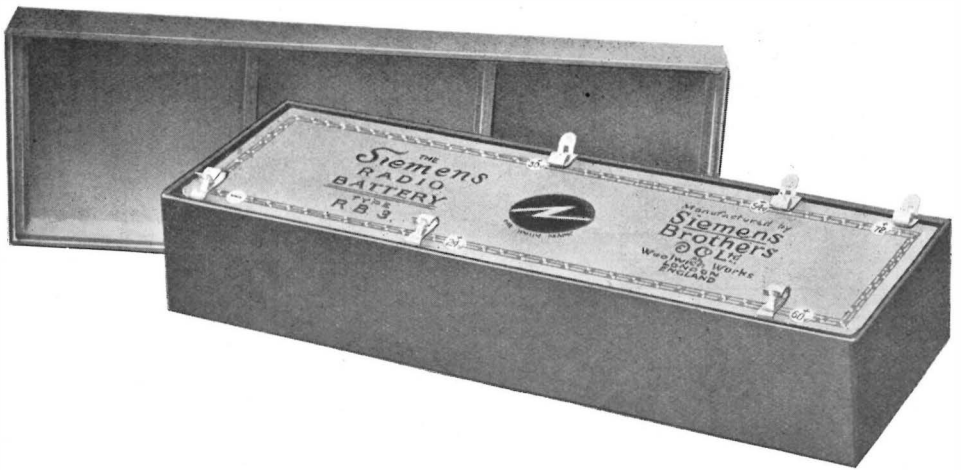

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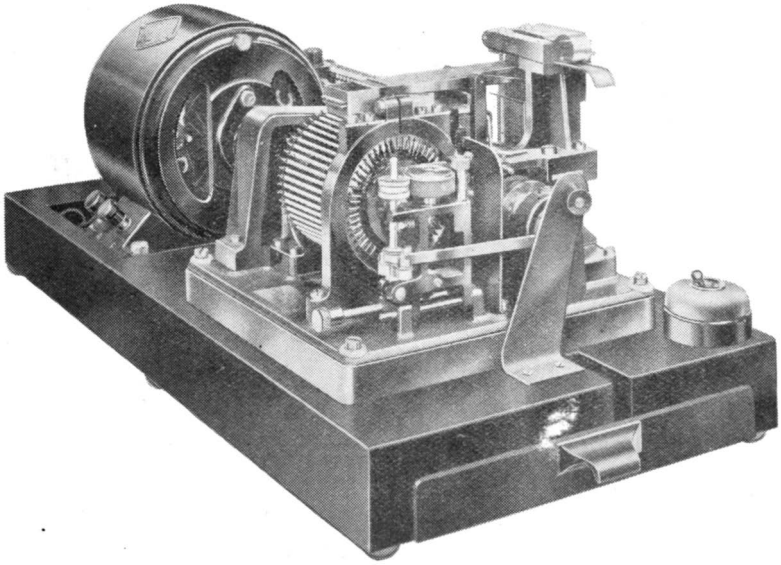

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THE PÉNOT MORSE PRINTER.

By A. C. Booth.

In "Annales des Postes, Télégraphes et Téléphones" for May, 1926, a very full description is given of an automatic printer for converting ordinary Morse signals of dots and dashes into Roman printed characters without the intervention of a perforated tape as is used in the well-known Creed system. The printing can be done on the ordinary tape or in column form. The description is too long to be reproduced in full in this Journal, but a brief outline of the scheme and the essentials are given in the following notes to enable an opinion to be formed of the device. It is a French production by M. Pénot and is patented in that country. It is said to have been used with complete success by the French Administration for printing the reception of Morse signals received from various International Radio services. It can be used also on submarine cable services as well as on land lines. The speed at which it can be worked is not given, beyond the statement that it will print at the highest speed used on busy Radio services. That may mean hand-signalling speed or even automatic transmission up to about 60 words a minute. It is probably not sufficiently rapid in action to deal with a speed much over 100 words a minute, judging by the detailed description of the apparatus supplied in the article referred to.

In addition to the ordinary telegraphic receiving apparatus there are three special other instruments to effect the translation of the Morse characters into printed Roman characters, viz., the Regulator, which is adjusted to the speed of the sending station; the Distributor, which selects the dots and dashes; and, lastly, the

Printer, which is controlled by the Distributor and prints the required character corresponding to the Morse signals received.

The Regulator has a main axle driven by a motor through a friction clutch. Normally the axle is held stationary by an escapement, or, as it is termed, an anchor, which is moved to and fro by the arriving signals. The axle has a small pulley which acts on one or other of two discs, thus winding up one or other of two flat spiral springs by an amount determined by the duration of the signals. One disc is for the marking signals, whether dots or dashes, and the other for the spacing signals of whatever length.

The two axles upon which the discs are mounted are fitted with commutators to make connection with different parts of the Distributor. These connections are determined by the extent of the angle through which the commutators have been moved, and consequently are made in accordance with the duration of the arriving signal, which may be a dot and dash on the marking side, or a letter-space or a word-space on the spacing side.

The Distributor has a number of pairs of pivoted axes, each fitted with a number of flat spring contacts which make or break connection with a corresponding number of fixed contacts according to whether the axes are in one or other of two positions. These positions are determined by electro-magnets controlled by currents from the Regulator. Each pair of axes functions independently, one with dots, the other with dashes. Hence for the letter P, for example, four pairs of axes will be required, so that the total number of pairs of axes is that of the Morse signal having the largest number of dots or dashes. The letter-space signal determines the printing. There is another axis which prevents printing when incorrectly formed or distorted signals are received.

The Printer is of the type-wheel form, driven by a friction clutch from an electric motor. The type-wheel is stopped when required by projecting pins actuated electrically by the Distributor. A printing magnet presses the tape against the type-wheel at the selected character, and also feeds forward the paper tape. The printer may also be of the drum type to print in page-form if required.

Further details regarding the results obtained with this apparatus would be interesting particularly with reference to the speed obtained and its reliability when working near to its maximum.

A HIGH QUALITY TELEPHONE TRANSMISSION SYSTEM.

By B. S. Cohen, M.I.E.E.

In the last issue of the Journal, under a note on "A Reference Telephone Transmission System," mention is made of a high quality system developed by the British Post Office. This was not put forward for use as a basic reference standard inasmuch as no data regarding its stability was available. The frequency characteristics of its component parts are sufficiently flat, however, to result in an overall articulation from mouth to ear which is practically perfection, *i.e.*, of the order of 100% efficiency. It is thought that a description of this system, which was to a considerable extent designed and built at the Research Station, Dollis Hill, would prove of interest, particularly as a detailed description will involve the elucidation of some of the acousto-electric problems of telephone transmission which have received so much attention during the past few years.

The complete system consists of a transmitter, a transmitter amplifier and coupler, an artificial line, a receiver amplifier and coupler and a receiver.

Transmitter.

The transmitter adopted is an electromagnetic device. It is the invention of C. W. Hewlett and may be referred to as an eddy current instrument. It consists of a lightly stretched diaphragm of thin aluminium foil, placed between two concentrically wound flat coils of wire, which are connected in series and in magnetic opposition so that a current through these coils will produce a radial magnetic flux between them. The coils are wound with annular air spaces in order to enable sounds to pass in and out to

the foil diaphragm. This instrument can be used either as a transmitter or a receiver. When used as a transmitter, sound falling on the aluminium diaphragm moves it backwards and forwards in the field caused by the direct current flowing in the flat coils, and this motion sets up eddy currents in the diaphragm which in their turn produce a fluctuating magnetic field superimposed on the stationary field, and by the use of a suitable transformer the corresponding voltage changes can be utilized.

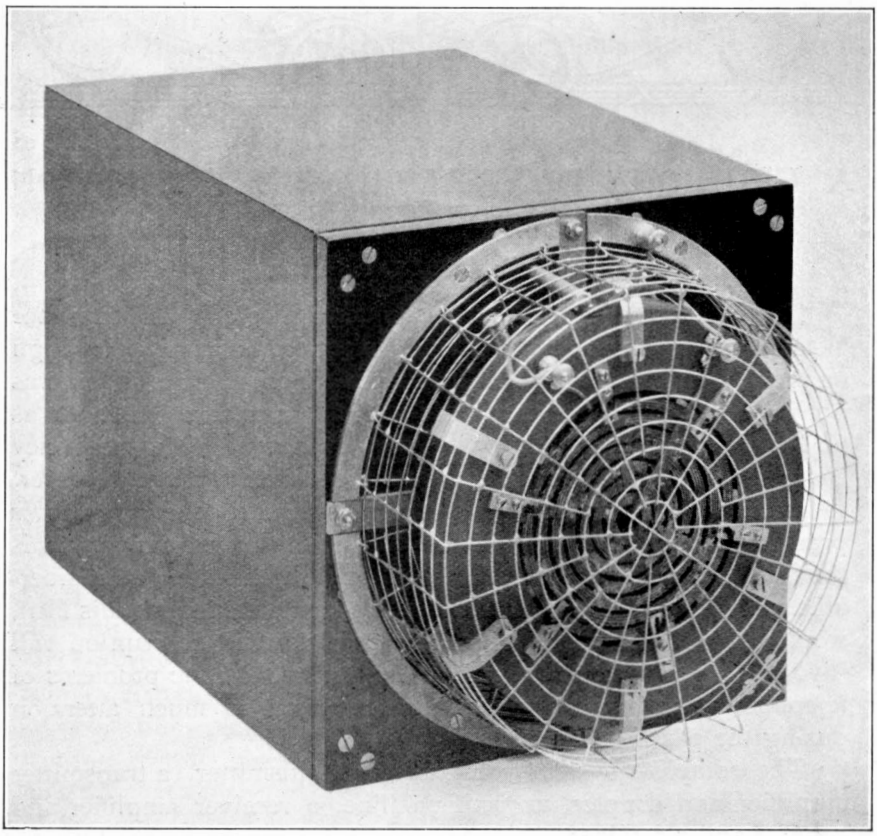


FIG. 1.—THE TRANSMITTER.

There is no iron present and the acousto-electric transformation is remarkably pure. Fig. 1 shows the complete instrument. The back is enclosed by the wooden box which is filled loosely with cotton waste. This prevents interference effects between sound waves impinging on the front and the back of the diaphragm; this effect is particularly liable to happen at the lower audio frequencies. At the same time the loose cotton waste absorbs the sound waves

produced by the motion of the diaphragm without the production of reflection.

The whole transmitter is also enclosed in a wire cage connected to earth; the front of this is visible in the photograph. This cage acts as a shield to prevent electrostatic induction. The polarizing current required is of the order of 0.7 ampere. This form of transmitter is insensitive, having only about 1/5000th the sensitivity of an ordinary commercial C.B. transmitter and in consequence requires an amplifier giving that order of amplification to render it equivalent to an ordinary transmitter. A four stage resistance capacity coupled audio frequency amplifier is used for this purpose; Fig. **2** shows the connections of the transmitter and its

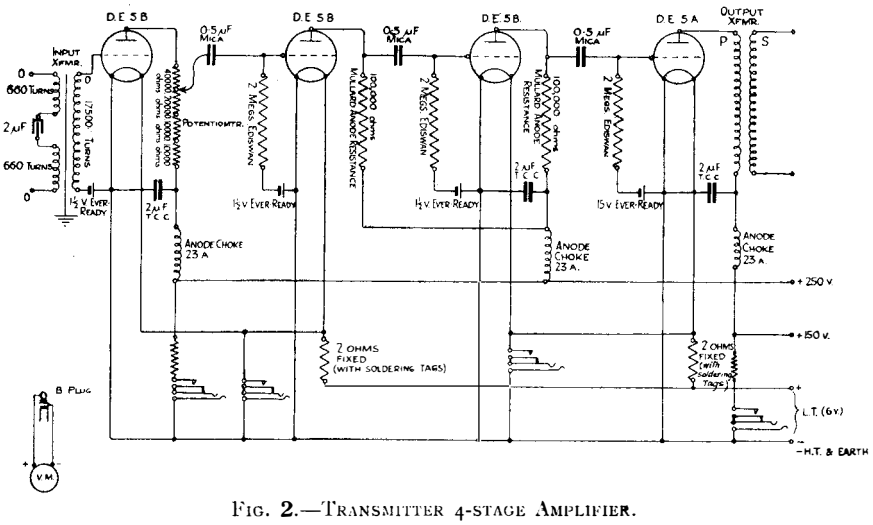


FIG. 2.—TRANSMITTER 4-STAGE AMPLIFIER.

associated amplifier. The three first stages are D.E. 5B valves, which have very high amplification and impedance, and the last stage is a D.E. 5A, which is of much lower impedance and may be described as a small power valve.

A potentiometer is connected in the anode circuit of the first stage and controls the magnification in 4 steps, giving full, $\frac{1}{2}$, $\frac{1}{4}$ or $\frac{1}{8}$ magnification.

Three separate anode chokes are used to connect up the H.T. battery and these connections are also shunted by 2 μF condensers. The filament supply is controlled by fixed resistances. By these means the amplifier, although giving a considerable amplification, is silent and free from self-oscillation. The amplifier is enclosed as a whole in a metal screen.

The efficient coupling of the eddy current transmitter to the amplifier requires a specially designed transformer, and particulars

of this will be of interest. The A.C. resistance of the eddy current transmitter is 10 ohms and its impedance over the audio frequency range is of the order of 90 /80° ohms.

The input transformer is built on a stalloy stamping core of $\frac{3}{4}''$ square section and consists of interleaved primary and secondary windings. There are 4 primary windings each of 330 turns, total 1,320 turns, and 5 secondary, 3 of which are each of 4,500 and the

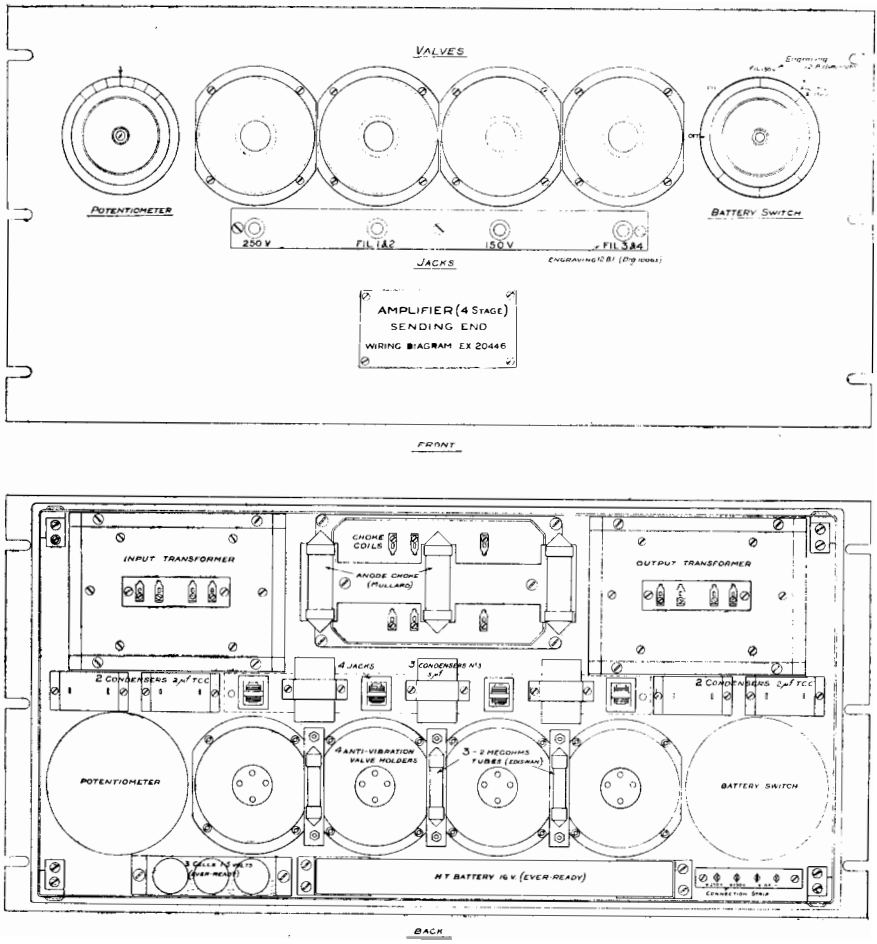


FIG. 3.—TRANSMITTER AMPLIFIER ASSEMBLY.

remaining two of 2,000 turns, so that in all there are 17,500 turns in the secondary, *i.e.*, a step up of about 15 : 1. The primary winding is divided in halves and connected to the eddy current transmitter in the manner shown. The output transformer for the transmitting amplifier has to step down from the anode impedance of the D.E. 5A valve (about 2000 ohms), to a 600 ohms non-

reactive line. This is also an interleaved winding transformer, giving a step down of about 2 : 1. The jacks shown in the circuit are for the purpose of plugging in a voltmeter for measuring filament, grid and anode voltages.

This amplifier is built up on a metal back plate provided with a metal cover and mounted on a small rack. Fig. 3 shows back and front views of this assembly.

Calibration of the Transmitter.

The detailed explanation of the calibration of the transmitter would be a lengthy one and outside the scope of the present article. It will, however, be advisable to give a short and general explanation of the methods adopted, as these are typical of the more scientific methods of quantitively measuring transmission apparatus which it is anticipated will ultimately replace the much less accurate older methods. The behaviour of a telephone transmitter, *i.e.*, an acousto-electric transformer, may be quantitively measured as regards its volume and articulation qualities by measuring the ratio of the acoustic input pressure (in dynes per sq. cm.) to its output volts for all frequencies in the audio range. The range of audio frequency that is of any importance in the reproduction of high quality speech may be taken as of the order of 100—5000 p.p.s., whilst a range of from 30—10,000 p.p.s. may be assumed to be ideally perfect for the reproduction of music and noises.

Apparatus is now available which produces pure sounds over most of this range, and sinusoidal A.C. over the whole of the range. Apparatus also exists which is capable of measuring the acoustic and electric pressures respectively of these supplies. With these four essentials it is possible to measure the acousto-electric ratios of transmitters, the electro-acoustic ratios of receivers and the electric-input—electric-output ratios of lines and circuits. Description of this apparatus must be deferred to another time. Reference may, however, be given to the paper entitled "The Frequency Characteristics of Telephone Systems and Audio Frequency Apparatus and their Measurement": B. S. Cohen, A. J. Aldridge and W. West: Journal I.E.E., No. 358, 1926, in which details of this apparatus will be found.

Let us assume then that we have apparatus available to produce a known acoustic input pressure p over the audio range on a transmitter diaphragm and to measure the corresponding voltage output E. The greater the ratio E/p at any given frequency, the greater will be the volume efficiency at that frequency. By plotting E/p against frequency, a frequency characteristic is obtained which will be a measure of the articulation efficiency.

Defining articulation as perfection of reproduction of originat-

ing wave form, a frequency characteristic consisting of a straight line parallel to the frequency axis would indicate that E/p would be a constant at all frequencies and in consequence that the apparatus would reproduce perfectly.

A sudden increase in E/p at any frequency or band of frequencies indicates resonant conditions at those frequencies. In the same way if E/p at the lower or higher frequencies was very small, or zero, it would indicate that the apparatus was incapable of responding to the lower or higher audio frequencies respectively.

FIG. 4.—FREQUENCY CHARACTERISTIC OF TRANSMITTER AMPLIFIER.

Owing to the accommodating qualities of the ear, however, apparatus with frequency characteristics departing to some extent from the ideal will yet give very high quality articulation.

We are now in a position to consider the frequency characteristics of the eddy current transmitter and its associated amplifier.

Fig. 4 is the frequency characteristic of the 4 stage amplifier used with the eddy current transmitter. In this case the Amplification/1000 is plotted against frequency. It will be observed that the amplifier resonates at about 100 p.p.s. This is due to

resonance in the input transformer, which has a 2 μF. condenser connected in its primary for this purpose. This resonance helps to push up the efficiency of the transmitter at the lower end. Beyond this the amplification remains substantially constant.

Fig. 5 shows the acousto-electric frequency characteristic of the eddy current transmitter and the ratio plotted against frequency is microvolts/dynes per sq. cm. The efficiency rises gradually to a maximum and then falls at the higher frequencies to the order of the values at the lower end of the audio range. The maximum variation, however, is about 30 : 10. There is a physiological law

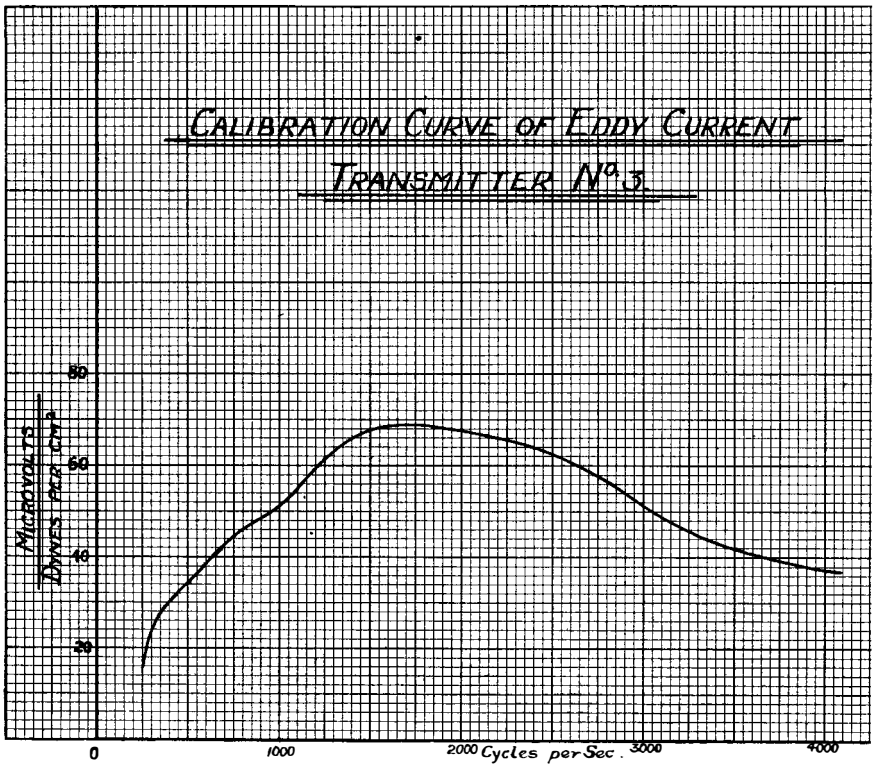


FIG. 5.—ACOUSTO-ELECTRIC FREQUENCY CHARACTERISTIC OF TRANSMITTER.

termed Fechner's law to the effect that sensation is proportional to the logarithm of the stimulus. This law applies to acoustic as well as to other sensations.

