THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

VOL. 6 PART 4

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The Post Office Electrical Engineers' Journal.

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Digging the Trench for the New Anglo-German Cable. The Cable Ship "Stephan" is seen lying close inshore.

THE
Post Office Electrical Engineers' Journal

A NEW ANGLO-GERMAN TELEGRAPH CABLE.

By A. C. Booth.

The Norddeutsche Seekabelwerke Aktiengesellschaft have constructed and laid by means of their cable ship "Stephan" (see frontispiece) a new 4-wire submarine telegraph cable (1) from Mundesley in Norfolk, near Cromer, to the island of Norderney off the north-west coast of Germany. The work of laying the cable was carried out on the 18th and 19th of September last.

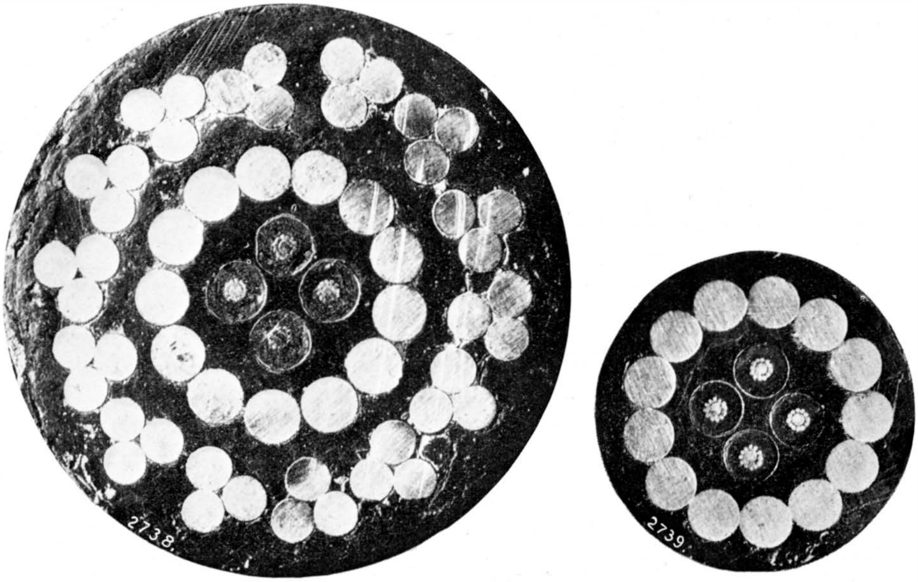
The cable is connected to the repeater station at North Walsham (2) by four copper wires, each 150 lbs. per mile, but this section of five miles will shortly be replaced by an underground lead-covered paper-insulated cable, having the same size of conductor. On the German side the cable is continued to the mainland, and thence by underground to the cable repeater station (3) at Emden with similar gauges of gutta-percha-covered conductors. The object of the cable sections on the land is to avoid disturbances produced on aërial sections by atmospheric changes and other causes to the somewhat difficult balances which have to be maintained on these lines.

The new cable from Mundesley to Emden is 274·287 nautical miles in length; each core has a resistance of 1753 ohms and a capacity to earth of 93 microfarads. Each conductor consists of a central solid wire surrounded by twelve smaller ones, the former being 1·65 mm. and each of the latter 0·55 mm., giving a total weight of 180 lb. copper per nautical mile. The gutta-percha covering is 150 lbs. to the nautical mile. The usual brass taping is provided.

The four wires will be utilised for improving the means of communication between England and Germany, but the actual towns which the cable will serve have not yet been agreed upon. There will, however, be a direct circuit between London and Leipzig.

The apparatus that will be employed on the new cable will be either Baudot or some other apparatus giving a greater output than the Hughes.

This cable forms the sixth four-wire cable working direct between England and Germany. The two earliest ones pass *viâ* Lowestoft, and the other three (*viâ* North Walsham) leave the coast at Bacton, a village situated two miles south of Mundesley. Details of the six cables are given in the following table:



I.—Sections of the new Anglo-German Cable: Shore-end and Mid-Ocean. Full Size.

Anglo-German Cables.

Cables.	Date laid.	Length in nautical miles.	Total resistance in ohms.	Capacity wire to E. in microfarads.	Weight in lbs. per nautical mile.		Remarks.
					Copper.	G.P.	
Lowestoft–Norderney	1866	234·2	2715	75·4	107	150	To Norderney Post Office.
Lowestoft–Borkum	1871	243·3	2578	73	107	150	To Emden
Bacton–Borkum I	1891	241·4	2578	73	107	150	,,
,, II	1896	253	1620	94	180	150	,,
,, III	1901	267·5	2385	103	130	130	,,
Mundesley–Norderney	1913	274·3	1753	93	180	150	,,

2.—North Walsham Repeater Station.

3.—Post Office and Repeater Station, Emden, Germany.

A few details of the cable-ship "Stephan" may be of interest. She was built at Stettin in 1902, and was named after the first Postmaster-General of the German Empire. Her carrying capacity is 5000 tons of cable in four tanks. The length of the ship is 380 ft. 9 in., the breadth 48 ft., and the depth 32 ft. 9½ in. She is equipped with twin engines developing 2400 h.p., and when loaded can steam 11·5 knots. The personnel numbers 120.

The "Stephan" is the second largest cable-ship in the world, ranking next to the C.S. "Faraday," belonging to Messrs Siemens Bros., Woolwich, which has been already illustrated in this JOURNAL. The Norddeutsche Seekabelwerke Aktiengesellschaft also laid the Bacton–Borkum III cable by their ship the "Podbielski."

PROGRESS OF THE BAUDOT SYSTEM.

By A. C. BOOTH.

(See also Vol. iii, part 4, January, 1911.)

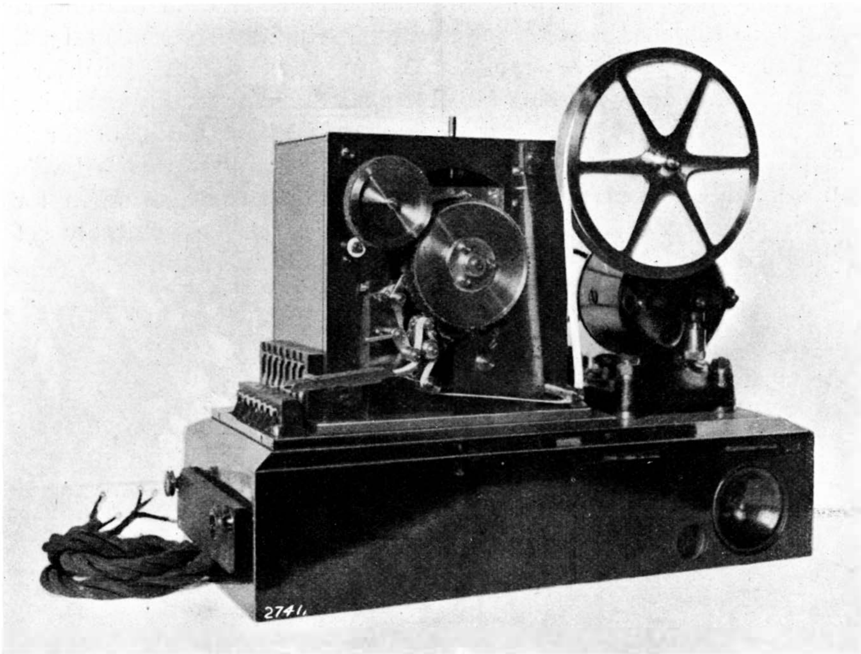
DUPLEX working of the Baudot system continues to yield the excellent results that were obtained from the sets installed at the Central Telegraph Office in 1910.

The quadruple duplex on the underground loop circuit between London and Birmingham gives a uniform daily output of some 3600 messages in twelve hours, including the slack hours of the early morning and late evening. Occasionally the daily total has exceeded 4000, while on the day following the fire at the test-box of the Central Telegraph Office, London, in August, 1912, the following results were obtained between 10 a.m. and 5 p.m.:

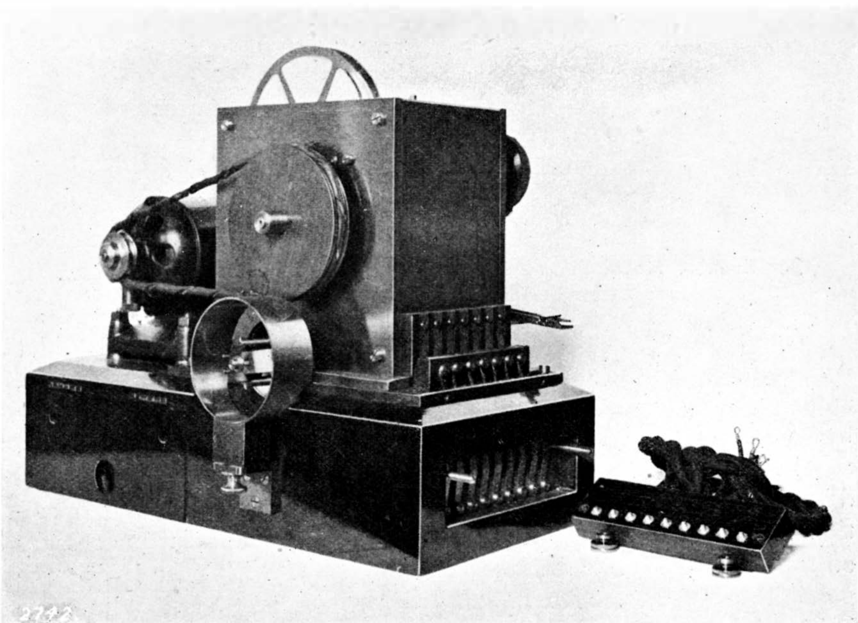
10–11 a.m. = 595 messages		
11–12 a.m. = 576 ,,	Average of 550 messages per hour.	
12– 1 p.m. = 551 ,,	,, 68·75 ,, per channel.	
1– 2 p.m. = 579 ,,		
2– 3 p.m. = 516 ,,	Total of 3851 in 7 hours.	
3– 4 p.m. = 501 ,,	,, 5025 in 12 ,,	
4– 5 p.m. = 533 ,,		

The hourly output obtained confirms my estimate given in the paper on the Baudot printing telegraph system before the Institution of Post Office Electrical Engineers in March, 1907, viz. 400 to 600 messages per hour, showing that the expectations were not so "fanciful" as was alleged at that time.

The consistently good daily output obtained from this set for nearly three years, without a stand-by set at either end, has induced the Post Office authorities to equip three more inland circuits with



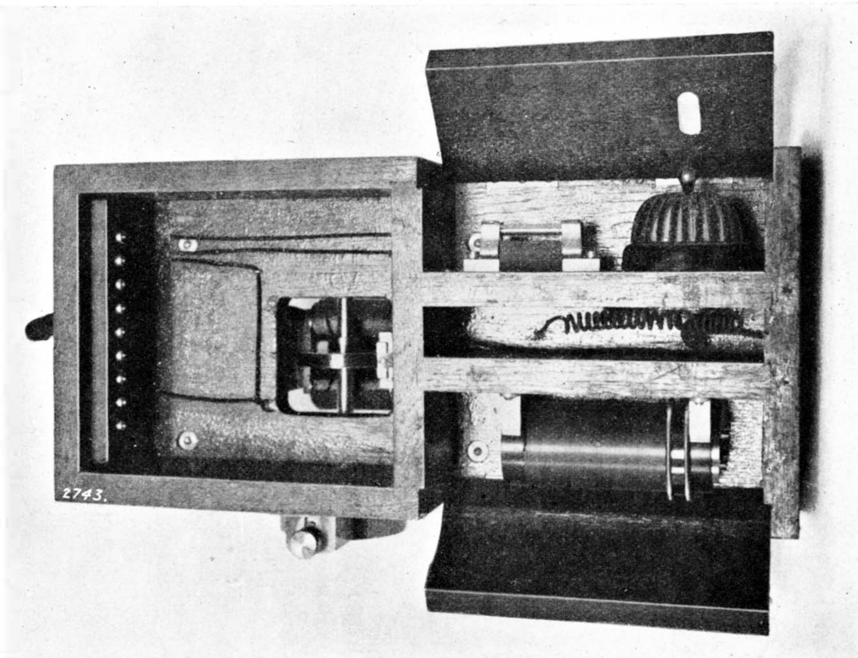
I.—Motor-driven Baudot Receiver. Front View.



2.—Motor-driven Baudot Receiver. Back View, showing Spring Connection Tablet on Side.

quadruple duplex apparatus, modified somewhat from the double plate quadruple set that was altered to provide the experimental set.

The new quadruple duplex sets are fitted with motor-driven receivers, 1, 2 and 3, having tablet connections for readily changing the entire receiver whenever necessary. Although the motor is adapted for 110 volts it is worked with 40 volts; and is provided with an adjustable resistance placed in the base of the instrument for varying the speed within small limits, after it has been suitably set by means of the friction-governor known as the " Moderator."

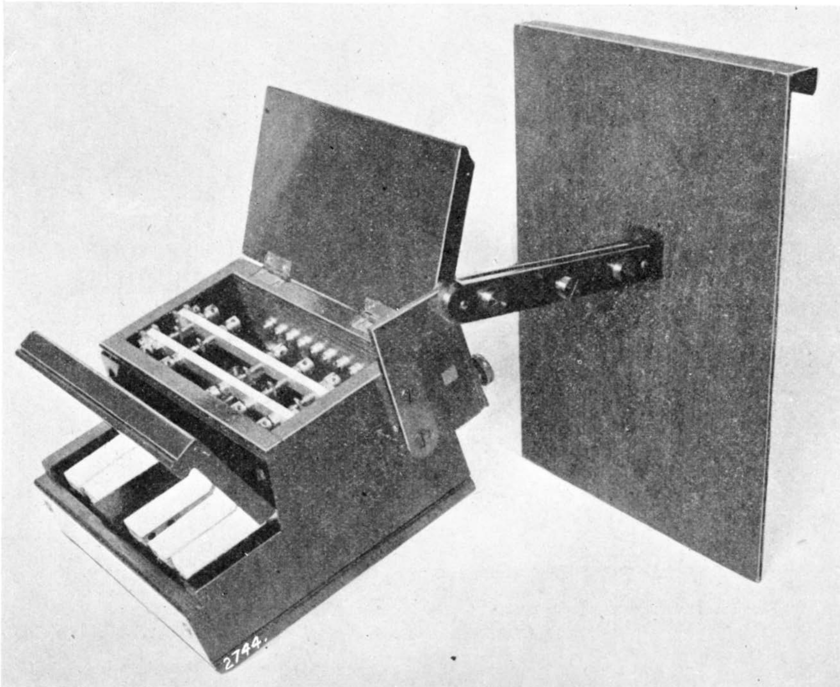


3.—Base of Motor-driven Baudot Receiver, as Viewed from Below.

The keyboard has been modified as shown in 4 and 5. A tablet connection has been fitted for easy and quick replacement purposes, and also a contact bar for automatically joining the spacing battery to the five distributor segments when a keyboard is being changed, so that the duplex balance at the distant station shall not be disturbed for more than a second or two during the changing operations. The set is always at duplex; a switch therefore is unnecessary on the keyboard; this lessens the amount of wiring and also the possibility of faults. The contact points have been made adjustable independently, and are entirely enclosed when the hinged cover is down. For cleaning purposes the bars carrying the contact screws have slotted ends, and have been arranged to slide friction-tight into slots, where they can be locked by screws.

The distributor is arranged with one relay only for reception, repeating directly into the shortened segments to which the receiver magnets are connected. As no propagation segments are required, the distributor plate is divided into twenty-two segments, as against twenty-four on the ordinary quadruple simplex set.

During the period of nearly four years that the sets have been working, not more than six serious stoppages have occurred; hence,



4.—Baudot Keyboard, showing interior.

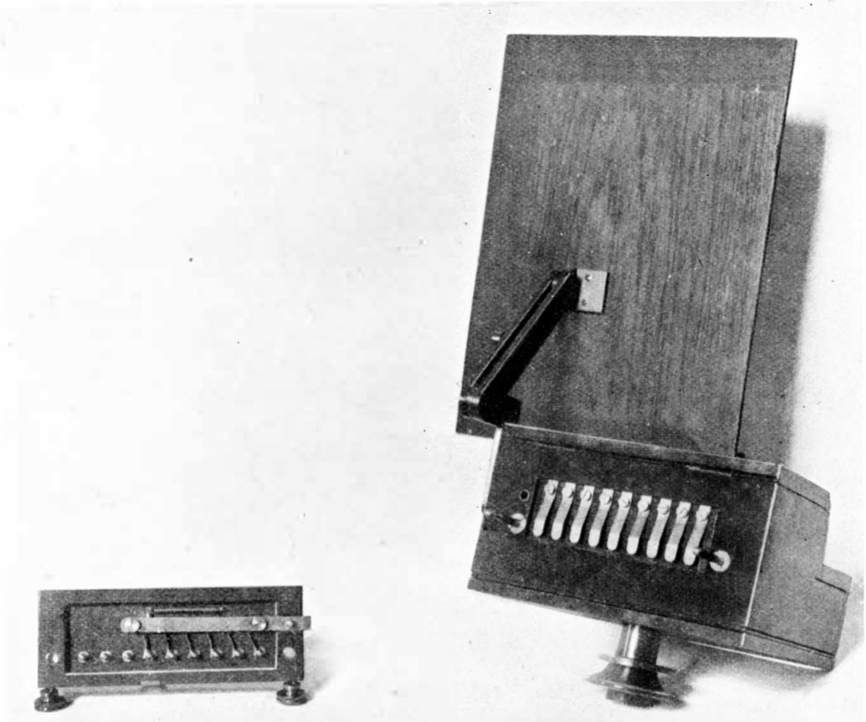
it does not appear necessary at present to provide two distributors at each end. On this account the sending plate is attached to the rear of the distributor in the usual way.

6 shows the distributor-plate, which is the same in construction for front and back with the exception of the movable contact; *A* being for front plate reception, *C* for back plate sending with the numbering of the segments in the reverse order to *A*; whilst *B* is for back plate reception should such be required, as in the combined double and triple duplex sets with two distributors.

7 shows the connections in the test-box on the distributor table.

In accordance with general practice the keyboards are connected to the two lower bars, and although a ten-wire cable is provided actually only nine wires are required, as the connection to the relay that is needed on a simplex set is not necessary on a duplex set. The tenth wire thus forms a convenient spare in case of a fault developing in one of the keyboard or receiver cables.

8 shows the main connections of the set, from which the paths of the outgoing and incoming currents can be traced by refer-



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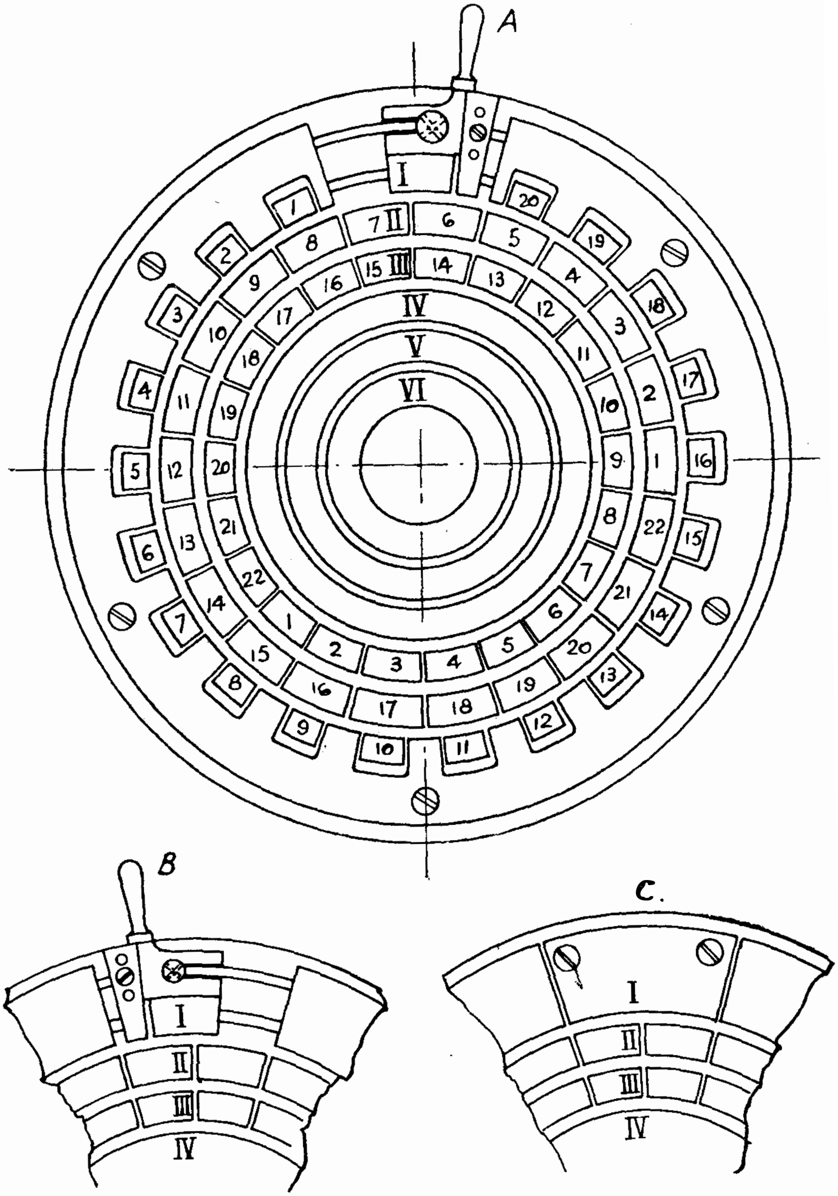
5.—BAUDOT KEYBOARD, SHOWING CONNECTION TABLET REMOVED.

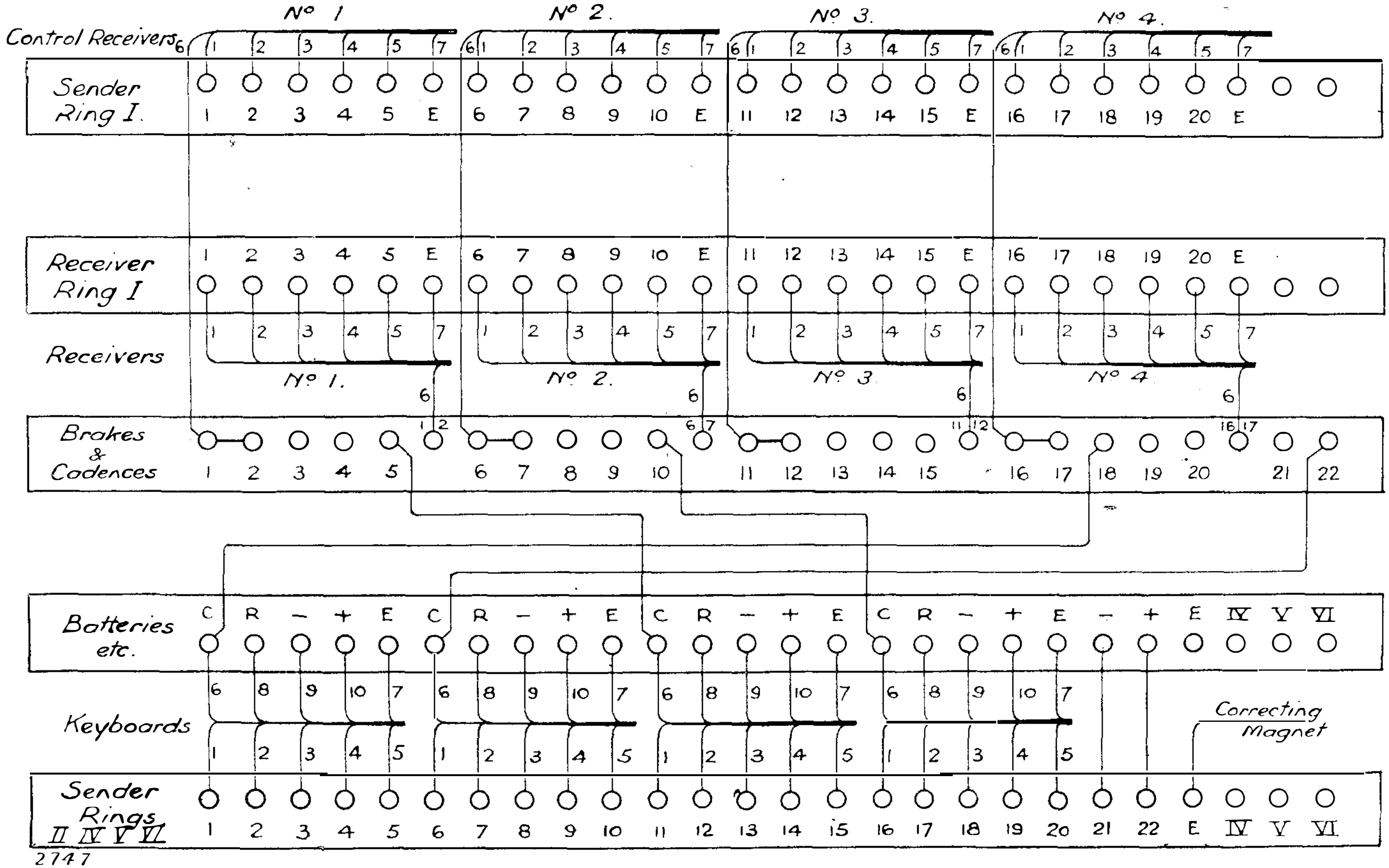
ence to the skeleton diagram in 9. A spare "line" relay is provided for immediate change-over purposes by means of the 9-terminal switch shown on the relay tray. Of the other switches shown, one is for turning to Morse, another is for replacing the battery by a resistance for balancing purposes, while the third is for checking the incoming or outgoing signals on a Wheatstone-Morse receiver joined through a resistance to either the "Line" or "Leak" relay as required.

10 shows a plan of the apparatus on the distributor table. It will be seen that three of the switches are placed vertically in order to provide sufficient writing space.



A. Moveable contact with fork - left hand.
B. " " " " - right hand.
2746 C. With fixed block

6.—Baudot Distributor Plate (22 Segments).



7.—Connections in the Test-box on the Distributor Table.

The setting of the brushes is a simple matter, as there need be no particular relation between the sending and receiving brushes at the corrected station. It is convenient, however, to set both the sending and receiving brushes on the centre of their No. 1 segments, and then to allow the correcting station to find his position by altering the brush-driving ring if necessary, in order to bring his front plate to a suitable position without undue strain on the connecting cable.

On comparatively short circuits the time of propagation of a signal over a line is small; but on the long circuits with one or more repeaters, such as on the London–Berlin double duplex circuits, the propagation time ranges up to 4 segments or 120 degrees, *i.e.* about one ninth of a second, and varies some 60 degrees, apparently in accordance with the way in which the relays and repeaters are adjusted.*

There are now four double duplex sets working between London and Berlin through the wires in the same 4-core submarine cable, which is approximately 300 miles in length.