In the case of the characteristic for the eddy current transmitter, the comparative sensations produced on the ear by sounds varying in loudness by 10 : 30 would be of the order therefore of only 1 : 1.5. It should be noted that the variations in the ratio E/p for commercial types of transmitters and receivers in general use over the audio range is enormously greater.

The combined eddy current transmitter and amplifier characteristic is plotted in Fig. **6**. It will be observed that the amplifier to some extent corrects the transmitter characteristic. For purposes of comparison a typical characteristic for a C.B. solid back transmitter is also shown in dotted lines.

The artificial line.

This consists of a non-reactive line with a range of from 0.01*b* to 11*b* by steps of 0.01*b* (approximately 0.09 to 96 T.U.). The impedance of this line is 600 /0 ohms and it is built up of T section

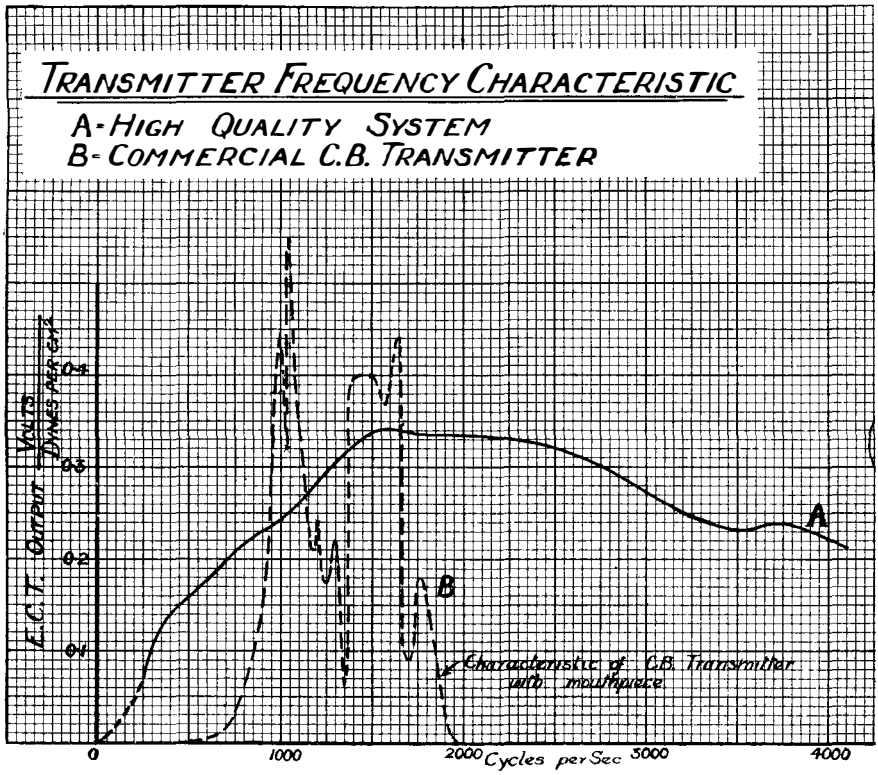


FIG. **6**.—COMBINED TRANSMITTER AND AMPLIFIER CHARACTERISTIC.

non-inductive resistances. This line is adjusted by three dials giving ranges of 0.01 – 0.1, 0.1 – 1 and 1 – 10*b* respectively. (Note $b = \beta l$.)

This line is mounted on a separate small rack together with voltmeter for measuring filament, anode and grid voltages.

The Receiver.

The receiver is of a special moving coil electro-magnetic type designed and built at Dollis Hill.

Fig. **7** shows the general assembly of the instrument, and Fig. **8** is a photograph of the disassembled instrument. The instrument has an electro-magnet with concentric pole-pieces, giving an annular field in which a very light moving coil can operate. This moving coil consists of 300 turns of No. 47 S.W.G.

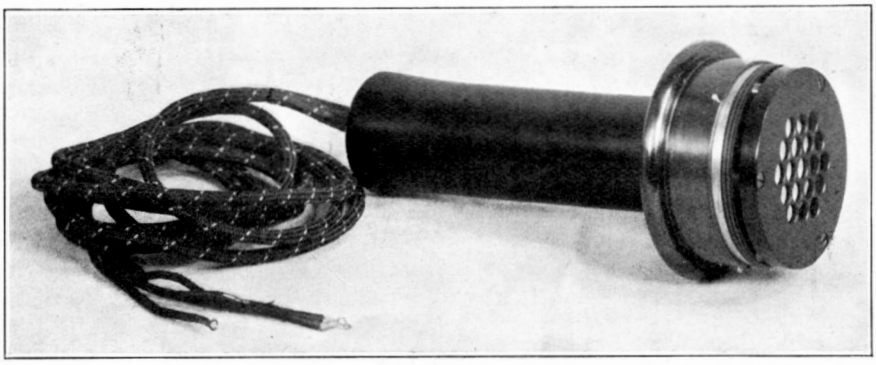


Fig. **7**.—Receiver Assembly.

copper wire, 500 ohms in resistance. The coil and its former only weigh $\frac{3}{4}$ gramme. The former is provided with feet by which it is fastened to a disc of elder pith, 1 inch in diameter and 3/16 inch thick and weighing about $\frac{1}{4}$ gramme, and also to a diaphragm of oiled silk, 2 inches in diameter, clamped around its circumference and only slightly stretched. The feet of the former provide an air gap round its base and prevent the trapping of air inside the

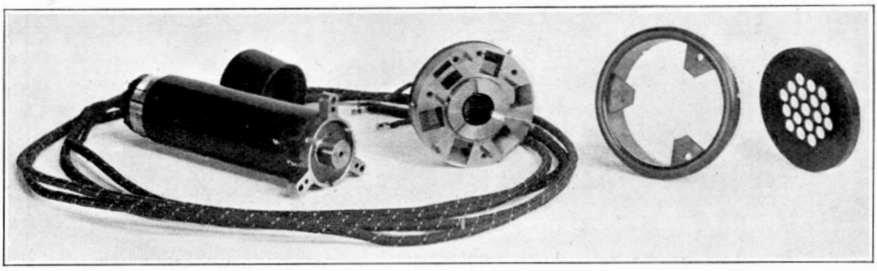


Fig. 8*a*.—Receiver Parts.

coil and consequent air damping. For the same reason the outer case of the receiver is cut away so that there is very little air damping produced, and the control on the moving coil is primarily due to inertia.

The annular field is uniform and extends well above and below the moving coil winding, so that small changes in the position of

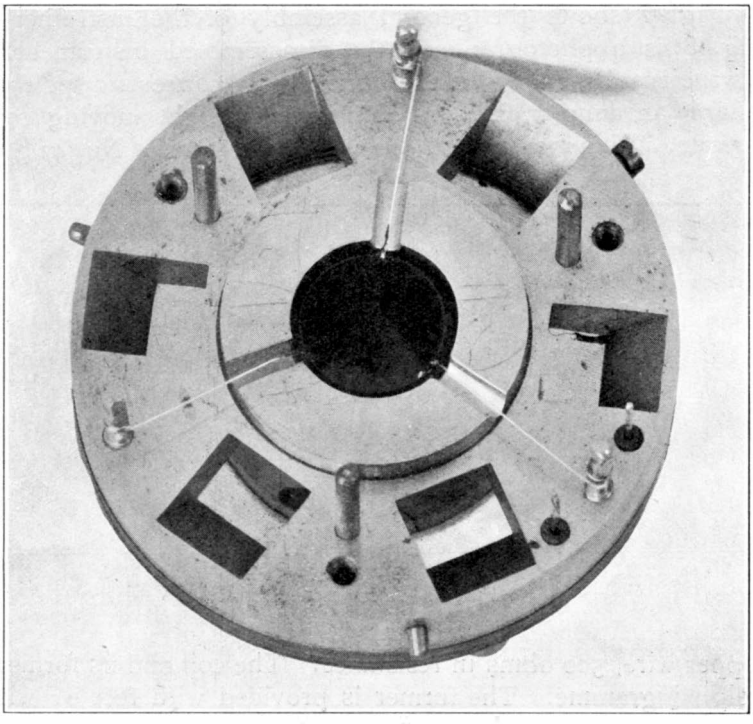


FIG. 8*b*.—ENLARGED VIEW OF RECEIVER COIL MOUNTING (BACK).

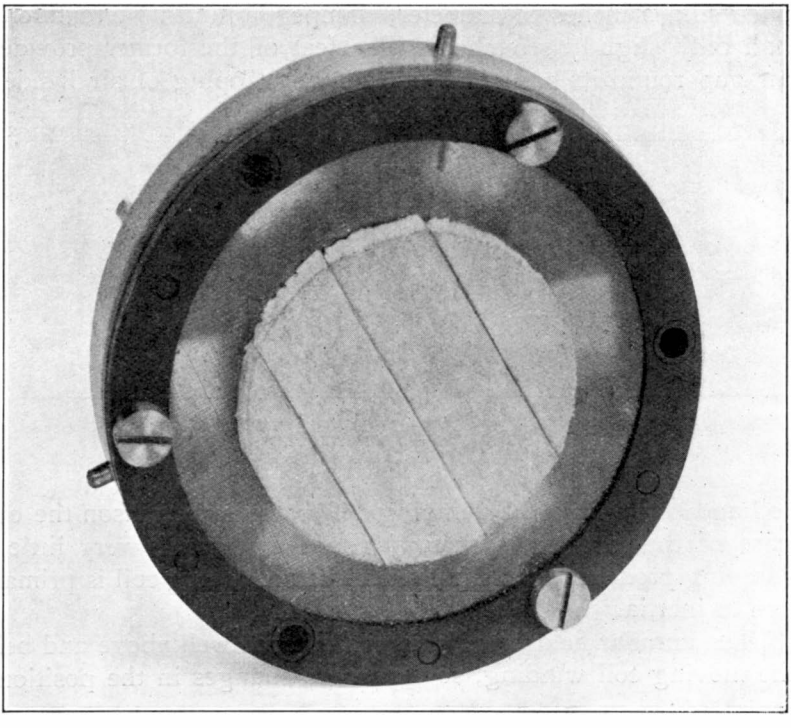


FIG. 8*c*.— ENLARGED VIEW OF RECEIVER COIL MOUNTING (FRONT).

the latter do not affect the receiver output efficiency. The field magnet is saturated with about 100 milliamps through its winding. To prevent the moving coil tilting in the field and touching the poles, it is supported at its lower end by three fine wires fixed radially. A perforated ear rest is supported on three pillars at a distance of about $\frac{1}{4}$ inch from the pith disc. There are such a number of perforations in this guard and its distance is such that the acoustic loading introduced by its presence is not appreciably altered by the application of an ear to the guard.

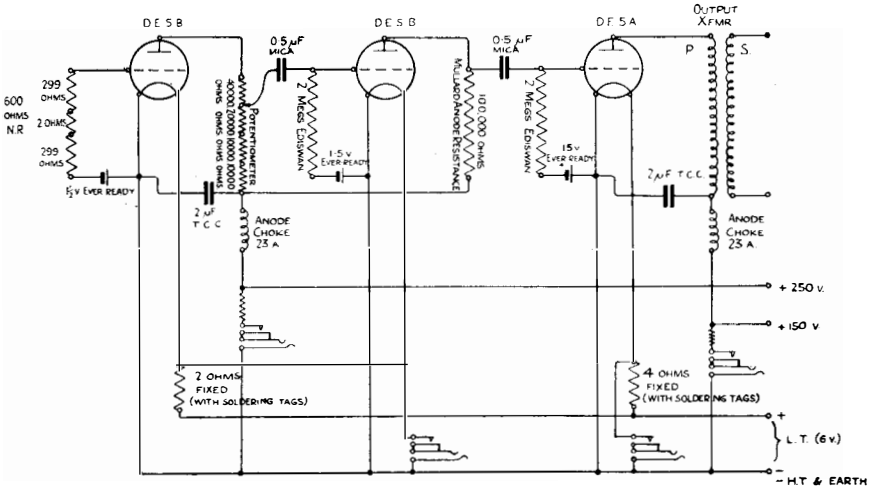


FIG. 9.—RECEIVER 3-STAGE AMPLIFIER.

Fig. **9** is the circuit of the 3 stage amplifier to which this receiver is connected. It is mounted on a separate rack in the same way as the transmitter amplifier. There is no input transformer at present, but the impedance of the grid circuit of the first valve is made equal to that of the non-reactive line by shunting with a 600 ohms non-reactive resistance. It will be observed that the centre 2 ohms of this resistance is tapped. This is for calibrating purposes.

The output transformer has a step down of 3.75 : 1 and is somewhat on the lines of the output transformer on the transmitter amplifier. The receiver impedance is of the order of 500 $\angle$ 10° for the audio frequency range.

Fig. **10** is the characteristic of the moving coil receiver together with its amplifier. It will be observed that the moving coil system has a resonance at a low frequency and that apart from some small fluctuations which appear to be due to acoustic reflections between the guard and the diaphragm the electro-acoustic ratios p/E gradually fall off from about 3.2 at 500 p.p.s. to 1.0 at 4500 p.p.s.,

or a 3 : 1 ratio which converted to aural sensations may be taken as a range of 1.5 : 1.

For purposes of comparison a typical 60 ohms Bell receiver characteristic is also plotted in dotted lines. This is the characteristic under the conditions of acoustic damping existing when the receiver is placed against the ear.

It is the intention to further improve the receiving circuit by modifying the amplifier and its transformers so that it has a rising characteristic, in order to compensate for the falling characteristic of the moving coil receiver.

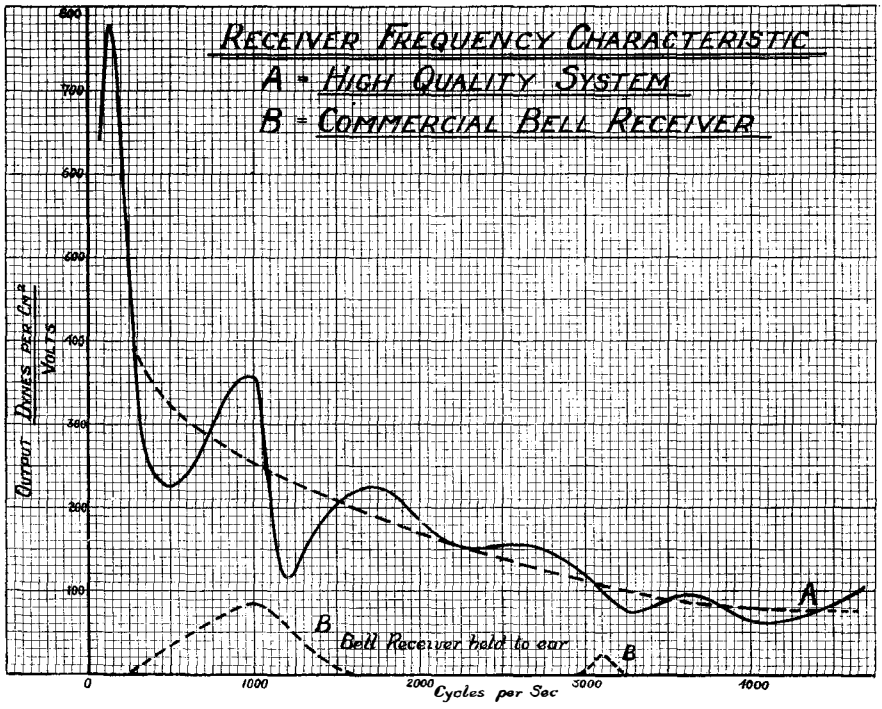


Fig. 10.—Frequency Characteristic of Receiver and Amplifier.

An interesting series of tests to demonstrate the comparative articulation efficiency of this high quality set has been carried out. Articulation tests have been made in the usual manner by reading lists of monosyllabic sounds and taking a mean value for percentage of sounds correctly recorded by 3 observers carrying out 6 tests.

The volume transmitted in this test has then been reproduced for direct transmission in an almost empty room between the same speakers and listeners and also in the open air. The balance was obtained by regulating the distance apart of the speaker and listener, the volume of the former's voice being kept the same as

when using the high quality set. Under these conditions a similar articulation test was carried out and the average percentage correctly recorded for direct transmission in open air and room was 97% and the corresponding figure for the High Quality System was 96%. This should be compared with about 60%, which is the value obtained with a Standard C.B. transmitter connected to a Bell receiver by a high quality non-reactive line equivalent to 30 miles of standard cable (27.7 T.U. or 3.2*b*).

In conclusion it should be stated that the reference system of Telephone Transmission, whose proposed adoption as the Master Standard was mentioned in the last issue of the Journal, and which was designed in the Bell Telephone Laboratories, whilst being of the same order of high quality as the apparatus described in this article, has in addition the following attributes : (1) Proved stability in use. (2) It is completely self-contained with acoustic and electric calibration apparatus.

It is to be anticipated that a complete description of the Master Reference Standard will be published in due course by the Bell Telephone Laboratories and that it will then be possible to publish a full description in this Journal.

JUBILEE OF THE TELEPHONE.

INTERESTING CELEBRATIONS AT THE INSTITUTION AND AT THE SCIENCE MUSEUM.

IT is fifty years since the world's first telephone message was sent from one room to another in a house in Boston, U.S.A., by Mr. Alexander Graham Bell. The jubilee of the telephone, the memory of Mr. Graham Bell, and the developments of the past half century were fittingly celebrated by the Institution of Electrical Engineers on the 24th June, when Sir William Mitchell Thomson spoke at a jubilee luncheon and Sir Oliver Lodge lectured to members of the Institution.

The luncheon, which was held at the Hotel Cecil, was attended by a thoroughly representative gathering of electrical engineers, and it was pleasing to note the presence of many P.O. representatives. Unfortunately the Engineer-in-Chief was unable to be present owing to his attendance at the International Conference at Paris. Among those supporting Mr. R. A. Chattock, the year's President of the Institution, at the top table were the following :— The Rt. Hon. Sir William Mitchell Thomson, Postmaster-General, The Rt. Hon. Lord Gainsford, Sir Ernest Rutherford, Sir Oliver Lodge, Senatore G. Marconi, Professor Fleming, Sir Wm. Henry

Ellis, President of the Civil Engineers, Wing Commander C. W. Nutting, Air Ministry, Lieut.-General Sir J. S. Fowler, Royal Corps of Signals, J. H. Jeans, Esq., Secretary of the Royal Society, J. C. W. Reith, B.B.C., and Dr. W. H. Eccles, together with the past presidents of the institution. The luncheon was also graced by the presence of many ladies.

A Record of Progress.

Looking back over the last half century, said Sir William Mitchell Thomson, the telephone deserved to be ranked as among the greatest of the contributions of science to industry. It was hardly too much to say that the telephone had now become a practical necessity to civilised life. Last year we installed as many telephones as were installed during the first twenty years of the development of the telephone. The jubilee of the telephone coincided with a number of interesting events in its development. He hoped it would coincide with the installation and completion of the first large London telephone automatic exchange. In the second place it would coincide with a deliberate and co-ordinated effort to improve international telephone facilities in Europe. There was just being completed a new submarine cable to Holland with twelve speech channels, which would bring the cities of Germany into complete telephonic touch with this country. Later in the year a new cable was to be laid to France with 21 speech channels, and a similar one to Belgium. The third event of the jubilee year was that for the first time they had covered such a distance in their experiments that ordinary two-way trans-Atlantic telephony was well within sight.

At a subsequent gathering in the Lecture Theatre of the Institution in Savoy Place, Sir Oliver Lodge lectured upon "The History and Development of the Telephone," and the Faraday Medal of the Institution was presented to Colonel R. E. B. Crompton as a mark of his lifelong work in the electrical industry.

If asked suddenly what was the simplest and greatest invention of the nineteenth century, he would be disposed to say the telephone, said Sir Oliver Lodge. The articulating telephone was an instrument of absurd simplicity. It was invented by one who was not a professed electrician, who was not really learned in physical science, but was interested mainly in introducing precision and clear intelligibility into human speech. Most people in talking slurred over words in a careless and barely intelligible manner. Clear utterance was never a strong point of the pulpit, though it used to be prevalent on the stage. (Laughter.) Even that could hardly be said now. Graham Bell's own articulation was of the most precise character. He had been concerned in the

training of the deaf and dumb, he had married a deaf and dumb wife, and devoted himself to the accurate production of human speech, whether by his own lips and larynx or through its reproduction by instrumental means. He once said that it was fortunate he was not a scientifically trained physicist, for if he had been he would probably have thought that an articulating machine of a simple character was an impossibility.