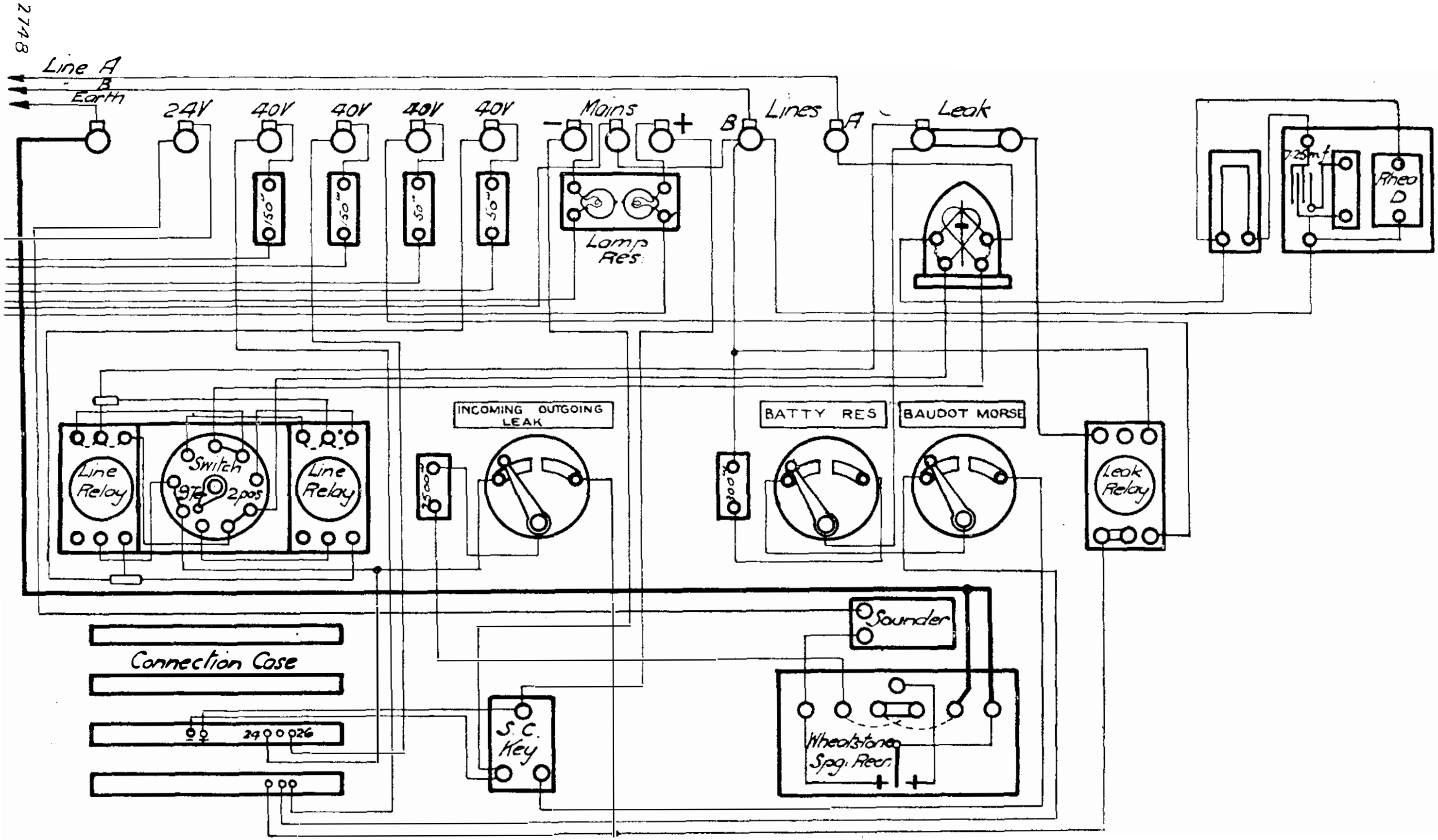
It is interesting to compare the traffic carried by the duplex double Baudot sets and the duplex Hughes sets which worked on similar circuits through the same submarine cable.

So far as I can ascertain, the best results from the duplex Hughes were on the Berlin Bourse circuit, where in February, 1909, a total for one hour of 170 messages was obtained, of which London sent 90 and Berlin 80. The next highest figure is 156; a total of 140 messages in one hour has been obtained a number of times.

In November, 1911, the duplex double Baudot for ten consecutive hours dealt with the following numbers of messages:

Time.	Sender.		Receiver.		Total.
	1	2	1	2	
10–11	50	40	60	47	197
11–12	80	70	70	63	283
12–1	62	85	61	70	278
1–2	71	62	55	50	238
2–3	53	70	45	40	208
3–4	62	46	47	71	226
4–5	65	75	47	49	236
5–6	70	60	63	52	245
6–7	44	26	50	28	148
7–8	49	47	55	50	201
	606	581	553	520	2260
	1187		1073		

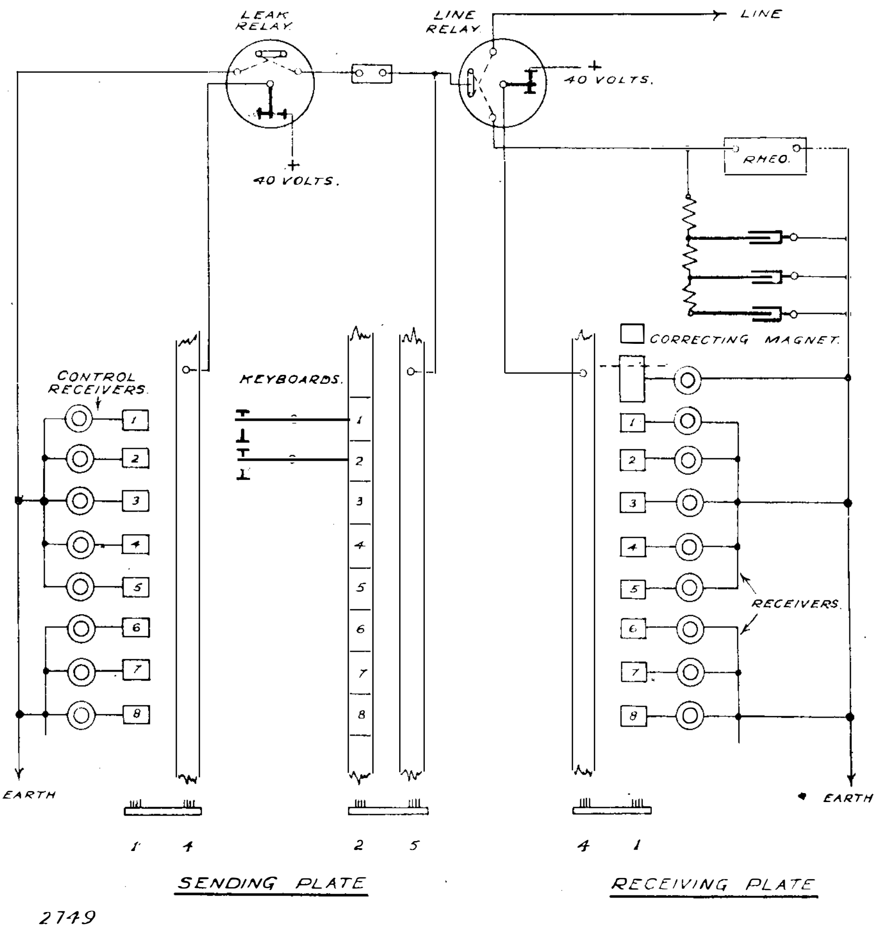
* Actually only seventeen segments are required for triple duplex working, but eighteen have been provided in order that complete alternations (reversals) may be sent over the line to enable the repeater stations to adjust their apparatus correctly.



8.—Baudot Quadruple Duplex. Circuit Connections.

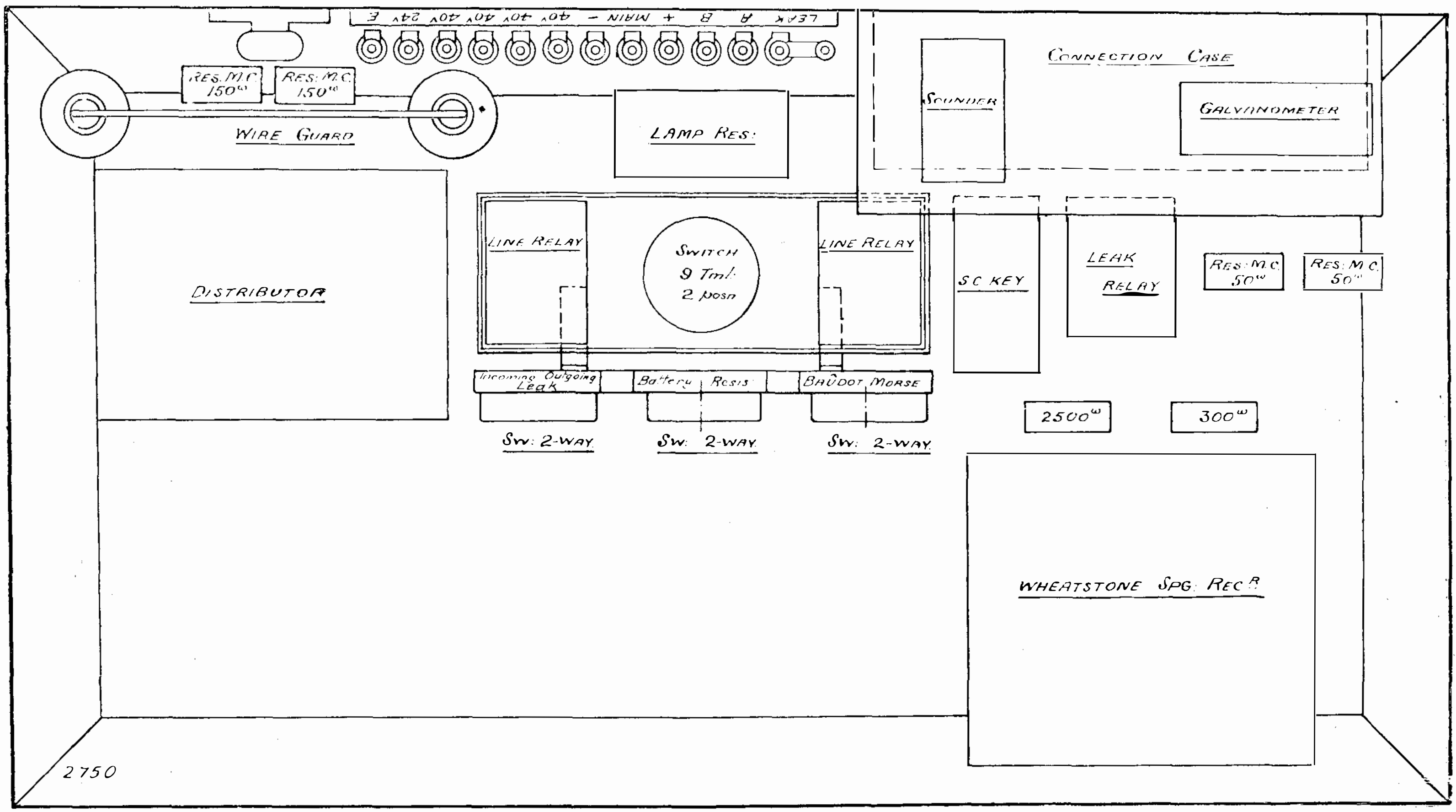
Although the foregoing record is the best obtained, there have been many other occasions when the output in an hour considerably exceeded 200 messages. Now that two such circuits exist there is not sufficient traffic to fill either set.

Several of the new sets will be equipped with two distributors,



9.—Baudot Duplex (Skeleton Diagram of Connections).

each of which will be fitted with eighteen segment plates for triple duplex working on the front, and twelve segment plates on the back for double duplex working, it being merely necessary to shift the brushes from the front and to put others on the back to change from triple duplex to double duplex. The arrangement will also permit of triple duplex working in one direction, while the other may be working double duplex. The connections and arrangements for



10.—Baudot Duplex. Arrangement of Apparatus on Distributor Table.

these combined sets are the same in principle as for the quadruple duplex sets just described.

It will be obvious that, although only Differential duplex has so far been employed, the Bridge duplex arrangement or the Gulstad Relay device can readily be provided for. Up to the present the simpler differential duplex arrangement has been sufficient for the length and type of circuits on which Baudot duplex has so far been fitted, but in order to avoid the introduction of a Duplex Repeater

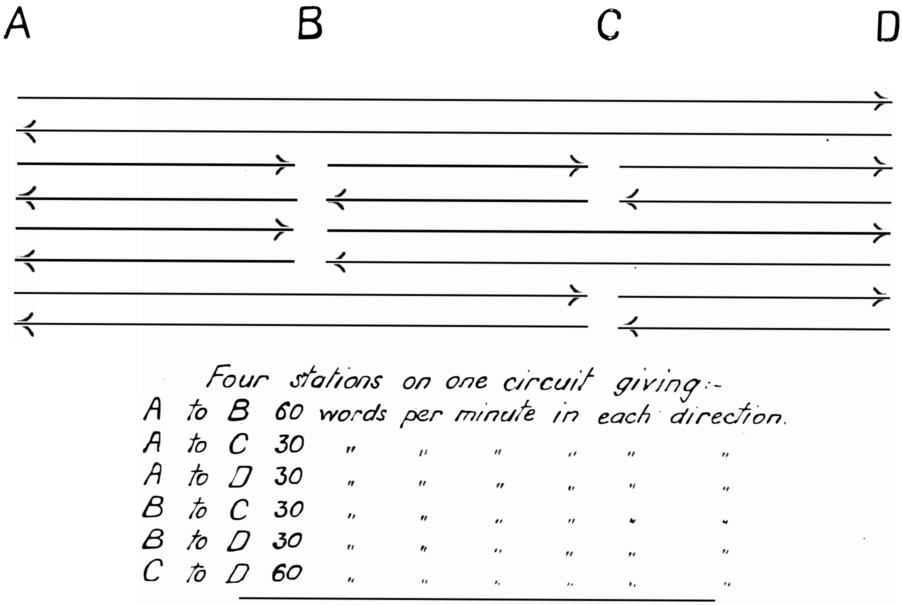


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Fig 11.

on the longer lines it may prove advantageous to adopt more delicate arrangements of relays, etc., for reception at the terminal stations.

Owing to the want of apparatus it has not been possible up to the present to attempt anything in the direction of omnibus circuit working with the duplex Baudot, but it is obvious that with eight or more channels on one circuit this most useful application of the Baudot system can be extended much more easily than has so far been the case with simplex sets. Apart altogether from the additional channels available, the extensions and the correcting arrangements will be simplified, and much less difficulty will be experienced in maintaining correct speeds.

By thus linking up four offices on one circuit to provide direct communication, each with each (11), the present somewhat costly arrangements of pasting-up Wheatstone-Morse slip and re-perforating for re-transmission at those intermediate points, with the unavoidable delay entailed in the process, will be eliminated. Even the proposal to use receiving perforators at the intermediate points entails the sorting out of the perforated slip, the conveyance to the forwarding circuit, the clerks' services, and the necessary time for the various operations.

All these disadvantages are avoided on the omnibus Baudot circuit, whether simplex or duplex, and it is a matter for regret that sufficient apparatus is not yet available to show what can be done in this direction.

Within the next twelve months there will be two more offices gaining the required experience, and it should, therefore, be possible to commence omnibus working with the duplex Baudot in about two years hence if sufficient apparatus can be made available in the meantime.

A circuit with quadruple duplex Baudot apparatus linking up four stations (11) may seem a rather formidable arrangement, and one likely to be out of order frequently, but on such a circuit working through the underground cable where balances are practically fixed, serious difficulty can only arise when the line or a distributor gets out of order. Such faults do occur, but at very infrequent intervals, as is proved by the working of the London-Birmingham Baudot circuit during a period of nearly four years. Keyboards and receivers can be changed in a few seconds, but more time is required at present to change a distributor. Improvement in this direction is already receiving attention.

Should such a fault arise, it would stop communication in the particular section concerned, but would permit working to continue on the other sections, where full use can be made of the eight channels. This feature makes the arrangement very useful for sudden increases of traffic between any two points, as any or all of the channels can be terminated or extended at any of the intermediate points by merely turning a switch.

The sextuple duplex apparatus is ready for trial, and will be equipped on a working circuit between London and Birmingham by the time this article appears.

SECONDARY CELL MAINTENANCE.

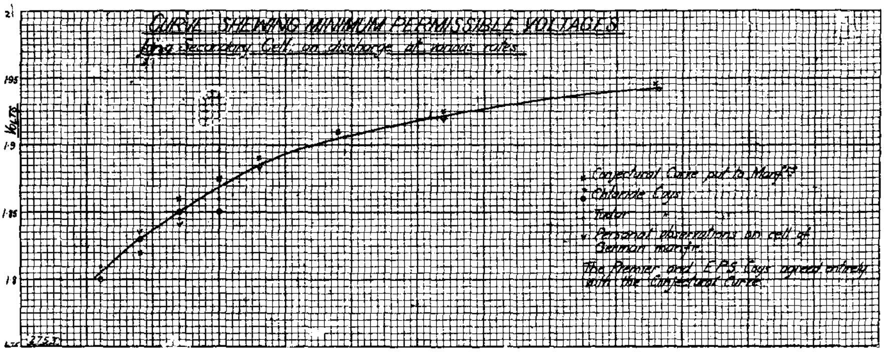
The Importance of Hydrometer Readings.

If the electro-motive force of a secondary cell which has been lying idle for a long period, even after it has been discharged, be measured with the usual high-resistance voltmeter the instrument will indicate 2 volts.

On the other hand, if a secondary cell from which the rated ampère-hour capacity has been taken be measured whilst a current is flowing equal to one-ninth the rated ampère-hour capacity, the voltage across the cell terminals will read 1·82 volts, or thereabouts, provided the cell is in good condition.

Now, if the current be increased, say, to three times the last value, the voltmeter will show something less than 1·82—probably about 1·75. By decreasing the discharge current, say, to one third the original value, the voltage will rise, and after a few minutes will reach a value of over 1·9 volts. The curve (1) shows the actual value which obtains in practice with cells in perfect order.

Suppose, however, the cell under observation happened to have lost a portion of its capacity for some reason or other, and, as is generally the case, the amount lost was unknown, how do the voltmeter tests stand? On open circuit the reading would be 2 volts.



I.

A discharge rate of one-ninth the *rated* capacity would now be equal to a higher *effective* rate. If, for instance, the cell had lost 50 per cent. capacity it would be equal to a two-ninths rate, and the voltage limit would not be the voltage at the one-ninth rate, viz. 1·82 volts, but a lower value.

It is known that if only a portion of the capacity of a cell be regularly drawn upon, the capacity not used will be permanently lost. Therefore, if a cell which has lost capacity be recharged each time the voltage reaches 1·82 volts at a fixed current discharge rate, special remedial steps will have to be taken by way of excessive overcharging, otherwise the loss will increase charge by charge.

The secondary cells used for telegraph and telephone purposes are subject to discharge rates which vary greatly. Seldom are such cells called upon to discharge at heavy rates, and certainly it is only by accident that one may see a set discharging at a rate which approximates to one ninth the capacity. As methods now stand, we cannot be certain of the effective ampère-hour capacity of cells used for telegraphs or telephones after two or three years' work, and one is driven to the conclusion that voltmeter tests form a very unsatisfactory and unreliable means of gauging the condition of secondary cells on discharge. In other words, there is no guarantee when the voltmeter shows from 1·82 to 2 volts per cell that the battery is safe. Even with the voltmeter showing 2 volts per cell it is possible that a heavy discharge for a short period may cause the battery to collapse. Then the voltmeter will show it—too late. A voltmeter and an ammeter are necessary, in order to give exact information as to what a battery may be doing from moment to moment, and for various purposes affecting adjustment of power, for charging, resistance measurements, etc.

It can readily be shown from fundamentals that, for practical purposes with any lead—lead peroxide secondary cell, the number of ampère-hours discharged will be—

$$A = \frac{CG\ (G - G_1)}{\cdot 345 - \cdot 183\ G_1} \quad . \quad . \quad . \quad . \qquad (1)$$

Where A = (total) ampère-hours discharged;
C = the volume of electrolyte in cubic inches;
G = specific gravity at the beginning of a discharge;
G_1 = specific gravity at the end of a discharge;

or when the range of specific gravity lies anywhere between $1{\cdot}170^{\circ}$ and $1{\cdot}210^{\circ}$.

$$A = \cdot 00924\ CR \text{ approximately} \quad . \quad . \qquad (2)$$

Where R = the total range in degrees ($\cdot 001^{\circ}$ $Sp.\ g. = 1$) of specific gravity moved through during a discharge.

From the formulæ it is clear that the normal range of change in specific gravity is, for all practical purposes, inversely proportional to the amount of the electrolyte in a secondary cell. Hence the reason, with perfect cells, for the slight variations sometimes observed in range of specific gravity in different cells of a battery and for different batteries, and if the information to be obtained is to be made use of, the necessity for maintaining a constant level of the electrolyte.

But the fact of greatest importance is that the number of ampère-hours obtained from each cell is practically proportional to the range of specific gravity moved through during a discharge.

The application of this principle is simple. Assume that the makers specify that the capacity of a battery be 400 ampère-hours, and it be found, either by volumetric* measurement of the electrolyte,

* The volume of the electrolyte may be taken to be:
Internal dimensions of tank to level of electrolyte, less—
Volume of plates + glass supports + displacement tank + solid sediment.
The volume of the positive and negative plates and separators in the various types of cells may be obtained from the following table:

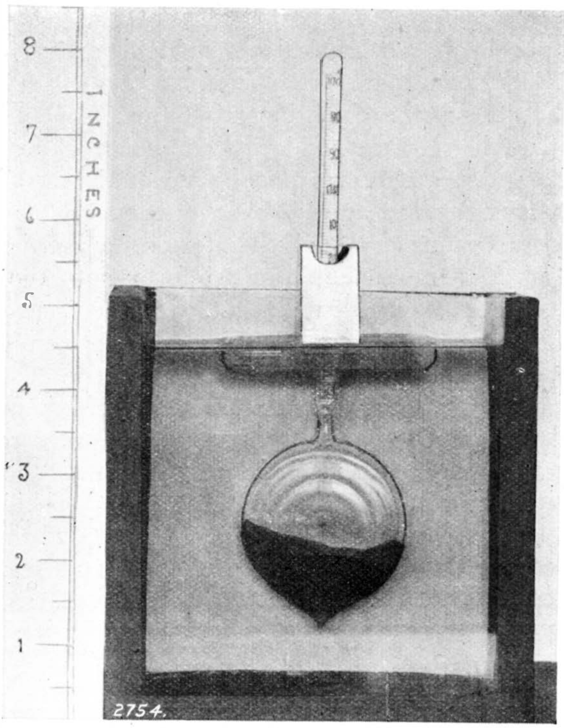
or by a test discharge, that the specific gravity changes from 1·210 to 1·170, *i. e.* 40°. The average discharge will be $\frac{400}{40}$ = 10 ampère-hours per degree. Therefore, when the specific gravity stood at 1·200, a change of 10°, which corresponds approximately to 10 × 10 = 100 ampère-hours, will have been obtained, and 300 ampère-hours will remain. A more exact value may be deduced by using the extended formula (1), which will show that actually 104 ampère-hours were obtained with the change of specific gravity from 1·210 to 1·200, C having a value of 1083 cubic inches, as may be deduced from (2).

Secondary cells do not break down suddenly except, of course, in case of accident, and there are, therefore, reasonable grounds for assuming that the range of specific gravity which the cell will move through will at least correspond to that which it moved through on the last discharge, if of reasonably recent date. Clearly, then, without having resort to ampère-hour meters, one has a reliable means of ascertaining not only what work a cell has done, but also, what is often more important information, the amount of additional work it may be expected to do; for example, whether it may be relied upon to carry the exchange load overnight.

The usual means of measuring specific gravity of secondary cells is by hydrometer. Unfortunately for the welfare of existing secondary cells generally, the importance of the use of these instruments has not hitherto been appreciated as it deserves. Most of the hydrometers at present in use will only indicate changes of specific gravity of 5°. There are others which are divided into 1° units, but the divisions are so close together, and the stem and scale so slight,

Maker and type of cell.		Total volume of negative and positive plates and separators in cubic inches (x = No. of positive plates).
Chloride	S Type	$75x + 25$
	C "	$230x + 80$
E.P.S.	D.H. "	$98x + 35$
	P. "	$150x + 60$
	O.M. "	$260x + 108$
Tudor	I "	$42x + 14$
	P "	$70x + 27$
	Q "	$130x + 50$
	R "	$260x + 50$
Premier	Small	$70x + 28$
	Large	$80x + 32$
D.P.	T "	$30x + 10$
	L "	$75x + 27$
	L.S "	$170x + 60$

that it is practically impossible to read accurately to two or three degrees. The difficulty is seriously accentuated by the fact that with all these instruments the reading must be taken at the surface of the electrolyte, and as the liquid rises up the stem of the hydrometer the true level of the electrolyte is indeterminable. The difficulty is a general one. When a hydrometer is designed for use in a clear solution contained in a glass vessel, the instrument is calibrated to be read through the side of the vessel. For use

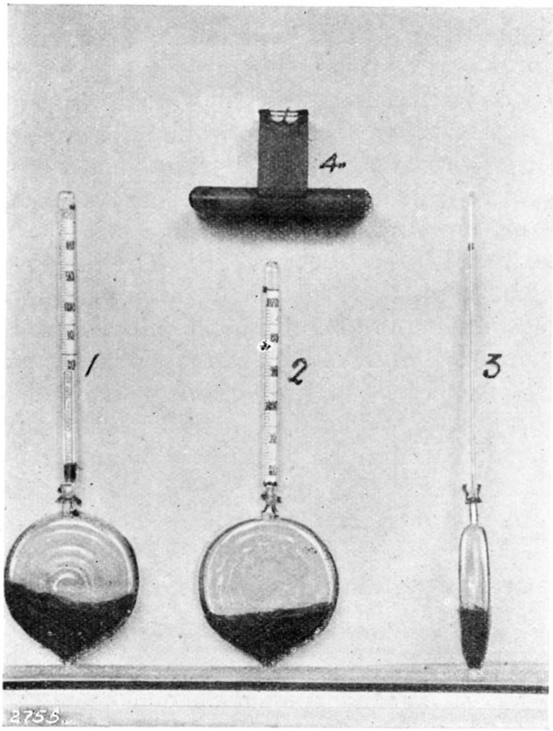


2.—HYDROMETER WITH FLOATING INDEX. 1·170° TO 1·220° SP. G.

in a liquid contained in an opaque vessel the calibration is such that the reading must be taken from above. Again, the usual type of hydrometer is suitable only for a deep secondary cell on account of the length of the buoyancy chamber. It cannot, therefore, be used in the small secondary cells serving many telegraph and telephone systems. These hydrometers will not remain steadily in position in the electrolyte, their movements being most tantalising when one desires to read quickly.

In order to obviate these difficulties a new type of hydrometer has recently been designed, and a number has been brought into use by the Department. It is shown floating in a glass-sided tank in 2, whilst three hydrometers and a floating curser are shown in 3.

The hydrometer consists of a flat scaled stem and a flat circular buoyancy chamber. The stem passes through the small float, and the scale is read 1½ inches above the surface of the liquid by means of a curser line carried by the float, as is shown clearly in 2. Thus, in a secondary cell, the reading, accurate to ·0005° specific gravity, is easily and quickly read slightly above the level of the tank. The



3.—1 and 3, Front and Side Views of 7-in. Hydrometer. 2, 6-in. Hydrometer. 4, Floating Index used with Hydrometers 1 and 3.

float keeps the hydrometer away from the sides of the plate and tank, with the full scale details always facing the observer. The shape of the buoyancy chamber permits of shallow floatage.

The maker of the new hydrometer is Mr. Thomas O. Blake, Hatton Garden.

The use of the new instrument soon brings to light the importance of regarding the effect of temperature variations upon specific gravity readings of the electrolyte. Hydrometer readings are correct at 60° F. For temperatures higher than 60° Fahr., 1° Sp. G. (·001°)

must be added for each 3° rise in temperature above 60°, and 1° Sp. G. deducted for each 3° less than 60° Fahr.

The earlier portion of this article deals mainly with the conditions which obtain during a discharge of a secondary cell, but the formulæ (1) and (2) apply also to charging; but in that case it must be remembered that, throughout the charge, the specific gravity of the electrolyte fails to rise for a time at the commencement of the charge, and then lags behind throughout the charge, only reaching its maximum value about fifteen minutes after the charging current has been disconnected. If a secondary cell is in perfect order the specific gravity readings will be consistent. Short circuits, due to paste or extraneous matter lodging between the plates, or sediment touching the bottom of the plates, will result in inconsistent behaviour. It makes no practical difference in the working of a cell whether the highest specific gravity be 1·215 or 1·205, and it is a waste of time to attempt to always maintain either the one value or the other. There should be, however, no abrupt changes in the maxima for consecutive charges. If there be a marked fall in the highest specific gravity readings "sulphation" may have taken place.

In course of time there will be a gradual reduction in the strength of the electrolyte as a result of the abstraction of sulphuric acid by the solid matter which falls to the bottom of the cell, and if this sediment be stirred up a sudden fall in the specific gravity may be observed. Partial neutralisation of the acid by an alkali—ammonia gas from Leclanché cells, for instance—will be indicated by the behaviour of the hydrometer. In fact it is doubtful whether any serious defect can arise in a secondary cell of which the hydrometer readings will not give warning, or which cannot be detected by an inspection of the cell.

J. G. L.

ALTERNATING CURRENT CALCULATIONS.

By F. Addey, B.Sc., A.M.I.E.E.

(*Continued from page* 195.)

We will now investigate a few bridge arrangements by means of this method.

With the arrangement for the measurement of capacity shown in **7**, we have—

$$R_1 \times \frac{1}{K_2\theta} = R_2 \times \frac{1}{K_1\theta}.$$

Therefore—

$$R_1K_1\theta = R_2K_2\theta,$$

or—

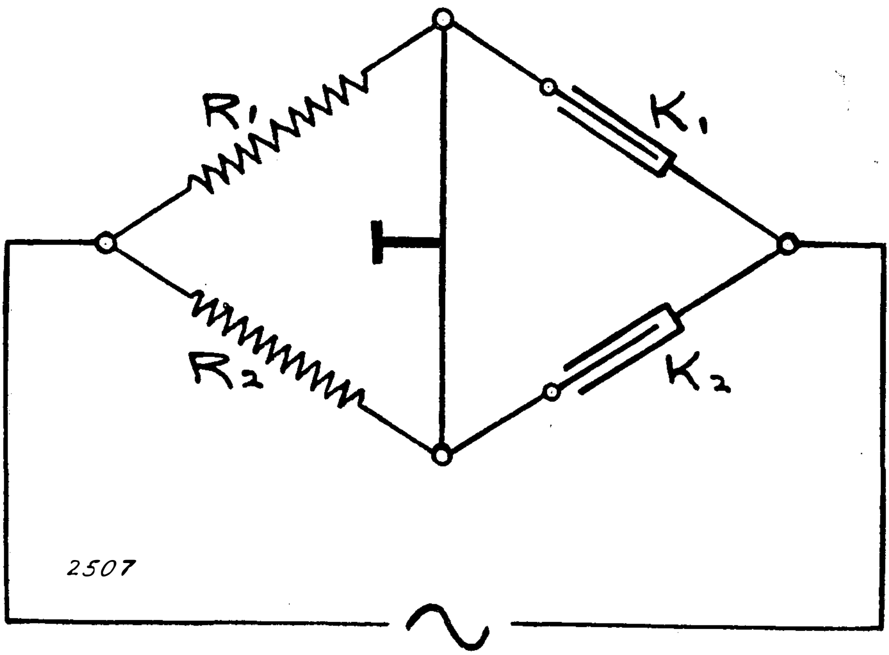
$$R_1K_1 = R_2K_2.$$

Thus, if R_1, R_2 and K_1 be known, and K_2 be unknown, we have—

$$K_2 = \frac{R_1}{R_2} K_1.$$

Since w does not enter into this expression, the balance is independent of the frequency of the current used for making the test.

The arrangement shown in **8** is a method for the measurement of the resistance and inductance of a coil of wire. The impedance



7.—Bridge Measurement of Capacity.

operator of the upper left-hand arm of the bridge, which consists of a condenser in parallel with a non-inductive resistance, is obtained in exactly the same way as the combined resistances of two wires in parallel. The required impedance operator for this arm is—

$$\frac{r \times \dfrac{1}{k\theta}}{r + \dfrac{1}{k\theta}} = \frac{r}{1 + kr\theta}.$$

Therefore, when balance is obtained, we have—

$$PQ = (R + L\theta)\left(\frac{r}{1 + kr\theta}\right),$$

$$PQ + PQkr\theta = Rr + Lr\theta.$$

Hence the conditions for balance are that $PQ = Rr$, or the bridge must be balanced for steady currents, and also that $PQkr = Lr$.

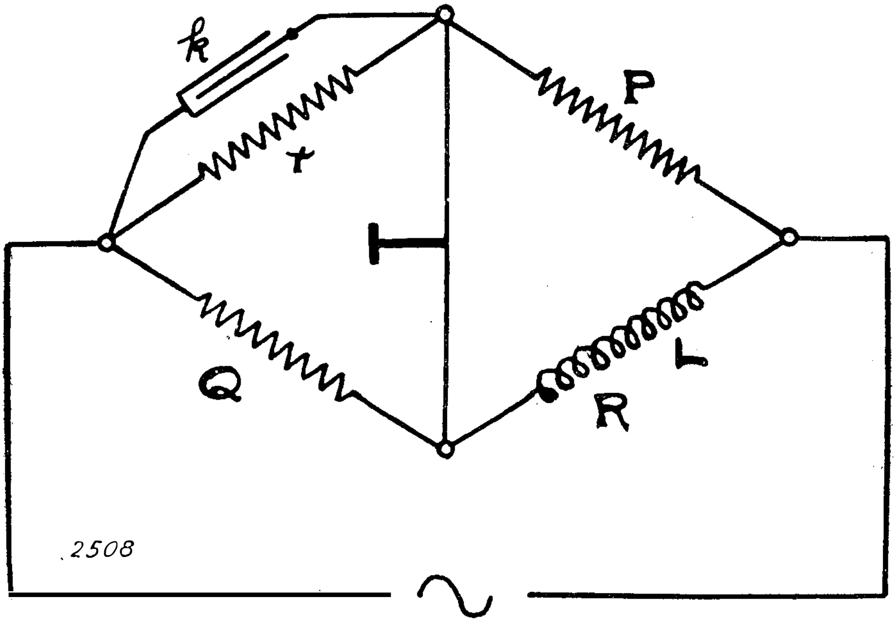
Hence we have—

$$R = \frac{PQ}{r},$$

and—

$$L = PQk.$$

In this case also it will be seen that balance is independent of the frequency.



8.—Bridge Measurement of Resistance and Inductance, using a Condenser shunted by a Resistance.

Another arrangement for the measurement of resistance and inductance is shown in 9. In this case we have—

$$PQ = (R + L\theta)\left(r + \frac{1}{k\theta}\right),$$

$$PQ = (R + L\theta)\left(\frac{1 + kr\theta}{k\theta}\right),$$

$$PQk\theta = R + (L + krR)\theta + krL\theta^2.$$

Therefore—

$$PQk\theta = (R - krLw^2) + (L + krR)\theta.$$

Equating co-efficients of like terms we have for the conditions of balance—

$$R - krLw^2 = O,$$

and—

$$PQk = L + krR.$$

Hence—

$$R = krw^2L,$$

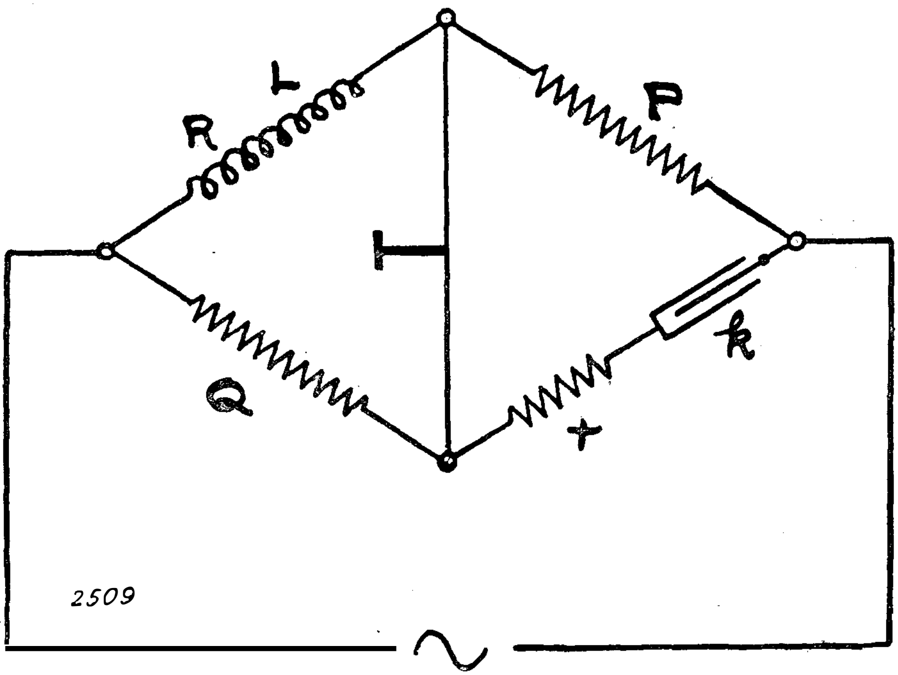
and substituting this value of R in the second balance condition we have—

$$PQk = L + k^2r^2w^2L,$$

or—

$$L = \frac{PQk}{1 + k^2r^2w^2}.$$

In this case, since w appears in the conditions of balance, the

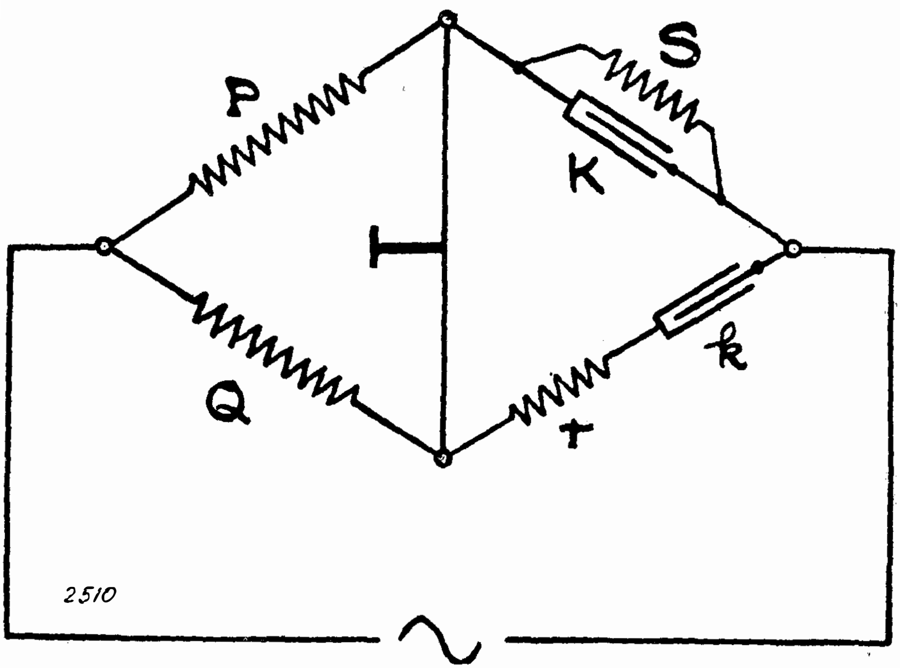


9.—Bridge Measurement of Resistance and Inductance, using a Condenser in Series with a Resistance.

balance will only be correct for a definite frequency. This means that a pure sine wave current must be used. If a complex current wave were used, and the conditions for balance with the frequency of the fundamental wave obtained, these conditions would not be correct for the frequencies of the overtones present, and therefore silence could not be obtained on the telephone used to indicate balance.

The last of the ordinary Wheatstone bridge arrangements which will be considered is that for the measurement of capacity and leakance shown in **10**. The upper right-hand arm of the bridge represents a leaky condenser, or other capacity, as, for example, a telephone loop. Such a leaky condenser is equivalent to a condenser with perfect insulation shunted with a resistance. Let S be the value of the *conductance* of this equivalent shunt round the condenser. The resistance of the shunt will be $\frac{1}{S}$, and the impedance operator of this arm of the bridge will therefore be—

$$\frac{\frac{1}{S} \times \frac{1}{K\theta}}{\frac{1}{S} + \frac{1}{K\theta}} = \frac{1}{S + K\theta}.$$



10.—Bridge Measurement of Capacity and Leakance.

Hence—

$$P\left(r + \frac{1}{k\theta}\right) = Q\left(\frac{1}{S + K\theta}\right),$$

$$P\,(rk\theta + 1)\,(S + K\theta) = Qk\theta.$$

$$PS + (PSrk + PK)\theta + PKrk\theta^2 = Qk\theta.$$

Therefore—

$$(PS - PKrkw^2) + (PSrk + PK)\theta = Qk\theta.$$

Therefore the conditions of balance are that—

$$PS - PKrkw^2 = 0,$$

and—

$$PSrk + PK = Qk.$$

From the first of these conditions we obtain—

$$S = Krkw^2,$$

and substituting this value for S in the second balance condition we have—

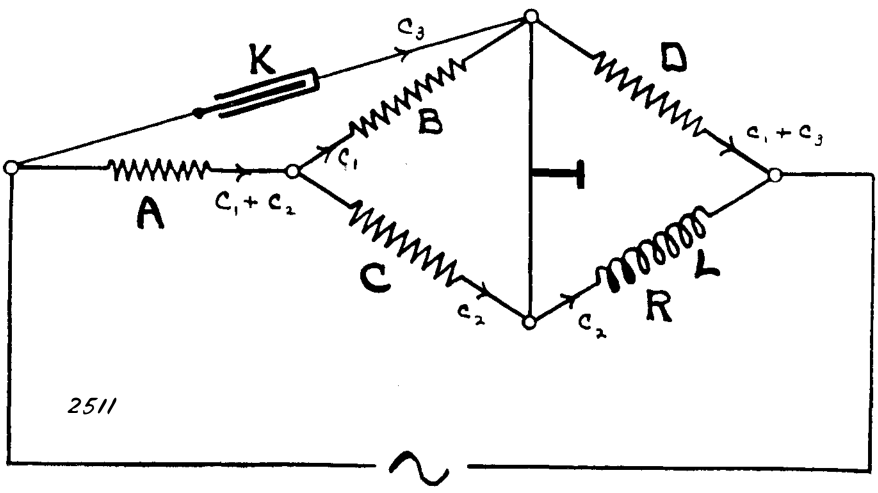
$$Pr^2k^2w^2K + PK = Qk.$$

Hence—

$$K = \frac{Qk}{P(r^2k^2w^2 + 1)}.$$

It will be seen that in this case, as in the previous one, the balance depends on the frequency of the testing current, which must therefore be a pure sine wave.

There are certain modifications of the ordinary Wheatstone bridge arrangement to which the rule given above for dealing with



II.—Anderson Bridge.

bridge problems is not applicable. The method of impedance operators is, however, of great use in the investigation of the theory of these methods.

We will here consider two such arrangements. The first is the Anderson method for the measurement of inductance and resistance. The connections for this method are shown in **II**.

The potential drop along the condenser branch K is equal to that along the branches A and B. Also, when balance is obtained, the potentials at each extremity of the telephone arm are the same. Hence the potential drop along the branch B is equal to that along the branch C, and the drop along the branch D is equal to that along the branch R.

Since there is no current through the telephone, the currents in the various branches will be as indicated on the diagram, and the following equations therefore hold good :

$$c_3 \frac{1}{K\theta} = (c_1 + c_2) A + c_1 B.$$
$$c_1 B = c_2 C,$$
$$(c_1 + c_3) D = c_2 (R + L\theta).$$

From the second of these equations we get $c_2 = c_1 \frac{B}{C}$, and substituting this value for c_2 in the first equation, we get—

$$c_3 = c_1 \left[\left(1 + \frac{B}{C}\right) A + B\right] K\theta.$$

Substituting the above values for c_2 and c_3 in the third equation, we get—

$$c_1 \left\{1 + \left[\left(1 + \frac{B}{C}\right) A + B\right] K\theta\right\} D = c_1 \frac{B}{C} (R + L\theta)$$

Therefore—

$$D + \left[\left(1 + \frac{B}{C}\right) A + B\right] DK\theta = \frac{BR}{C} + \frac{BL}{C} \theta.$$

Equating co-efficients of like terms, we get—

$$D = \frac{BR}{C},$$

and—

$$\left[\left(1 + \frac{B}{C}\right) A + B\right] DK = \frac{BL}{C}.$$

Hence—

$$R = \frac{CD}{B},$$

and—

$$L = \frac{CDK}{B} \left[\left(1 + \frac{B}{C}\right) A + B\right].$$

If $B = C$, we have

$$R = D,$$

and $L = DK (2A + B)$.

It will be seen that with this arrangement, balance is independent of the frequency of the testing current.

The second arrangement we will consider is the Campbell bridge for the measurement of resistance and inductance. The connections are shown in **12.**

The current is led to the bridge through one coil of a variable mutual inductance M, the other coil of which forms one arm of the bridge. Let R^1 and L^1 be the resistance and inductance of this second coil, R and L the resistance and inductance to be measured, and P and Q the resistance of the other arms of the bridge. When the bridge is balanced the currents will be distributed as shown on the diagram. The voltage drop along R^1 will be equal to that along R, and the drop along P equal to that along Q. We have therefore the equations—

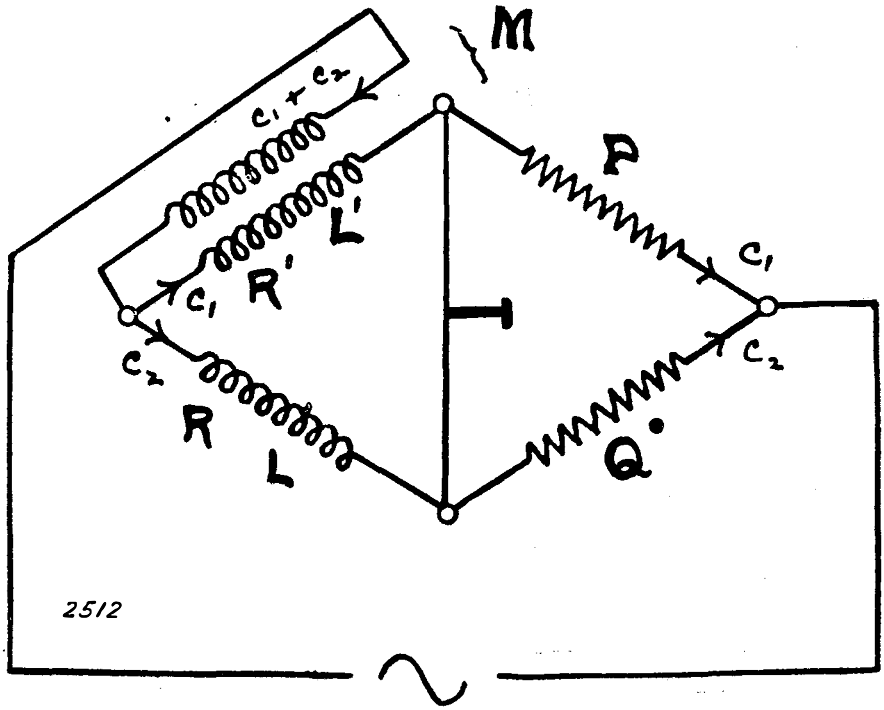
$$c_1(R^1 + L^1\theta) + M\theta(c_1 + c_2) = c_2(R + L\theta),$$

and—

$$c_1P = c_2Q.$$

Substituting for c_2 in the first equation in terms of c_1 from the second equation, we get—

$$c_1 (R^1 + L^1\theta) + M\theta c_1 \left(1 + \frac{P}{Q}\right) = c_1\frac{P}{Q} (R + L\theta).$$



12.—CAMPBELL BRIDGE.

Therefore—

$$R^1 + \left[L^1 + M\left(1 + \frac{P}{Q}\right)\right]\theta = \frac{PR}{Q} + \frac{PL}{Q}\theta.$$

Hence—

$$R^1 = \frac{PR}{Q},$$

and—

$$L^1 + M\left(1 + \frac{P}{Q}\right) = \frac{PL}{Q}$$

Therefore—

$$R = \frac{R^1Q}{P}.$$

and—

$$L = \frac{Q}{P} L^1 + \left(\frac{Q}{P} + 1\right) M.$$

If the arms P and Q be equal we have—

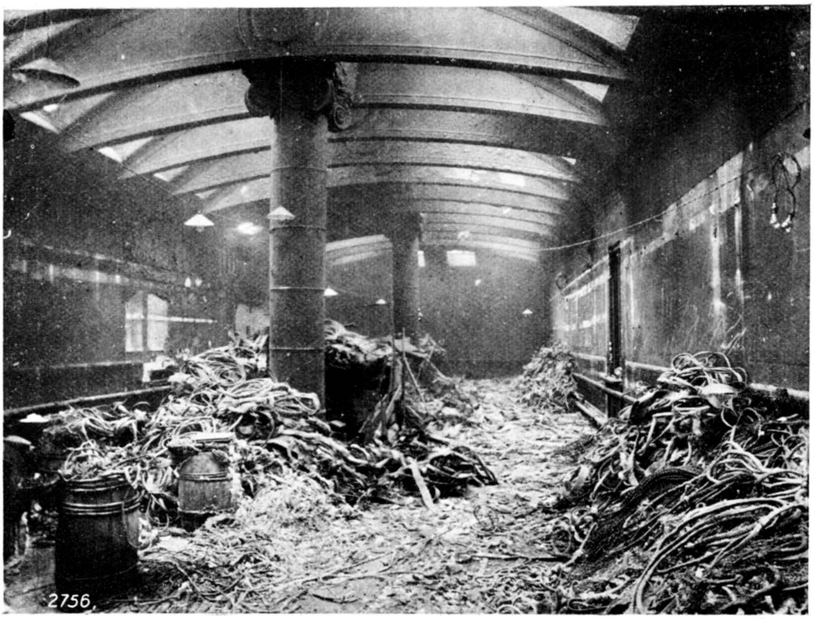
$$R^1 = R,$$

and—

$$L = L^1 + 2M.$$

It will be seen that this method is also independent of the frequency.

THE END.



THE LAST SCENE. DEMOLITION OF ROYAL EXCHANGE, GLASGOW.

WIRELESS

RE-ORGANISATION OF THE BRITISH COAST COMMUNICATION WIRELESS SERVICE.

By E. S. PERRIN, B.Sc., A.M.Inst.C.E., and F. W. DAVEY.

THE re-organisation scheme of the wireless coast stations undertaken to put the coast communication service upon a satisfactory basis allowed for the following:

CULLERCOATS.—To be purchased from the Poulsen Company.

NORTH FORELAND.—The power plant to be duplicated and the existing apparatus improved.

NITON.—A new station to be built to replace the existing one and the power to be increased from $\frac{1}{4}$ kw. to $1\frac{1}{2}$ kw.

LIZARD.—A new station to be built at St. Just to replace the Lizard, and the power to be increased from $\frac{1}{4}$ kw. to 5 kw.

ROSSLARE.—A new station to be built at Fishguard to replace the Rosslare station and the power to be 3 kw. instead of $\frac{1}{4}$ kw.

MALIN HEAD.—A new station to be built to replace the existing one and the power to be increased from $\frac{1}{4}$ kw. to 5 kw.

VALENCIA.—A new 10 kw. station to be built on Valencia Island.

A musical note is provided for the last five stations, the spark frequencies being 300, 400, 300, 400 and 600, respectively in the order given.

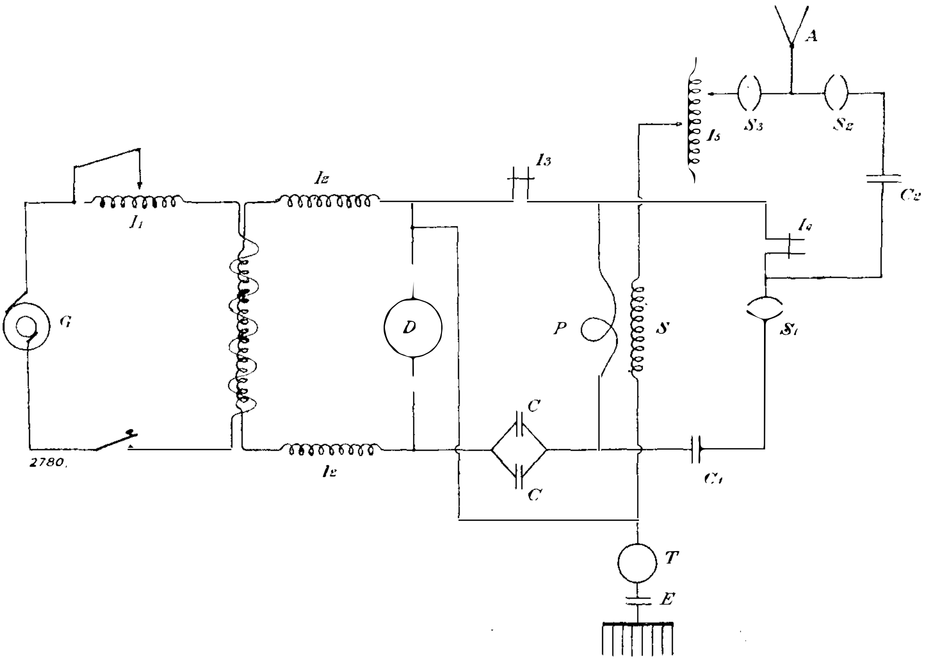
CULLERCOATS.—The completion of the purchase of Cullercoats took place in March, 1912. The mast is 220 ft. high, of wood lattice construction, and the aërial of umbrella type. The transmitting apparatus is of the ordinary De Forest direct coupled type.

The power is taken from a public D.C. supply and feeds a motor alternator. The power normally used is about 2 kw. A Poulsen arc and some experimental plant were also included in the purchase of the station. Since the station has been taken over, the stays of the mast have been entirely renewed. New anchorages have been made, and the station has been re-wired.