"It is difficult to exaggerate the delight with which the telephone was received," said Sir Oliver. "In these days it is occasionally customary to regard the telephone as a nuisance, and so I found it in America in 1920. At any time, day or night, I might be called up. It was little use telling the hotel clerk not to switch people on. They got through any ordinary barriers, and when too much bored, my plan was to turn the receiver on to the transmitter and let the communicator talk back to himself—a plan which was usually effective. It was also said that Bell himself found the telephone a sort of nuisance, and had it removed from his room." (Laughter.)

Sir Oliver gave a most interesting description of his bringing the first receivers to this country and explained how a fault in the diaphragms threw light on the theoretical and practical operation of the apparatus. He was applauded enthusiastically by the crowded audience at the close of his address.

Conversatione and Exhibition.

In the evening a large company of members and their friends attended the annual reception by the President in the Science Museum, South Kensington.

By the courtesy of Colonel H. G. Lyons, F.R.S., Director of the Science Museum, and Colonel T. F. Purves, O.B.E., Engineer-in-Chief of the General Post Office, an Exhibition was arranged on the First Floor (Gallery XXVI.) of a representative collection of telephone apparatus of historical interest. The exhibits included the following:—

1. *Original Reis Telephones.* The first electric apparatus for the transmission of sound was invented by Philip Reis, of Friedrichsdorf, in 1863, and called by him a "telephone." The apparatus was not, like Bell's, a speaking telephone.
2. *Early Bell Telephones.* One of these instruments is very similar to that exhibited by Graham Bell at Philadelphia on June 25th, 1876. The diaphragm is of goldbeater's skin and has at its centre a piece of cork to which is attached an armature. Two subsequent forms of the Bell telephone are also shown.
3. *Original Hughes Microphones.* A selection from the original

apparatus made and used by D. E. Hughes in connection with his discovery of the microphone in 1878.

4. *Edison Carbon Transmitter.* The main features of this—the first commercial application of the carbon transmitter—were patented by Edison in 1877.
5. *Early Telephone Instruments.* A selection showing the evolution of the present-day telephone from the original apparatus of Bell, Hughes and Edison.
6. *Telephone Switchboards.* A series of manual switchboards from 1888 to the present day.
7. *Automatic Telephone Apparatus.* Some of A. B. Strowger's original instruments, and also working models of the automatic telephone systems for London and the Provinces which may be inspected and operated.
8. *Telephone Repeaters.* Models of two-wire and four-wire trunk telephone repeaters (in operation).
9. *Trunk Testing Equipment.* Apparatus used by the General Post Office for measurements on trunk telephone lines.
10. *Samples of Submarine and Underground Telephone Cables, Etc.*

TIME SAVING TESTERS.

FOR AUTOMATIC EXCHANGES.

By W. PRICKETT and H. S. SMITH
(Engineer-in-Chief's Office).

THAT a selector is not of much use without its bank is a truism, but in the consideration of the testing-out of automatic exchange equipment, tests of the switch functions are apt to overshadow those of the uninteresting, but no less important, banks. In the past the latter have, in the main, been tested by means of a buzzer and battery, a method more productive of eyestrain than accuracy. The time which this method occupied was enormous while the results were disappointing, for such faults as high resistance contacts between adjacent lines, contacts between adjacent levels and failure of the switch wipers to make satisfactory connections with the bank circuits were not detected.

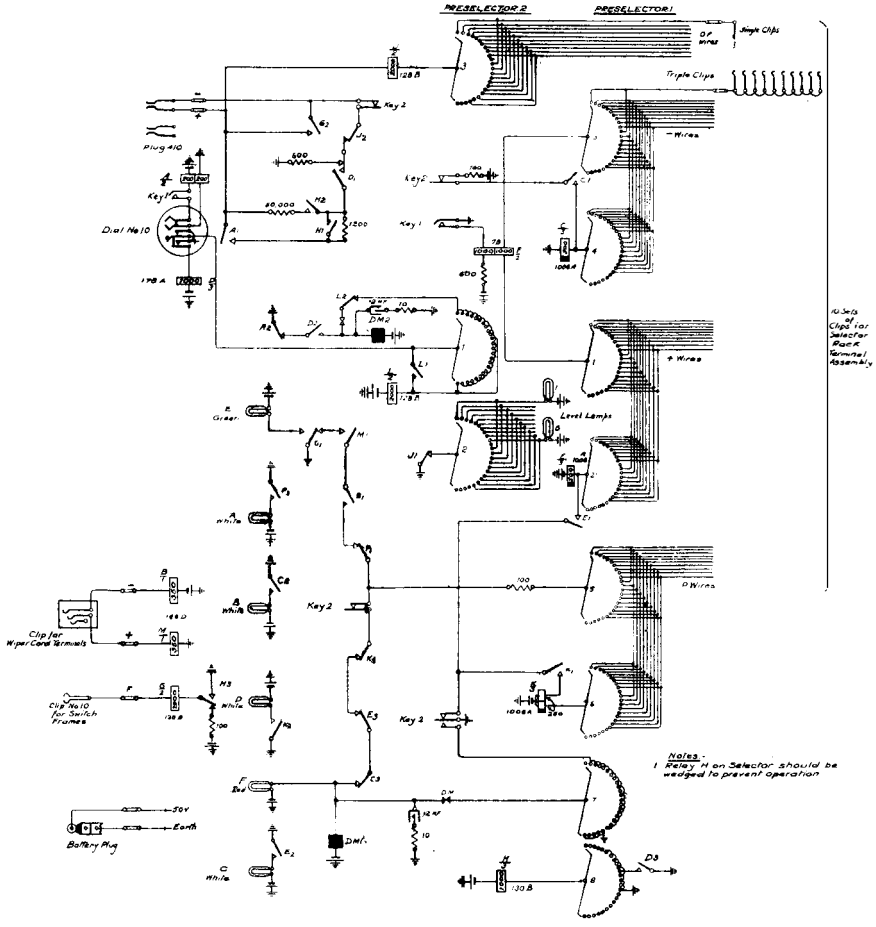
Alternative methods had, therefore, to be adopted to deal with faults not covered by the simple tests for continuity.

In an exchange such as Holborn Tandem there are about seven thousand group selectors and the time taken to "buzz out" their banks would approach 3500 man-hours. The advent of a tester

which enabled the testing of these banks to be completed in one-tenth of this time was, therefore, welcomed by those who had had experience of the laborious task of performing these tests by the old method.

This tester, which will now be described, applies tests not only to replace the "buzzing-out" but many others to cover the deficiencies of that method, with the result that before the exchange is opened for service, faults are discovered which might cause much trouble.

In addition to the bank test, which is the primary object of the design, an effective operating test of the selectors is made without additional expenditure of time.



CIRCUIT OF TESTER N.

TESTER "N."

Tester "N," a circuit diagram of which is here reproduced, consists of a few relays and two preselectors, together with the

means of connection to the bank wiring and the switch to be tested.

The equipment contractors have arranged to run the grading wires the whole length of the selector rack terminal assembly, thus commoning all the banks and to leave the jumpers disconnected until the completion of the tests. The ten outgoing circuits from each level of the banks are connected, one level at a time, as the test on the first switch proceeds, in parallel with the circuits from the other levels, by means of the ten sets of ten triple clips provided. These clips are connected in the tester to the bank of an eight level preselector. In addition the eleventh ("O.F.") contacts of each level are connected, by means of the ten single clips provided, to the bank of the second preselector in the tester.

The test plug is inserted in the test jack of the first selector to be tested and the + and − clips are attached to its wipers.

A clip is also provided for attachment to the bank rod or frame of the selector under test.

Relay H of the selector is wedged in order to prevent operation and Key 2 depressed, if necessary, to set preselector 1 to contact 1. Key 1 is also operated. The latter causes relay F to be energised *via* its polarising winding and also operates the impulsing relay A.

The dial is now operated to step the selector under test to level 1.

Immediately the dial is moved off normal, relay D operates to connect the impulsing loop at D1 op. An earth is also applied to wiper 1 of preselector 2, causing the latter to rotate home in readiness for indicating the level dialled. The circuit is from battery, *via* DM2, interrupter springs, L2 nor., bank and wiper 1 to earth at the dial. When the wipers reach contacts 11 or 25, relay L operates and locks to the same earth, thus disconnecting the homing circuit at L2 op.

On the release of the dial, relay A responds to the impulses transmitted, and repeats these impulses to the selector under test *via* A1, and to DM2 *via* A2 and D2 op. Preselector 2 steps round to the contact corresponding to the number dialled and causes the appropriate level indicating lamp to glow *via* wiper 2 and J1 nor.

The selector should now step up to the required level and cut in to the first contact on the bank.

Relay D, releasing when the dial returns to normal, completes a holding circuit to the − line of the selector *via* D1 nor. and 600 spool to earth. A circuit is now completed for relays M and B *via* the + and − bank wires, arcs 1 and 3 of preselector 1 and relay F.

Receipt of a current of correct strength and polarity by relay F causes the latter to release and complete the circuit of DM1 *via* F1 nor., B1 op. and M1 op. to earth at G1 nor.

This earth is also connected *via* the 100 spool and arc 5 to the P wire, causing the selector relay G to operate and step on the switch to the next contact.

The circuit for relays B, M and F is now broken and DM1 steps on when its circuit is interrupted at F1 op.

The sequence of operations is repeated on the remaining contacts of the level until the selector comes to rest with its private wiper on the eleventh contact, and its cam springs operated to give the busy signal.

If the latter is correct, battery is received *via* the + line by relay J, which is connected to earth at the selector *via* wiper 3 of preselector 2, O.F. clip 1 and the eleventh contact on which the switch wiper is resting. Each battery period of the busy signal operates relay J, which flashes the level lamp at J1 op. At J2 op., the holding circuit is disconnected in order to test the selector for the "busy hold" feature. The latter is faulty if the switch releases.

If the lamp, corresponding to the dialled level, flashes correctly three times, it may be assumed that the required level has been successfully tested and the selector should be released by the depression of key 2.

In addition to the foregoing a test is provided on each bank wire for contact with the adjacent wire. This is effected by relays C, E and K, which are connected *via* arcs 4, 2 and 6 to the required lines adjacent to those under the previous test.

A contact causes the appropriate relay to operate and lock *via* its own contact.

Lamps B, C and D are provided to indicate this condition and are operated *via* contacts C2, E2 and K2 respectively. The rotation of preselector 1 is also interrupted at C3, E3 or K3, and attention is drawn to the fault indicated by the stopping of the tester.

A further test for earth or battery in contact with the switch or bank frame is provided by relay G, which is alternately connected to battery and earth by the operation or release of relay H at arc 8. A fault of this nature is indicated by lamp E, which glows *via* G1 op., and by failure to impulse or stopping of the test. If, however, it is an eleventh contact which is framing, the fault is indicated by failure to release on operating key 2. Relay H also changes over the dialling conditions from a 1200 ohm loop to a zero loop for alternate tests.

The position in which preselector 1 stops usually indicates the corresponding contact of the selector bank on which a fault exists. In certain cases, however, a departure is made from this condition, but reference to the table following will enable the testing officer to decide where the fault is located :—

Nature of Fault.	Wire.	Indicating Lamps.	Position of Wipers. (On fault unless otherwise stated).	
			Preselector Contact.	Selector Contact.
Dis.	−	A	−	−
	+	A	−	−
	P	F	−	−
Earth	−	A	−	−
	+	ABC (except Contact 1)	One before fault	−
		None (Contact 1)	−	−
	P	AD (except Contact 1)	One before fault	One past fault (On fault if high res.)
		ABC (Contact 1)	−	
Contact	− & + (S/C)	AB (except Contact 1)	One before fault	−
		A (Contact 1)	−	−
	− & P	ABC	One before fault (except Contact 1)	−
	+ & P	A	−	−
	Adjacent − & −	ABC	− (1st line)	− (2nd line)
	+ & +	ABC	− ,,	− ,,
	P & P	ABCD	− ,,	− ,,
	P & OF	A	1 (or II)	Premature Release
	Frame & OF or Eth.	AE	1 (or II)	
Reversal	− & +	A	−	−
	− & P	−	−	−
	+ & P	A	−	−

Lamp F also gives warning in the event of the Tester Preselector 1 being held continuously operated.

REMARKABLE VITALITY OF A P.A.B.X. EQUIPMENT.

A REMARKABLE instance illustrating the ability of modern telephone plant to withstand the most adverse conditions has recently occurred in Lancashire, where a Private Automatic Branch Exchange equipment installed in the basement of a cotton mill was inundated by the floods consequent upon an exceptionally severe thunderstorm.

The charging machine, ringing machine, one battery of secondary cells and practically the whole of the automatic equip-

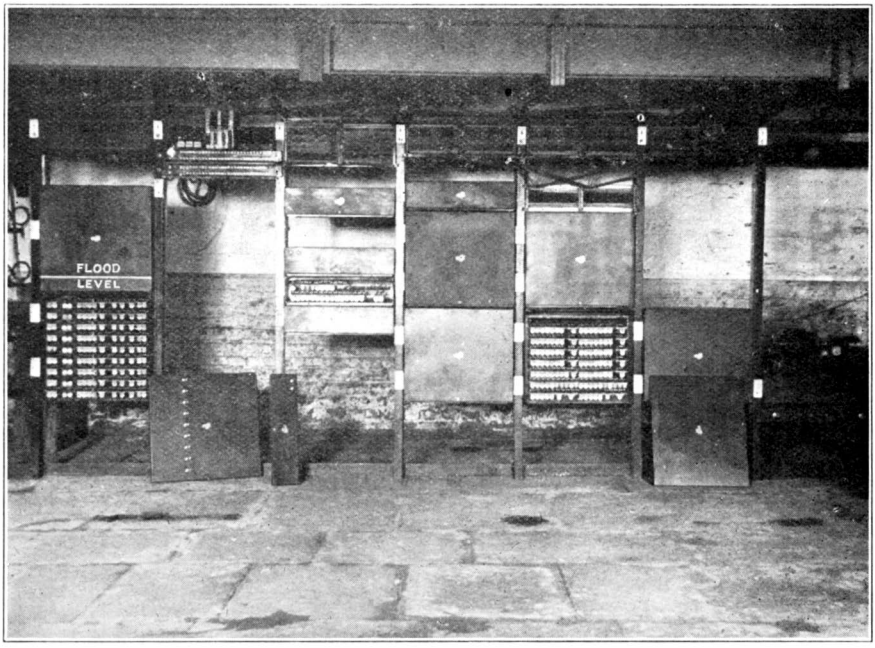


FIG. 1.—APPARATUS RACK SHOWING FLOOD LEVEL.

ment were submerged. The flood occurred late one evening and no steps to restore the service could be taken until the storm had abated, when a fire engine was employed to empty the basement, which had been filled to a depth of about 4 feet.

From 2 to 3 inches of mud was left on the floor, and besides being soaked with water the apparatus was found on removing the relay covers to be smothered with a film of slime and green rubbish.

Although the position appeared hopeless, the idea of salving the equipment was formed, and as a first step in this direction

a hose was connected to a hydrant and turned on the apparatus to wash away the filth; any mud remaining after washing with the hose was removed from the relays and cable forms by the use of Pyrene fire extinguishers. The washing completed, the standing water was mopped up and all surfaces were wiped with clean cloths. The machines, after further washing and wiping, were dismantled and placed in the boiler house to dry.

Two sets of secondary cells were fitted at different levels on a rack. The lower set was submerged and left partly filled with mud, the electrolyte having mingled with the waters of the flood. To restore the cells to service they were emptied, cleaned and

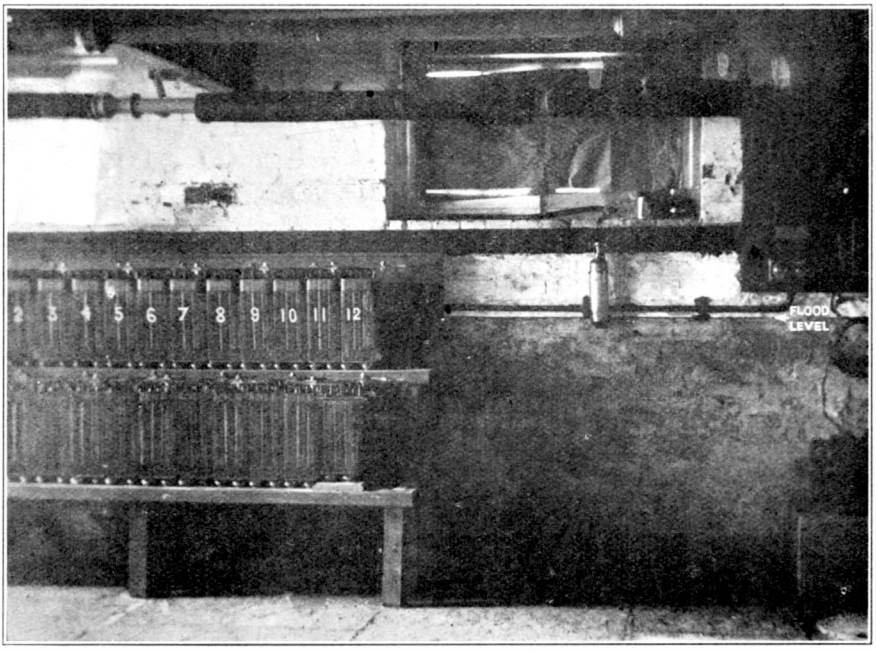


FIG. 2.—BATTERY SHOWING FLOOD LEVEL.

refilled with acid and, pending the availability of the charging dynamotor, they were charged through a resistance direct from the mains.

The ordinary heating apparatus of the room was brought into use, but this was found to be quite inadequate if the water were to be evaporated before the plant was damaged by corrosion. A motor desiccator, a number of blow lamps and as many electric radiators as could be obtained were brought into use. The most efficient way of removing the moisture, however, was found to lie in the use of "Vacuum cleaners" reversed and used as blowers,

with the suction sides arranged to draw the heated air from blow lamps through 6" diameter metal tubes in which were placed bags of calcium chloride. As much as possible of the water standing on the relay springs and other parts was removed by the use of blotting paper and the cable forms that had been submerged were opened and boiled out with wax.

Attention was then directed to the reconditioning of the automatic apparatus in detail, the work being carried on continuously day and night. It was necessary to brush and clean the various parts of each relay before any regulation or adjustment could be made. All relay armatures were removed and cleaned, every contact throughout the equipment was cleaned, and every spring was tested for tension and adjusted if necessary.

Immediately following the flood notice had been given to the manufacturers (the Relay Automatic Telephone Coy.) of the possibility of a demand being made for plant to replace the damaged equipment, but, thanks to the quality of the original apparatus and to the initiative and the persistent efforts of the staff, the installation, as it stood, was restored to service on the morning of the seventh day after the flood.

600 relays, one set of secondary cells, one charging machine, one ringing machine and the associated wiring and cabling were submerged, but with the following exceptions the whole of the plant was salved and is still in use. The exceptions were one choke coil and 3 transformers in the ringing equipment and 8 relays and 4 condensers in the automatic switching equipment.

The protector cases were also flooded, but on the morning after the flood the subscriber was given service to the exchange and to some of the extensions through the Manual Board situated on the floor above. This partial service was continued until complete restoration.

Some idea of the conditions prevailing after the flood may be gained by the fact that the staff found it desirable for the first two days to work in Wellington boots, which were supplied to them by the subscriber.

The local staff who carried out the whole of the work can be heartily congratulated on the result, and it is pleasant to record that the appreciation of the Engineer-in-Chief was conveyed to each man who had so wholeheartedly worked to achieve success in what, for a few days, seemed an impossible task.

Twelve months have now elapsed since the flood, and the occurrence of faults in the automatic apparatus has been at the rate of one fault per circuit per annum, a figure which, although about four times as great as the normal for this type of installation, cannot be regarded as high in the circumstances described.

THE TUNGAR RECTIFIERS.

By H. C. Jones, B.Sc.