NORTH FORELAND.—The power for the station is taken from a public D.C. supply and feeds a motor alternator. The motor alternator has now been duplicated and the apparatus has been renewed.

FISHGUARD.—This is the first station that the Post Office has designed, and the installation of the wireless plant has been carried out by the Department.

The site was tested from a receiving point of view, by erecting



I.—FISHGUARD WIRELESS STATION.—SKELETON DIAGRAM OF CONNECTIONS.

two portable 70 ft. masts—one at Strumble Head and one at Fishguard—with suitable aërial and receiving gear. Messages were received from a boat going westwards from Fishguard. The object of this test was to determine whether there was any pronounced screening at Fishguard, but such was found not to be the case. An arrangement was therefore made with the Great Western Railway Company for a site on their property. The lay-out of the building was prepared by the Wireless Section, and the building plan got out by the Buildings Branch of the Secretary's Office, the building being put up by the Great Western Railway Company and rented to the Department.

The power is derived from the Great Western Railway Company's generating station. The system is three wire D.C. 440 volts across the outers. The power is led to the switchboard, and from thence feeds a 3 kw. motor-alternator.

The skeleton diagram of connections is given in I.

The arrangement is similar to that installed at North Foreland, but the power used is greater.

G is the alternator supplying power through an iron core choke, I_1, to the primary of a high-tension transformer. The secondary of the transformer is connected through two air core chokes to a rotary disc discharger, D. Round the disc discharger are formed two circuits, one tuned to a 600-metre wave consisting of the discharger D, condensers C, C, the primary of an oscillation transformer P, and an inductance I_3; the other (when the switch S_1 is closed), tuned to a 300-metre wave, consisting of the disc discharger D, condensers C, C and C_1, and inductances I_4 and I_3. The 600-metre aërial circuit (operative when the switch S_3 is closed) is inductively coupled to the 600-metre closed circuit through the oscillation transformer $P.S.$ Included in the aërial circuit is a variable inductance, I_5, a thermo-ammeter T, and an earth arrester gap E.

The same aërial is used for 300 as for 600 metres, but in the former case direct coupling is adopted, S_3 is open and S_2 is closed, and the aërial is joined through a condenser C_2, and thence through I_4, I_3, T and E to earth. The connections between S_1 and the earth connection on D are common to the primary and aërial systems.

The mathematical development of the theory of "The Low-frequency Circuit in Spark Telegraphy," by Mr. L. B. Turner, M.A., published in the 'Electrician,' August 2nd, 1912, was used as the basis for the design of the power plant and wireless plant. For the design of the station the capacity of the main condenser to be charged from the A.C. supply was fixed as ·065 mfd., the R.M.S. open-circuit voltage of the alternator at 300, and the periodicity at 150. There was to be one spark per half period attained by making the low-frequency system resonant—that is to say, the natural period of this system was made the same as the period of the applied E.M.F. In the design of an installation of this character the transformer can be considered as replaced by a capacity ρ^2C (where ρ is the ratio of transformation and C the capacity of the condenser in the secondary circuit of the transformer), and the resonant low-frequency circuit can be considered as equivalent to G, I_2 and ρ^2C in series. Resistance is negligible in comparison with other factors under the particular conditions, and the inductance of the transformer perforce does not enter into the calculation.

If P = power (watts), ρ = transformer ratio, c = capacity, and n = periodicity of supply,

$$P = nc\,(\rho v)^2$$

where ρv is the actual sparking $P.D.$

$$i.e.\ 3000 = 150 \frac{\cdot 065}{10^6} (\rho v)^2$$

$$\therefore (\rho v)^2 = \frac{3000 \times 10^6}{150 \times \cdot 065}$$

$$= (17\cdot 5)^2 \times 10^6$$

$$\therefore \rho v = 17{,}500 \text{ volts.}$$

Assuming a simple sine wave form of the supply voltage and resonant conditions, then if E is the peak voltage, the transformation ratio of the transformer is given by the formula—

$$\text{Sparking } P.D. = \frac{\pi}{2} \rho E$$

$$i.e.\ \frac{\pi\rho}{2} 300 \sqrt{2} = 17{,}500,$$

$$\therefore \rho = \frac{17{,}500 \times \sqrt{2}}{\pi \times 300}$$

$$= 26\cdot 6 \text{ approximately.}$$

Hence the transformer was specified for ratio of—

300 to 7860 volts,

but insulated to carry the working load at 17,500 volts on the secondary.

The value of the inductance of the low-frequency circuit is calculated as follows:

$$L = \frac{E^2}{16\, n\, P}$$

$$= \frac{(300 \sqrt{2})^2}{16 \times 150 \times 3000}$$

$$= \cdot 025 \text{ henry.}$$

The inductance of the armature was specified to be not greater than ·005 henry and a variable iron core choke of maximum value ·05 henry was fitted in the low-frequency circuit.

Referring to 1, the alternator G delivers 3 kw. at a voltage which can be regulated between 200 and 400. The inductance of the armature does not exceed ·005 henry. The working frequency is 150. I_1 is an adjustable inductance fitted with ten stops; the maximum value is ·05 henry. The transformer has a ratio of 300 to 7860, but is insulated to withstand a working voltage of 17,500. I_2, I_2 are air core chokes to prevent the surgings from the high-frequency circuit getting back on to the low-frequency side. D is a rotary disc discharge fitted with twelve studs. The rotary discharger consists of a disc fitted with as many studs as the alternator has poles. The disc rotates between two fixed discharging points so disposed that studs are opposite both discharging points at the same instant, and the constants of the apparatus and phase relationship of the discharger studs and alternator armature are so arranged that one discharge of the condenser occurs per half period. To enable this to be done the disc is bolted to the end of the alternator shaft, but the bolts pass through radial slots so that the two are held together only by friction, and the disc can be moved relative to the armature of the alternator by slackening the bolts. The fixing of the disc relative to the armature is a very important point. It is essential that the instant of sparking should coincide with the instant of maximum charge in the condenser; if the discharge takes place too soon the condensers are not fully charged, and irregular sparking results; if the discharge takes place late the condensers are again not fully charged at the instant of sparking.

The few figures appended indicate how the power factor varies for small variations in the position of the disc and how critical the position is:

Position of disc.	Power factor.
20°	·39
21·0°	·47
22·0°	·72
22·5°	·68
23·9°	·60
25·0°	·56

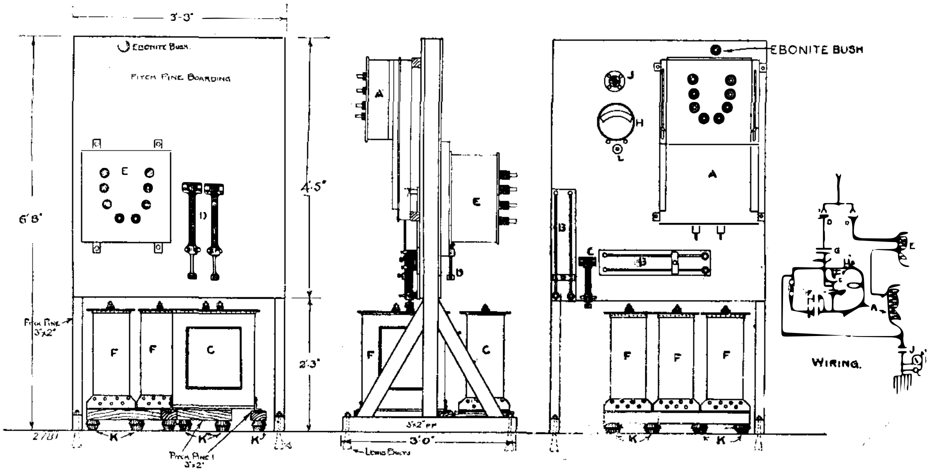
30° on the disc represent the pole pitch.

The point indicated by position 25° is when the armature coils are directly under the poles.

As a matter of fact, at the peak of voltage of the alternator the moving stud should be two or three degrees behind the fixed stud.

C C are each ·030 mfd. approximately. *P S* is an oscillation transformer for coupling the aërial to the primary circuit, and I_3 is a variable inductance for adjusting the wave length of the primary 600-metre circuit, and consists of two parallel brass bars about 15 inches long, with a sliding contact between them. The condensers are charged and discharged once every half period; if S_3 is closed and S_2 and S_1 open the 600-metre aërial circuit is coupled to the 600-metre primary circuit, I_5 being a variable inductance for adjusting the wave length of the former. Most of the adjustment was done on the aërial, so as to make I_5 practically nothing. The aërial thus oscillates as near as possible on its fundamental. *T* is a hot wire ammeter fitted with a suitable shunt to act simply as an indicator of current in the aërial circuit. *E* is an earth arrester gap, consisting of two parallel brass discs, separated by a thin sheet of mica, the top disc being of smaller diameter than the lower. In this way a small air gap is provided, across which the oscillations can readily pass during transmission, but which effectively blocks the received signals, the received signals thus passing through the receiving apparatus which is joined across the two discs.

In transmitting on the 300-metre wave, the switches S_1 and S_2 are closed and S_3 is open. The condenser *C C* is charged by the low-frequency supply round the inductance P, thus charging under resonance conditions and keeping the power factor constant, but discharges with H.F. oscillations through C_1, I_1, I_3, D, and C C. This circuit is tuned to 300 metres, C_1 being equal to C. The aërial is direct coupled to this circuit through the inductances I_3, I_4 and the leads joining them to the spark gap. The wave length of the aërial is reduced by inserting a condenser C_2 of such a value that the wave length of the aërial circuit A, C_2, I_4, I_3, D, T, E is 300 metres. In this design the energy radiated on the 300 metre wave is very much less than that radiated on the 600-metre wave. The station, however, is normally designed to work on 600-metre



A. Transformer oscillation W.T. No. 1.
B. Inductance W.T. No. 1.
C. Switch wave changing No. 1.
D. Switch wave changing No. 2.
E. Inductance W.T. No. 5.
F. Condenser W.T. No. 10.
G. Condenser W.T. No. 2.
H. Ammeter aërial No. 1.
J. Discharger earth.
K. Insulators' messroom No. 3.
L. Switch tumbler No. 1.

2.—FISHGUARD WIRELESS STATION. ARRANGEMENT OF APPARATUS.

and the arrangement allows for resonance working on the 300-metre wave, with sufficient power on the latter to work the Great-Western Railway boats, without interfering with the neighbouring stations, at St. Just and Seaforth.

GENERAL.—The D.C. mains are led into the building and go straight to the main switch; from thence they go to the motor side of the motor alternator through a motor starter, the motor starter being of the Bray, Markham and Reiss type, controlled by a tumbler switch placed close to the operator.

The A.C. mains go from the alternator to a switch fitted on the power board, and from thence to the primary of the transformer, the transmitting key and iron core inductance being in circuit. The power is broken directly on the transmitting key, no electro-magnetic key being used as difficulty was anticipated with the adjustment of an electro-magnetic key at such high frequency. The connections on the H.T. side of the transformer have already been explained, and **2** shows the manner in which the apparatus is disposed.

The mast is an ordinary three part ship's mast, 150 ft. high. It was recovered from the old Seaforth Wireless Station, and after being overhauled and repainted was erected by the Sectional Engineer at Fishguard. The anchorages are made up of bent railway metals set in concrete, and were designed in the Wireless Section. They form a cheap and effective anchorage, as the rails could be obtained on the spot from the Great Western Railway Co. The stays are four 2-$\frac{7}{8}$ G.I. stay wire for the mainmast, four $\frac{7}{8}$ G.I. stay wire for the topmast, and four $\frac{7}{8}$ G.I. stay wire for the topgallant mast. It was originally intended to put up four cages to form an umbrella aërial, but later it was decided that the mast was not strong enough to withstand the pull of the cages in such an exposed position, and single wires were used. The aërial is insulated from the mast and the poles carrying the extension by vulcanised strop insulators. The four lower ends of the wires are bunched and taken to a Bradfield insulator fixed in the wall of the building, and the inside of the Bradfield connected to the internal apparatus.

The earth consists of twenty-four plates $2\frac{1}{2}$ ft. by 5 ft. of stout galvanised iron placed vertically in the ground and bolted together to form two semicircles of 20 ft. radius. $\frac{7}{16}$ copper H.D. wires are soldered to the plates, three to each plate, the outside wires being common to two plates. The wires converge from the earth plates to a central point, and are carried above the ground and bunched at the central point. The bunched wires are fixed by means of a globe porcelain insulator to the top of a 10-ft. light creosoted pole. The two earth systems are connected together and a common wire is led into the building to the earth arrester gap. The ground at Fishguard is very rocky, and this type of earth was adopted to provide a capacity earth in addition to the ordinary earth.

Receiving Gear.—The receiving gear is connected across the earth arrester gap, and consists of a multiple tuner which can be worked with either a magnetic or a crystal detector. The skeleton diagram of connections is given in **3**.

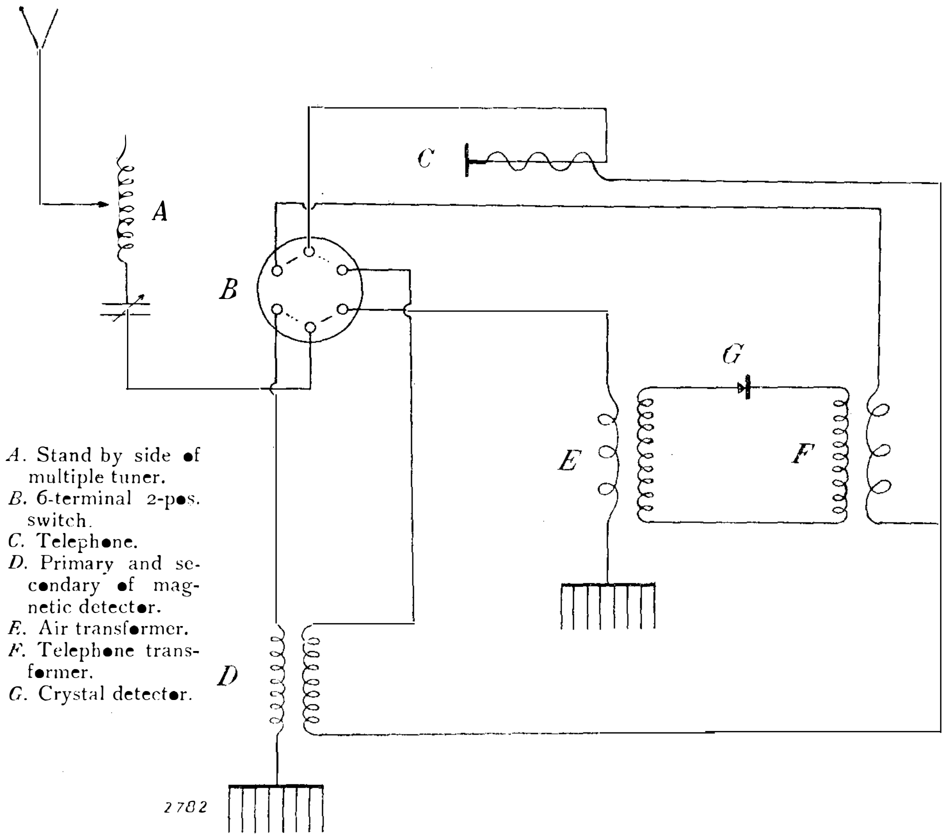
It will be observed that in switching over to the crystal an air transformer is joined across the detector terminals in place of the primary coil of the magnetic detector. As the multiple tuner is designed to work normally with the magnetic detector the inductance of the primary of the air transformer is made the same as that of the primary of the magnetic detector.

Low-resistance telephones are used for both magnetic and crystal working by the aid of a telephone transformer for the latter.

It should, perhaps, be added that the crystal receiver set shown in the diagram was not available for the opening of the station, but separate pieces of apparatus serving the same purpose were temporarily fitted; the standard set, however, is about to be fitted.

The station was open for commercial work at the end of August, and Crookhaven in tests gave note clear and signals strength 6.

The range of the station is reckoned to be about 250 miles in the day-time, but it has taken traffic at 1200 miles at night.



7.—FISHGUARD WIRELESS STATION. RECEIVING CIRCUIT DIAGRAM.

ST. JUST.—This is the second wireless station erected by the Department.

It was originally intended that power should be derived from a high-voltage supply to the mines in the district, but as the mains were not run it was found necessary to convert the transformer house into an engine and battery room, and to arrange for prime movers and batteries with the necessary accessories.

The lay-out of the operating building was prepared by the Wireless Section, and the erection of the building was arranged for and supervised by the Buildings Branch in the Secretary's Office.

In the case of both Fishguard and St. Just the instrument room, where the operating is done, is kept well away from the power room. The motor generator is started up by a remote control switch operating an automatic starter. This assures the necessary silence during reception of messages though the motor generator may be running.

The diagram of connections and general lay-out of the internal transmitting plant follows closely the lines of Fishguard. The fundamental differences are greater power—5 kw. instead of 3 kw. —and the provision of two aërials, one for the 600-metre wave and one for the 300-metre wave, instead of only one.

Using the same formulæ as those employed in the Fishguard case, taking the power at 5 kw., the frequency of the supply 200, and the open-circuit R.M.S. volts 300, we have:

Power	=	5 kw.
Cap	=	·07 m.f.d.
n.	=	200 p.s.
Speed	=	2000 r.p.m.

No. of studs on disc discharger:

$$= \frac{400 \times 60}{2000} = 12$$

If v = spark voltage:

$$\tfrac{1}{2} \times {\cdot}07 \times 10^{-6} \times 400\, v^2 = 5000$$

$$v^2 = \frac{50}{{\cdot}14 \times 10^{-6}}$$

$$v = 18{,}900 \text{ volts, say } 19{,}000.$$

Open circuit:

$$\text{E.M.F. generator} = 300$$

$$\therefore E = 300\sqrt{2}$$

$$1{\cdot}57\,\rho \times 300\sqrt{2} = 19{,}000$$

$$\rho = \frac{190}{1{\cdot}57 \times 3\sqrt{2}} = 28{\cdot}6, \text{ say } 29.$$

The transformer was therefore specified for 300/8700 volts, but insulated in the secondary to carry the working load at 19,000 volts.

$$\text{Power} = \frac{E^2}{16\,nL}$$

$$L = \frac{(300\sqrt{2})^2}{5000 \times 16 \times 20} = {\cdot}0112 \text{ henry.}$$

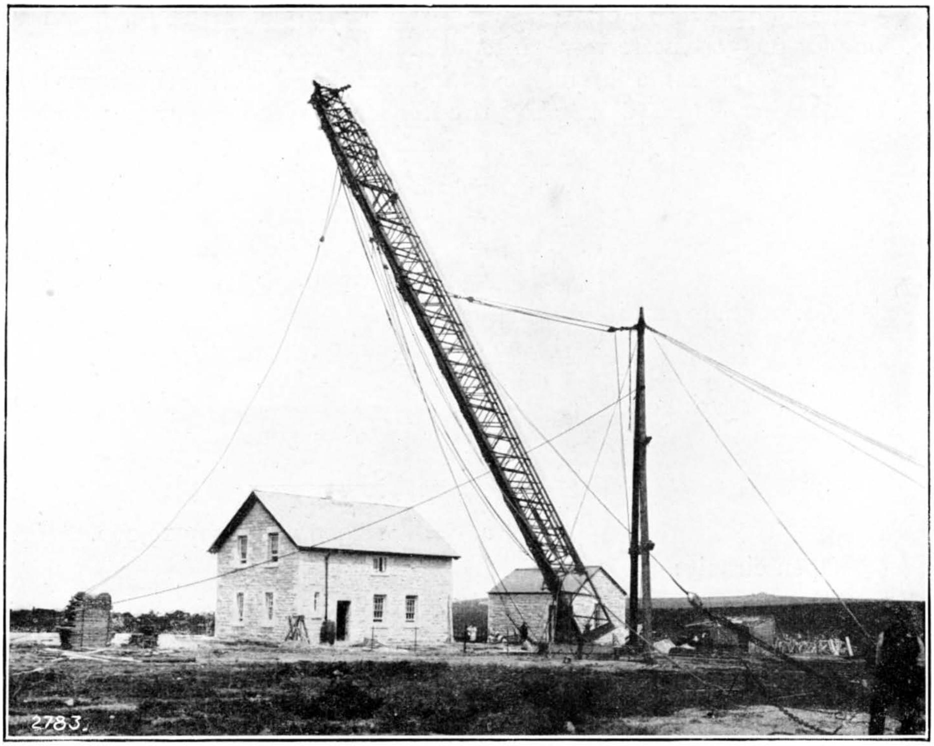
The inductance of the alternator was specified to be not greater than ·005 henry.

The added inductance is variable up to ·015 henry in 10 equal steps.

The alternator is fitted with 12 poles, and the E.M.F. is variable between 200 and 400 volts.

Although the capacity of the condensers in the primary circuit is approximately the same as Fishguard, yet, to allow for the greater power, the mass of dielectric is doubled. Hence twice the number of condensers of similar dimensions are used.

Two 200-ft. lattice girder steel masts support the aërials. The masts were designed by Mr. S. A. Pollock. It is not necessary, however, to dwell upon their design here, as the matter will be dealt with in a later issue of this JOURNAL.



4.—ST. JUST WIRELESS STATION. ERECTING ONE OF THE 3-SECTION LATTICE GIRDER MASTS.

Each mast is in three sections, the sections telescoping into one another.

4 shows the three sections nearly in position.

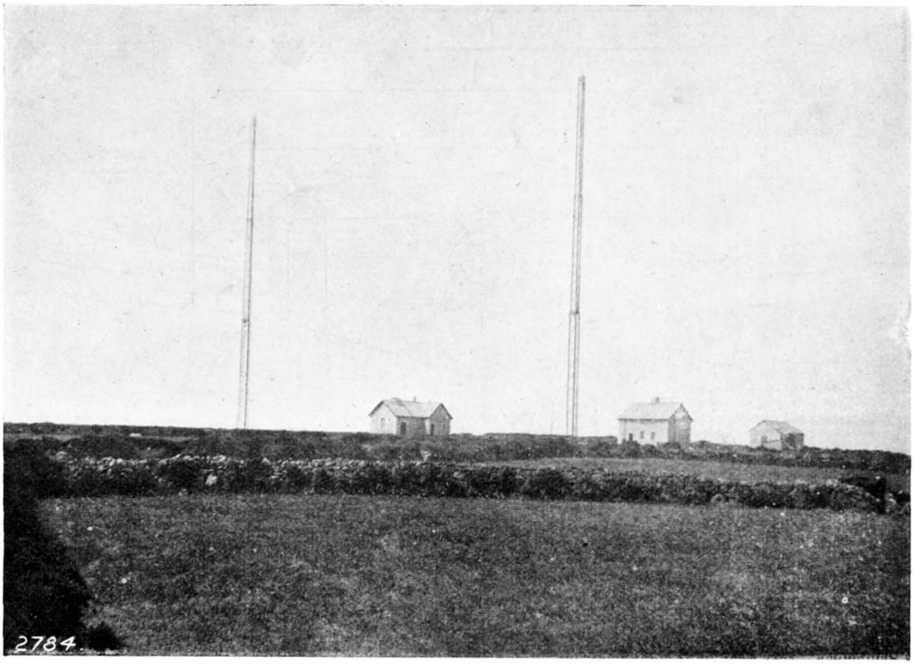
In raising the mast an axle was fitted to one side of the mast at the base and this was mounted so as to allow the mast to rotate in a vertical plane during erection.

When the three sections were in position the two inner sections were lifted vertically to the top of the outer section and the two outside sections bolted together. The innermost section was then lifted to the top of the second section and the second and third sections similarly bolted together. The completed masts are shown in 5.

There are three sets of four stays to each mast, the stays being 2½″ steel rope.

A pulley is fitted at the top of each mast and over these run the halyards for supporting the aërial. The anchorages consist of re-enforced concrete blocks.

The 600-metre aërial is triangular in shape, the base of the triangle being at the top; each side consists of a cage made of six



5.—St. Just Wireless Station. The Masts completed.

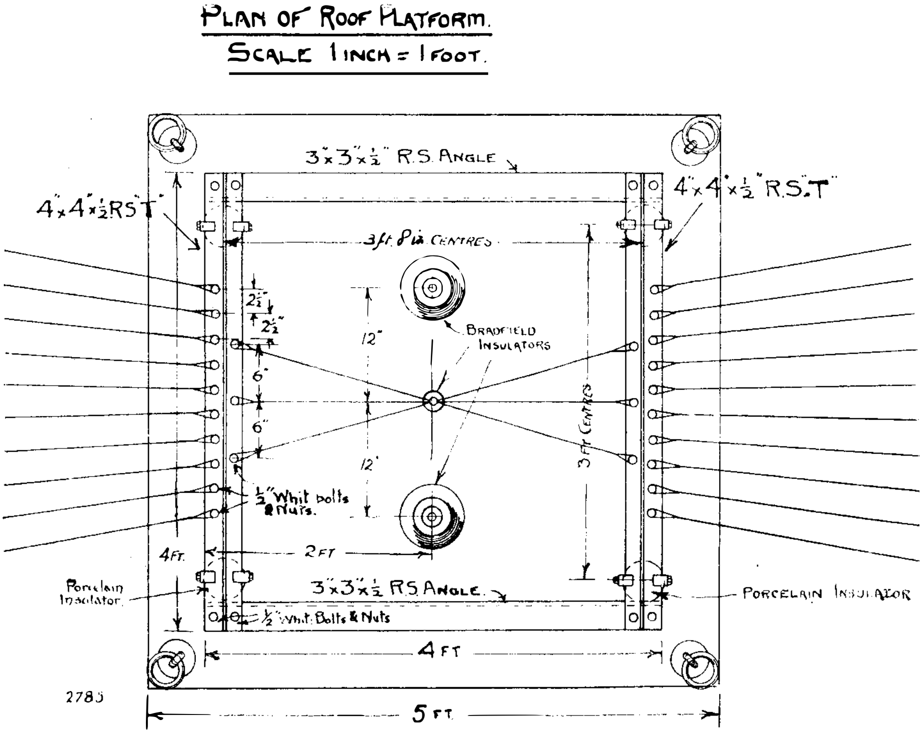
wires of 7/19 H.D. copper. The two side cages are anchored down to ringbolts set in concrete in the ground.

The aërials are insulated from the masts and the ground by vulcanised strop insulators. Leads are taken from the bottom of the two legs to a Bradfield insulator fitted in the roof of the power room.

It was originally intended to strengthen the roof and to anchor the aërials to it, but this idea was abandoned. A special platform is built on the roof of the power room, and 6 is a plan of this platform. The leads from the 600-metre aërial go to one of the outside insulators and the lead from the 300-metre aërial goes to the other, the earth leads being joined to the centre one. The inside terminals of these insulators go to corresponding points of the internal apparatus.

The 300-metre aërial consists of two parallel wires 160 ft. in length and separated by wooden spreaders at the top and bottom.

The earth system consists of two sets of ten galvanised iron plates each 6 ft. by 3 ft. arranged in two segments of a circle of 80 ft. radius having as centre the mid-point between the masts. The plates are buried as vertical as possible without having recourse to blasting the ground, which is of a rocky nature. The longer edges are placed horizontally and bolted together at the upper corners so as to form a continuous sheet. To the centre of each plate a lead of



6.—RADIO INSTALLATION.

bare 100-lb. H.D. copper wire is soldered, the wire being passed in and out through three holes in the plate so as to form a good mechanical as well as a good electrical joint.

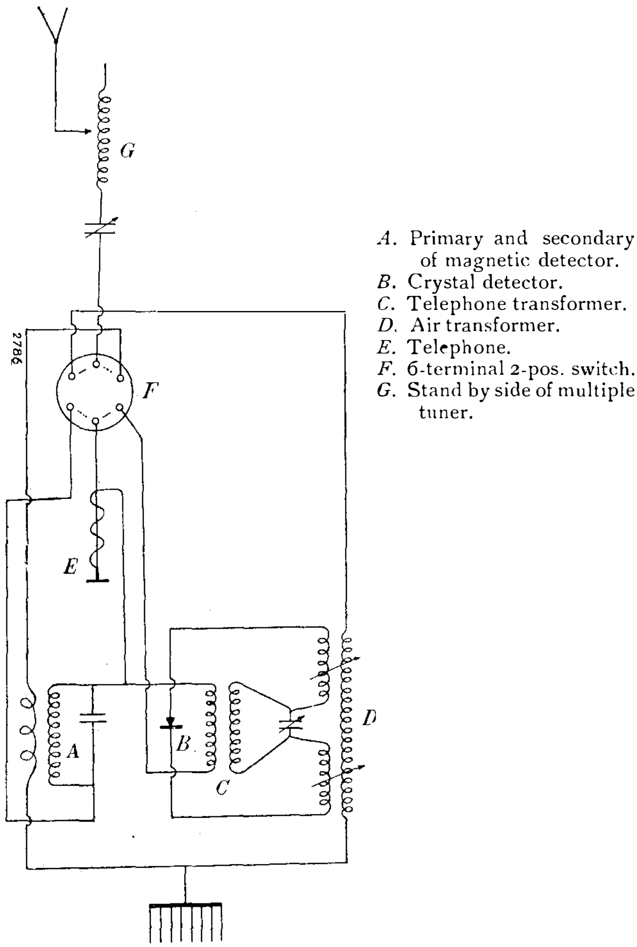
The earth leads are carried over short posts projecting 2 ft. above ground 5 ft. from the centre of each plate, and thence in a single span to a special earth bar carried on insulators on the roof platform over the high-tension room in the operating house.

A wire connecting each set of earth leads is carried to the centre insulator in the roof, the under side of the insulator being connected to the earth arrester gap. The earth bars on the platform consist of T. iron carried on Buller's third rail insulators.

The prime movers are two semi-high-speed engines, each capable of developing 10 H.P. at 800 revs.

They are fitted with overhead valve gear and govern on the throttle.

In each engine the carburetter is of the single-jet automatic type and fitted with exhaust heated vaporiser. The carburetter is



7.—St. Just Wireless Station. Receiving Set Connections.

arranged for a petrol start and is turned over to paraffin when it warms up. High-tension magneto ignition is employed.

Each prime mover is connected to a D.C. generator designed for an output of 5 kw. at 100 to 140 volts at a speed not exceeding 700 revs. per minute.

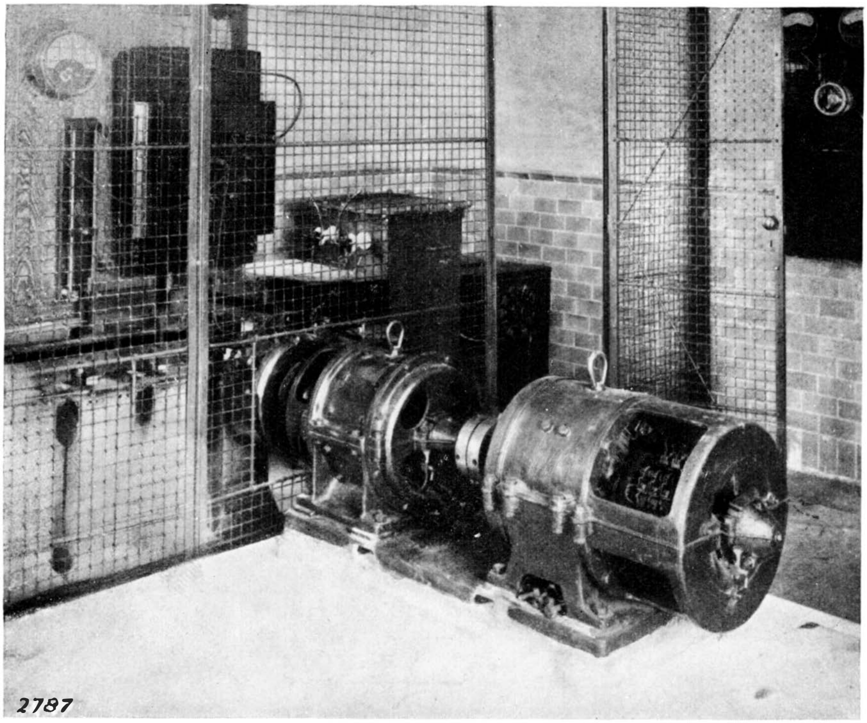
The D.C. generator charges a battery of 52 cells suitable for a discharge of 378 ampère-hours at the 9-hour rate.

The battery supplies energy to a motor alternator ; the motor is

100- to 140-volt compound wound of sufficient power to drive the alternator and disc discharger; the alternator is designed to give a single phase current at 300 volts, 200 periods per second and a total output of 5 kw. at unity power factor.

Spare armatures are provided for all the machines.

7 shows the skeleton connections of the receiving set. It will be seen that in conjunction with the multiple tuner either a magnetic detector or crystal detector may be used. The arrangement of the air-transformer, with a split secondary winding having the telephones



8.—St. Just Wireless Station. Motor Alternator fitted with Rotating Disc Discharger and High Tension Apparatus.

at the split and the crystal detector across the outer terminals, was suggested by Mr. J. E. Taylor, and follows the arrangement used for coherer jiggers. This set has, however, only been installed temporarily, and will be superseded later by a standard set as at Fishguard.

In tuning up the station and testing with Crookhaven, 200 miles west, the signals were given: "Clear as a bell and very strong." A boat, 300 miles west, gave the signals as strong. It is impossible to say exactly at present what the range of the station is, but it is considerably in excess of that of Fishguard.

In installing the apparatus the electrical constants were slightly altered from those scheduled. Difficulty was experienced in arranging the circuits for the desired wave-length with so large a capacity.

Malin Head will follow closely the design of St. Just, but there will be only one mast and one aërial instead of two.

Malin Head, Valencia, and Niton Wireless Stations will be completed early next year.

RECENT DEVELOPMENTS IN TRANSPORTATION.

By H. C. Gunton, M.I.E.E.

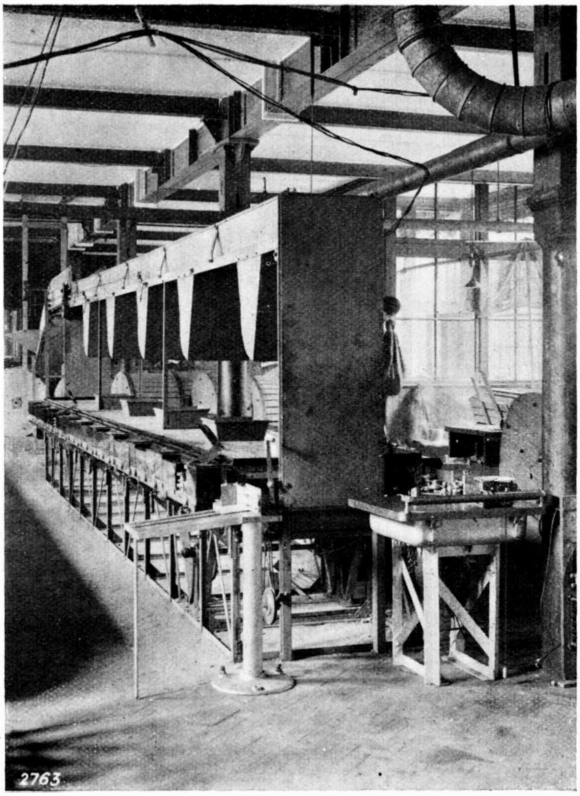
A considerable amount of attention has recently been given to the application of mechanical power for Post Office transportation purposes, and the following notes on some of these schemes will probably be of interest.

Sorting Office Conveyors.

The sorting offices in the larger postal centres offer a wide but by no means an easy field for the ingenuity of the designer of mechanical appliances. Before proceeding to describe what has been done in this direction it will be well to state briefly the processes through which a letter passes in one of these offices, choosing a simple case of what is known as "outward sorting" for the purpose of explaining the objects to be kept in view.

Letters inserted in the posting boxes at the Head Post Office, or brought in by the postmen from the local pillar-boxes, say at one of the principal provincial towns, are deposited on tables and "faced" by picking them up and placing them so that the addressed sides all face one way with the stamp in the lower left-hand corner. The faced letters receive the locality and time impression and have their stamps obliterated. They are then taken to the primary sorting tables and sorted into twenty or thirty "roads," each of which may include several towns or districts. The letters for each road are next taken to secondary sorting or despatch tables where they are further sub-divided and made up into bundles which are placed in bags in which they are conveyed to the railway stations. It should be stated that bags of mail matter received from the railway stations similarly pass through a process of "inward sorting" before delivery, but the above explanation of "outward sorting" will probably suffice.

It will be understood that while there are certain selective processes which can only be carried out by human agents, there is scope for mechanical transportation between the processes. Until recently the conveyors which have been used in sorting offices, and with which no doubt readers generally are familiar, have been installed in order to facilitate operations carried out, more or less, in accordance with existing ideas. The difficulties in design involved in adapting these appliances to these operations in old offices,



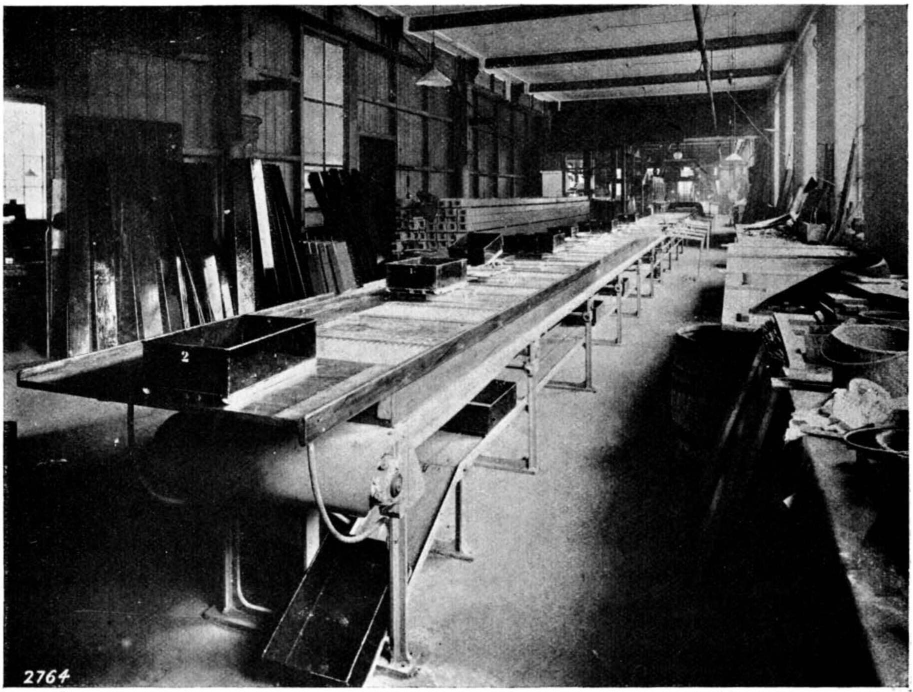
I.—Mechanical Sorting. Facing Table.

constructed and arranged without reference to their embodiment, have, of course, been very considerable.

Experiments have recently been made which aim at the mechanical transport of correspondence practically right through an office, from the posting boxes to the despatching tables and thence to the loading platform.

The practicability of conveyors from posting boxes to facing tables has already been proved, and bands are also in use carrying faced letters from one end of a facing table to the other, but the experimental installation provides for the stamping machine at the end of the table being fed mechanically instead of by hand.

In framing the complete scheme, it was assumed that all correspondence would be received on a platform at one end of the sorting office adjacent to the facing tables, and at this platform one man is required to watch and adjust the flow of work along the facing tables, the letters, etc., being carried by bands above these tables and deflected at will (through shoots) to the facers at their various positions along the tables. At intermediate positions (between these

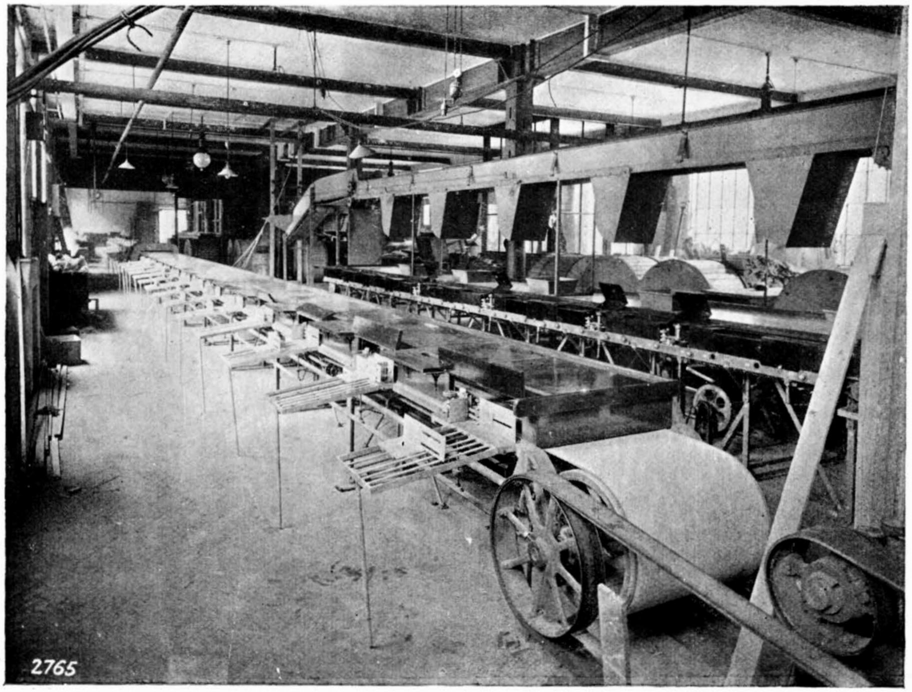


2.—Mechanical Sorting. Primary Sorting Table.

overhead shoots) there are openings in the table through which the newspapers and packets picked out from the general correspondence are dropped on to the return half of the band which is carried beneath the table, and deposits them at the end of the table for separate treatment.

The facing table has along its edge a series of slots formed by smooth sheet iron or wood, through which the facers drop the letters, in an upright position, on to a running band below the table. Each of these individual slots forms a "siding" leading to a main slot which runs from end to end of the table, and into which the letters pass without "fouling." At the end of this main slot the letters are mechanically separated and fed direct into the stamping machine, and then "stacked" by the mechanical stacker which forms part of the machine.

As an alternative arrangement each small slot or "siding" is fitted with its own stamper, consisting of an impression roller and die. By this means noise is reduced, there are fewer failures, and it is possible to fit a mechanical counting device to each stamper so that the output of each facer can be ascertained. On the other hand the periodical changing of so many dies causes some additional work.



3.—Mechanical Sorting. Despatch Table.

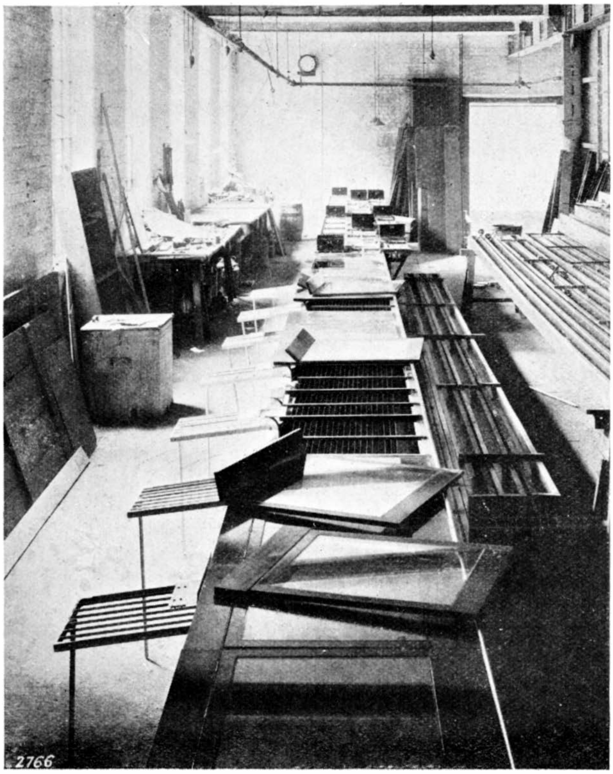
The letters are automatically stacked at the end of the table.

We have so far followed the letters through the facing, stamping and stacking processes.

At this point attendance is required to transfer the stacked correspondence into boxes, which, when filled, are carried away by a specially designed chain conveyor to selected points on the primary sorting table. The boxes travel along the back of the sorting table and are delivered automatically at the side of the sorters, being deflected on to moving platforms which move out to meet their respective boxes.

As the sorters empty their boxes, they send them back to the machine (empty) by a similar conveyor, and the officer there refills them in turn and places them again (full) on the conveyor. As the conveyor discharges them only at the particular points from which they have been returned as empties, the sorters are kept supplied without any trouble.

The primary sorting is done through a grid (*i. e.* through vertical slots) on to a wide band running below the table. For each division



4.—MECHANICAL SORTING. PRIMARY SORTING TABLE WITH COVERS REMOVED.

or "road" a slot is provided, one inch wide, and a sorter can have as many as twenty-four divisions easily within his reach.

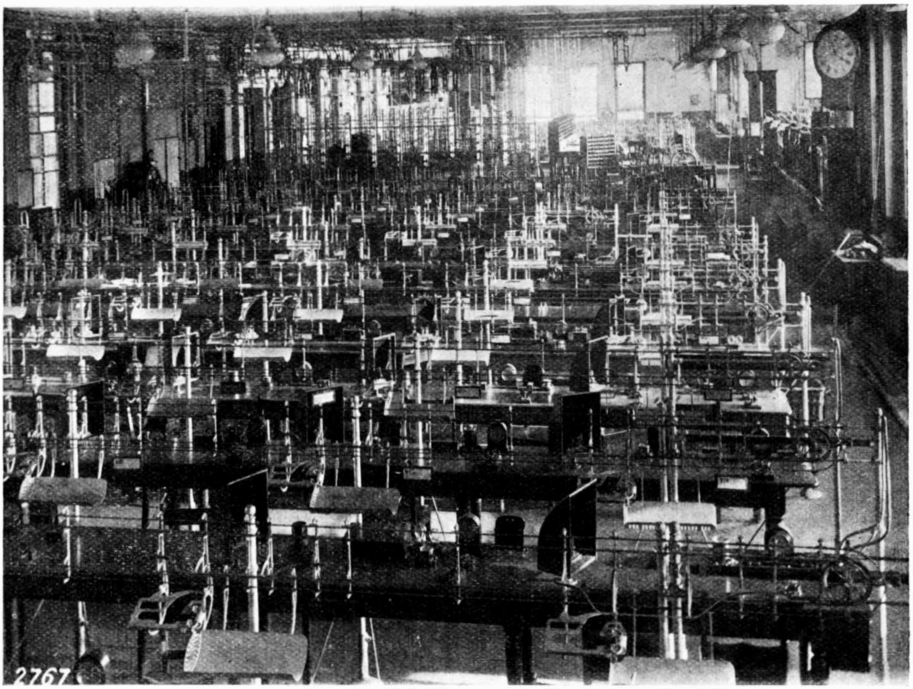
The width of the "bay" for each man is only 2 ft. 6 in. and the sorters thus stand shoulder to shoulder.

From the primary table the band runs to the dispatching tables, and at each "road" the slot carrying the correspondence for that particular "road" is turned outwards to the front edge of the table so as to discharge the correspondence proper to that road, and at that point it is stacked again by a mechanical stacker ready for the secondary sorting. It will thus be seen that the correspondence passes direct from one process to the next without any delay such as is inherent to hand collection.

The experimental apparatus has been installed at Liverpool Post Office, and the preliminary trials have been satisfactory and indicate a substantial saving of time over the existing methods.

Improvements are at present being made in one or two points of detail and it is, of course, too early to say how far these new methods can be generally applied.

1 shows the facing table, stacker and stamper.



5.—PICK-UP CARRIER. BIRMINGHAM INSTRUMENT ROOM.

2 shows the primary sorting table, and conveyors for distributing the baskets of faced letters.

3 shows the despatch-table and stackers. A side view of the facing table is also shown.

4 shows another view of the primary and part of the despatch-table, with some of the covers removed in order to show the slots.

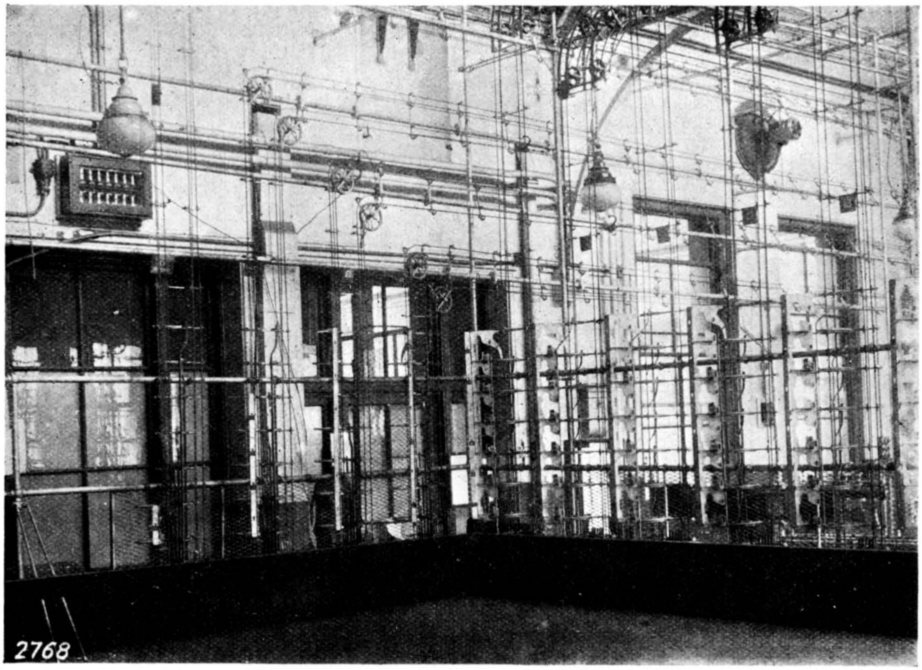
The whole of this experimental apparatus is electrically driven.

TELEGRAPH INSTRUMENT ROOM CONVEYORS.

In telegraph instrument rooms the problem has been how to displace boy labour by means of mechanical appliances which would save time and which would meet the following conditions:

(1) The system of mechanical appliances should, as far as possible, be uniform throughout the instrument room, and the control should preferably be concentrated at a central point.

(2) The apparatus must be automatically selective as regards distribution to the operators, *i.e.* it must be possible to despatch a telegram form to any desired point on any table. The forms must also be conveyed from any point on any table to the check table, but this is not a selective operation.



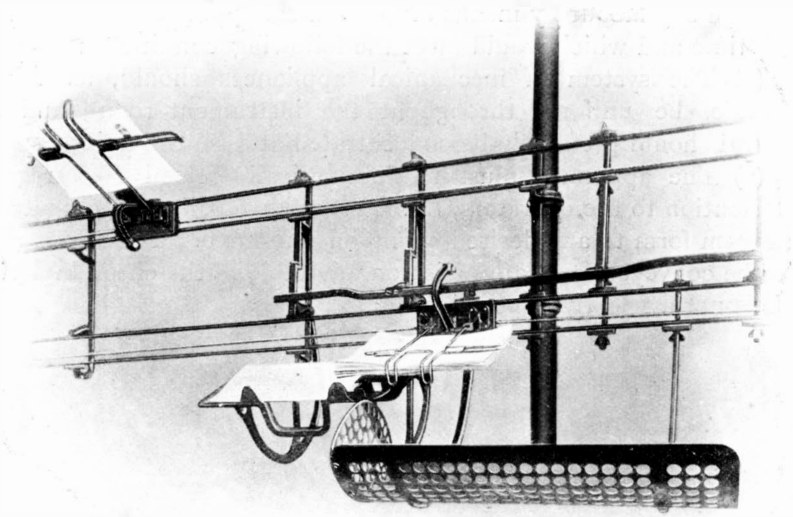
6.—Pick-up Carrier. Birmingham. Another View.

(3) The despatch of the telegraph forms by the various operators should not involve any further break in the continuity of their work than is at present involved by the placing of the forms on the message baskets provided, and from which the boy messengers collect.

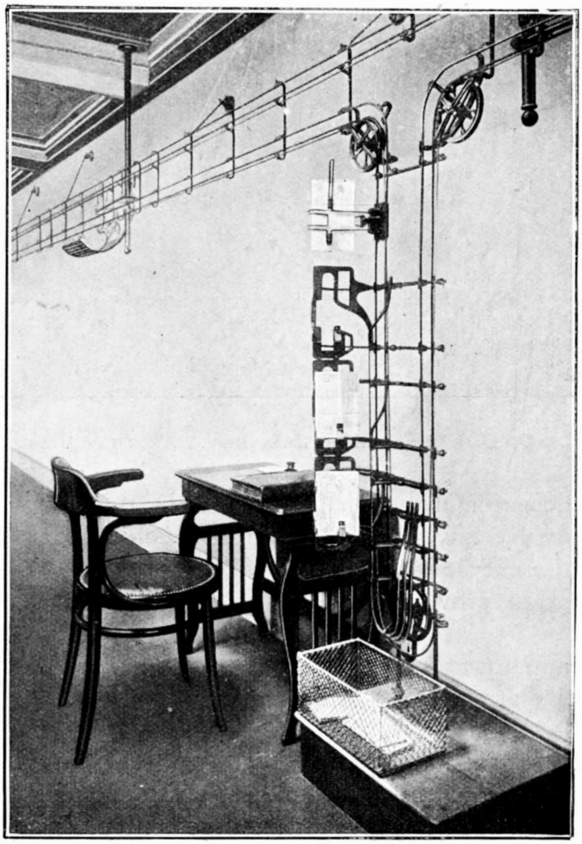
(4) The apparatus must be silent in its operation, and moving parts must be arranged so as to obtrude to the smallest possible extent on the vision of the operators.

(5) The gangways and the lighting of the instrument room should be interfered with to the smallest possible extent.

5, 6, 7 and 8 show the general arrangement of the plant which



7.—Pick-up Carrier. Details of Horizontal Run.