In view of the increasingly large number of small telephone installations such as P.A.B.X.'s, C.B.S. No. 2 and C.B. 10A

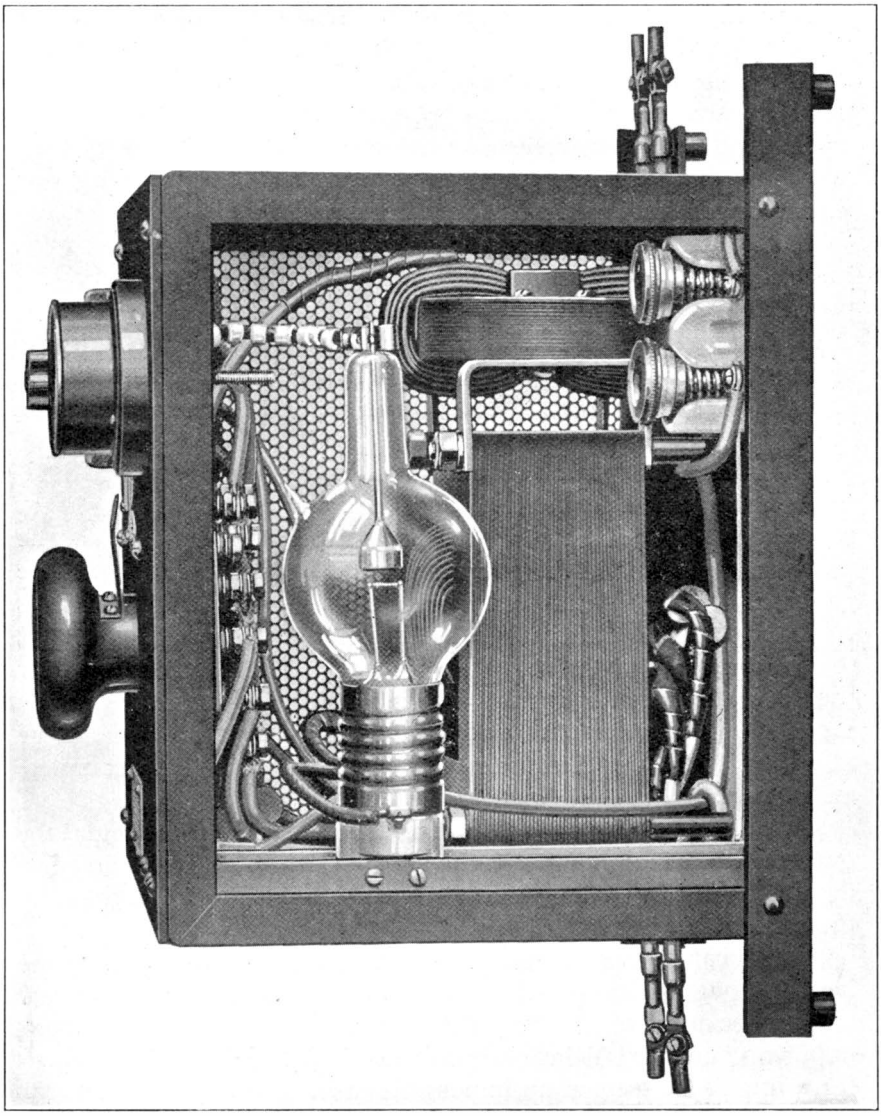


Fig. 1.—Internal view of Half-Wave type, Tungar Rectifier.

exchanges which require secondary cell power plant, it has become necessary to standardise suitable apparatus for charging small

capacity secondary batteries from alternating current mains. Trials have been made with rectifiers of various types, such as the ordinary motor-generator set and the aluminium lead electrolytic cell, and an investigation is now being carried out on the tantalum lead cell, but up to the present the thermionic valve type has proved to possess several important advantages which have resulted in its being adopted as a standard. Between three and four hundred of these machines are now in operation in all parts of the country and it is thought a brief description of the apparatus may prove of general interest to all and of use to those who have thermionic valve rectifiers under their care.

The machine most generally used by the Department is the "Tungar Rectifier." There are two standard sizes, one using a

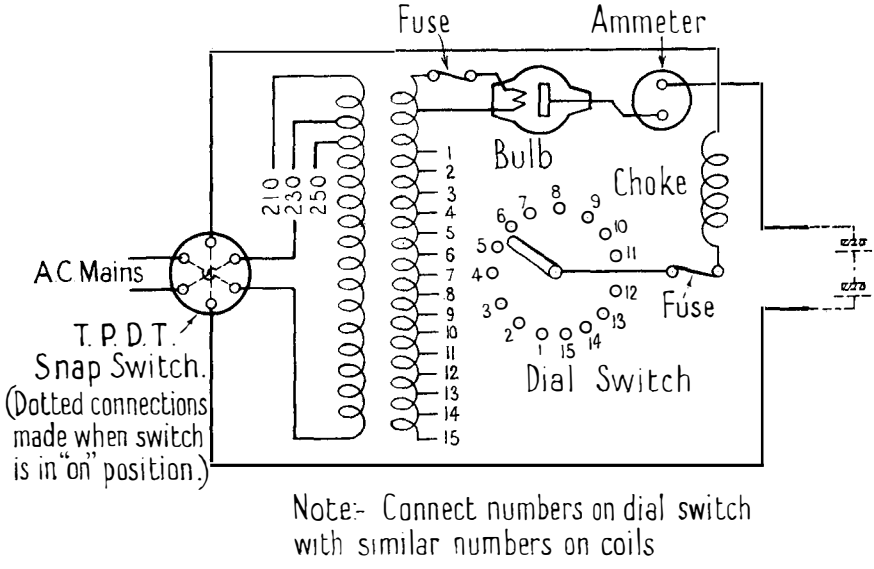


FIG. 2.—CONNECTIONS OF HALF-WAVE TYPE, TUNGAR RECTIFIER.

single bulb and giving an output of 10/70 volts 6/5 amps; the other, which rectifies the whole wave, having two bulbs and giving an output of 10/70 volts 12/11 amps. Each size can be wound suitable for any electric supply between 100/250 volts and 25/100 cycles.

Considering first of all the single bulb model which is illustrated in Fig. 1 and the circuit diagram of which is shown in Fig. 2, it will be seen that its chief components are a transformer and a two electrode valve, upon which the operation of the rectifier chiefly depends. The type in most general use is that suitable for a supply of 200/250 volts, 40/50 cycles. The transformer of this machine

has three tappings on the primary, suitable for 210,230 and 250 volt supplies. The secondary is tapped in 15 places and by means of a regulating switch it is possible to obtain a range of voltage between 25 and 90 across its terminals. This variation is necessary so that the apparatus may be capable of charging batteries containing any number of cells between 6 and 30.

The bulb (see Fig. 3) has a thick, low tension filament wound in the form of a spiral which, when it is screwed into its socket, is tapped across a small portion of the transformer secondary. It also contains a graphite electrode which forms the anode of the bulb. During manufacture, the bulb is exhausted to the highest possible vacuum and is then filled with an inert gas, argon, to a pressure of about 3 m.m. of mercury. As it is impossible practically to make the argon absolutely pure and as the impurities,

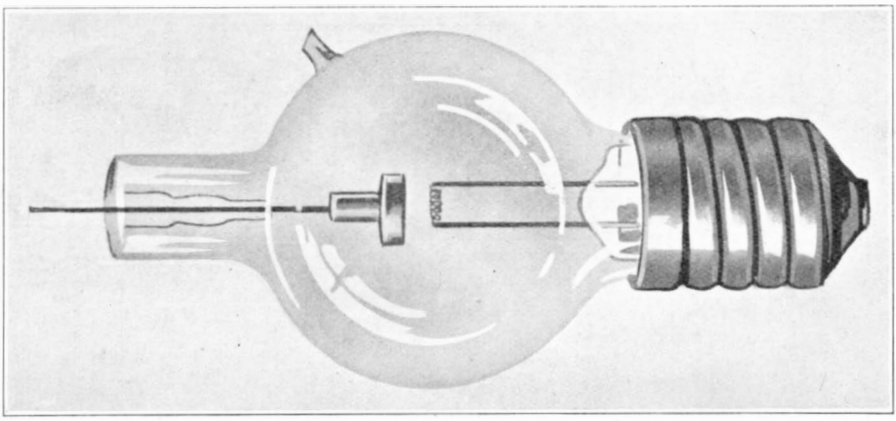


FIG. 3.—THE TUNGAR BULB (SHOWN IN HORIZONTAL POSITION).

if not neutralised, result in the disintegration of the filament and adversely affect the characteristics of the valve, special means are adopted to ensure freedom from these gases when the bulb is in operation. At the time of manufacture, therefore, other substances, principally magnesium, are introduced into the bulb and react chemically with the impurities in the argon. The purifying agent takes the form of a ring wrapped round one of the filament supports, or sometimes round the graphite anode, and the discolouring which appears on the inside of the glass after the bulb has been in operation for a short time is the result of its chemical action.

The principle of operation of the Tungar bulb is similar to that of the Fleming two electrode valve. The filament which is heated to incandescence by alternating current, emits electrons, which are

attracted to the anode, provided the latter is at a positive potential relative to the filament. During their journey across the valve, they collide with the gas molecules and ionise them, thus forming a conductive path from the anode to the filament. Provided the anode is negative relative to the filament, however, the electrons emitted by the latter are attracted back again and under these circumstances the bulb remains non-conductive. The presence of the argon makes the bulb extremely "soft" and not more than 90 volts can be applied to it without the risk of a "flash over," and this is one reason why it is necessary to use a transformer.

Fig. **2** shows that the battery which is to be charged is arranged with its negative terminal connected to the anode of the bulb. As the latter is non-conducting in such circumstances it will be seen

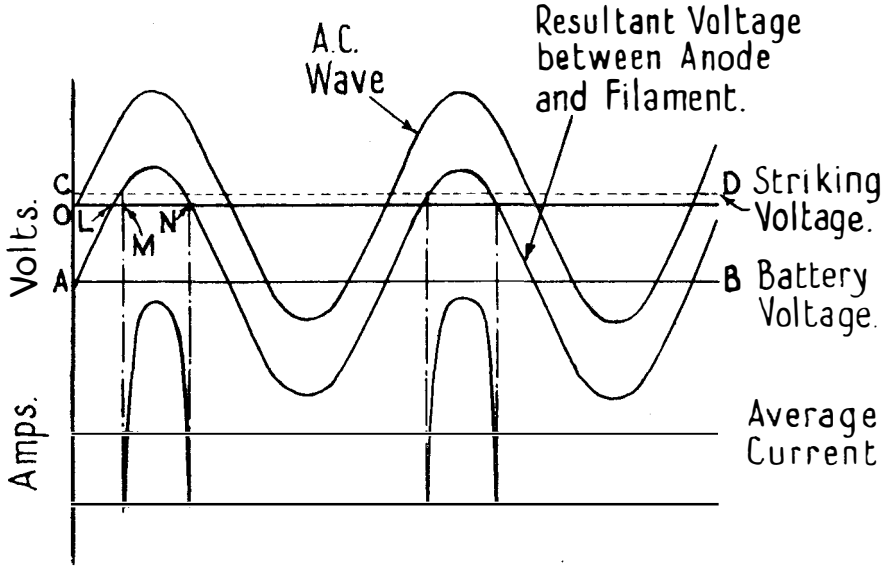


FIG. 4.—CURVES SHOWING PRODUCTION OF CURRENT WAVE.

that until the machine is connected to the mains the battery can neither be charged or discharged. In the event of a failure of the power supply, there is therefore no danger of the battery discharging back, as there is when a motor-generator not fitted with a reverse current circuit breaker is used.

After the alternating supply has been switched on, during every alternate half cycle, the secondary voltage wave will be in a direction such as to oppose the voltage of the battery and consequently if the amplitude of the wave be great enough the anode of the bulb will become positive relative to the filament. When the anode has a potential of about 10 volts positive, the bulb strikes, that is to say, the bulb being in a conductive state, current flows across it

from anode to filament. This current also flows through the battery from positive to negative and thus charges it. Assuming no inductance in circuit the current will cease to flow when the alternating voltage has fallen to that of the battery and therefore only flows for a small portion, usually about 1/3, of the cycle.

Thus, if the current as recorded by a moving coil instrument be 6 amperes the actual peak value may be between 18 and 24 amperes. Tungar Rectifiers as used by the Department, however, are now fitted with a choke coil in series with the charging circuit and this has the effect of prolonging the period during which current flows and reducing the maximum value of the wave.

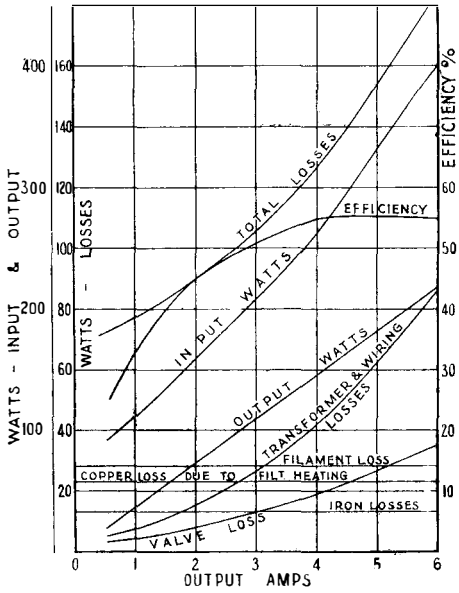


FIG. 5.—CURVES SHOWING LOSSES AND EFFICIENCY OF A TUNGAR NO. 1C WHEN CHARGING A 36V. BATTERY.

The foregoing brief description may be more fully appreciated by a consideration of Fig. 4. The line AB represents the negative voltage on the anode due to the battery. This may be regarded as constant. The top sine curve represents the alternating voltage induced in the secondary of the transformer. The sum of these two curves is represented by the lower sine curve and shows the resultant voltage between the filament and anode at any portion of the cycle. It will be seen that the latter is positive for a small portion LN of the cycle. The line CD represents the striking voltage and current therefore flows for a period MN. The peak voltage on the plate, as shown by this diagram, is actually not obtained in practice for the reason that as soon as current com-

mences to flow a resistance drop occurs between the anode and filament, the voltage being thereby reduced.

An interesting fact arising out of the unusual shape of the current wave is that the various types of ammeter indicate different currents. A moving-coil instrument, of course, measures the average current, which is the figure required in connection with secondary cell work. A hot-wire ammeter, however, which records R.M.S. values, reads considerably more, usually between 1.4 times and twice the figure indicated by the moving coil instrument.

The efficiency of the single bulb Tungar compares very favourably with that obtained with all other types of rectifier of similar

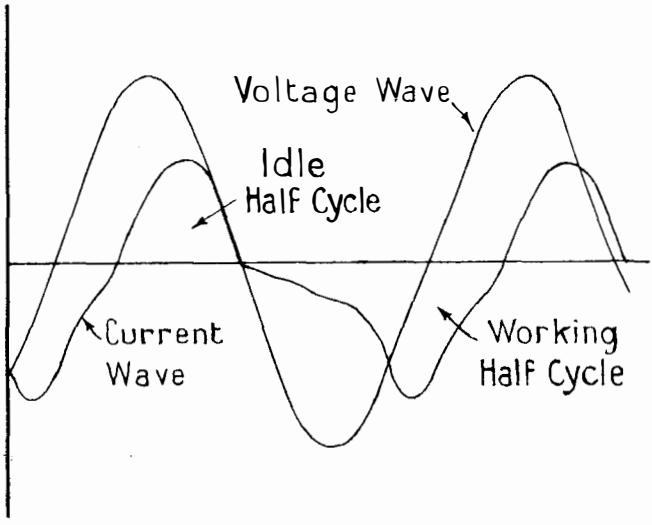


FIG. 6.—INPUT VOLTAGE AND CURRENT HALF-WAVE TYPE.

output. It varies between 28% and 60% according as it is charging a 16 or 60 volt battery respectively at full load current. The losses are as follows:—

(1) Transformer iron losses which are independent of load; (2) Transformer copper losses; (3) Loss due to the heating of the filament and small portion of the transformer winding across which it is tapped; (4) Resistance loss between the anode and filament of the bulb; and (5) Switch and wiring losses. The first and third of these are, generally speaking, independent of the load, whilst the others vary approximately as the square of the load. The curves shown in Fig. 5 give some idea of the magnitude of the various losses and efficiency when charging a 36-volt battery.

An interesting point is that the efficiency can exceed 50%. It would appear at first sight that, as the bulb rectifies alternate half waves and that certain losses also take place, the efficiency must be

considerably less than 50% even when the Tungar is working under the most suitable condtions. During the idle half cycle, however, the secondary of the transformer, with the exception of the few turns which supply power to the filament, is on open circuit and consequently the primary acts as a choke. The current therefore tends to be reduced and to lag considerably behind the

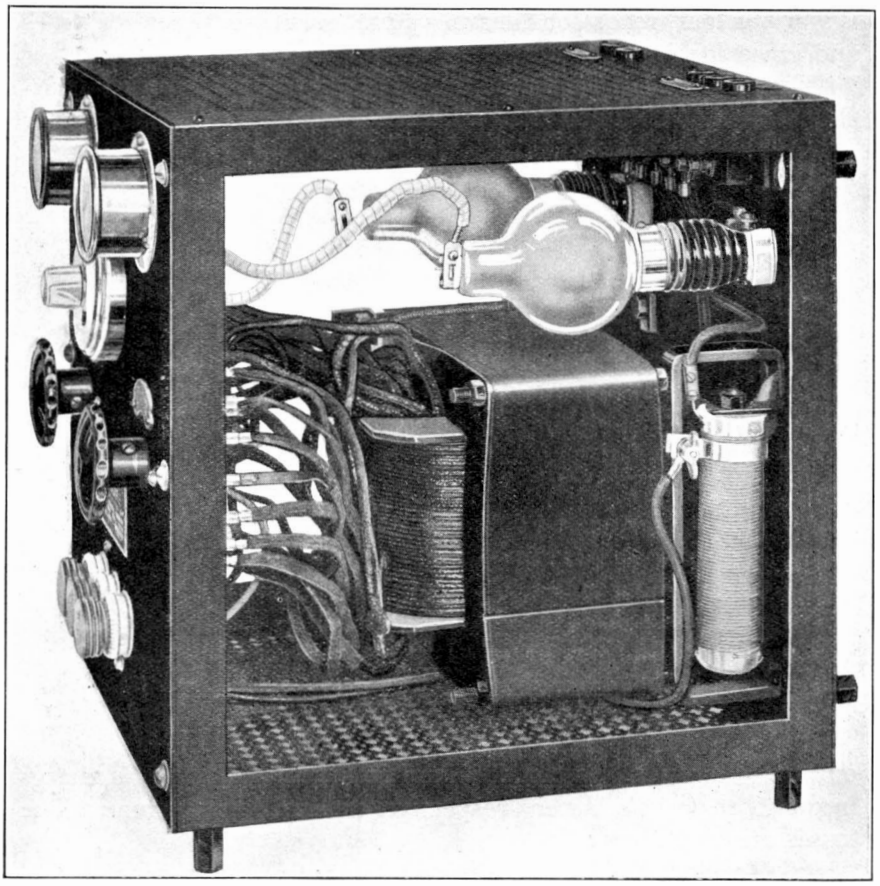


FIG. 7.—INTERNAL VIEW OF FULL-WAVE TYPE, TUNGAR RECTIFIER, 12-AMP.

voltage wave, with the effect that the power in the circuit during the portion of the cycle is reduced and the efficiency increased. This is clearly shown in Fig. **6**, which is a copy of an oscillogram of the primary voltage and current waves.

The only difference between the 6 amp. and the 12 amp. type (which is illustrated by Figs. **7** and **8**) is that the latter has two bulbs and two windings on the secondary of the Transformer. The bulbs rectify alternate half cycles and hence the full wave is

utilised. It might be expected that this would result in the two bulb type having a much higher efficiency than the single valve type, but this is not so, for although the output is doubled, the iron loss, filament, transformer and valve heating losses are also doubled, and the efficiency is therefore not unduly affected.

The output under various conditions is shown in Figs. **9**, **10** and **11**. Fig. **9** shows the nature of the charging current with the choke coils cut out of circuit. The sine curve represents the primary voltage wave and it will be seen that there are two current impulses per cycle. Fig. **10** shows the output of one valve when

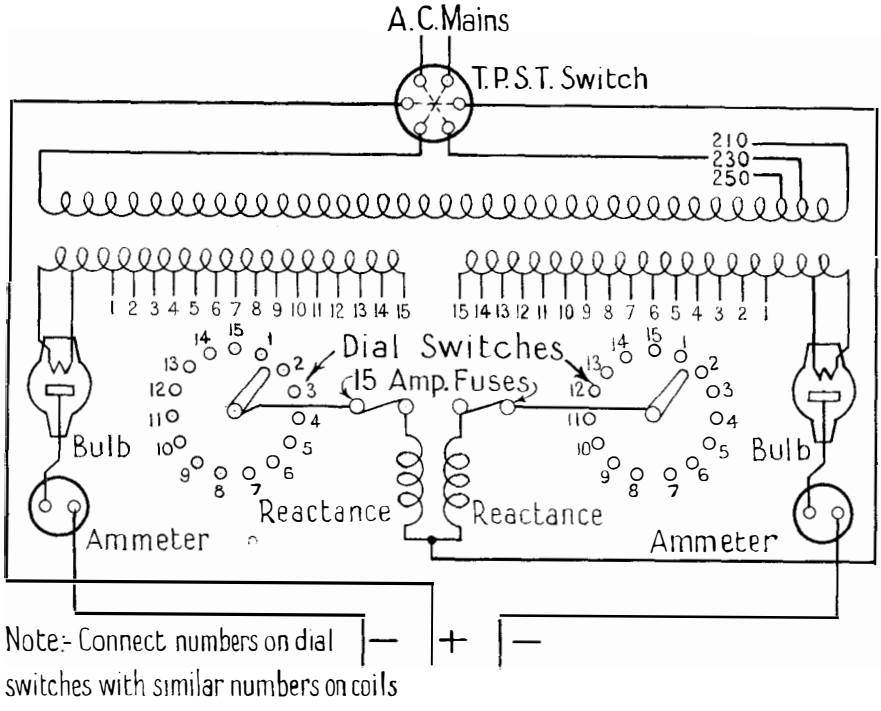


FIG. 8.—CONNECTIONS OF FULL-WAVE TYPE, TUNGAR RECTIFIER.

a choke coil is inserted in circuit and it clearly illustrates the smoothing effect of the latter. Fig. **11** shows the total output of the Tungar. It will be noticed that in this case the peaks have been almost flattened out and an almost uniform direct current produced.

For small telephone installations it would be almost impossible to find a more convenient charging agent than the thermionic valve rectifier. It is only necessary to switch on the power and adjust the charging current and the whole apparatus may be safely left until the end of the charge. If used with an automatic charge

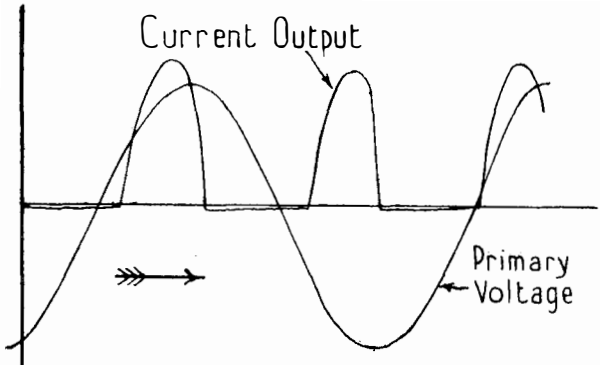


Fig. 9. D.C. output of two-bulb Tungar without choke coil charging battery.