8.—Pick-up Carrier. Elbow and Vertical Detail.

has been installed experimentally at Birmingham. "Pick-up" carriers bring the incoming telegrams from the various operators' stations and drop them on to band conveyors, which deliver them at the "check" table, whence they have to be distributed selectively to the operators who deal with outgoing circuits. This selective distribution is effected by placing the telegrams on tablets arranged vertically in groups of five or six corresponding to the various stations on each table.

The endless cord running between the "central check" and each table draws the selective carriers, the jaws of which, by means of ramps, are made to open and close and so pick up the telegrams only from their proper tablets and similarly to deliver them only at their proper stations. The carriers also pick up at the table stations and deliver on to the bands at the check table referred to above. The carrier installation has been supplied by Messrs. Lamson, while the band conveyors have been installed by the Post Office. The cord and band conveyors are driven by electric motors placed underneath a platform at the "central check."

Post Office (London) Railway.

As no doubt our readers are aware, powers have recently been obtained to construct an electric railway for purely postal purposes between the Paddington District Post Office in London Street and the Eastern District Post Office at Whitechapel, with intermediate stations at the Western District Parcel Office, at the Western District Post Office, at the Western Central District Post Office, at Mount Pleasant Sorting Office, at King Edward Building Post Office, and at Liverpool Street Station.

The railway contemplated under the present scheme is indicated in full lines, while the ultimate extensions contemplated are indicated by dotted lines on 9.

Between the stations the railway will consist of two tracks, each 2 ft. gauge, one for east-bound and the other for west-bound traffic, and contained in a single tunnel of 9 ft. internal diameter.

A complete scheme has been worked out in detail in collaboration with Mr. Dalrymple Hay. The latter is responsible for the tunnelling, while the Engineer-in-Chief is responsible for the equipment.

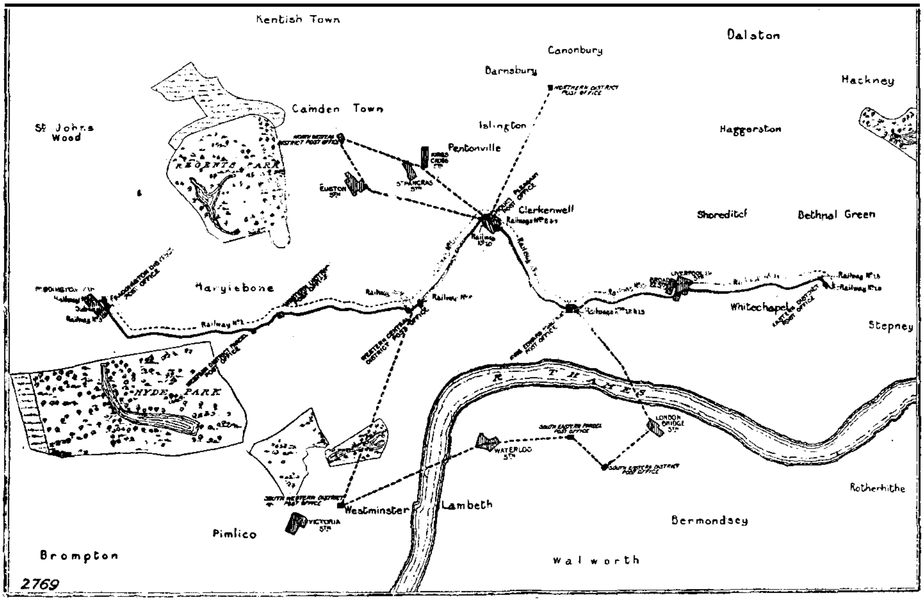
Three of the stations, viz. the Western Central District Office, Mount Pleasant, and King Edward Building, will form important junctions when extensions to the north and south are undertaken.

It is intended that the trains shall be operated without drivers on the remote control system.

The present is clearly not a convenient or proper time to give a detailed description of the scheme, which, whilst it will form the basis of invitations to tender, will leave the way open for alternative proposals as regards the electrical equipment.

A brief reference to the main outlines of the model scheme may, however, be of interest at this point in view of the information which has already been published.

A station will consist of an island platform arranged in two sections, between which will be placed a control cabin, and the lifts and conveying appliances which have been specially designed to suit the different classes of postal matter which have to be dealt with between the station platforms and the postal buildings above. This is the general design of station which has been adopted in all cases,



9.—MAP OF P.O. TUBE RAILWAY.

the arrangement of the tracks and of the conveying appliances being adjusted to suit the requirements at the different points.

It is proposed to operate the wagons or trains by three types of current, which it will be convenient to refer to as high speed (H. S.), intermediate speed (I. S.), and low speed (L. S.). Between the stations the H. S. current will be applied. At the approach to a station the wagons will pass over a short gap in the conductor rails, and brakes (which will be electrically released when the train is taking current and applied when the train is not taking current) will be applied. The next section of conductor rail will normally be "dead," and will be of such a length as to allow the wagon to come to rest, the brake remaining on.

In the case of a wagon which is required to stop at the station, a L. S. current will be applied to this brake section, and the train will move to the station platform and will finally be brought to rest owing to the application of the brakes when it reaches the sub-section of the station platform, the conductor-rails of that subsection having been made "dead" for its reception. In the case of a through train, I. S. current would be applied to the brake section, and the wagon would run at this speed through the station, would pass over a short gap in the conductor-rails, and then on to the sections of the track energised by H. S. current without a stop. In the event of its being possible to accept, without delay, either a stopping train or through train, the braking section, or a certain portion thereof, would be energised with L. S. or I. S. current respectively before the train reached that section, in which case the train would merely be retarded down to the speed corresponding to the current applied and would either pass up to the platform or straight through the station. A wagon will be despatched from the station by making alive the conductor-rails of the sub-section on which it has been standing with I. S. current if it is being sent on to a main line or with L. S. current for shunting operations.

Wagons will be moved into the sidings and brought to rest in certain sections in the same manner as at the platforms, and a device will be provided for automatically reversing the connections of the motors, when desired, just as they are coming to rest, so that they may move off in the opposite direction when current is applied to withdraw them from the sidings. Means will also be provided for holding the brakes off without applying driving current to the motors so that the wagons may readily be coupled up to form two or three car trains. When coupled up in this manner it will be arranged that by means of a train cable and certain switches the shoes of the rear wagon only will collect current from the conductor rails, but the motors on all wagons will be operative and share in the driving of the train. This arrangement will overcome difficulties which would otherwise arise in dealing with both single wagons and trains at gaps, braking sections, and dead sections, at the platforms and in the sidings.

It should be made quite clear at this point that it is not intended that the control of the wagons as they come to rest in, or pass through, the stations should need the continuous attention of the switchman.

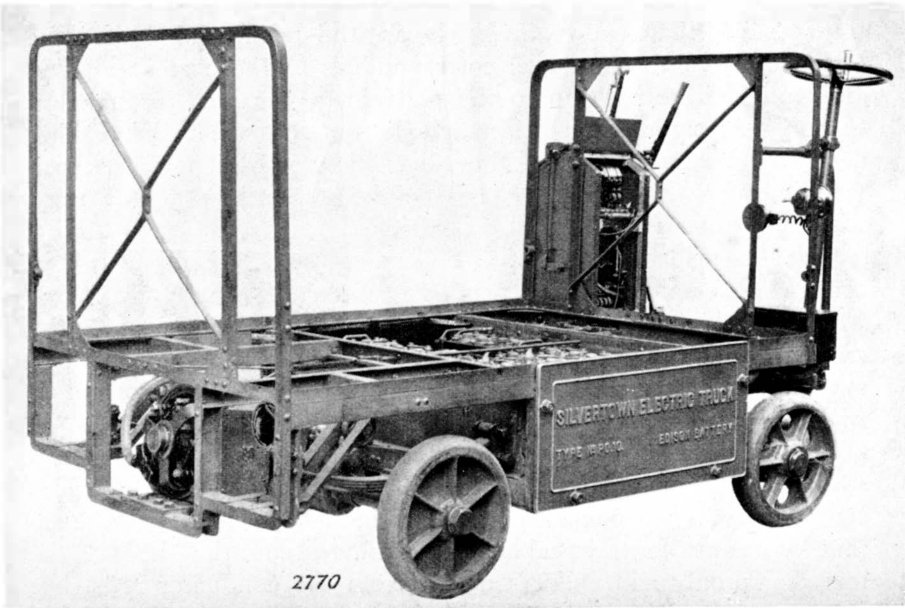
The position and destination of each wagon will be notified to this officer, who, by means of small levers in the cabin, will set points for the particular route desired, and will energise certain sections of the conductor rails with the appropriate current. The wagon will then come to rest at the proper section of the platform, or will run through the station, without further attention.

The operation of the points will be interlocked with the application of the current and there will be a complete interlocking arrangement between the different routes.

The proposed system of control may be briefly described as being generally similar to the power-operated point-and-signal systems adopted for modern railway undertakings but with the signal element replaced by the application of current to the track.

It is considered that it is only by such a system of complete interlocking that a remote control electrical railway of this scope can be safely operated.

Between stations the conductor rails will be divided into sections,

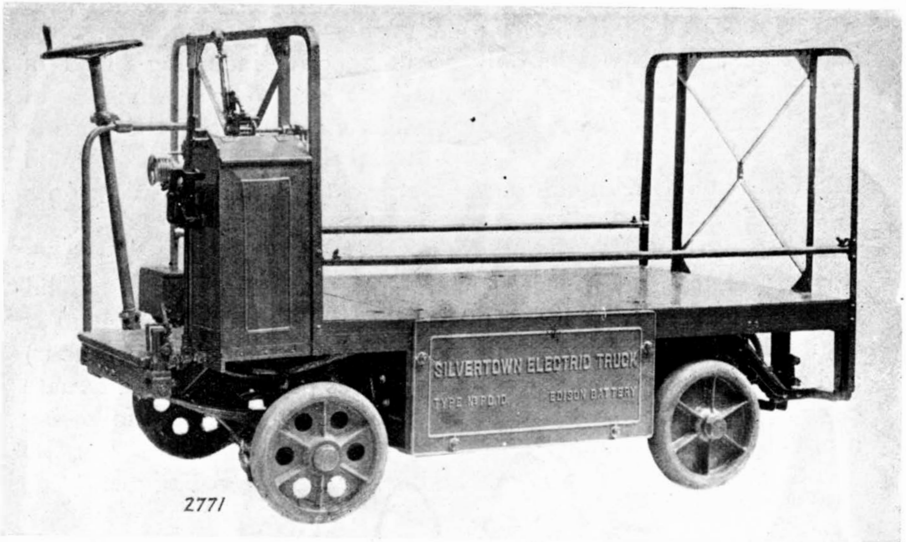


10.—Electric Truck. Flooring and Sides removed.

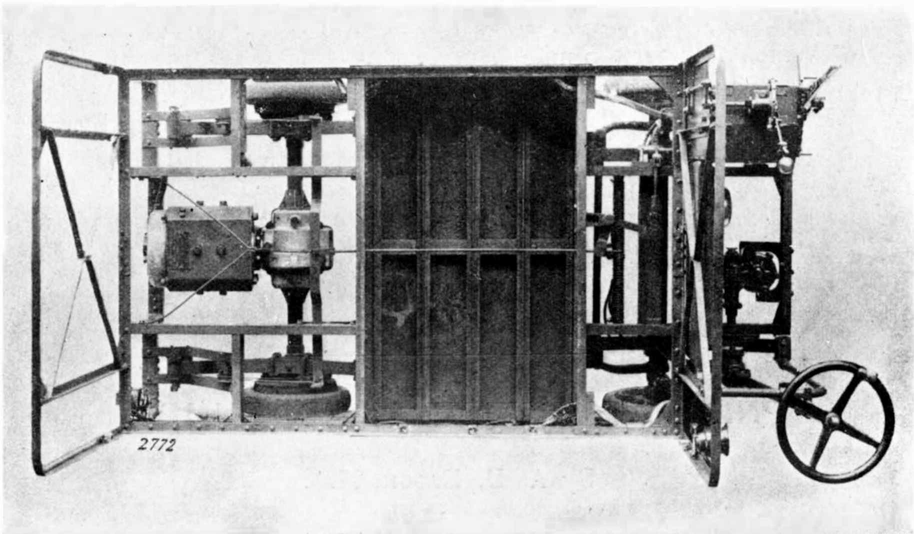
and while running between stations and before coming within the control of the switchman the wagon will itself render each section "dead" as it leaves it, and will make it "alive" again on entering the next section but one, that is to say, there will always be a "dead" section between adjacent wagons.

Means will be provided for indicating, not only the position, but also the destination of approaching trains and so enabling the switchmen to arrange for their reception either separately or simultaneously as the case may be, being protected against mistakes by the interlocking arrangement which has been described above.

Possibly, at a later stage, a separate article may be written on this railway and its equipment, as the problems which have presented themselves for solution have certainly proved very interesting, and in many respects novel.



10a.—Electric Truck. Complete.



10b.—Electric Truck. Plan of Frame.

Electric Trucks and Vans.

The electric railway is not the only direction in which the employment of electric traction for postal purposes is being introduced.

With a view to reducing human labour and delays connected with double handling, trials are at present being made with an electric truck equipped with an Edison battery, a description of which appeared in the 'Electrical Review' of August 29th, 1913. This truck, which weighs only about 25 cwt., including a load of 10 cwt., is intended for use more particularly at offices which are in close proximity to railway stations and can ply between the Sorting Office and the mail vans, the control being sufficiently safe and flexible to meet the conditions of a crowded platform, while slopes as steep as 1 in 10 can be negotiated.

Trials of the truck, which is equipped with 42 B4 cells, have been carried out on level wood block flooring (the truck having solid indiarubber-tyred wheels 15 in. in diameter) over a rectangular course 824 ft. per circuit at full speed (five to seven miles per hour) and at about half speed (three to four miles per hour) over alternate circuits and with a stop at the end of each circuit, and the following results have been obtained;

Total weight of truck, load and driver . . .	26 cwt.
Voltage before run (half battery)	30 volts
Voltage after run (half battery)	20 volts
Total number of journeys	160
Number of miles	25
Charging units	7·3
Watt hours per ton mile	225

10, 10A and 10B are views of the truck.

Experiments are also being made with electrically equipped vans for collecting purposes.

[*We are indebted to the Institution of Electrical Engineers for permission to print the foregoing, which was extracted by Mr. Gunton from his paper on "The Employment of Power in H.M. Post Office," read before the Institution on December 18th.*]

PNEUMATIC TUBE HAND PUMPS.

By A. B. Eason, M.A.

There are a considerable number of hand-pumps in use in the country, and the following information as to the probable power required to work them may be of interest. The amount of work actually required to send carriers through the 1½ in. brass tube and lead tube varies with the length of tube, size and type of pump, state of pump, type of carrier used, and whether the carrier travels up or down. To evaluate the work done in any particular case is difficult, as there is no ready simple means of integrating "force × space" when working a hand-pump.

The results of tests made upon hand-pumps in London do, however, furnish results which give some idea of the work necessary, though they cannot be vouched for as highly accurate.

The tests were made by fastening a spring balance to the handle and watching the force required to move the handle, noting the number and length of strokes. The balance read up to 20 lb. and had a 7 in. dial; the pointer rose quickly to a value 4, 6, or 10 lb. or so and varied 1 or 2 lb. at that value, and then dropped at the end of the stroke. A mean value was then chosen and multiplied by the stroke to obtain the foot-lbs. used.

The figures in this article are the results of tests taken by Mr. W. G. Carter in 1911 and by myself in 1913. All the tests were made in London offices and practically all with No. 1 hand-pumps having a cylinder of 6 in. diameter. The tests show that the foot-lbs. of work required to send leather carriers No. 4 or No. 5 through a $1\frac{1}{2}$ in. brass tube are roughly: $15 + L$ when sending up between floors; $L - 10$ when sending down between floors; L when sending on same floor. L is the equivalent length of straight tube and equals $l + 6' b + 3' s$, where l is the actual length in feet, b is the number of bends, and s the number of sets. These equations hold up to $L = 100$ feet, but for larger values of L they should be increased, I think. A sufficient number of long tubes are not available in London to allow of tests being made to determine the force accurately.

The steady pull on the handle of horizontal pumps when no carrier is in the tube is about 3–4 lb. when one double stroke is made each two seconds. In the case of vertical pumps it is slightly greater, say about 5–6 lb. When sending carriers the pull on the handle varies from 7–14 lb. at strokes 14 in. to 18 in. long. The number of strokes required is approximately 2, 3 or 4 double strokes according as the equivalent length, L, of the tube is 30–40, 40–50, 50–100 ft. When driving carriers up vertical tubes quick strokes should be used as otherwise the carriers tend to fall back after each stroke. Now and then one comes across stiff pumps which require about 3–6 ft. lbs. per stroke more than usual. This is a serious item of work if there are a large number of carriers to be sent.

This information together with other information concerning telegraph and carrier traffic enables one to place facts before the Secretary, postmasters and medical officers which should assist in determining the suitability of counter clerks working hand-pumps.

Taking the following example, the Postmaster of X—— states that the counter clerks find the work at the hand-pump too heavy. The message traffic is 60,000 forwarded messages a year; the estimated daily maximum is $\frac{60,000}{300} \times (2\cdot0) = 400$. During the day about 250 carriers will be used, and during the four busiest hours there will be approximately 40 per cent. of this traffic, *i.e.* 100 carriers. The counter tube is 80 ft. long and has four bends; to send each carrier requires $15 + L$ ft. lbs. = 119 ft. lbs. The work done per hour will be about 2920 ft. lbs., but this will be done in 25×5 seconds = 2 minutes; the rate of working is ·0442 H.P. The work done in pumping in the busiest hours is $117 \times 35 = 4080$ ft. lbs., and in the four busy hours 11,700 ft. lbs. This amount will be nearly doubled if the pump is stiff, and will be increased appreciably if the feed slide is very leaky. Whether the counter clerks should be expected to do the work is for medical men to decide.

Summary of Statistics; Offices with Pneumatic Tubes Worked by Hand-Pumps, 1912–1913.

District.	No. of offices.	No. of pumps.	No. of tubes.	Total length of tubes; yards.	Average length of each tube.
Northern	11	14	18	379	21·1
N. Eastern	9	12	14	206	14·7
N. Western	25	35	36	689 (170*)	19·1
N. Wales	17	22	24	476	19·7
N. Midland	29	32	37	698	18·9
S. Midland	30	36	38	555	14·6
S. Wales	25	28	31	542	17·5
S. Eastern	25	37	38	638 (90*)	16·8
S. Western	24	29	29	613	21·2
S. Lancashire	2	2	3	72	24·0
Eastern	19	25	25	341	14·6
Ireland	30	32	32	496	15·5
Scotland East	21	25	25	520 (116*)	20·8
Scotland West	24	25	26	423	16·4
Total	291	354	376	6648 (376)	17·7
London	49	68	116	2600 ?	—
Total	340	422	492	9624 (say $5\frac{1}{2}$ miles)	—

* One single tube; not included in average length.

THE NEW ANGLO-IRISH TELEPHONE CABLE.

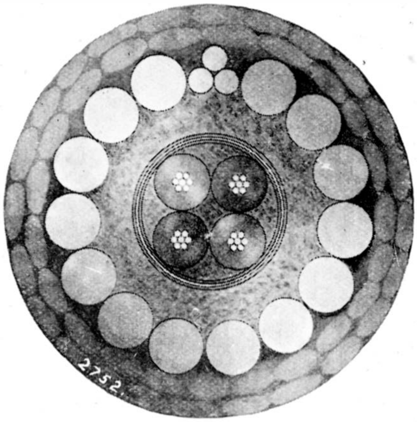
The new Irish telephone cable, which is to serve as the main trunk route between the southern half of the United Kingdom and Ireland, is the longest submarine loaded cable yet laid by the Department. Its total length is approximately sixty-four nautical miles, being thus some sixteen nautical miles longer than the Anglo-Belgian cable, which was laid in 1911 (described on pages 50–58 of Volume 5 of this Journal). In several respects the two cables are similar in construction; the dielectric in each consists of the specially treated gutta-percha patented by Messrs. Siemens. They are both loaded on the transformer and phantom circuits, with coils spaced one nautical mile apart; the 7-wire copper strand forming each of the four conductors weighs 160 lbs. per nautical mile, and the dielectric 150 lbs. in both cases. The over-all weight of the completed cable is some $12\frac{1}{2}$ tons per nautical mile. Where the coils come in, the cable is strengthened by extra sheathing for about 92 feet. The following are the particulars:

Length of double sheathed portion . .	92 feet
Weight of the 92 feet	8·0 cwt.
Weight of 92 feet of ordinary cable . .	3·85 ,,

A special feature of this cable is the provision of a fifth core of 50 mils copper G.P. insulated, which runs in the centre for half a naut. at each end of the cable. It is then brought out by means of an insulated iron strand, which is bound in and soldered to the sheath. This wire has been provided as an earth wire in connection with experiments on single-wire submarine telephone cables which are at present being conducted. The object of the length of half a naut. is to permit of the earth wire being taken out to sea and soldered to the sheath, so as to avoid the inductive disturbance which is generally found, to a greater or less extent, when earths are made in a cable hut, especially when telegraph cables are terminated in the hut.

The value of the attenuation constant β was specified not to exceed ·016 per naut. when the transformer circuits and superimposed circuit were tested with a sinusoidal electro-motive force, having a periodicity of 800 per second, applied directly to the end of the cable, and producing one milliampère at the sending end.

The results obtained on the completed cable were as follows. A "Franke" machine was used for the tests.



SECTION OF NEW ANGLO-IRISH TELEPHONE CABLE. FULL SIZE.
(*From a drawing kindly supplied by Mr. Dieselhurst, of Siemens Brothers.*)

TRANSFORMER CIRCUIT.

Angular velocity ($2\pi n$) of testing current.	Attenuation Constant β. Mean values.	Characteristic Impedance Z_0. Modulus.	Angle.
3000	0·0138	665	$-5^\circ 45'$
5000 ϕ	0·0150	690	$-2^\circ 40'$
7000	0·0168	695	$-2^\circ 40'$

ϕ Specified angular velocity.

SUPERIMPOSED CURRENT.

The attenuation constant when $2\pi n$ equals 5000 is 0·0150.
The characteristic impedance Z_0 equals 446 0° 52′.

The transformer circuits (the two diagonal pairs) have thus a standard cable equivalent of approximately nine miles.

The efficiency of the coils is such that, when taken separately, the ratio of the effective resistance (R) to the inductance (L) in each case is $\frac{R}{L} = 48$.

The constants of the completed cable per naut. loop are as follows.

	Resistance of circuit without coil.	Effective resistance of coils at $2\pi n = 5000$.	S/K.	Inductance (millihenries).	Wire-to-wire capacity (mfs).
Transformer circuits	14·2$^{\omega}$	6·8	15	100	0·166
Superimposed circuit	7·1$^{\omega}$	3·2	15	50	0·320

Where S is the leakance in mhos and K is the capacity in farads.

Overhearing was specified on the completed cable between either of the transformer circuits and the superimposed circuit to be not greater than would be observed in direct speech over 65 miles of standard cable having a resistance of 88 ohms per mile loop and a wire-to-wire capacity of ·054 microfarads. The figure of 65 miles was stipulated because a similar result was obtained in the Anglo-Belgian cable, and it was feared that a higher figure could not be guaranteed.

The copper conductors are of 100 per cent. conductivity to E.S.C. standard for annealed high-conductivity copper. The sheathing wires, fourteen in number (with an additional 3-wire strand to indicate that the cable is a loaded one), are made of the best selected ball furnaced "all wire" pig iron, specified to have a strength not less than 23 tons per square inch and well galvanised with zinc spelter. Experience has shown that iron of this type is less subject to corrosion than the homogeneous iron which was formerly used by the Post Office.

Each completed set of loading coils, with their insulated covering and before jointing into the cable, was subjected to an external hydraulic pressure of 15 cwt. per square inch for not less than half an hour without producing distortion or other injury. The cable was constructed by Messrs. Siemens Bros. in their works at Charlton, Woolwich.

Aërial land lines of 600 lbs. copper have been run from the respective landing points to Manchester and to Dublin in order to secure a high standard of speech on the circuits. A description of the laying of the cable will appear in our next issue. J. G. H.

GHENT EXHIBITION.

AWARDS ACCORDED TO EXHIBITORS IN POST OFFICE COURT.

Class 15.—Scientific Instruments.
Gold Medal: Gell Telegraphic Appliances Syndicate.

Class 23.—Mechanical Production and Utilisation of Electricity.
Silver Medal: Sauvée & Co., Ltd., A.

Class 24.—Electro-Chemistry.

Grand Prix: Siemens Bros. & Co., Ltd.

Class 26.—Telegraphy and Telephony.

Grand Prix: General Post Office; Siemens Bros. & Co.; Western Electric Co.

Diploma of Honour: Gell Telegraphic Appliances, Ltd.; Sullivan, H. W.

Gold Medal: British Insulated and Helsby Cables, Ltd.; Burt, Boulton & Haywood, Ltd.; Lamson Pneumatic Co., Ltd.; Peel-Conner Telephone Works, Ltd.

Silver Medal: Gent. & Co., Ltd.; Oliver Typewriter Co., Ltd.

Class 27.—Miscellaneous Applications of Electricity.

Grand Prix: Siemens Bros. & Co., Ltd.

Gold Medal: Gent. & Co, Ltd.; Silent Electric Clock Co., Ltd.

Class 28.—Materials, Plant and Processes relating to Civil Engineering.

Gold Medal: Burt, Boulton & Haywood, Ltd.; Lamson Pneumatic Tube Co., Ltd.

Class 32.—Railway and Tramway Plant.

Silver Medal: Burt, Boulton & Haywood, Ltd.

Class 33.—Materials and Plant used in the Mercantile Marine.

Hors Concours: P. & O. Steamship Co.

Grand Prix: Oceanic Steam Navigation Co., Ltd.; Pacific Steam Navigation Co., Ltd.; Royal Mail Steam Packet Co.

Diploma of Honour: Orient Steam Navigation Co., Ltd.; Union Castle Mail Steamship Co., Ltd.

Gold Medal: City of Dublin Steam Packet Co.; British and African Steam Navigation Co., Ltd. (Elder, Dempster); Great Eastern Railway Co.; South Eastern and Chatham Railway Co.

Class 50.—Products of the Cultivation of Forests and of Forest Industries.

Diploma of Honour: Burt, Boulton & Haywood, Ltd.

Class 87.—Applied Chemistry and Pharmacy.

Silver Medal: Burt, Boulton & Haywood, Ltd.

The whole of the British exhibitors secured a total of 200 awards, of which the Post Office alone obtained 15·5 per cent.

During the month of October a number of technical officers from the various administrations in Europe visited the Post Office Court in connection with the reconstruction of some of their postal and telegraph appliances. Monsieur Hubar, the Directeur de Service des Postes, took particulars of the Department's latest appliances for dealing with mails, whilst M. Pierre Pasquier, who, it is understood, made a special journey from China to Europe in connection with the equipment of a new line of railways in China with Morse apparatus, was directed to the Post Office Gallery.