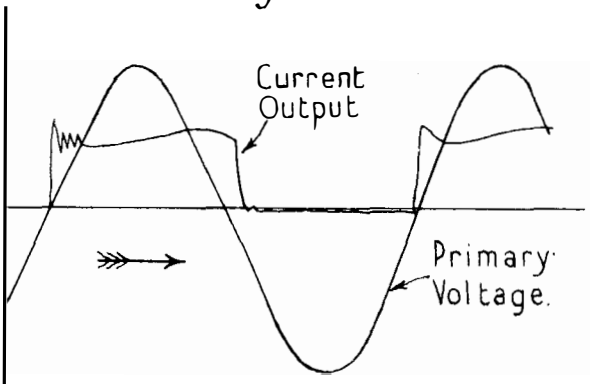


Fig. 10. Output of one bulb of two-bulb Tungar with choke coil.

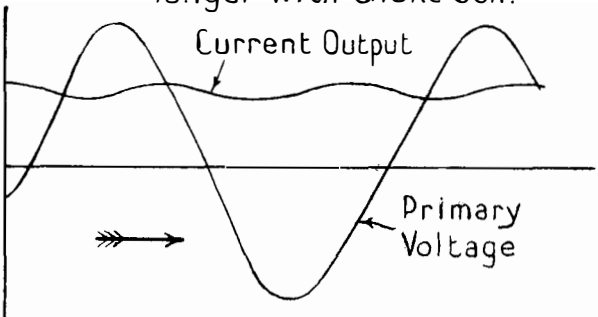


Fig. 11. D.C. Output of two-bulb Tungar with choke coil on D.C. Circuit.

cut-off panel consisting of an ampere-hour meter in the charging circuit which trips a circuit breaker in the primary circuit of the charging machine after a definite output has been given, the plant need not be attended until the next charge is required.

Unlike rotary charging sets the Tungar is almost noiseless in operation and this is a great advantage as in many small installations the power plant is situated in the same room as the switchboard.

The cost of upkeep is, generally speaking, negligible. The only replacements required are bulbs, but provided the rated output currents are not exceeded, these usually have a lengthy life, some bulbs having been known to operate for more than 3000 hours.

On one or two occasions attention has been called to the fact that this kind of charging machine, especially the single bulb type, produces noise on the exchange during charging operations. This is due to the fact that the current impulses in the charging leads induce current pulses in the adjacent discharge leads. This represents the only disadvantage of the thermionic valve battery charger and the trouble can easily be overcome by using twisted pairs for each battery lead.

The operation of the thermionic valve rectifier is at present being studied mathematically and it is hoped to deal with the Tungar from this point of view in a later issue.

TELEGRAPH AND TELEPHONE PLANT IN THE UNITED KINGDOM.

TELEPHONES AND WIRE MILEAGES, THE PROPERTY OF AND MAINTAINED BY THE POST OFFICE, IN EACH ENGINEERING DISTRICT AS AT 30TH JUNE, 1926.

No. of Telephones owned and maintained by the Post Office.	Overhead Wire Mileages.				Engineering District.	Underground Wire Mileages.			
	Telegraph.	Trunk.	Exchange.	Spare.		Telegraph.	Trunk.	Exchange.	Spare.
496,248	579	4,171	54,057	479	London	23,454	57,230	1,704,531	70,561
59,976	1,887	21,311	59,750	1,652	S. East	3,823	27,452	121,563	15,961
64,765	4,481	27,410	47,401	2,097	S. West	14,632	6,936	103,996	28,884
51,127	8,322	32,305	44,231	5,015	Eastern	13,919	28,147	67,782	51,152
83,537	8,670	42,017	53,579	3,594	N. Mid.	21,417	40,463	153,093	123,339
61,675	4,872	27,775	60,130	3,805	S. Mid.	12,518	17,817	122,174	83,845
53,676	4,983	28,884	47,244	2,066	S. Wales	5,278	21,196	89,599	68,998
86,611	8,045	24,768	45,263	5,212	N. Wales	12,419	36,586	182,937	55,111
135,993	1,612	16,999	43,923	2,946	S. Lancs.	12,637	75,349	392,565	36,695
81,491	6,018	30,820	42,974	2,909	N. East	9,718	36,125	183,248	27,618
55,133	3,664	24,260	35,517	1,626	N. West	8,629	31,259	118,301	36,277
41,522	2,298	15,719	24,111	2,281	North	4,207	9,802	76,360	54,417
19,101	4,803	6,220	12,271	264	Ireland N.	140	249	35,560	710
56,647	5,454	23,302	34,350	1,295	Scot. East	2,673	8,721	109,270	38,111
77,280	7,443	23,808	40,629	815	Scot. West	12,265	22,520	194,019	33,323
1,424,782	73,131	349,769	645,430	36,056	Totals.	157,729	419,852	3,654,998	725,002
1,396,384	73,228	345,738	640,865	37,033	Figures on 31st March, 1926.	153,621	400,959	3,489,485	676,976

THE ANGLO-DUTCH No. 3 CONTINUOUSLY LOADED SUBMARINE TELEPHONE CABLE.

By A. B. Morice, B.Sc. (Eng.), A.M.I.E.E.

The first submarine telephone cable laid between Aldeburgh (Suffolk, England) and Domburg (Walcheren, Holland) contained four cores insulated with specially prepared gutta percha and was coil-loaded. It was laid in 1922 and a description of it is given in Vol. 16, Part 4, Jan. 1924, of this Journal. The construction of this cable is similar to that of the Anglo-Irish cable which was laid in 1913 between Nevin, North Wales, and Howth, Ireland.

In August 1924, a second Anglo-Dutch telephone cable was laid between the same two places. This cable was the first paper-insulated submarine cable laid between England and the European Continent. It contained four quads of continuously-loaded telephone conductors. A description of it is given in "The Electrician" for September 5th, 1924.

Both of these cables were manufactured by Messrs. Siemens Bros. & Co., Ltd., Woolwich.

In April of this year, a third Anglo-Dutch cable was laid and it is the purpose of this article to give some particulars of its construction and electrical properties.

The Anglo-Dutch No. 3 cable was manufactured by Messrs. Felten & Guilleaume, of Köln-Mülheim, and was laid by the firm's cableship "Neptun," from Domburg to Aldeburgh. The cable consists of four groups of four-wire cores, each spirally wound, together with one central single-conductor core. Each of the 17

conductors is continuously loaded by means of a uniform winding of special silicon iron, and is insulated with three layers of paper.

The conductors of the four-wire groups consist of solid, soft copper of 2.33 mm. (0.0917″) diameter, and are wound with an iron loading wire of 0.2 mm. (0.0079″) diameter; the conductor of the central core consists of 7 copper wires, each 0.81 mm. (0.0319″) diameter and is wound with an iron loading wire of 0.3 mm. (0.0118″) diameter.

The various four-wire groups are distinguished by blue, red, green and white paper wrappings. The distinctive colours for each four-wire group are red, green, white and blue, arranged in that order so that (*a*) red and white and (*b*) blue and green form the diagonal pairs of each quad.

The lengths of lay of the four-wire groups are all different and vary from 350 mm. (13.8″) to 420 mm. (16.5″).

There are two lead sheaths, each 2 mm. (0.079″) thick, and the cable was manufactured in lengths of approximately 30 nauts without a joint in these sheaths.

The armouring consists of 22 steel wires, each 5.8 mm. (0.228″) diameter; the overall diameter of the completed cable is 55 mms. (2.17″), and its weight approximately 19.8 tons per naut.

The length of the cable after laying was 85.736 nauts.

The electrical characteristics obtained from tests will now be given.

D.C. Tests.

From measurements taken of the cable after laying the following results were obtained:—

Average resistance of the 16 cores = 7.308 ohms per naut.
Resistance of centre core = 8.608 ,, ,, ,,

Average insulation resistance of the 17 cores, measured with 100 volts, between each core and the remainder earthed

= 72,900 megohms per naut after 1 min. electrification.
= 109,000 ,, ,, ,, ,, 2 mins. ,,

A.C. Tests.

(*a*) *Transmission Constants.*

The mean A.C. constants of all the pairs and all the phantoms were measured at angular velocities of 5,000, 10,000 and 15,000 radians per second. These tests were made from both ends of the first armoured section, 29.13 nauts in length. The results obtained are given in Table I., in which the measured D.C. resistances have also been included.

TABLE I.

MEAN CONSTANTS OF ALL THE CIRCUITS TESTED FROM BOTH ENDS OF 29.13 NAUTS OF ARMOURED CABLE. TEMP. = 11°C. TESTING CURRENT = 1 M.A.

Circuits tested.	ω Radians per second.	Characteristic Impedance in Vector Ohms.	A.C. Constants per Naut Loop.					D.C. Resistance per Naut Loop in Ohms.
			Attenuation Constant.	Propagation Constant.	Resistance in Ohms.	Inductance in Milli-Henrys.	Capacity in Micro-Farads.	
Pairs	5000	443.0 $\angle 5°11'$	0.01805	0.1843 $\angle 84°23'$	15.58	16.15	0.0828	14.70
	10000	444.4 $\angle 3°56'$	0.02051	0.3661 $\angle 86°48'$	17.30	16.12	0.0828	
	15000	431.8 $\angle 2°47'$	0.02384	0.5493 $\angle 87°29'$	20.00	16.13	0.0828	
Phantoms	5000	185.3 $\angle 5°45'$	0.02074	0.2089 $\angle 84°18'$	7.60	7.82	0.2215	7.35
	10000	188.0 $\angle 4°39'$	0.02290	0.4140 $\angle 86°51'$	8.12	7.69	0.2215	
	15000	180.8 $\angle 1°45'$	0.02653	0.6227 $\angle 87°32'$	9.41	7.75	0.2215	

The variation of the attenuation constant and of the wave length constant with frequency for a selected pair and a selected phantom

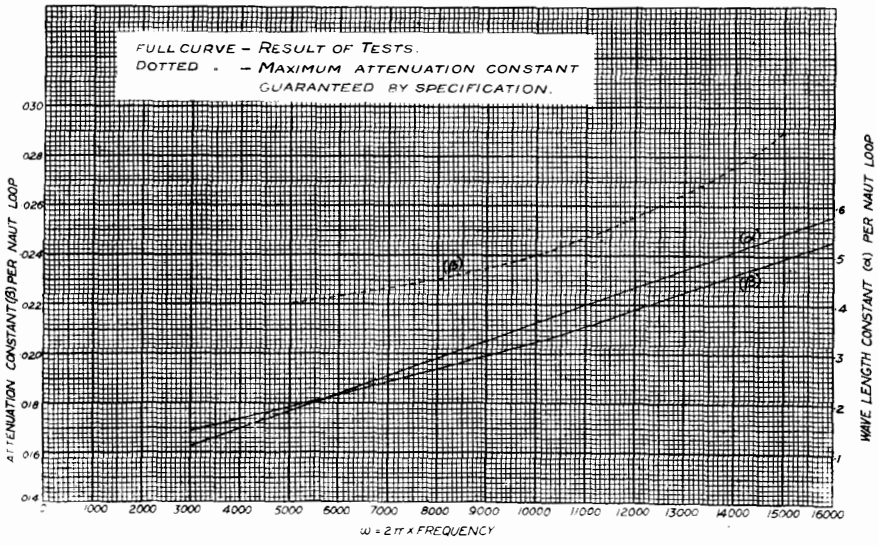


FIG. 1.—ANGLO-DUTCH NO. 3 CABLE. ATTENUATION AND WAVE LENGTH CONSTANTS OF PAIR 5 OF FIRST ARMOURED LENGTH OF 29.13 NAUTS.

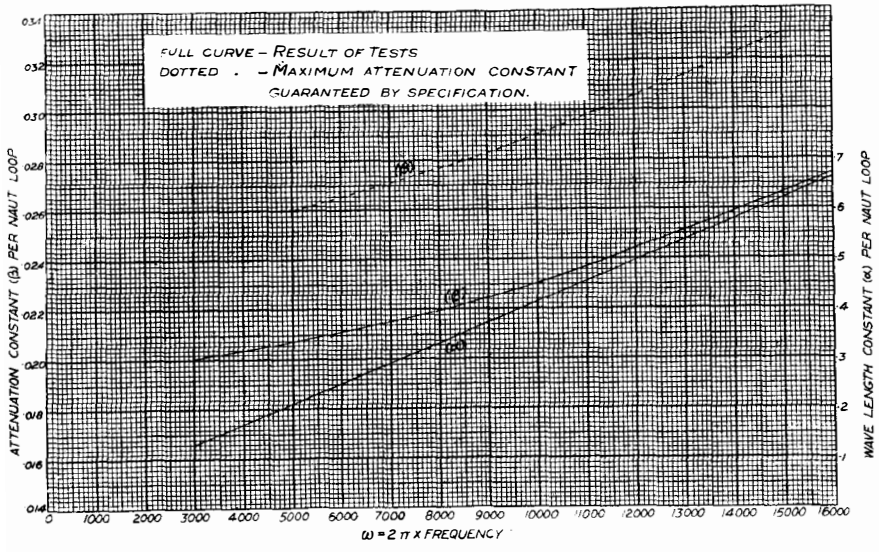


FIG. 2.—ANGLO-DUTCH NO. 3 CABLE. ATTENUATION AND WAVE LENGTH CONSTANTS OF PHANTOM CIRCUIT OF FIRST ARMOURED LENGTH OF 29.13 NAUTS.

of this same length of cable are shown on Figs. **1** and **2** respectively. It will be observed that the actual attenuation constant

is in each case much less than the figure demanded by the specification. It will also be seen that the difference between β (ω = 12,500) and β (ω = 5000) is 0.0042 and 0.0040 per naut loop for the pair and the phantom respectively.

After laying the cable, the attenuation constant and characteristic impedance of the 8 pairs, the 4 phantoms, and the centre core were measured and the following values obtained:—

TABLE II.

ATTENUATION CONSTANT AND CHARACTERISTIC IMPEDANCE OF THE CIRCUITS OF THE CABLE 85.736 NAUTS LONG.

Circuits.	ω Radians per sec.	Attenuation Constant per Naut Loop.	Characteristic Impedance in Vector Ohms.
Mean of 8 pairs	5000	0.0180	439.0 $\angle 6^\circ 0'$
,, ,, 8 phantoms ...	,,	0.0205	186.2 $\angle 5^\circ 51'$
Centre Core. (Mean of tests from both ends)... ...	,,	0.0227	286.8 $\angle 8^\circ 17'$

From Table II. it is found that the side and phantoms circuits are equivalent to 14.5 and 16.5 miles of standard cable respectively.

The centre core-earth return circuit is equivalent to 18.3 miles of standard cable. A speaking test proved that it formed a very good speaker wire between Aldeburgh and Domburg and, although an earth return circuit, it was free from extraneous noise.

(*b*) *Uniformity of Characteristic Impedance.*

The characteristic impedance of each pair and each phantom was measured over a frequency range from 3,000 to 15,000 radians per second. These tests and the cross-talk tests which follow were all made at Aldeburgh about one month after the cable had been laid.

Fig. **3** shows the variation of the resistance (real part of the characteristic impedance) for the 8 pairs.

Fig. **4** shows the variation of the reactance (imaginary part of the characteristic impedance) for the 8 pairs.

Fig. **5** shows the variation of the resistance and of the reactance for the 4 phantoms.

From Figs. **3** and **5** the results given in Table III. are obtained.

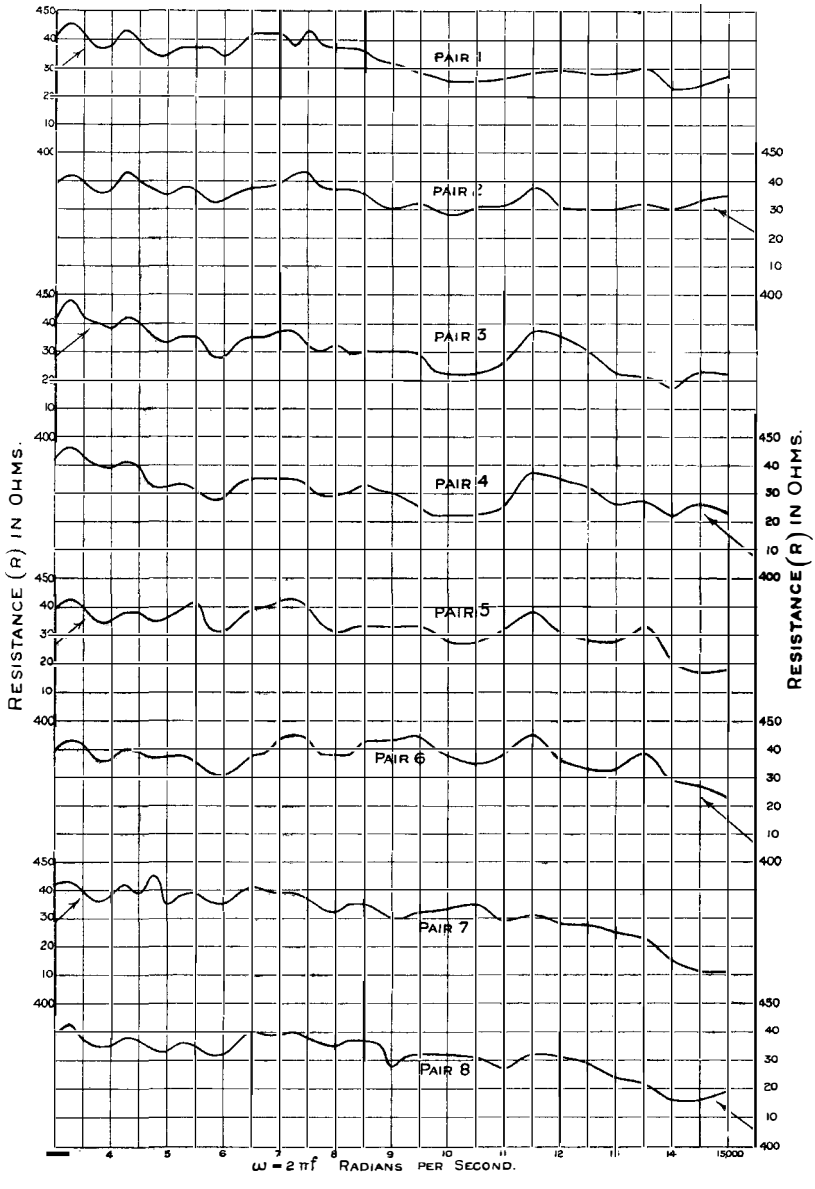


FIG. **3.**—ANGLO-DUTCH NO. 3 CABLE. CHARACTERISTIC IMPEDANCE (REAL PART) OF THE EIGHT PAIRS.

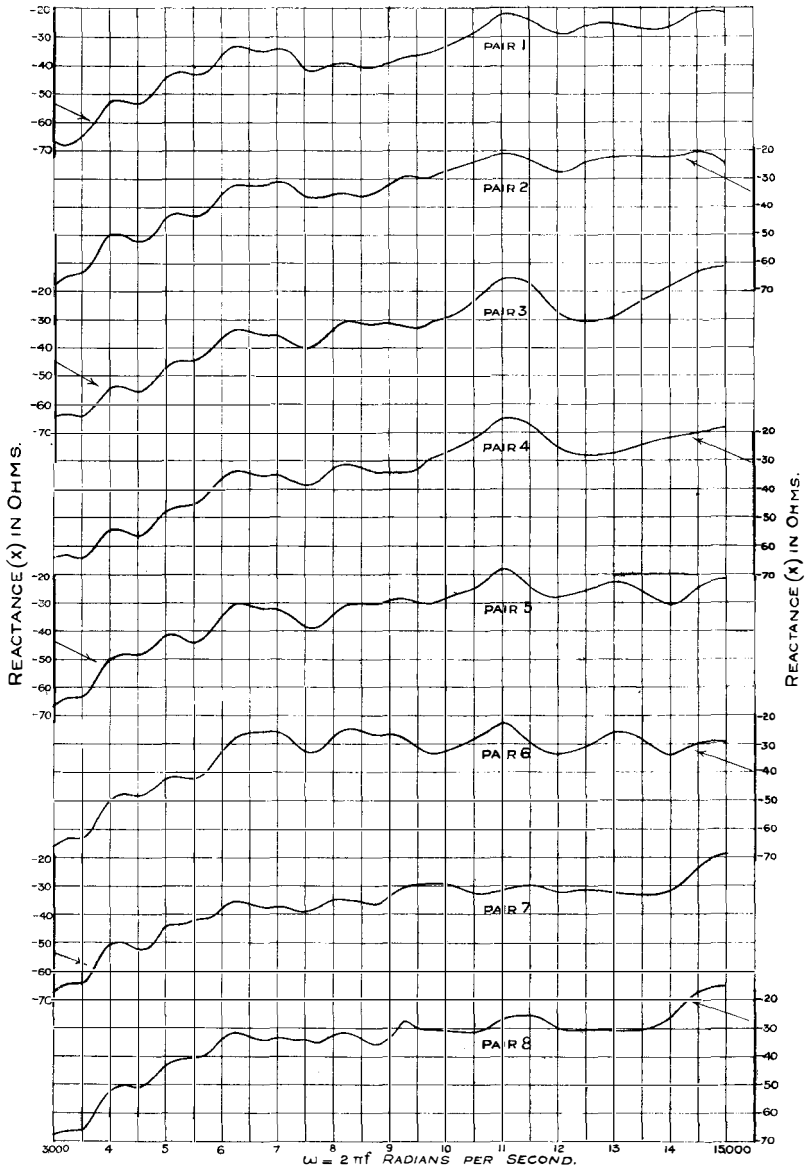


FIG. 4.—ANGLO-DUTCH NO. 3 CABLE. CHARACTERISTIC IMPEDANCE (IMAGINARY PART) OF THE EIGHT PAIRS.

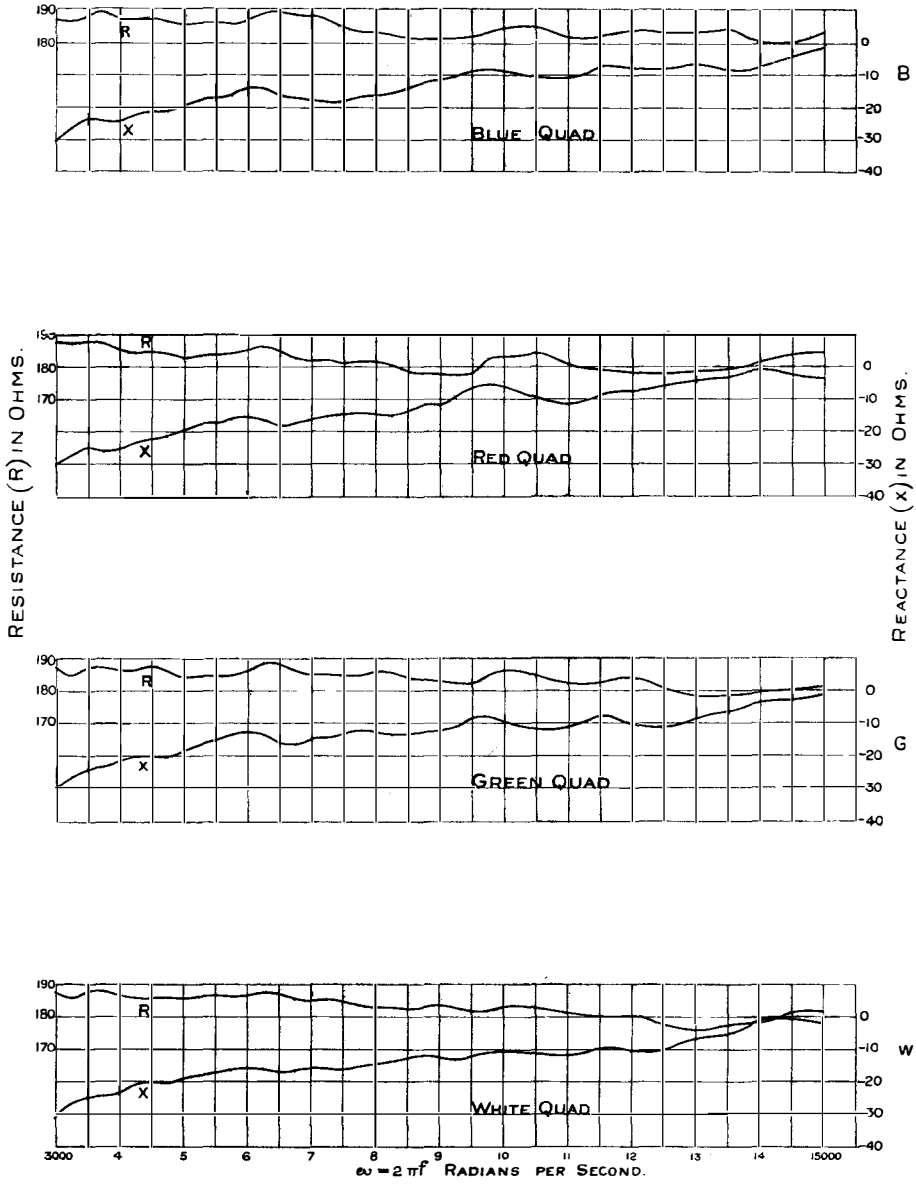


FIG. 5.—ANGLO-DUTCH NO. 3 CABLE. CHARACTERISTIC IMPEDANCE OF THE FOUR PHANTOM CIRCUITS.

TABLE III.

CHARACTERISTIC RESISTANCE WITH FREQUENCY RANGE 3000 TO 12500 RADIANS PER SEC.

Circuit.	Resistance in Ohms.		Variation of Resistance from Mean of Maximum and Minimum values.	
	Maximum.	Minimum.	Ohms.	Percentage.
Pair 1... ...	445.5	425.0	± 10.2	± 2.3
,, 2... ...	443.0	428.0	,, 7.5	,, 1.7
,, 3... ...	448.0	422.0	,, 13.0	,, 3.0
,, 4... ...	446.0	422.0	,, 11.5	,, 2.6
,, 5... ...	442.5	427.5	,, 7.5	,, 1.7
,, 6... ...	445.0	430.5	,, 7.2	,, 1.6
,, 7... ...	445.0	427.5	,, 8.7	,, 2.0
,, 8... ...	442.5	427.0	,, 7.7	,, 1.8
Mean of 8 pairs	—	—	,, 9.2	,, 2.1
Blue Phantom	189.5	181.2	,, 4.1	,, 2.2
Red ,,	187.8	177.5	,, 5.1	,, 2.8
Green ,,	188.9	180.7	,, 4.1	,, 2.2
White ,,	188.0	177.5	,, 5.2	,, 2.9
Mean of 4 Phantoms ...	—	—	,, 4.6	,, 2.5

It will be seen from these figures and the corresponding curves that the characteristic impedances of all the circuits are satisfactorily uniform.

(*c*) *Cross-Talk.*

The cross-talk between the circuits in each four-wire group was measured using (1) alternating current having a frequency range from 2,500 to 15,000 radians per second, and (2) speech.

The measurements on the red and the white quads were made with Siemens and Halske apparatus in βl units, the ends of the cable circuits being suitably terminated. The results obtained with the white quad are shown on Fig. **6**; the five different curves are marked to indicate the test conditions given in the following table:—

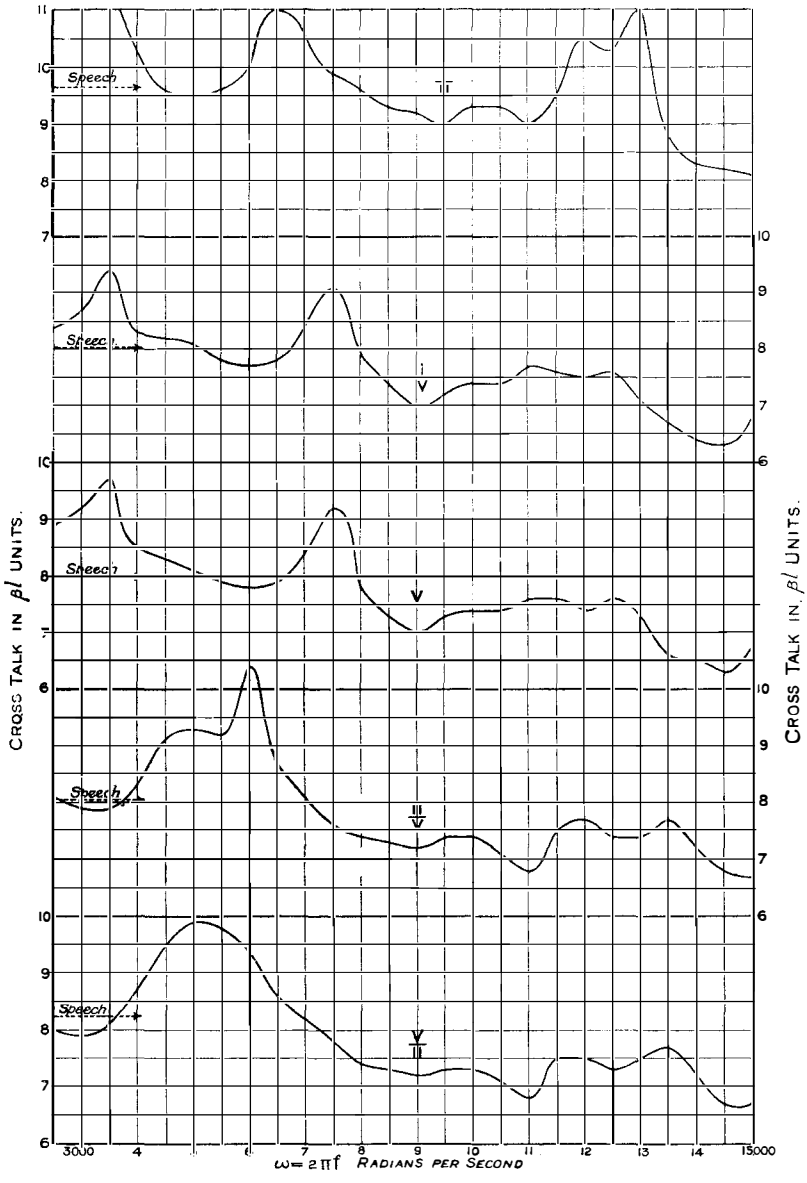


FIG. 6.—ANGLO-DUTCH NO. 3 CABLE. CROSS-TALK BETWEEN THE CIRCUITS OF THE WHITE QUAD.

CROSS-TALK TEST CONDITIONS.

Marking.	Disturbing on	Listening on
$\frac{I}{II}$	Red—White Pair.	Blue—Green Pair.
$\frac{I}{V}$	,,	Phantom.
$\frac{V}{I}$	Phantom.	Red—White Pair.
$\frac{II}{V}$	Blue—Green Pair.	Phantom.
$\frac{V}{II}$	Phantom.	Blue—Green Pair.

From the test results of these two quads the figures shown in Table IV. are obtained.

TABLE IV.

CROSS-TALK READINGS IN βl UNITS WITH SIEMENS & HALSKE APPARATUS.

Source of Disturbance.		Red Quad.					White Quad.				
		$\frac{I}{II}$	$\frac{I}{V}$	$\frac{V}{I}$	$\frac{II}{V}$	$\frac{V}{II}$	$\frac{I}{II}$	$\frac{I}{V}$	$\frac{V}{I}$	$\frac{II}{V}$	$\frac{V}{II}$
Alternating Current Range of ω 2500 to 15000 radians per sec.	Max.	> 11	9.3	10.6	9.8	9.4	> 11	9.4	9.7	10.4	9.9
	Min.	9.4	7.0	6.9	6.1	6.0	8.1	6.3	6.3	6.7	6.7
	Mean	—	8.0	8.0	7.6	7.6	—	7.7	7.8	7.8	7.9
Speech. (Mean of two observers)		> 10	7.8	7.9	7.7	7.6	9.6	8.0	8.0	8.0	8.2

The cross-talk measurements on the blue and the green quads were made with P.●. apparatus, using a Western Electric Cross-Talk Meter connected in parallel, the circuits being terminated with P.●. end sets. The actual readings were in millionths of the disturbing current, but these have been converted to βl units after correction to allow for the effect of the external apparatus and for the difference in impedance between the disturbed and the disturbing circuits. The figures so obtained are given in Table V. which follows :—

TABLE V.

CROSS-TALK READINGS (CORRECTED) IN βl UNITS WITH P.O. APPARATUS.

Source of Disturbance.		Blue Quad.					Green Quad.				
		$\frac{I}{II}$	$\frac{I}{V}$	$\frac{V}{I}$	$\frac{II}{V}$	$\frac{V}{II}$	$\frac{I}{II}$	$\frac{I}{V}$	$\frac{V}{I}$	$\frac{II}{V}$	$\frac{V}{II}$
Alternating Current Range of ω 2500 to 15000 radians per sec.	Max	> 10.3	8.1	8.5	9.3	8.5	10.3	8.5	8.5	9.2	10.3
	Min.	9.0	6.6	6.6	6.6	6.6	8.8	6.8	6.6	6.8	6.7
	Mean	—	7.0	7.1	7.2	7.3	9.5	7.4	7.4	7.6	7.6
Speech. (Mean of two observers)		9.8	7.0	7.1	7.3	7.4	9.7	7.3	7.4	7.7	7.8

The figures in Tables IV. and V. are considered to be satisfactory and it will be noticed that the cross-talk results with speech are, in each of the tables, in close agreement with the mean of the frequency figures.

The cross-talk reading between any circuits in different four-wire groups, measured with a W.E. Cross-Talk Meter, was never less than 9.5 βl units and was usually considerably higher.

A very large number of tests was made on this cable, but it

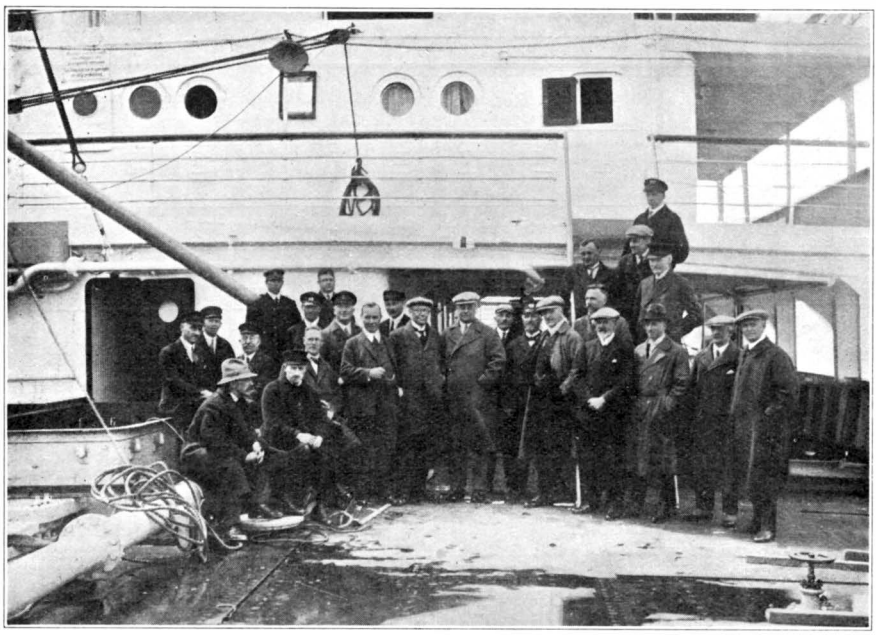
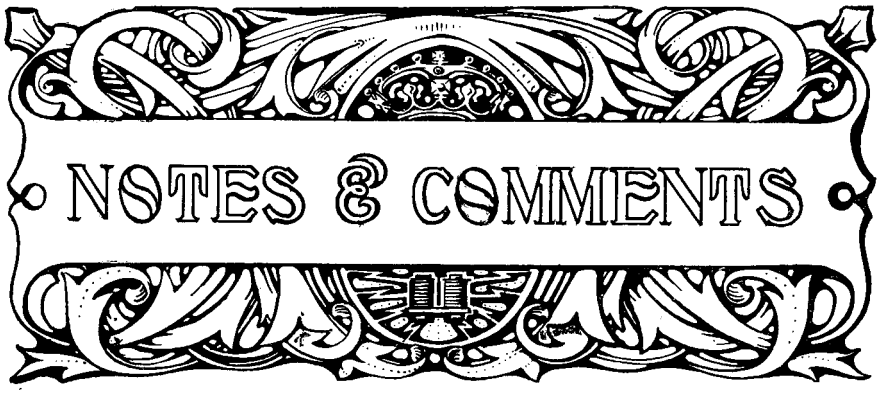


FIG. 7.—AN INTERESTING GROUP ON BOARD THE "NEPTUN."
(From a photo supplied by Messrs. W. F. Dennis & Co.).

would be impossible to include them all in an article of moderate length. It is thought, however, that the representative figures which have been given will suffice to convey an accurate idea of the characteristics of the cable from the telephone point of view.

In conclusion, an interesting photograph is given on page 282, which was kindly supplied by Messrs. W. F. Dennis & Co., 70, Queen Victoria Street, E.C.4, who represent Messrs. Felten & Guilleaume in this country. This photograph was taken on board the cable ship during the laying operations and shows the firm's representatives, together with those of the British, Dutch and German Administrations. See Fig. 7.



NOTES AND COMMENTS.

LONDON has now reached its half million telephones, and although our empire metropolis is still very far behind New York we think there is ground for self-congratulation. Englishmen were a long time in acquiring the telephone habit and even now in private dwellings a telephone is considered more of the nature of a luxury than a necessity. However, the habit will grow and judging from the development during the post war years—which even the most cheerful among us could scarcely call prosperous years—we should see the full million in much less than ten years' time. The five hundred thousandth instrument was handed over to the Chairman of the Press Gallery Committee in the Mother of Parliaments by the Controller of the London Telephone Service on the 16th July.

The coming of the Automatic will be brought under the eyes of London subscribers in the October issue of the Directory, which will be printed with the first three letters of the exchanges in capitals to impress the users with the method of operating the dials when they are supplied with them.

CHARLES EZRA SCRIBNER.—With great regret we have to record the death, on June 25th, of Mr. C. E. Scribner, whose name is familiar to all connected with telephony, and who was personally known to many on this side of the Atlantic. Mr. Scribner was a

schoolboy experimenter in telegraphy, and devised a relay which he submitted to the Western Electric Co. for manufacture or development. This led to his employment by that company, and he was engaged on the maintenance of some special telegraphic instruments when Bell's telephone was introduced. He has related how his company engaged in experiments with the new instrument, which, in telegraphic parlance, was called "the speaker." It was to "the speaker" and its developments that Mr. Scribner's life work was thenceforward devoted. The British patent specification for the multiple switchboard was issued to him in November, 1879, and it has been sometimes assumed that he was the sole inventor of the multiple principle. He was the inventor of the first test system put in operation, but not of all the systems described in that patent. In switchboard development, however, Scribner's name stands pre-eminent. Patents granted to him were very numerous, but as chief engineer of the Western Electric Co. it fell to him to determine the new lines upon which ever-growing requirements should be met. A close student of every phase of telephone operating, he promptly realised new conditions, and set his mind to their provision on lines of economic operating efficiency. His outlook was broad and his advice always governed by the needs of the service. His influence in Europe was considerable and by all those who came in contact with him his loss will be deplored. Mr. Scribner retired from active work some years ago, and it was when on his farm in Vermont—a favourite spot with him even when in active work—that an attack of apoplexy caused his sudden death.—[*Electrical Review*.]

Another well-known man in the States has passed away in the person of John B. Taltavall, publisher of the *Telegraph and Telephone Age*. He was an Englishman, born in North Shields 69 years ago, but went across to the other side at an early age and for the whole of his life was associated with the telegraph business.

We draw our readers' attention to the Montefiore Triennial Prize Competition which falls due again next year. The prize, which has a value of the accumulated interest of a capital of 150,000 francs invested in Belgian 3% Rentes, is awarded to the writer of the best original work on scientific advancement and the technical application of electricity throughout the world. The MS., which must be printed or typed in French or English, should be sent to M. le Secrétaire-Archiviste de la Fondation George

Montefiore, àl'hotel de l'Association, rue Saint Gilles, 31, Liége (Belique), not later than the 30th April, 1927, and should bear plainly at the top of the text the words " Travail soumis au concours de la Fondation George Montefiore, session de 1823-1926." The advice has been issued by Le Secrétaire Général, M. L. Calmeau, at the above address, who no doubt will furnish full information on application.

BRITISH AUTOMATIC TELEPHONE SYSTEM FOR CZECHO-SLOVAKIA.

" Relay " System for Gross-Ostrau and other towns.—The State Telephone Department has decided to convert the manually operated system in the large Moravian industrial town of Mayrish-Ostrau to automatic working. For this conversion the Relay Automatic System of Marconi House has been selected.

According to the scheme already prepared there will be a central exchange of initially 2,500 lines, which will later be extended to 7,000 lines and which will be capable of further extension to 10,000 lines.

In addition to the main exchange at Mayrish-Ostrau six local exchanges will be erected, one for 200 lines in Witkowitz and others in Marienberg, Radvanitz, Hohenstadt and Kruschen and Schonbrunn.

Mr. C. C. Roe, the Publicity Manager of the Relay Automatic Telephone Co., Ltd., of Marconi House, has been appointed Publicity Manager of the Sterling Telephone & Electric Co., Ltd., of Dagenham, Essex. Mr. Roe will continue as Publicity Manager of the " Relay " Company.

Mr. G. A. Saunders, for many years with the British L.M. Ericsson Company and latterly one of the Superintendents at their Beeston Factory, has accepted an appointment as Production Manager at the Dagenham Works of the Sterling Telephone & Electric Co., Ltd., and takes up his new duties on July 5th.

The Sterling Telephone & Electric Co., Ltd., of Dagenham, were successful recently in securing from the Australian Commonwealth, an order for Switchboards to a value of £50,000 in addition to substantial export orders for the Argentine, South Africa and elsewhere.

The Doon,
Purley Oaks Road,
Sanderstead,
Surrey.
24th July, 1926.

The Managing Editor,
P.O.E.E. Journal.

Dear Sir,

In your July issue there is an article entitled "Simplex working on Fast Speed Repeaters." An arrangement very similar to that given by Mr. Lack in this article was adopted in India some 7 or 8 years ago on all D.C. Simplex and D.C. Simplex-Duplex repeaters. In the Indian arrangement in place of two Auto (Neutral) Relays a single relay with two separate and distinct windings is used, one winding being connected in the line circuit (as Auto Relay No. 1 in Mr. Lack's diagram) and the other winding being connected in a leak circuit containing a condenser to the tongue of the line relay (as Auto Relay No. 2 in Mr. Lack's diagram); the connections were, of course, such that the condenser impulses in the auxiliary winding assisted the line currents in the line winding.