The official closing day of the exhibition was fixed for November 3rd, and on this date a grand banquet and ball was given to the exhibitors and their assistants, in the Palais des Fêtes. The function, which was typically Continental, did not conclude until the early hours.

Owing to the great demand from the residents of Ghent and others to acquire the exhibits, the authorities decided to keep the Sections open until November 10th. Numerous applications were made to the officer-in-charge of the Post Office Gallery during this period with reference to the various exhibits.

At daybreak on the morning of the 11th an enormous army of housebreakers entered the grounds, and by noon, what had been a veritable fairyland became one huge collection of vans and packing-cases. Unfortunately, the authorities discontinued the supply of current to the grounds on this date, and, consequently, all work had to cease at dusk.

H. N.

RULES AND REGULATIONS TO BE OBSERVED BY INSPECTORS IN THE SERVICE OF THE ELECTRIC TELEGRAPH COMPANY (1850).

[*In view of the revival of the title "Inspector" it is thought the following instruction on the duties of the class, issued by the Electric Telegraph Company in* 1850, *may not be without interest to the staff to-day.*]

DUTIES OF INSPECTORS.

1. You will be considered entirely *responsible* to the Company for the attention and vigilance of the men placed under you, and for the good working order of your District.

2. You will take care that each man *examines* his portion of line as frequently, and as carefully as required; and with this view, you will inspect each Note Book, and check the dates and signatures frequently, and will, also, take opportunities of *walking* over each portion of the lines, examining every part as minutely as the Linemen are directed to do.

3. You will *report* the result of such examination, and append

your recommendations with respect to any peculiar care and vigilance you have observed. You will on no account fail to report every fault and imperfection you detect.

4. You will, if possible, *walk* over some portion of your District *every week*, taking care so to arrange as that every portion may be subjected to your examination in turn. You will *test* each part as frequently as your other duties will allow, comparing the several results, so that you may know at all times the condition of every part of your line, and the effect of the works undertaken upon it. In these *examinations* you will look to every cone, clip, winder, joint, shackle, etc., and ascertain that all parts are clean, perfect and in good and safe working order.

5. You will see that the *store boxes* are kept in good order, and well supplied with all necessary tools and stores, and that *no waste*, or undue use of these takes place.

6. In the event of any *accident* occurring, you will take immediate steps to remedy the same, directing the Linemen as to the measures they are to adopt for its rectification; and, if necessary, you will proceed thither yourself, or provide additional *assistance*. With a view to enable you to prevent the recurrence of a similar fault, you will in all cases require a full *report* from the Lineman (in whose district the accident may occur) of the nature of the same, and of the means adopted to rectify it. You will transmit this with your Notes to this Office.

7. Should you find it desirable to *alter the usual Orders* of the Linemen owing to the existence of any undiscovered or unrectified fault, you will direct them in the morning before leaving their Stations as to their employment during the day.

8. You will be required to take care that the *Stations* are so fitted as not to lead to any fault or interruption, and also that proper conveniences are afforded to the several Linemen for assisting in your *testing* of the different portions of the Line. The Stations and conveniences for testing are placed peculiarly under *your immediate charge*.

9. You will receive weekly a *return of work* from each of your Linemen. You will examine these, and forward them with your remarks, to this Office on each Saturday night.

10. You will be required to take care that, although all needful facilities are afforded to the Linemen, yet, that no fares are incurred unnecessarily, and also that no extra assistance is employed unless absolutely requisite.

WORKMEN'S TECHNICAL CLASSES.

It is with great satisfaction that we view the most recent development in the efforts to solve the problem of training the rapidly expanding body of workmen employed in the Engineering Department of the Post Office—namely, the establishment of special courses of study at various Polytechnic and Technical Institutes in London and the Provinces as the result of co-operation between the Post Office and the respective authorities.

For nearly twenty years past—since 1896, in fact, when the Telephone Trunk System was transferred to, and re-designed by, the Post Office—this problem has been one of the chief difficulties encountered in dealing with the enormous increase of electrical work, both in volume and in complexity. The expansion is due mainly, of course, to the advance of the telephone, but it must not be overlooked that the telegraph service also has contributed its quota in the shape, for example, of improved methods of working, such as the Central Battery System and the relayed and forked quadruplex, whilst among the miscellaneous items are goods and passenger lifts, letter-stamping machines, and synchronised clocks.

Looking back—sometimes a profitable course, even for the engineer—it is of interest to see that the first step towards enabling the executive staff to conform to the changing requirements took the shape of informal classes held on official premises, and, generally, after the engineer-teacher and the lineman-pupils had performed their respective duties for the day. At the same time, a number of the more advanced linemen and mechanics in the large towns attended the technological classes designed primarily to prepare students for the examinations in Telegraphy and Telephony conducted by the City and Guilds of London Institute.

After a time, the individual efforts on the part of engineers lapsed, probably because the needs of the moment had been satisfied, but with the advent of the Post Office London Telephone System they were again in evidence, and in one instance, at least, on a more systematic basis—indeed, we cannot refrain from the thought that the germ of the present arrangements is to be found in the synopsis and notes of a series of lectures delivered gratuitously in a London office some eight years ago.

About the same time, schools for training youths in the jointing of underground cables were established in London and Birmingham as part of the official machinery, but the pressure of other matters operated to prevent the emergence of any definite scheme for covering the whole of the ground.

Two years ago, the approaching acquisition of the business of the National Telephone Company, under whose control had been established a system of correspondence classes for their staff, and the knowledge that increased activity in local telephone work would undoubtedly produce a general demand for more trained men, brought the question into renewed prominence, and, after the preparation of suitable syllabuses by the Engineer-in-Chief to the Post Office, thirteen classes were established last year in various parts of London, and one in each of twenty-one provincial towns, namely, Belfast, Birmingham, Bristol, Cambridge, Cardiff, Croydon, Dublin, Dundee, Exeter, Glasgow, Gloucester, Hull, Liverpool, Manchester, Newcastle, Newport, Nottingham, Reading, Sheffield, Swansea, and Tunbridge Wells.

The instruction was given free of charge on Post Office premises by selected engineering officers willing to undertake the work in return for small fees, and the necessary equipment was provided by the Post Office, which also defrayed the travelling expenses of men stationed away from, but within ten miles of, the point at which they attended. Attendance on the part of any man was, of course, voluntary.

After the commencement of the classes in London, negotiations took place between the educational authorities and the Post Office, with the result that at the beginning of the present session the whole of the London classes were transferred to the following centres of technical education, namely: Battersea Polytechnic; Chiswick Polytechnic; Goldsmiths' Institute, New Cross; Northampton Institute, Clerkenwell; Paddington Technical Institute; Regent Street Polytechnic; Tottenham Polytechnic; West Ham Municipal Technical Institute.

In a few provincial towns the arrangements in force last session remain undisturbed for the present, but we understand that the principle adopted in London has been extended to some 52 towns in which there are educational institutions, and a total of 2300 students are taking advantage of the courses provided.

Briefly, the arrangements are that the Post Office pays the fees of the men attending (subject to refundment by the latter in certain circumstances), and the syllabuses have been drafted to meet the requirements of the Post Office; but, in all other respects, the normal organisation of each Institute comes into operation. In the main, the instruction continues to be given by the engineering officers previously in charge of the classes, their services having been retained by one or other of the governing bodies.

The advantages of this development are obvious: not only is the accommodation for the classes of a suitable character, but the whole environment must tend more to stimulate the interest of the men than could be hoped from the semi-official conditions which, in spite of the very best intentions, is all that the Post Office, working directly, can provide.

Those of our readers who have not the good fortune to be included in the Engineering Department of the Post Office may be inclined to wonder why the training which these classes are designed to provide cannot be afforded in the ordinary course of the men's daily work. The answer is that it can be afforded in that way, but only at the cost of many mistakes and a correspondingly long period of inefficiency—bad alike for the reputation of the Post Office, the characters of the men and the interests of the telephone public. The nature of their duties requires that the men shall work largely as individual units instead of being engaged in groups under the immediate control of a foreman as is the case with most analogous works, and although a preliminary training in general principles and many details is given, the actual conditions encountered in practice vary so greatly that much has to be left to the judgment and experience of the individual and his power to apply the knowledge he possesses. It is here that the sphere of the class is found, that is, in providing information which is such a combination of theoretical principles and practical directions as will enable an intelligent man to understand why he does those things which he knows are right, and thus to reason his way through a difficulty which he has not had to face previously. If the number of men affected were but small, it might be possible to provide this collective instruction as part of, and during, the ordinary working-day, until such time as each individual attained the desired standard; but under the most favourable conditions the objections to such an arrangement in the Engineering Department are very strong, and whilst the work and staff are expanding as rapidly as of late years they are insuperable.

It will be clear from what we have already said that the object of the training scheme is to secure skilled craftsmen—not workmen to whose practical attainments has been added a smattering of theoretical electrical knowledge; and we think it may be well here to give voice to a word of warning in regard to the inevitable tendency, as time goes on, to " raise the standard " of the instruction, either by failing to treat with the same completeness as formerly the most elementary portions of the work, or by endeavouring to compress within the limits of the respective courses advanced matter which has previously been excluded. The aim of each course throughout should be to provide for the men who are a little below rather than above the average; the latter, if they want more after having acquired all the benefit they can from the special classes, will find their way naturally to the more ambitious courses based on the examination syllabuses of the Board of Education and the City and Guilds of London Institute.

It would doubtless be of interest to some of our readers if we were to examine the arrangements described in the light of the history of the Trades and Crafts Guilds and of the apprenticeship system in the outside world; but on this occasion the usual considerations of space prevent—nevertheless, we would say that any contribution on that aspect of the matter will receive our most generous consideration.

BOOK REVIEWS.

'The Economics of Telegraphs and Telephones,' by John Lee, M.A., Traffic Manager, G.P.O. (Pitman's Business Handbooks.) (Published by Sir Isaac Pitman & Sons, Amen Corner, E.C. Price 2*s.* 6*d.* net.)

Of text-books dealing with the technical developments of telegraph and telephone systems there is no end, but those dealing with the economics of the subject have neither been numerous nor exhaustive. Mr. Lee's excursion into this field is, therefore, a welcome one. It would be difficult to find anyone better qualified, alike by predilection, study, and experience, for the task he has set himself. The title he has chosen is probably the best obtainable, but it does not describe very precisely the purport of his book. He does not deal with such things as operating costs, message costs, or plant costs at all. Economics is, perhaps, best defined as *the science of management*, but the main theme of his treatise is outside the scope of such a definition. His prime object has obviously been to exhibit the importance of telegraphy and telephony as factors in the development of modern industry, and in the building up of national and international social and trade relationship. These considerations are fundamental. They represent the *raison d'être* of the great telegraph and telephone services of the world, and they are matters of the greatest interest to every man engaged in these services who desires to view his profession in proper perspective, and to realise adequately how it reacts upon the world at large.

Mr. Lee has gathered his data from widely scattered sources, and has built it up in a bright and attractive manner, with much originality of thought and inference. The work is far from exhaustive, but it has the essential quality of suggestiveness, and few will read it without feeling that many pregnant little side-issues are presenting themselves for useful consideration.

Mr. Lee does not argue for state ownership of telegraphs and telephones, but he has much to say which clearly indicates that it is along these lines that his convictions lie. In the telephone service, at least, monopoly, with its unity of administration, is treated as an essential. His optimism in the matter of State services perhaps leads him to under-estimate the alternative which is so powerfully advocated by some of the leaders in the telephone world of the United States—the ideal that private ownership, starting with its immense advantages in the way of providing personal stimulus and direct interest in the efficiency and success of the organism as a whole, may have its evils neutralised by vesting the service in a great business corporation subject to the scrutiny and control of public authority in all matters where its interests may run counter to the interests of its *clientèle*. Such a system is on trial for its life in America, and Mr. Lee appears to anticipate that the ultimate verdict will be an adverse one.

Among the many points of interest which the book contains may be mentioned a brief history of the development of the telegraph and telephone in Europe and America, written mainly from the standpoint of the public; the manner in which some trades, such as the fish trade, have for many years used the telegraph in a thoroughly systematic way, while other trades, that might have derived equal profit from its aid, have consistently neglected it; the extent to which the spread of the idea of municipal telephones helped the Post Office to acquire the English trunk-lines from the National Telephone Company, and the subsequent complete collapse of the municipal idea; the growth of the trunk system represented by the difference between the purchase price in 1895 (£450,000) and its present capitalisation of six million pounds; the ethics and economics of the English telegraph rates for news; the effect of highly elaborated code-word systems in preventing the lowering of cable rates; the measure of dealings between nations obtainable from the statistics of the international telegraphing of money; the effect of the telephone in facilitating the decentralisation of industry from urban localities, and the establishment of large factories in places where land is cheap and rates are low.

Regarding the purchase of the telegraph system of Great Britain in 1870, Mr. Lee remarks on the interesting fact that the price paid (£10,000,000) was only 25 per cent. lower than that paid for the very much more extensive and valuable system of the National Telephone Company in 1912. A more striking proof of the over-valuation of the telegraph system in 1870 could hardly be produced. Mr. Lee remarks that as a result of the recent telephone transfer the Post Office begins its management of telephones on the national scale with a financial foundation that does not cripple its enterprise, but he refrains from any exuberance regarding the reduction in the National Telephone Company's claim from twenty-one millions to twelve and a half millions. It is curious how little has been said of the fact that even with this reduction the Post Office paid several millions more for the system than it considered it to be worth!

Mention must be made of Mr. Lee's testimonial to the Post Office trunk service; he says: "The English long-distance telephone service is, without doubt, the best in the world for clearness of speech and moderateness of charge."

The book is one alike for those engaged in the provision and administration of communication services and for business men. The latter cannot fail to be edified by such passages as those on pages 59 and 60, in which the use made of the telephone by a great American insurance company is vividly described. Wide perusal of the work by the business community would go far towards engendering a feeling of sympathetic co-operation with the administration of the Post Office services, and such a result would probably be deemed by the author to be the fulfilment of his hopes.

T. F. P.

'Die Abhangigkeit des erfolgreichen Fernsprechanrufes von der Anzahl der Verbindungsorgane' ('The Dependence of the Attainable Number of Telephone Calls on the Number of Connecting Circuits'), by Dr. Ing. Freidrich Spiecker, Diplom-Ingenieur. (Published by Julius Springer, Berlin, 1913. 65 pp. Price 2 *m.* 40 pf. 11 in. by 8 in., paper covers.)

After reviewing formulæ used by the Western Electric Co. of America and the late National Telephone Co. for manual exchanges, also that of A. Campbell for automatic exchanges, and the theoretical work of Grinstedt on 'A Study of Telephone Traffic Problems,' 1907, the author concludes that the available formulæ are insufficient and in some cases inexact. (It is somewhat surprising that the review of previous work done is not more extensive, so as to include, for example, the work done by the Copenhagen Telephone Co. on the same subject.) In any case the author undertook the working out afresh, on the theory of probability, of the most important problems which present themselves for solution, taking into account actual working conditions. The book under review is the result. In order to test the accuracy of the formulæ deduced, a series of experiments was made on the private automatic telephone system of the Allgemeinen Eliktrizitäts-Gesellschaft in November, 1912, and the results are compared with the formulæ previously deduced. Finally, the author gives formulæ which he considers most suitable for practical application.

In an appendix the complete data of a series of experimental trials are given and the results fully worked out.

The work should be very useful to traffic experts.

J. G. H.

'Dynamo and Motor Attendants and their Machines,' by Frank Broadbent, M.I.E.E. (Seventh edition. Rentell & Co. Price 1*s*. 6*d*. net.)

When a book reaches its seventh edition the reviewer's task is a happy one, particularly when, as in this case, the work bears ample evidence of the author's thorough grasp of his subject. As the title suggests, the book is essentially practical, and at every page the reader feels that he is being advised by one who has learnt in the hard school of experience.

The entire absence of mathematics, which is a great point in the favour of any book appealing to the practical man, is made possible by simple lucid methods of description, *e.g.* p. 140, action of auto-transformer, which, while only approximating to the true theory, are all that is required for a work making no pretence of being an examination text-book.

Chapter VII contains some good mechanical "tips," and the portions of Chapter IX dealing with sparking at commutators and heating of bearings should be read and re-read by every man in charge of electrical machinery.

By way of criticism we would suggest that in Chapter II the paragraph on "Direction of Current" and "Polarity of an Electro-magnet" should precede those on induced currents, and in applying Fleming's hand rule (figs. 55 and 56) those fingers should be taken, the names of which give helpful mnemonics: *First finger, Flux; thuMb, Motion; seCond finger, Current.*

The connections for synchronising alternators on p. 73 would be more up-to-date if the plug-holes were on separate generator panels connected by synchronising bus-bars, and there is certainly no justification for implying on p. 74 that synchroscopes are in the experimental stage.

There is much repetition throughout the book, but this is an advantage rather than otherwise, as it makes each section very complete and facilitates quick reference.

The many illustrations and diagrams are of the highest order, and the publishers in providing clean print and a good paper have maintained the high standard of excellence set by the author.

P. D.

'Electric Circuit Theory and Calculations,' by W. Perren Maycock, M.I.E.E. (Whittaker & Co. Price 3s. 6*d.*)

Mr. Maycock's books now run into a very considerable list, and represent some excellent work in the interests of students and of those engaged in the practical side of electric lighting, motors, etc. This, his latest book, deals very simply and thoroughly with the quantities involved in the daily work of the engineer, contractor, and wireman. Commencing with the fundamental rules as to current, resistance, etc., it leads naturally on to installation work, power required, permissible drop, etc., and thence to efficiency of lamps, dynamos and motors. Every section is illustrated by a wealth of worked-out examples. Ordinary and three-wire D.C. systems, single and polyphase A.C. systems are then dealt with, as well as light, illumination, fire rules, etc. To a steady worker the book is an excellent guide, and the systematic working-out of the examples given should ensure a firmer grip of the principles involved.

The book also contains a section devoted entirely to the arithmetic called for in making the calculations. The inclusion of such a section will be, to many, of doubtful propriety. To say that a book on electrical matters is not the vehicle for teaching arithmetic is a criticism very easily made, but we think the author is well advised in including it. His reasons for so doing are substantial and will be endorsed by many teachers, who find in their classes a considerable leaven of students, eager and painstaking, whose school-days are far behind, who are seriously hindered by a "weakness in figures." The book deserves, and should have, a large sale.

'Handbook of Technical Instruction for Wireless Telegraphists,' by J. C. Hawkhead. (Published by the Marconi Press Agency, of Marconi House, Strand, London, W.C. 3s. 6*d.* net.)

This course of instruction has been arranged so that the diligent reader who has gone carefully through it might be qualified to sit for the Postmaster-General's examination for wireless telegraphists. The book will be found extremely useful to the large and increasing number of amateurs now interested in wireless telegraphy. The author has had practical experience in the operation and construction of all classes of wireless apparatus and stations and the text-book embodies this experience. The numerous illustrations of apparatus and diagrams form a useful feature. The instruction begins with a good groundwork in the fundamental principles of electrical science, and carries the student forward to the application of those principles to up-to-date wireless practice. The telegraphist who in the course of his manipulative training masters the contents of the volume will be a man capable of maintaining as well as working the apparatus.

HEADQUARTERS NOTES.

SINCE the last issue of the JOURNAL, orders have been placed for the equipment of new C.B. Exchanges at—

Cleckheaton	360 lines
Greenwich	1600 ,,
Lowestoft	480 ,,
Romford	360 ,,
Smethwick	300 ,,

Orders have also been placed for extending the existing equipments at—

Altrincham	300 lines
Chester	840 ,,
Worcester	320 ,,

Installation of C.B. equipment has been commenced at—

Edinburgh	Trunk extension
Harrod's Private Branch Exchange Extension	180 lines
Shipley Extension	180 ,,
Purley New Exchange	1200 ,,
Tunbridge Wells New Exchange	1200 ,,

The installation of the following equipments has been completed:

Barnsley New Exchange	480 lines
Kilmarnock New Exchange	440 ,,
Port Talbot New Exchange	300 ,,
Avenue Extension	420 ,,
Hop Extension	1720 ,,
Ibrox Extension	120 ,,
Langside Extension	100 ,,
Lee Green Extension	180 ,,
Regent Extension	5700 ,,

Automatic Telephone Development.

Orders have been placed for the following exchange equipments:

Newport (Mon.)	1800 lines	Automatic Tele. Mfg. Co.
Portsmouth	5000 ,,	,, ,,
Accrington	700 ,,	,, ,,
Paisley	1100 ,,	,, ,,
Chepstow	65 ,,	,, ,,
Leeds	6800 ,,	,, ,,
Darlington	800 ,,	Western Electric Co.
Dudley	500 ,,	,, ,,
Grimsby	1300 ,,	Siemens Bros. & Co., Ltd.
Stockport	950 ,,	,, ,,

An order has been placed with Messrs. Siemens Bros. for apparatus for the automatic selection of the "B" operator on position 132 at the Central Exchange, London, which is a "split-order-wire" position.

An extension of the official switch by 150 lines has also been arranged for.

C.B. Manual Exchanges.

New Exchanges opened.	Date.	No. of subscribers working at opening.
Mansfield	September 20th	328
Barnsley	November 29th	410
Victoria (London) (advance portion)	October 3rd	42

Relief Underground Scheme for Exchange Subscribers.

In order to cope with the rapid development in the requirements of subscribers' service, also to relieve heavy congestion in existing overhead and underground plant, special arrangements have been made under which contractors will be empowered to carry out underground works to completion on an annual contract basis, *e.g.* the contractors will lay the pipes or ducts, also provide, draw in, and joint the cables.

The various engineering districts have been grouped so as to form seven contractors' areas, and the particulars shown below indicate the method of grouping, also the firms with whom the contracts have been placed for each of the areas:

Section.	Districts.	Contractor.
1	Scotland East and Scotland West	Messrs. Henleys.
2	Ireland	The British Insulated and Helsby Co.
3	Northern and North-Eastern	Messrs. Siemens.
4	North-Western and South Lancashire	The British Insulated and Helsby Co.
5	North Wales and North Midland	Western Electric Co.
6	South Wales, South-Western, and South Midland	Messrs. Callender's Cable and Construction Co.
7	Eastern, South-Eastern, and London	Messrs. Callender's Cable and Construction Co.

At the time of writing these notes, approximately 140 schemes in different parts of the country have been authorised, and a large number of schemes are under consideration for authorisation, on the special contract basis.

The responsibility and pressure in the Engineering Department could scarcely find better expression than in the activities of its popular chief, Mr. Slingo, who took up the reins of this great Department at a period when it was well before the notice of the public—that is to say, at the transfer of the National Telephone Company's plant to Post Office control and during the inventory and valuation of that plant. The leading part which Mr. Slingo played in the Telephone Arbitration proceedings last year is well known to our readers, as are also Mr. Slingo's appearances before the Holt Parliamentary Committee and the Parliamentary Committees dealing with the Post Office (London) Railway Scheme. In these days the calls upon the Engineer-in-Chief's time are not restricted to Post Office work proper, and the inclusion of Mr. Slingo's name in the list of members of the two new Government Committees mentioned hereunder will doubtless cause no surprise.

Electrical Explosions Committee.

The Board of Trade has appointed the following gentlemen, viz. Sir T. Edward Thorpe, C.B., F.R.S. (Chairman), Mr. Robert Nelson, Mr. W. Slingo, Mr. James Swinburne, F.R.S., and Mr. Alexander P. Trotter, to be a Committee to consider the causes of explosions which have occurred in connection with the use of bitumen in laying cable-mains at Nottingham, Hebburn, and elsewhere, and to report as to any steps which should be taken to prevent explosions in future from the use of this or similar substances.

Wireless Telegraphy Research.—New Government Committee.

The Postmaster-General has, we are officially informed, appointed a committee "to consider how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with any ordinary telegraphy and telephony." The members of the committee are as follows:

The Right Hon. C. E. H. Hobhouse, M.P. (chairman), Chancellor of the Duchy of Lancaster. The Right Hon. Lord Parker of Waddington. (In January last, as Mr. Justice Parker, he was appointed chairman of the expert committee which investigated the merits of the various systems of long-distance wireless telegraphy. This inquiry was made on the recommendation of the Select Committee of the House of Commons on the Marconi contract. In February he became a Lord of Appeal.) Sir Joseph Larmor, M.P., F.R.S., secretary of the Royal Society, 1901–12. Sir Henry Norman, M.P., chairman of the War Office Committee on Wireless Telegraphy, 1912. Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory, and past-president of the Institution of Electrical Engineers. Mr. W. Duddell, M.I.E.E., F.R.S., past-president of the Röntgen Society, and president of the Institution of Electrical Engineers. Mr. R. Wilkins, C.B. Rear-Admiral E. F. B. Charlton, R.N. Commander J. K. Im Thurn, R.N. Sir Alexander King, K.C.B., secretary to the General Post Office. Mr. W. Slingo. Commander F. Loring, R.N., Inspector of Wireless Telegraphy to the Post Office. Major the Hon. H. C. Guest, M.P.

The office of the committee is at 6, Catherine Street, Strand.

—(*'The Standard,' Monday, November 10th,* 1913.)

Major W. A. J. O'Meara, C.M.G., Ret. R.E., Barrister-at-Law.

Just before going to press we learn that Major O'Meara, formerly Engineer-in-Chief of the Post Office, has retired from the position of Engineering Special Commissioner, a position which he held from March 1st, 1912, until November 27th, 1913.

An outline of the career, both military and civil, of this distinguished public servant appeared in the Journal for April, 1912, and a few details of his activities since he relinquished the position of Engineer-in-Chief were furnished in our issue of April, 1913.

It is understood that Major O'Meara proposes to practise as a barrister, and it may be confidently anticipated that with his wide experience in different parts of the world as an organiser and administrator, his high standing in the engineering profession, and his outstanding ability and energy, he will attain a position of eminence in the legal profession.

LONDON ENGINEERING DISTRICT NOTES.

New Telephone Lines.

During the thirteen weeks ended October 28th, 1913, 4081 direct Exchange lines, 195 external extensions and 2604 internal extensions were completed. In the same period 2858 Exchange lines, 180 external extensions and 1521 internal extensions were recovered, making a net increase of 1223 direct Exchange lines, 15 external extensions and 1083 internal extensions.

This work resulted in a net increase in the number of telephone stations in the London Engineering District of 2483 stations for the quarter, and it will be seen that this means an addition of one telephone station for every fifteen minutes of the working day.

In the same period 693 removals of Exchange circuits were carried out for subscribers.

Exchange Departments.

Victoria.—An advance equipment of 400 lines was brought into use on October 3rd. The main transfer will be made early in the new year.

Museum.—10,000 lines. Approaching completion.

North Exchange.—Extension for 1000 lines. The work has been delayed by difficulties in connection with the building accommodation.

Toll Exchange.—The work in connection with the provision of fifty additional positions is approaching completion.

Harrod's Private Branch Exchange.—Increased accommodation for 180 lines, three additional positions and renewal of power plant. The work was completed in readiness for Christmas pressure.

Technical Classes.