The two windings were obtained by separating the two sets of coils normally paralleled inside the relay, one set being connected to (U). (D)–U.D., making the resistance of the line coils, 200 plus 200 ohms, and the other set connected in series and joined to two additional terminals, making the auxiliary winding 400 ohms. This arrangement was found most satisfactory.

Yours faithfully,
C. LAWTON,
late Chief Electrician,
Indian Telegraph Dept.

The above communication was submitted to Mr. Lack, who replied as follows:—

"The first arrangement we tried was similar to that described by Mr. Lawton. (We did not, of course, know of Mr. Lawton's arrangement). It was found that in these conditions the relay acted as a transformer and upset the weak incoming signals in the line relay and we therefore adopted the second auto relay.

Another disadvantage is that the self-induction of the auto relay is greater with a single coil than with the two coils in parallel and has therefore a tendency to reduce the speed of working. I don't know the speed of the Indian circuits, but presumably it would be less than that obtained in this country.

Yours,
E.L.

HEADQUARTERS NOTES.

EXCHANGE DEVELOPMENTS.

The following works have been completed :—

Exchange.	Type.	No. of Lines.
Bedford New	Auto	1450
Blackburn Extension ...	,,	1000
Grimsby Extension ...	,,	920
Hartlepool New	,,	160
Paignton New	,,	296
Sketty Extension	,,	170
Stanningley Extension ...	,,	260
York Extension	,,	330
Aberdeen Extension ...	Manual	1520
Battersea New	,,	5500
Beaconsfield New	,,	660
Liverpool Central Extn....	,,	3920
Putney Extension	,,	1700
Southend 2nd Relief ...	,,	1110
Walworth New	,,	3700
Whitley Bay Extension ...	,,	900
Armitage & Rigby ...	P.A.B.X.	40
Avonbank Co-op. Society..	,,	20
Burberry's Ltd.	,,	60
Camberwell Guardians ...	,,	40
W. H. Cullen. Ltd. ...	,,	30
Dunkelsbuhler, Ltd. ...	,,	40
Failsworth Co-op. Society.	,,	50
Featherstones, Ltd. ...	,,	30
Fisher & Ludlow	,,	40
Gaumont, Ltd.	,,	50
General Accident Corpn....	,,	30
Harrisons, Ltd.	,,	50
Hawkes & Sons	,,	30
Hinshelwood & Co. ...	,,	40
Manifoldia, Ltd.	,,	30
Motherwell Hospital ...	,,	30
Newton Chambers & Co....	,,	100
Pollard & Co.	,,	60
Rudders & Payne	,,	30
Shell-Mex, Ltd., Fulham...	,,	70
Shoreditch Council ...	,,	50
Stelp & Leighton	,,	40
Stewart Thomson & Co....	,,	40
Swan & Edgar	,,	100
Watney Coombe (Mortlake)	,,	40
Ye Mecca, Ltd.	,,	60

Orders have been placed for the following new Exchanges :—

Exchange.	Type.	No. of Lines.
Colwyn Bay	Auto	1220
Halifax	,,	3100
Llandudno	,,	1140
Llandudno Junction ...	,,	140
Monument	,,	10,000

Exchange.	Type.	No. of Lines.
Old Colwyn	,,	500
Penrhynside	,,	180
Sloane	,,	8700
Batley	Manual	800
Belfast Relief	,,	3610
Govan	,,	660
Maryhill	,,	480
Merstham	,,	340
Wallington	,,	2900
Albright & Wilson ...	P.A.B.X.	40
Anchor Cable Co.	,,	60
Beswick Co-op. Society ...	,,	40
Birmingham Theatre Royal	,,	30
Clyde Valley Co.	,,	60
Equitable Trust Co. ...	,,	50
John Gardner	,,	60
E. & R. Garrould, Ltd. ...	,,	50
Gestetner, Ltd.	,,	40
S. Gratrix, Junr.	,,	30
Hampton & Sons	,,	30
Leyland Rubber Co. ...	,,	30
Liverpool Co-op. Society...	,,	60
Producers Distributing Co.	,,	30
Riseley & Sons	,,	30
Rowe Bros.	,,	30
Rylands Bros.	,,	60
Shell Mex, Ltd., Liverpool	,,	30
Watts Watts & Co. ...	,,	70
West Riding Council ...	,,	100
Weymouth Corporation ...	,,	30
Wiggin & Co.	,,	40
J. Wright & Sons ...	,,	30

Orders have been placed for extensions to existing equipments as follows :—

Exchange.	Type.	No. of Lines.
Torquay	Auto	300
Barnet	Manual	760
Birmingham North ...	,,	960
,, South ...	,,	1360
Darlaston	,,	40
Enfield	,,	760
Leeds Trunk	,,	—
Norwich	,,	720

RETIREMENTS.

Two well known officers at headquarters, Mr. F. L. Henley, Staff Engineer in charge of the Test Section, and Mr. E. Lack, Assistant Staff Engineer, Telegraph Section, have retired owing to the operation of the age limit. Both received tokens of the respect in which they were held by their colleagues. We hope to give further particulars in our next issue, together with sketches of their careers.

LONDON DISTRICT NOTES.

DURING the quarter ended June 25th, 1926, the number of exchange lines, internal extensions and external extensions provided and recovered were as follows:—

	Exchange lines.	Internal Extensions.	External Extensions.
Provided ...	9,865	6,054	1,033
Recovered ...	3,460	3,080	522
Net increase ...	6,405	2,974	511

In the January issue of this journal there appeared two plates illustrating a description of a new Kiosk designed by Sir Gilbert Scott.

These handsome iron structures are now making their appearance in all parts of the Metropolis. An outstanding feature is the amount of glass employed in the construction of the Kiosk, giving a maximum of natural lighting, whilst at night the electric light provided throws an opal telephone sign into relief, thereby attracting the attention of the public to the facilities.

The pierced crowns near the dome provide a means of ventilation through a pierced inner ceiling.

The door itself is of teak and the whole structure, with base, is about 9 ft. in height.

Those already completed have a pleasing external claret-coloured effect, but a definite decision as to the final finish has yet to be reached.

EXTERNAL CONSTRUCTION.

Mileage Statistics.

During the three months ended 30th June, 1926, the following changes have occurred:—

Telegraphs.—A net decrease in open wire of 20 miles and a net increase in underground of 101 miles.

Telephones (Exchange).—A net decrease in open wire (including aerial cable) of 413 miles and a net increase in underground of 46,426 miles.

Telephones (Trunk).—A net increase in underground of 1,658 miles.

Pole Line.—A net increase of 90 miles, the total to date being 5,452 miles.

Pipe Line.—A net increase of 241 miles, the total to date being 6,786 miles.

The total single wire mileages at the end of the period under review were:—

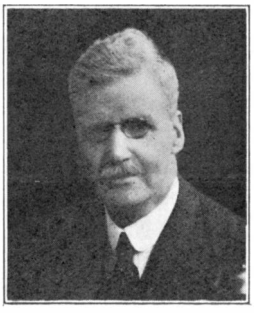
Telegraphs	24,847
Telephones (Exchange)	1,759,375
Telephones (Trunks)	62,656
Spares	71,040

Internal Construction.

New Exchanges.—A new C.B. 10 Exchange installed by Messrs. Siemens Bros. at Popesgrove (Twickenham) was opened on September 11th. The initial capacity is 1,360 lines.

New Exchanges at Rodney (Walworth) and Battersea will be ready for opening during the ensuing quarter.

G.P.O. South.—Forty ticket tubes from the Trunk Exchange to the Annexe have been provided. These tubes, which are of a special type to carry the Trunk record tickets without the aid of a carrier, run from a distribution table in the main Trunk Exchange to alternate positions in the Annexe.



Mr. William Pennington.

The London Engineering District recently suffered a regrettable and irreparable loss when Mr. William Pennington, Assistant Superintending Engineer, passed away on August 4th, in his 53rd year.

He entered the Service as a Telegraphist at Belfast in 1889, and was transferred to the Engineering Department in 1895 as a Junior Clerk, subsequently passing through the Engineering grades to Executive Engineer, and quite recently to Assistant Superintending Engineer. Some weeks before his decease, Mr. Pennington was absent on sick leave through digestive trouble. This proved somewhat serious, but, thanks to the nursing of a devoted wife and his own will power, he pulled through and returned to duty. The resumption was, however, temporary, for after a few weeks duty complications ensued and medical advice

had again to be sought during the August Bank Holiday period. An operation was later deemed necessary, but Mr. Pennington did not recover.

Mr. Pennington was responsible for the carrying out of several large and important works for the Department during his service as Engineer. He took a prominent part in the erection of the Fishguard Wireless Station, in which he took the keenest interest. During the War period he laid and repaired many submarine cables in connection with the defences of Milford Haven and Pembroke Dockyard, and was held in high esteem by the Naval and Military Authorities for his services.

Not only has the Department lost a most efficient and capable officer, but the Staff in all its ranks has lost a very sincere and helpful friend. " Pen's " personality was a charming one. He was a raconteur of the first order, had a ready flow of sympathy, and was always full of cheery optimism. He was scrupulously fair in his judgments, which were arrived at surely and quickly. To any of the Staff who wished for instruction and guidance Mr. Pennington possessed that rare quality of giving each one " individual " consideration. He had an excellent memory. His wide provincial experience in Ireland and South Wales was a valuable asset on transfer to London to take charge of the City External Section, where his zeal and administrative qualities soon began to take effect.

H.C.S.

FEDERATED MALAY STATES.

ANNUAL REPORT, 1925. POSTS AND TELEGRAPHS.

THE annual report shows a decided increase in business by the Department over the preceding year in spite of floods and landslides which occurred on an unprecedented scale in various parts of the country. The following extracts from the report may prove of interest :—

Correspondence.—The estimated number of letters, postcards, packets and parcels posted and delivered during the year was 26,755,028, an increase of 1,626,554 on the figures for 1924. The increase is shared by all classes of correspondence and are the highest on record in each class.

Registered Articles.—The number of registered articles posted was 484,323 and 452,308 were delivered—increases of 27,659 and 41,515, respectively, over the 1924 totals. These were actual not estimated figures and the total posted and delivered exceeded the record of any previous year by 69,174. There has again been no

case in which it has been necessary to pay compensation from public funds for the loss of a registered article.

Parcels.—The parcels posted numbered 72,695 and those delivered 150,878, increases of 4,168 and 11,461 respectively.

It is regretted that the British postal authorities have been unable to see their way to establish a weekly instead of a fortnightly parcel despatch in Malaya. Such an improvement it is felt would be greatly appreciated by the public of this country and further representations are being addressed to London.

Cash-on-Delivery.—Seven thousand four hundred and fifty-nine packets bearing trade charges to the value of $71,807 were posted, an increase of 697 in number and $6,333 in value as compared with the 1924 figures. The packets delivered numbered 31,963 and bore trade charges to the value of $533,915, showing an increase of 8,147 in number and $148,645 in value over those delivered in 1924.

Telegraphs. — During the year 413,512 telegrams were despatched and 451,518 were delivered, increases of 58,614 and 161,964 respectively. The revenue derived from telegrams was $342,017 of which $212,153 is included in the stamp sales shown in Appendix XII. The revenue shows an increase of $31,380 as compared with 1924. The value of telegrams sent free of charge for other Government departments was $43,971, a decrease of $2,632.

The question of the introduction of high-speed apparatus has been engaging the attention of the department more particularly with a view to dealing with traffic during and after breakdown of the main lines. The general opinion, taking into consideration the traffic loads, the general state of the lines, climatic conditions and available engineering maintenance staff, seems to favour Wheatstone and action is being taken accordingly.

Telephones.—The number of subscribers to the telephone exchange on the 31st December was 2,827, an increase of 391 during the year. In addition there were 1,401 extension lines, extension bells and private circuits maintained by the department as compared with 1,249 in 1924. The increases have been nearly as great as in any two previous years.

The revenue derived from telephones was $696,782, an increase of $136,426 or 24 per cent. over 1924. The trunk revenue amounted to $212,844, 92 and 41 per cent. higher than the 1923 and 1924 figures respectively.

Engineering.—On 31st December there were 2,561 miles of telegraph and telephone lines and 18,492 miles of overhead wire in the Federated Malay States of which 15,127 miles were telephone

wires. In addition there were 62 miles of underground cables containing 5,959 miles of wire single line. These figures do not include the poles and wires maintained by the Railway Department for their own use. The Posts and Telegraphs Department also owns and maintains 122 miles of line and 422 miles of wire in Johore. It also maintained in addition to its own lines 1½ miles of pole line for Kedah and 327 miles of wire for Johore.

Preliminary investigations continued throughout the year with a view to furnishing data necessary to enable the Consulting Engineers to advise upon the Malayan Trunk Telephone (Cable) Scheme. The completion of a comprehensive trunking scheme for Malaya is becoming a matter of urgency and a vote of $1,000,000, as part of an estimated total cost of $4,500,000, has been entered in the budget for 1926. The data collected have been sent to the Crown Agents with a request that the advice of the Consulting Engineers be sought and that firm estimates of cost be furnished. The Telegraph Engineer is now in England and will be in close touch with the Consulting Engineers and the Crown Agents while the matter is under their consideration.

There seems to be a misapprehension in the public mind in regard to this scheme. It is not merely a matter of connecting Singapore and Penang by telephone—that is only an incident in the scheme which is designed primarily to meet the immediate and future requirements of the Federated Malay States where the demand for trunk service is rapidly outrunning the capacity of the existing system. The scheme will give nearly all telephone subscribers in Malaya reciprocal telephonic facilities. It is moreover hoped that it will be possible to incorporate several telegraph channels in the cable and thereby to increase the reliability and efficiency as well as the capacity of the telegraph system.

One of the greatest needs of the Engineering Branch is a technically trained Asiatic staff. The arrival of an additional Assistant Telegraph Engineer at the end of 1924, appointed specially for instructional purposes, enabled a regular and systematic course to be instituted. Progress was slow, due mainly to the inadequacy of the mathematical knowledge of the students which necessitated a course of mathematics being given as a preliminary to the technical course. The students are keen, however, and the results to date justify the expectation that within a few years the classes will provide the department with a well-trained Asiatic engineering staff.

The only means of entering the better grades of the Engineering Branch will in future be through the technical classes and the qualifying examinations. Apprentices and probationers were appointed in accordance with the scheme for technical subordinates,

preference being given to Malays, the natives of this country, and they are now in training. The department has gladly undertaken the training of Malay youths from Johore and Kedah for the engineering service of those States.

Wireless.—The issue of temporary licences for the use of wireless receiving apparatus was commenced in April and twenty-eight such licences were applied for and issued.

The opening of the new British wireless station near Rugby enabled the British Government to broadcast news throughout the world for free reception by anyone who possessed a suitable receiving set and a knowledge of Morse and the experiments showed that the messages could be fairly reliably picked up by the Penaga Wireless Station. Regular transmissions of news started on 1st January, 1926. Negotiations have since been concluded with several Malayan newspapers whereby the messages are re-transmitted from Penaga by land lines and delivered to them on payment of a small monthly fee. It is understood that the additional news so received has been very acceptable both to the press and to the newspapers reading public.

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

LOCAL CENTRE NOTES.

SOUTH LANCASHIRE CENTRE.

The Programme for the second half of the 1925/26 Session included a lecture on "Wireless," by Mr. E. H. Shaughnessy, O.B.E., M.I.E.E.; a paper on "Staff Matters; a General Review," by Mr. G. H. Green; and a paper entitled "Notes on Cabling work and Labour Saving Tools," by Mr. R. C. Balcombe. Good attendances and interest were maintained through the Session.

The lecture on Wireless was of a special interest and importance, and the opportunity was taken, in accordance with the practice of the last few years, to invite the members of the Local Centre of the I.E.E. A large hall was rented for the occasion, and there was a splendid response to the invitation resulting in an attendance of approximately 600.

The lecturer described in some detail, and in his characteristically telling manner, the outstanding features of the Rugby Station. Great interest was aroused and the magnitude of

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93.

1 Hunt, R. W.
2 Bentley, F. E.
3 Joscelyne, S. J.
4 Wilcoxon, F. J.
5 Shaw, V. C. H.
6 Ellinson, F.
7 Dunkerley, H. W.
8 Massey, E.
9 Sanderson, E. R.
10 Hibbert, J.
11 Carron, J. R.
12 Ashworth, J.
13 Heaton, A.
14 Gibson, W.
15 Halsall, T. G.
16 McIlwreith, J. W.
17 Shoults, G. M.
18 Warburton, T. E.
19 Partington, J.
20 Lockton, C. P.
21 Downward, F.
22 Jones, J. W.
23 Edwards, F. R.
24 Wilson, C. C.
25 Williams, J. P.
26 Thompson, J. W.
27 Standring, W. W.
28 Barratt, C.
29 Buchanan, J. R.
30 Cross, W. H.
31 Spargo, E.
32 Ball, W.
33 Austin, T. W.
34 Payne, C. F.
35 Cox, C. R.
36 Vernon, R. J.
37 Mercer, H.
38 Harrison, J.
39 Michaelson, F.
40 Goodall, R.
41 Minta, T. A.
42 Gange, A.
43 Partington, B. G.
44 Tansley, R.
45 Batho, G.
46 Dunning, F. T.
47 Williams, C.
48 Potter, W.
49 Hale, F.
50 Wood, W. T.
51 Chase, S. H.
52 Pearson, S. J.
53 Jackson, S.
54 Law, J.
55 Kemp, A.
56 Heathcote, A.
57 Impey, A. B.
58 Jackson, A. G.
59 Wood, W.
60 Storey, C. W.
61 Graham, R. B.
62 Balcombe, F. G.
63 Baxter, F.
64 Wilson, W.
65 Jackson, J. T. H.
66 Bagshaw, H. M.
67 Crossley, W. C.
68 Rowlands, W.
69 Cleaver, J.
70 Cooper, J. O.
71 Capt. Cowburn.
72 Barnard, A. S.
73 Wildgoose, G. H. A.
74 Stevenson, G.
75 Herbert, T. E.
76 McKinnon, E. C.
77 Fletcher, J. F.
78 Dean, H.
79 McCormack, W.
80 Morgan, C. E.
81 White, A. E.
82 Matthews, T. E.
83 Pinkham, W. W.
84 Turley, T. G.
85 Hepplestone, H.
86 Hignett, A. A.
87 Blacow, W. G.
88 Whittaker, W. N.
89 Critcher, W. T.
90 Wainwright, S. W.
91 Lown, S. J.
92 Meldrum, F. A.
93 Turner, H. M.

SOUTH LANCS. CENTRE AT THE CHLORIDE WORKS, CLIFTON.

numerous items of plant installed as well as the complexity of the problems involved came as a surprise to many in the audience.

In the afternoon prior to the meeting, which was held on the 16th February, the members of this Centre visited the works of the Chloride Electrical Storage Company at Clifton Junction. Their visit to the largest accumulator works in the Empire proved most instructive and pleasant, largely because of the truly admirable arrangements made by the Directors for the convenience and comfort of the visitors. Small groups were formed and visited every portion of the works under the guidance of the Company's officials. These gentlemen had evidently been very carefully selected, since the questions raised by our members during the inspection were answered with promptitude and accuracy. To achieve this result the Company provided no less than 14 guides, 4 control officers, and 6 stewards.

The routes taken by the parties never clashed, nor was there a single hitch or wait, and this speaks volumes for the care with which the arrangements had been organised. One little point of detail may be mentioned. Each machine and each process was clearly and distinctly labelled so that even without the guides professional visitors would have been enabled to get quite a good idea of the manufacture of a secondary cell. Everyone was very much struck with the arrangements made to avoid injury to the workers from lead poisoning and it was gathered that in practice such cases were rare. The final exhibit of the standard plates for Post Office cells was interesting and should mark the passing of the day when many differently sized plates are used for approximately the same A.H. capacity.

After the conclusion of the inspection a very welcome light tea was served in the canteen, and a photograph of the party was taken. Mr. Herbert took the opportunity to express our thanks to the Directorate for the admirable arrangements made for our convenience and suggested that after seeing the care bestowed upon the manufacture of the cells it should be appreciated that equal care in their maintenance was clearly called for. Mr. Stevenson suitably responded and, as it transpired, this was the last duty he ever performed for his Company, for we were all shocked to learn of his death only a few days later.

The photograph of the group, with a key, is given on p. 296.

BOOK REVIEWS.

"La Telephonie Automatique." By H. Milon, Engineer-in-Chief of Posts & Telegraphs, France. Published by Ganthier-Villars & Co., Paris.

In the preface of the second edition of this work, M. Milon describes the difficulties that face an author of a treatise on Automatic Telephony. He says:—

> "A complete description of all the existing systems of automatic telephony would provide material for many large volumes. I have, therefore, had to limit myself to describing the essential characteristics of the various systems, to separate out the leading ideas which were present at their conception, and to enter into circuit details only of those systems which are actually in use or under construction in France. Beside this, it is certain that most of these systems have not yet reached their final form; if ever the expression 'final form' can apply to these mechanisms which are almost comparable to living organisms in their flexibility and in the ever-growing combinations which can be obtained, and like them are in a permanent state of evolution. It would, therefore, be useless to attempt to describe the minor details as they exist to-day for they will certainly be different to-morrow."

In spite of these difficulties, M. Milon is to be congratulated on his successful attempt to compress into one volume so much information on the chief systems and at the same time finding room for a chapter on Traffic Calculations and for another on Present and Future Developments.

Although it is perhaps a little unfair to pick out certain parts on which to lay particular stress, one naturally turns first to the description of Strowger systems and, secondly, to the chapter dealing with the fascinating question of the application of automatic telephony to large areas.

It is somewhat unfortunate that the consideration of Strowger switches should commence with a description of plunger line switches and of selectors fitted with side switches, but the author probably considers that in a treatise of this kind some attention must be given to earlier systems.

By way of compensation a chapter is devoted to the latest forms of Strowger equipment. This contains several very interesting circuits which, it is believed, have not been described previously, at any rate outside patent specifications, and which are worthy of serious study.

In the description of the Director system, the circuits and the equipment differ considerably from those about to be installed in

London, but this does not detract from the interest of the text, which shows a very good grasp of the principles governing the use of automatic telephony in large cities.

In other chapters the author deals with the Siemens & Halske, the Austrian, Betulander, Relay, Ericsson and the Western Electric systems of full automatic working, as well as the Clement, Siemens & Halske and Western Electric systems of semi-automatic working.

Consisting of 405 pages with 175 diagrams (of which a large percentage are actual photographs) the book is well printed. As is to be expected, a few slight errors were noticed—the most important being that Figs. 17 and 55 are printed upside down.

In conclusion, the book is considered to be a valuable addition to the text-books on Automatic Telephony and it is to regretted that an English translation or an English treatise covering similar ground is not available.

F.I.R.

"The Lead Storage Battery." By H. G. Brown, A.M.I.E.E. (Second Edition). The Locomotive Publishing Company. 5*s*. nett.

The Secondary Cell has never been so widely used as it is to-day, and the enormous developments during the past few years in connection with the introduction of automatic signalling and switching have resulted in a great increase in the numbers and in the dimensions of Secondary Cell installations used for telephone, telegraph and radio services. In consequence, those responsible for the installation and maintenance of such installations have now more need than ever of a convenient and reliable work of reference on the subject. Mr. Brown's book is eminently suitable for all those who must be acquainted with the essential facts regarding the chemical reactions of the lead cell and who wish to obtain sound practical advice on the erection, treatment, testing, and repair of stationary and portable batteries. The author is to be congratulated on having succeeded in compressing so much authentic and practical information into a book of such convenient size.

J.J.M.

STAFF CHANGES.

POST OFFICE ENGINEERING DEPARTMENT

PROMOTIONS.

Name.	Grade.	Promoted to.	Date.
Cohen, B. S.	Asst. Staff Engineer, E.-in-C. Office.	Staff Engineer, E.-in-C. Office.	12-9-26
Ridd, P. J.	Executive Engineer, London District.	Asst. Staff Engineer, E.-in-C. Office.	12-9-26
Wilby, E. J.	Executive Engineer, E.-in-C. Office.	Asst. Staff Engineer, E.-in-C. Office.	13-9-26
Wright, A.	Executive Engineer, London District.	Asst. Suptg. Engr., London District.	1-9-26
Sanger, P. M.... ...	Assistant Engineer, London District.	Executive Engineer, London District.	15-6-26
McDonald, C. G. A....	Assistant Engineer, N. Wales District.	Executive Engineer, (In Charge), Oxford Radio Stn.	1-7-26
Morice, A. B.	Assistant Engineer, E.-in-C. Office.	Executive Engineer, E.-in-C. Office.	15-6-26
Nancarrow, F. E. ...	Assistant Engineer, E.-in-C. Office.	Executive Engineer, (In Charge), Bodmin Radio Beam Station.	15-6-26
Gadsby, G. J.	Assistant Engineer, E.-in-C. Office.	Executive Engineer, E.-in-C. Office.	27-7-26
Elston, J. S.	Assistant Engineer, E.-in-C. Office.	Executive Engineer, E.-in-C. Office.	13-9-26
Wilson, F.	Chief Inspector, (In charge), Northolt Radio Stn.	Assistant Engineer, (In Charge), Northolt Radio Stn.	4-9-26
Wilson, A.	Chief Inspector, Scot. West District.	Assistant Engineer, Scot. West District.	1-9-26
Irwin, A.	Chief Inspector, E.-in-C. Office.	Assistant Engineer, (In Charge), St. Albans Radio Stn.	13-9-26
Temple, W.	Inspector, E.-in-C. Office.	Chief Inspector, E.-in-C. Office.	16-6-26
Read, A.	Inspector, S. East District.	Chief Inspector, S. East District.	8-5-25
Faithfull, F. E. ...	,,	,,	25-4-26
Smith, A.	Inspector, S. Wales District.	Chief Inspector, S. Wales District.	6-1-26
Smith, J. G.	Inspector, E.-in-C. Office.	Chief Inspector, E.-in-C. Office.	16-6-26
Vause, A. H.	Inspector, London District.	Chief Inspector, London District.	3-9-26
Miller, A.	Inspector, London District.	Chief Inspector, London District.	9-7-26
Petrie, W.	Inspector, Scot. East District.	Chief Inspector, Scot. E. District.	30-4-26
Ward, D. V.	Inspector, South East District.	Chief Inspector, South East District.	9-8-26
Attenborough, F. C....	Inspector, N. Wa. District.	Chief Inspector, N. Wales District.	4-5-26
Hyde, J.	Inspector, N. Mid. District.	Chief Inspector, N. Mid. District.	31-8-26
Manton, C.	Inspector, Met. Power District.	Chief Inspector, Met. Power District.	8-3-25
Prickett, W.	Inspector, E.-in-C. Office.	Chief Inspector, E.-in-C. Office.	16-6-26
Bothwell, A. D. ...	,,	,,	16-6-26
Carter, T.	,,	,,	16-6-26
Little, W. R.	Inspector, London District.	Chief Inspector, London District.	To be fixed later.

PROMOTIONS—(*Continued*).

Name.	Grade.	Promoted to.	Date.
Flanagan, W. J. C. ...	Skilled Workman, Class I., Wireless Station.	Inspector, Wireless Station.	2-7-26
Bradley, V. A. F. ...	S.W.1, N. Mid. District.	Inspector, N. Mid. District.	5-7-25
Woodhouse, W. T. ...	,,	,,	14-8-25
Finch, T. H.	S.W.1, S. Wales District.	Inspector, S. Wales District.	30-5-26
Verney, J. P. S. ...	,,	,,	30-5-26
Linck, H. C. A. ...	,,	,,	12-1-26
Jacobs, G. E. J. ...	,,	,,	8-3-26
Yeats, H. T. F. ...	S.W.1, S. Mid. District.	Inspector, S. Mid. District.	26-4-26
Farr, A. G. K. ...	,,	,,	12-1-26
Reeves, F. C.	,,	,,	12-4-26
Logan, H. D. ...	,,	,,	26-6-26
Henry, J.	,,	,,	1-3-26
Forrester, J.	S.W.1, Scot. West District.	Inspector, Scot. West District.	9-7-26
Burnett, H. J. ...	Skilled Workman, Class I., London District.	Inspector, London District.	23-4-26
Wright, T. D. ...	,,	,,	21-5-26
Sheppard, R.	Skilled Workman, Class I., N. Wales District.	Inspector, N. Wales District.	1-3-26
Sands, J. L.	,,	,,	1-3-26
Wylie, F. L.	Telegraphist.	Repeater Officer, Class II., S. Wales District.	10-7-26

RETIREMENTS.

Name	Grade.	District.	Date.
Henley, F. L. ...	Staff Engineer.	E.-in-C. Office.	11-9-26
Lack, E.	Asst. Staff Engineer.	,,	12-9-26
Henshilwood, G. ...	Executive Engineer.	S. East.	17-6-26
Gallagin, J.	2nd Class Engineer.	Northern.	31-7-21
Pope, T.	Chief Inspector.	S. Mid.	6-6-26
Greenwood, E. ...	,,	,,	21-9-26
Conway, J. M. ...	Inspector.	N. West.	13-6-26
Lang, J. W.	,,	S. Lancs.	30-6-26
Dunigan, J. F. ...	,,	Scot. W.	6-6-26
Bowers, J. S. ...	,,	N. West.	23-7-26

DEATHS.

Name.	Grade.	District.	Date.
Pennington, W. ...	Asst. Suptg. Engr.	London.	4-8-26
Everatt, W. C. ...	Assistant Engineer.	N.E.	14-6-26
Price, J. T.	,,	London.	21-6-26
Cole, J. T.	Inspector.	S. West.	23-6-26

STAFF CHANGES.

RESIGNATION.

Name.	Grade	District.	Date.
Sanger, P. M. ...	Executive Engineer.	London.	8-9-26

TRANSFERS.

Name.	Grade.	Transferred. From.	To.	Date.
De Wardt, R. G....	Exec. Engineer	Oxford Radio Station.	Grimsby Radio Station.	13-7-26
Wilson, F. ...	Asst. Supt, (Wireless)	I. of T.'s Department.	Eng. Dept. as Chief Insp	13-7-26
Chapman, F. G....	Asst. Supt. (Wireless)	,,	,,	13-7-26
Semple, L. G. ...	Pro. Asst. Engr.	E.-in-C. Office.	E. District.	13-6-26
Procter, W. S. ...	Pro. Asst. Engr.	,,	N.W. District.	18-7-26
Gibbs, F. J. ...	Inspector	S. Mid.	E.-in-C. Office.	8-8-26
Brown, A. H. ...	,,	,,	,,	25-7-26
Jarvis, J. W. ...	,,	Scot. E.	Egyptian Telephones.	13-11-25
Coxon, J.... ...	Asst. Engr.	E.-in-C. Office.	N. Wales Dist.	18-7-26

CLERICAL ESTABLISHMENT.

PROMOTIONS.

Name.	Grade.	District.	Date.
Lyle, R.	Clerical Officer, South East District.	Higher Clerical Officer, North East District.	11-7-26

RETIREMENTS, ETC.

Name.	Grade.	District.	Date.	Remarks.
Feben, H. M. ...	Exec. Officer	E.-in-C. Office.	17-9-26	Retired.
Watson, E. W. ...	Higher Clerical Officer	Scot. West.	15-8-26	,,
Badger, E. J. C....	Higher Clerical Officer	South Wales.	10-8-26	,,

TRANSFERS.

Name.	Grade.	From.	To	Date
Lean, W. G. ...	Higher Clerical Officer	North East.	Scot. West.	20-6-26
Gain, P. G. W. ...	,,	South East.	South Wales.	22-8-26

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

PROGRAMME, 1926-27.

LONDON CENTRE.

Date.	*Title.*	*To be read by*
1926.		
12 Oct.	"Trans-Atlantic Telephony" ...	Lt.-Col. A. G. Lee, M.C., B.Sc., M.I.E.E.
9 Nov.	"Phases in Automatic Telephony"	W. Day, M.I.E.E.
14 Dec.	"Economics of Line Plant Provision"	H. Kitchen, M.I.E.E.
1927.		
11 Jan.	"Motor Transport in the Engineering Department"	R. T. Robinson, A.M.I.E.E.
8 Feb.	"Voice Frequency Telegraphs" ...	W. Cruickshank, M.I.E.E.
8 Mar.	*Subject to be arranged.*	J. W. Atkinson, M.I.E.E.
10 May	"Telephone Repeaters: Operation and Maintenance"	J. E. Statters.

EASTERN CENTRE.

1926.		
Oct.	"Telephone Repeaters"	C. J. Jones.
Nov.	"Steam Turbines"	L. G. Semple.
Dec.	"Some Notes on Automatic Telephony"	C. W. Brown, M.I.E.E. (*E.-in-C.O.*).
1927.		
Jan.	"Local Line Plant Economics" ...	H. Kitchen, M.I.E.E. (*E-in-C.O.*).
Feb.	"Traffic Records in Auto-Exchanges"	G. F. O'Dell, B.Sc., A.K.C., M.I.E.E. (*E.-in-C.O.*).
Mar.	*To be arranged.*	T. Cobbe.

NORTHERN CENTRE.

1926.		
1 July	Visit to Cable Laying Work at Holy Island.	
20 Oct.	"Scientific Organisation and the P.O. Engineering Department"... ...	F. G. C. Baldwin, M.I.E.E.
17 Nov.	"The Control of Adivce Note Work"	J. Lane.
15 Dec.	"Wayleaves and relative difficulties"	B. Miller.
1927.		
19 Jan.	"Local Line Plant Economics" ...	H. Kitchen, M.I.E.E. (*E.-in-C.O.*).
16 Feb.	"Local Underground and Open Faults, their detection and clearance"	J. Brown.
16 Mar.	"The West Hartlepool Automatic Exchange and Transfer" ... ... And Visit to West Hartlepool Exchange.	W. Nicholson and J. Parker.

NORTH EASTERN CENTRE.

1926.		
1 Oct.	"Hull Telephone System"	J. T. Tattersall.
9 Nov.	"Local Line Plant Economics" ...	H. Kitchen, M.I.E.E. (*E.-in-C.O.*).
— Dec.	"Preparation of Underground Development Schemes and suggestions *re* Cabling Layout"	G. Bailey.
1927.		
— Jan.	"Engineer-in-Chief's Automatic Telephone Training School. Impressions"	W. V. Ryder.
— Feb.	"Overhead Construction"	J. Shee.
— Mar.	"Works Estimates"	J. E. Suret

PROGRAMME, 1926-27.

NORTH WESTERN CENTRE.

1926.		
11 Oct.	"A comparison of desiccation methods"	E. HOPPER.
2 Nov.	"Local Line Plant Economics" ...	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
6 Dec.	"Ways and Means in an Engineering Section"	S. UPTON, A.M.I.E.E.
1927.		
11 Jan.	"A Comprehensive View of Automatic Switching"	W. BEATTIE, A.M.I.E.E.
14 Feb.	"More about Amateur Wireless Stations"	H. HORROCKS.
6 Mar.	"Curiosities of Official Literature"	R. A. JONES.
	Visit to Southport New Automatic Exchange. (Date will be announced later.)	

SOUTH LANCASHIRE CENTRE.

1926.		
18 Oct.	"Progress and Development in the P.O. Engineering Department" ...	W. J. MEDLYN, M.I.E.E.
15 Nov.	"Reminiscences"	A. MAGNALL.
6 Dec.	"Local Line Plant Economics" ...	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
1927.		
17 Jan.	"Motor Transport"	T. KENYON.
7 Feb.	"Problems in Large Underground Construction Works"	J. CLEAVER, A.M.I.E.E.
7 Mar.	"Voice Frequency Telegraphs" ...	W. CRUICKSHANK, M.I.E.E. (*E.-in-C.O.*).
11 Apr.	"Telephone Repeaters — Operation and Maintenance"	J. E. STATTERS (*E.-in-C.O.*).

NORTH MIDLAND CENTRE.

1926.		
4 Oct.	"Derby Repeater Station"	T. S. SKEET.
8 Nov.	"Local Line Plant Economics" ...	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
6 Dec.	"Private Auto Branch Exchange. Relay Automatic System"... ...	J. HYDE..
1927.		
3 Jan.	"Transmission on low power" ...	C. A. CARPENTER.
	To be followed by a visit to the Nottingham Super-Power station.	
7 Feb.	"Electrolytic Action in Lead Covered Cables"	J. R. MILNES, A.M.I.E.E.
7 Mar.	"Private Automatic Branch Exchange. W.E. Type"	F. H. ROBERTS.

NORTH WALES CENTRE.

1926.		
13 Oct.	"Control of Expenditure by Supervising Officers"	G. H. CARRIER.
10 Nov.	"Birmingham Telephone Repeater Station"	R. P. COLLINS.
	(Meeting at Birmingham.)	
8 Dec.	"Ferro-Concrete Construction" ...	J. B. SALMON.
1927.		
12 Jan.	"Local Line Plant Economics" ...	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
9 Feb.	"Inspection of Amateur Wireless Stations"	H. B. SOMERVILLE, B.ENG. (*E.-in-C.O.*).
9 Mar.	"Protection of Department's Plant from Power Circuits"	H. W. GREEN.

SOUTH WALES CENTRE.

1926.		
11 Oct.	"Local Line Plant Economics" (Provisional date for this paper.)	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
8 Nov.	"Extension circuit from C.B. Private Branch Exchanges and from C.C. Bell Sets"	W. H. LANE.
13 Dec.	"Trans-Atlantic Telephony"	LT.-COL. A. G. LEE, M.C., B.SC., M.I.E.E. (*E.-in-C.O.*).
1927.		
10 Jan.	"Inspectors' Work"	J. H. HAYNES.
14 Feb.	"Repeater Station Working"	G. E. J. JACOBS.
14 Mar.	"Phonogram Switches"	H. C. A. LINCK.

SOUTH MIDLAND CENTRE.

1926.		
— Oct.	"The theory of the Electric Current. An Historical Survey"	J. E. TAYLOR, M.I.E.E. (*The Chairman*).
— Nov.	"Local Line Plant Economics"	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
— Dec.	"Economical Construction"	S. D. PENDRY.
1927.		
— Jan.	"Some Notes on Local Arrangements for financing a District"	E. W. DEANE.
— Feb.	"The Training of Inspectors"	E. CLIFFORD HARRIS.
— Mar.	(1) "Advice Notes"	S. MOODY.
	(2) "Advice Note Work from an Engineering point of view"	W. L. TAYLOR.
— Apr.	"Power Plant. Acceptance Testing"	P. J. CAMPBELL.

SOUTH WESTERN CENTRE.

1926.		
—	"The Rugby Station"	E. H. SHAUGHNESSY, O.B.E., M.I.E.E. (*E.-in-C.O.*).
—	"The Automatic Relay System"	PROF. DAVID ROBERTSON, D.SC., M.I.E.E.
—	"Local Line Plant Economics"	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
1927.		
—	"Traffic Records in Auto Exchanges"	G. F. O'DELL, B.SC., A.K.C., M.I.E.E.
—	*To be arranged.*	(*E.-in-C.O.*).

SCOTLAND EAST CENTRE.

1926.		
— Nov.	"Automatic Trunking Schemes"	H. W. DIPPLE, A.M.I.E.E. (*E.-in-C.O.*).
— Dec.	"Reports"	J. D. TAYLOR, M.I.E.E.
—	"Local Line Plant Economics"	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
1927.		
— Feb.	*To be arranged.*	
— Mar.	"Secondary Cell Installations"	J. M. COUCH.
— Apr.	*To be arranged.*	

SCOTLAND WEST CENTRE.

1926.		
4 Oct.	"Wireless" popular lecture	VINCENT A. M. BULOW (*Brit. Broadcasting Co.*).
1 Nov.	"Main and Local Overhead and Cable Records"	M. MCKENZIE.
6 Dec.	"Description of Working 4-wire Trunk Circuits from Glasgow Trunk Ex."	A. ARNOLD.
1927.		
17 Jan.	"Local Line Plant Economics"	H. KITCHEN, M.I.E.E. (*E.-in-C.O.*).
7 Mar.	*To be arranged.*	T. HETHERINGTON, A.M.I.E.E.

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Each Competitor may choose any subject relevant to current Telegraph or Telephone practice. It is thought that the list given below of suitable subjects for Essays, though not exhaustive, will prove of assistance to Competitors. The subject need not, however, be chosen from this list, but must be relevant to current Telegraph or Telephone practice :—

Telephone Repeaters.
Telephone Development.
Telephone Fitting.
Cord Circuit Repeaters.
Trunk and Junction Testing.
The Wiring of Large Buildings.
Extension of Large Multiples.
Subscribers' Switchboards.
Telephone Buildings.
Automatic Telephony.
Semi-Automatic Telephony.
Rural Automatic Exchanges.
Automatic Private Branch Exchanges.
Multi Office Automatic Telephony.
Underground Cables.
Precision Testing in Underground Cables.
Cable Drawing.
Cable Balancing.
Overhead Line Construction.
Overhead Line Maintenance.
Aerial Cables.
The Training of Youths.
Primary Batteries.
Secondary Batteries.
Matters for Reform.
Development Studies.
Advice Note Procedure.
Unit Costs.
Store Keeping.
Oscillographs.
Fire Alarm Systems.
Electrical Clocks.
Insulation.
Numbering Machines.
Stamping Machines.
The Loading of Telephone Circuits.
Modern Telephone Practice.
Telephone Line Construction.
A Short History of Telephony.
Telephone Transmission over A.S.P.C. Cables.
The Installation of a New Telephone Exchange Equipment.
Change Over from an Old to a New Exchange Equipment.
Common Battery Manual Telephone System.
Common Battery Signalling Manual Telephone System.
The Telephone System in the British Post Office.
The Elementary Principles of Telephonic Repeaters.
Telephony Considered from a Subscriber's point of View.
A Long Distance Conversation.
The Use of Motor Transport in the Telephone Business.
Routine Testing of Automatic Exchanges.
A Practical Analysis of Characteristic Faults at Automatic Exchanges.
Manual versus Automatic Telephony.
Fault Procedure at Automatic and Manual Exchanges.
The London Trunk Exchange.
The Laying of Pipes and Ducts.
The Construction of a modern Balanced Cable.
Overhead Construction—Precautions to avoid Interference with Working Circuits.
Technical Education in Practice.
Modern Aspects of Electricity and Magnetism.

The Theory of the Accumulator.
The Economy of the Leclanché Cell.
Practical Electrical Units, Sub-Units, etc.
The Ventilation and Heating of Automatic Exchanges and Repeater Stations.
Telegraph Working without Batteries.
Telegraph Printing Apparatus.
Emergency Maintenance.
Long Distance Wireless.
The Thermionic Valve.
Capacity Effects in Telephony—Wired and Wireless.
Carrier Wave Telegraphy and Telephony.

Each Essay must be written on foolscap, one side of the paper only, and must not exceed 5,000 words.

The Essays must reach the Secretary,
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by the 31st December, 1926.

The Council reserves the right to refrain from awarding the full number of prizes, if in its opinion, the Essays Submitted do not attain a sufficiently high standard.

R. V. HANSFORD,
Secretary.

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Printed by Birch & Whittington, Epsom, and
Published by The Electrical Review, Limited, at 4 Ludgate Hill, London, E.C.