Efforts which have been made in previous years to improve the technical education of the Department's junior workmen by providing classes on Post Office premises have not been quite as successful as was desired, mainly owing to the unsuitability of the premises which had to be used and the difficulty of obtaining adequate teaching equipment. Some few months ago negotiations were opened with the London County Council and the other Metropolitan County Councils, and the councils have undertaken to provide classes at various technical institutes to work through a syllabus which has been prepared by the Department. A two years' course has been arranged, the first year consisting of lectures and laboratory work in technical electricity, and practical work in connection with wiring and instruments, while the second year continues the practical work, the student in addition taking either telegraphy or telephony (C. and G. 1st Grade) and technical arithmetic. Each student attends two nights per week. The Department is defraying the fees, and also paying the travelling fares of students up to a distance of ten miles. The student, on the other hand, in the event of his failing to obtain a certificate or to make 80 per cent. of the attendances, will have to refund the amount paid by the Department, which will not exceed 10s. The Department has undertaken to enrol the students, and the institutes have undertaken to provide for the Department monthly reports of the students' work and attendances. To judge from the number of students who have enrolled, the new departure is popular; over 1000 men out of a staff of 4000 are attending the classes.

New Offices for the Superintending Engineer's Staff.

When the concentration of the London staff into one engineering district was carried out on October 1st, 1912, it was found that it was not possible to accommodate the whole of the Superintending Engineer's clerical staff in any of the existing buildings, and the awkward expedient had to be resorted to of subdividing the staff, accommodating the Engineering and Administrative sections at Denman Street, London Bridge, and the Accounting and Wayleave sections at Wandsworth, in the buildings which had previously been used by the South Metropolitan District. The provision of a new building capable of accommodating the combined staff, some 350 in number, was at once taken up, and a site is available adjoining the present Denman Street building. Treasury authority has been obtained for a building 215 ft. long by 45 ft. wide, which will consist of six floors. Unfortunately, however, difficulty has been encountered in obtaining a good foundation, and it is found that it will be necessary to undertake additional expenditure for the provision of a sub-basement. It is hoped that this will not unduly delay the completion of the work, because the present conditions make difficult the smooth working of the Metropolitan District. The addition of the sub-basement will make seven floors. Two lifts will be provided, one for passengers and one for stores.

Metropolitan Power District.

South-Western District Office Alterations.—The old lighting installation of approximately 1000 points on the individual lighting system has been replaced by a new installation of general lighting comprising about 750 points. Owing to the height of the ceilings being insufficient to allow of the use of 3/100 c.p. clusters, units of 3/50 c.p. have been utilised in the new installation. Practically the whole work was carried out whilst the ordinary postal work was in progress, but a considerable amount of night work was necessarily involved to avoid inconvenience.

The old switchboard has been replaced by a modern board, provision being made for separately metering the energy consumed by the lifts, lighting and conveyors, etc., respectively. The final change-over to this board was effected on Sunday, October 26th, last.

Four new electrically driven lifts and three conveyors have also been installed.

At the recent Motor Show held at Olympia, the following telephone circuits were provided: 179 Exchange lines; 4 private wires; 4 telegraph circuits, in addition to the 15 permanent circuits.

Although the orders for many of these lines were not received until the day preceding the Show, all lines were completed and working before the opening.

SOME PERSONAL REMINISCENCES OF SIR WILLIAM HENRY PREECE, K.C.B.

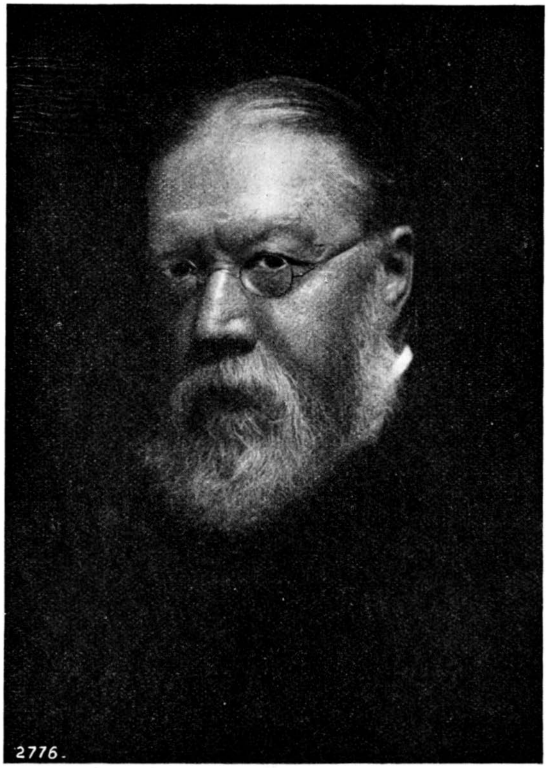
By H. R. Kempe.

Although my personal acquaintance with Sir W. H. Preece does not date further back than 1870—the year in which I had the good fortune to enter the Postal Telegraph Service—I had knowledge of the existence of such a person as Mr. Preece (as he then was) through reading with great interest a short series of articles on "Railway Telegraphs" written by him, which appeared in 'The Electrician' (the precursor of the present journal of that name) of 1862.

On the subject of railway telegraphs Mr. Preece was, even at that comparatively early date, an expert, and, indeed, to him is due the credit of having done more to popularise block-signalling on railways than any other engineer. In 1862 the London and South-Western Railway completed its connection between the Exeter Queen Street and the St. David's stations by means of a somewhat unusually steep incline. Block-signals were required to work it. To meet this demand Mr. Preece invented his system, the characteristic of which is, independent of its electrical advantages, its assimilation in form and mode of working to the outdoor form of signals in use for the guidance of the engine-driver; this system was in due course fully developed and adopted over the whole of the London and South-Western Railway and also on other railways.

Under Mr. Preece's administration not only the electrical block-signal system, but also the ordinary telegraph system on the railway, in connection with the Electric and International Telegraph Company, was carried on, and as a natural consequence, on the transfer of the various telegraph systems to the State, Mr. Preece was selected for an important position under the new State administration, this position being that of Divisional Engineer of the Southern Division, which included the whole of the south of England (except that portion which was then worked by the R.Es.) and also South Wales, the headquarters being at Southampton.

It was shortly after this arrangement had been made that I had the honour (in 1870) of coming on the staff of Mr. Preece, somewhat unexpectedly, and without my knowing that Mr. Preece (whom I had always associated purely in connection with railway matters) was a Post Office official. From the day I joined the Department at Southampton up to the day that Mr. Preece retired from the service, my association with him, as his personal assistant, was unbroken and of a most pleasing character. I will not enlarge upon his personal kindness to me, I say all if I say that I can never forget it. Extraordinarily energetic, a fact partly due to his physical build,



Mr. Preece was perpetually and systematically at work. In the earlier part of his career he would take but four or five hours of sleep; waking up in the morning at four o'clock and sitting up in bed he would set to work jotting down or arranging notes on various electrical subjects.

He was very strong on the subject of the technical education of the members of his staff, never failing to impress upon them the necessity of doing all they could to educate themselves by reading and by attendance at scientific lectures. He was insistent upon the advisability of the study of the higher branches of mathematics, pointing out that it was quite possible for anyone with quite ordinary ability to obtain a considerable knowledge of these if the subjects were tackled fearlessly. Fully appreciating the advantage of a mathematical knowledge, Mr. Preece was not an expert mathematician himself, though he fully understood the principles involved; in fact, a thorough and quick grasp of the bearing of all scientific matters was one of his characteristics. He never lost an opportunity of giving information on, and taking full notes in reference to, current scientific matters, and any new electrical discovery, announced in any of the scientific papers, had to be verified, when possible, by a repetition of the experiments described, all hands on his staff being requisitioned for the purpose.

Probably the first time Mr. Preece came into prominent public notice was on the occasion of a *soirée* given at the Royal Albert Hall on July 18th, 1871, on which occasion he gave a lecture before a large audience on the subject of "Telegraphy: Its Rise and Progress in England." The necessity of "self-assertiveness" was a thing which Mr. Preece was fully alive to, and it is certain that he deliberately (and most effectually) worked with this idea in his mind; to say that he was ambitious of fame (using the word ambitious in its best sense) is only to state a fact, and he succeeded in obtaining it. He used to tell me in the earlier days of my acquaintance with him that he had two ambitions—one was to lecture at the Royal Institution, and the other to become an F.R.S. These ambitions were fulfilled in due course: he lectured on three occasions at the Friday evening lectures of the R.I., first, on "The Inventions of Sir Charles Wheatstone," secondly, on "Railway Block Signalling," and thirdly, on "The Telephone." His lectures and papers elsewhere are too numerous to detail. They were always given in the happiest manner, and were excellent, both as regards composition and delivery. He had apparently no nerves, though he used to assure me that he was always in a state of great trepidation before commencing to speak.

As an administrator at the Post Office Mr. Preece was great, his strong personality overcoming numerous official obstacles, and he was highly sympathetic with the operating staff in regard to their attempts to improve their position as regards pay, etc.

When the electric light boom commenced, Mr. Preece at once threw himself with all his energy into the movement, and having once obtained a grasp of the subject, both from an engineering and commercial point of view, he maintained a lead. He was one of the first to have a private electric light installation (at his Wimbledon residence), and he took great credit for having arranged for his gardener to run the same, so much so in fact that *le jardinier de M. Preece* was often referred to in continental journals. That Mr. Preece was a "showman" is undeniable, but he was not at all so in any invidious sense; he always knew thoroughly well what he was talking about, and he did that talking in a most taking way, so that it was always a great pleasure to listen to him, whether the subject were scientific or social.

By the death of Sir William Preece one more of the very few remaining links which have connected the past of telegraphy with the present is gone, and the world is markedly poorer than it was.

[*We are indebted to Messrs. Histed, Baker Street, W., for permission to reproduce the photograph accompanying this memoir.*]

FUNERAL AT CARNARVON.

There was a large assemblage of mourners at the funeral of Sir W. H. Preece, K.C.B., which took place at Carnarvon on Tuesday, November 11th, the funeral service being conducted in Lanbebling Church.

The chief mourners were: Mr. A. H. Preece, Mr. P. J. Preece, and Mr. F. H. Preece (sons); Mrs. David Moseley, Miss M. F. Preece, and Miss Amy Preece (daughters); Mr. J. R. Preece, C.M.G. (only surviving brother of the deceased); Mrs. Llewelyn Preece (wife of deceased's eldest son, who was unable to attend owing to illness); Mr. David Moseley (son-in-law); Major C. J. Eccles, 16th Lancers (nephew); Mr. E. E. Eccles (nephew); Mr. G. F. Preece (nephew); Mr. J. H. Woodward (representing Messrs. Preece, Cardew and Snell); Nurse Bettany; maids of Penrhos; Dr. Lloyd Roberts (medical attendant).

The members of the Carnarvon Town Council were present, in their robes, and representatives of the Carnarvon Harbour Trust. A number of wreaths from numerous friends and acquaintances were received together with letters and telegrams of sympathy.

A memorial service was held at St. Margaret's, Westminster, at noon on Tuesday; there was a large congregation. Representatives of all the great scientific institutions and public departments were present.

Preaching at the morning service at Christ Church, Carnarvon, on Sunday, the Vicar (the Rev. J. Wynne Jones) said that the remains of the late Sir. W. H. Preece would on Tuesday be laid to rest within sight of the great wireless installation to which his life work contributed so much. Though he was absent from the town for many years, Carnarvon never faded from his heart and he never forgot one old friend, however humble his circumstances. The thought of God was always present to him. A favourite passage often quoted by him was from Job, "Canst thou send out the lightnings that they may go and say unto thee, 'Here we are?'" and his referring of his electricity work to this was characteristic of the attitude of his mind throughout. To him science and religion were one. There was nothing more striking than the tremendous sacrifice made by men of science. Science seemed sometimes to teach sacrifice and unselfishness certainly better than any narrow form of religion. The greatest benefactor of Wales at the present moment would be a theologian with half the brains of the late Sir William Preece, who would teach us that death was not the end of all things.

The ex-Mayor of Carnarvon (Mr. Newton), presiding at the opening proceedings of the election of Mayor on Monday, dwelt upon the great loss the town had sustained by the death of Sir William Preece. The late Sir William, he said, was possessed of characteristics which were only too rare in the present day. When in 1889 he retired from his public appointment with his honours thick upon him, there was no honour which he appreciated more than that of being made the first honorary freeman of his native town, for which he had the deepest affection.

DEATH OF SIR ROBERT HUNTER, K.C.B.

It is with profound regret that we record the death of Sir Robert Hunter, K.C.B., which took place at his residence at Haslemere on November 6th. Only two weeks previously Sir Robert had been at the General Post Office clearing up preparatory to taking his final departure from his room there which had been the scene of so much of his activities. He was suddenly taken ill on reaching home, and breathed his last within such a short time of his official retirement.

Undoubtedly his death was accelerated by the serious inroads which he had made upon his strength during the last two years in conducting the strenuous fight with the National Telephone Company over the price to be paid by the Government for that Company's system.

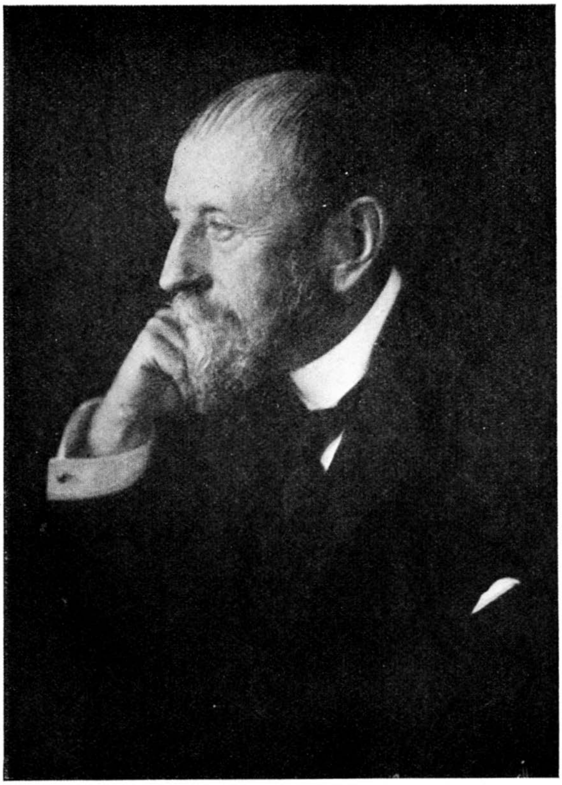
He was spared to see that gigantic arbitration brought to a successful issue, but the strain left him unable to struggle with the illness which overtook him and robbed him of the well-earned ease which he was on the eve of enjoying.

The funeral took place at Haslemere on November 10th, and the service at the Parish Church there was very numerously attended by officials of the Post Office and of other Government Offices and by representatives of the numerous Public Societies and Institutions with which Sir Robert was intimately associated.

Simultaneously with this service a memorial service was held at Christ Church, Newgate Street. Among the crowded congregation were the Postmaster-General, the Attorney-General, and the heads of almost all the Post Office departments who had been unable to go to Haslemere.

The following notes had been prepared for insertion in this issue of the JOURNAL before the lamented death took place, and it may not be out of place to record them now, as they would have appeared had the sad event not happened:

Sir Robert came to the Post Office early in 1882, and after thirty-one years of official life, retired from the service on the 31st of July last at the age of sixty-nine, having been specially retained in order that he might conduct, on behalf of the Post Office, the



purchase from the National Telephone Company of its plant, property and assets.

Sir Robert was always far more than a legal adviser to a particular Government Department. He looked at the questions which came before him from a broad point of view, and always had in mind the fact that the interests of the Crown were involved as opposed to those of the subject. His great ability soon made him a man to be consulted by other Government departments on questions where Crown rights were concerned, and his advice was always as readily given as it was sought. It was often a matter of wonder how he found time and energy to advise on such a diversity of questions.

As a defender of prerogatives of the Crown Sir Robert had few equals.

At the Post Office no big questions of policy were decided without Sir Robert being consulted, and so highly were his advice and assistance valued from an administrative point of view that he was made a member of many departmental and inter-departmental committees, *e.g.* the Postage Rates Committee and the Landing Rights Committee, while he was Chairman of the Committee which revised and incidentally made useful and understandable the 'Post Office Guide.'

On many occasions he was called upon to give evidence before Parliamentary committees and to state the views of the Post Office on questions of policy as well as on Post Office law.

As Solicitor to the Post Office, Sir Robert had perhaps a larger range of subjects to deal with than any officer in the service except the Secretary himself. Apart from the many questions arising in connection with telegraph, telephone and wireless matters, he had to deal with a multiplicity of questions affecting the Post Office in its original capacity as carrier of the correspondence of the Nation, the Savings Bank, Money Order and Postal Order Departments; he closely watched the interests of the Post Office in relation to Parliamentary Bills (both public and private) introduced each Session. He always jealously guarded the monopoly of the Postmaster-General from encroachment, fought big fights in the courts with railway companies on the question of the amount to be paid to them for carrying the mails; was always ready to help in the development of Savings Bank facilities and all other services of the Post Office for the benefit of the public.

One of the most useful works undertaken by Sir Robert was the consolidation of the many Acts under which the Postmaster-General derived his powers in relation to the conduct of the postal service. This was indeed a labour of years, and involved the codification of no less than thirty-five Acts of Parliament ranging from the year 1710. It was undoubtedly largely if not entirely due to his energies that the Acts were at last consolidated in the Post Office Act of 1908.

But it was in connection with the wayleave rights of the Post Office under the Telegraph Acts that Sir Robert came in close touch with the Engineering Department most frequently. The many questions affecting the telegraph wayleave relations of the Post Office with railway and canal companies and with the road authorities throughout the country always received his most careful attention. The preservation of amicable relations with railway companies, whilst maintaining the statutory rights of the Postmaster-General on their various systems, required much tact, and it was largely due to Sir Robert that the railway companies some years ago made agreements with the Post Office whereby they gave up their right of sending an unlimited number of free telegrams on their own business over the State telegraph lines. This arrangement, which was commonly known as the commutation of the railway free message privilege, resulted in an enormous reduction of the number of free messages sent annually by railway companies, and, of course, in a consequent saving of expense to the Department.

From the very outset of his career at the Post Office to the day of his retirement Sir Robert was in close touch with the policy of the Government in relation to the National Telephone Company. He drafted the important agreements between the Postmaster-General and the Company, notably those for the transfer to the State of the trunk lines, the agreement for intercommunication, etc., in London (when the Post Office commenced to construct a rival telephone system), and the agreement for the purchase of the whole of the Company's system under which the recent arbitration proceedings were conducted.

It will doubtless be in connection with the purchase of the National Telephone Company's system that Sir Robert Hunter's name will be associated with the history of the Post Office for all time.

A very able account of the arbitration proceedings appeared in the last issue of the JOURNAL; it is therefore unnecessary to make any further detailed reference to those proceedings here. Suffice it to say that Sir Robert was the man who directed the operations of the Post Office throughout. For the last three years he devoted the whole of his time to the advancement of the Post Office interest in this arbitration; day after day he worked hard and long in order to secure that the State should not pay too high a price for the plant which it was purchasing. How successfully he laboured can best be seen from a comparison of the amount finally awarded by the Court, viz. £12,515,264, with the amount originally claimed by the Company, viz. £20,924,700.

Outside the Post Office Sir Robert was well known as a champion of the rights of the public in respect of common lands. He was for many years Honorary Solicitor to the Commons Preservation Society and later one of its most enthusiastic and hard-working members. He was also Chairman of the Executive Committee of the National Trust for places of historic interest and natural beauty. In one or other capacity he was mainly instrumental in preserving for the public for all time many beautiful tracts of country, notably Epping Forest and the Devil's Punch Bowl, Hindhead. His loss to these societies will be as severely felt as it will to the Post Office.

[*The photograph of Sir Robert was prepared from a block kindly lent us by the Editor of " St. Martin's-le-Grand."*]

MR. C. T. FLEETWOOD.

MR. C. T. FLEETWOOD, a prominent figure in the official telegraph life of London for many years before he retired in 1902, died at his residence in North Finchley on November 28th in his seventy-seventh year. For the last few years his speech had become noticeably slower, but in other respects he retained remarkable health and vigour until a few weeks ago, when acute paralysis gradually developed.

Born April 23rd, 1837, Mr. Fleetwood entered the service of the Electric and International Telegraph Co. on December 8th, 1854, and came over to the Post Office with the transfer of the telegraphs to the State in 1870. He was appointed Superintendent Lower Section on January 29th, 1870; Assistant Superintending Engineer on June 17th, 1887; and Superintending Engineer on June 26th, 1894. He retired from active service on April 23rd, 1902, but only to continue with much enthusiasm his favourite experimental work in electrical science.

Perhaps the earliest work of unusual magnitude undertaken by Mr. Fleetwood for the Post Office was supervising the wiring of the new Central Telegraph Office in St. Martin's-le-Grand in preparation for the transfer from the Lothbury Office. It is only a few months ago that Mr. Fleetwood in conversation recalled this incident in his life, and explained that Mr. R. S. Culley sent for him specially and offered the supervision of the work to him. He remembered this work as calling for the most strenuous effort from everyone connected with it in order to have the new office ready in time.

Mr. Fleetwood was intensely interested in the advent both of the telephone and of wireless telegraphy in this country. When he saw the pair of telephones brought over from America by the late Sir William Preece he immediately embarked upon a series of experiments to ascertain the best resistance to wind the bobbins. He related with pleasure the profound astonishment which his first pair of telephones created amongst his friends, and particularly the effect upon the Editor of the 'Times,' with whom he was on very friendly terms, and who, when he learned of Mr. Fleetwood's experiments, invited him to give a demonstration. Again, the first sight of the Marconi coherer started him on the quest of best dimensions. Most of us have seen the gigantic coherer which he ultimately constructed for popular lecture purposes.

After retirement Mr. Fleetwood retained his interest unabated in telegraphic and telephonic matters, and spent many hours with his Geissler tubes and wireless telegraph installation. As an indication of the spirit which carried him successfully through life, it may be mentioned that he began in his seventy-seventh year to practise with the enthusiasm of youth the Morse key in order to improve his reception and transmission of wireless signals. He took great pleasure in his almost daily habit of attending in his wireless shed after breakfast to take time from Paris and find the "tune" on his home-made "tuner" of the numerous stations he "picked up." It may be said that Mr. Fleetwood was not satisfied with ordinary efficiency in his wireless installation. He worked to make it as good as it could be made, and he exercised his love for winding and re-winding his "tuners" and altering his "aërial" until he obtained the improvements desired. But these were Mr. Fleetwood's recreations. His retirement did not terminate his social and religious activities. He remained until the end an earnest Christian worker and an active member of the Wesleyan Church in Finchley. The Engineer-in-Chief's headquarters staff, the clerical force of the Metropolitan District, the C.T.O. mechanics and the Metropolitan linemen sent representatives and floral tributes to the funeral service, which was largely attended by Mr. Fleetwood's numerous friends.

INSTITUTION NOTES.

COUNCIL MEETINGS.

A Meeting of the Council was held at the Institution of Electrical Engineers, Victoria Embankment, on October 7th, 1913.

Mr. J. Sinnott (in the absence of Mr. W. Noble) presided.

The Secretary read a letter from Mr. A. Moir, Chairman of the Telephone and Telegraph Society of London, in reply to a communication from the Council, in which it was suggested—(1) That the Telephone Society and the Institution of Post Office Electrical Engineers should confine themselves to Traffic and Engineering matters respectively. (2) That the members of the former should be allowed to attend the meetings of the latter, and *vice versâ*.

Mr. Moir stated that the Telephone and Telegraph Society were fully in agreement with the Council that the presentation of papers to one Society which were more properly suitable to the other should, as far as possible, be avoided. Also it was agreed that members of the Institution should be allowed to attend the meetings of the Society.

Proposed Alteration of the Constitution of the Council.

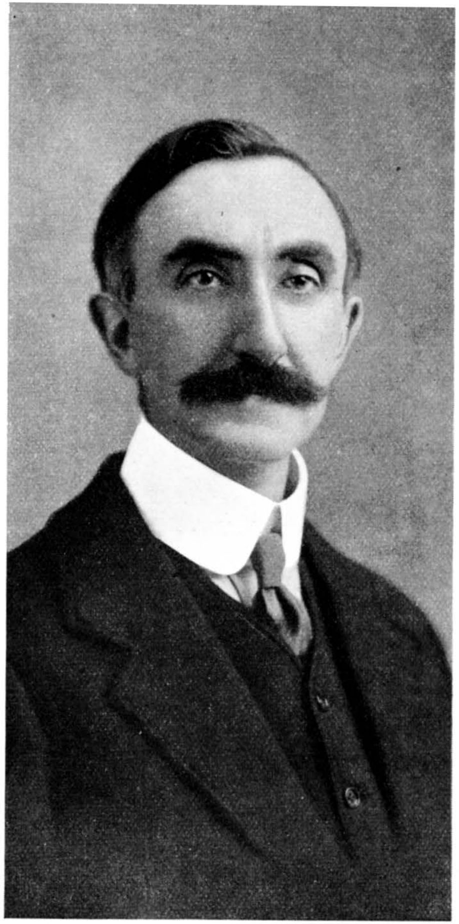
With further reference to the proposal of the London Centre, the Chairman of the Committee reminded the Council that in effect the suggestion put forward by the London Centre was that the Council, composed of London and provincial members, should control the London Centre.

The Council adhered to their decision not to adopt the recommendations made by the London Centre, but as regards the method of appointing the Secretary the members of Council were asked to ascertain as far as possible the views of their constituents, and the matter was postponed until the next meeting.

Medals Award.

The following awards were made in respect of papers read before the Institution during the Session 1911–12.

Senior Silver Medal.—Mr. B. O. Anson for his paper entitled "Machine Switching."



WINNERS OF INSTITUTION MEDALS FOR SESSION 1911–12.

MR. R. NIMMO, SENIOR BRONZE MEDAL FOR PAPER ON "THE MANCHESTER FIRE ALARM SYSTEM."

MR. B. O. ANSON, SENIOR SILVER MEDAL FOR PAPER ON "MACHINE SWITCHING IN TELEPHONY."

MR. E. A. PINK, JUNIOR SILVER MEDAL FOR PAPER ON "PARALLEL DISTRIBUTION."

Senior Bronze Medal.—Mr. R. Nimmo for his paper entitled "The Manchester Fire Alarm System."

Junior Silver Medal.—Mr. E. A. Pink for his paper entitled "Parallel Distribution."

RELAY CLERKS.

These officers, who were transferred to the Commercial Branch last year, have been re-transferred to the control of the Engineering Branch as Chief Inspectors or Senior Inspectors respectively. Those officers who were members of the Institution prior to the transfer may retain their membership, but new entrants will be admitted either as members or associates respectively.

REPRINT OF LIBRARY CATALOGUE.

The Catalogue is now being reprinted in its present form, and it is hoped to supply all new members and associates with a copy before the end of the year.

The next meeting of the Council was fixed for November 18th, at Reading, when it was hoped an opportunity of meeting the members and associates of the South Midland Centre would be afforded.

READING MEETING.

The November meeting of the Council was held at Reading on the 18th, when the following items of business were dealt with:

METHOD OF APPOINTING THE SECRETARY OF THE INSTITUTION.

The proposal of the London Centre that the Secretary be appointed by the Council and not elected by the membership generally was further considered, and the Council were unanimous in deciding that the present practice of electing the secretary be adhered to.

FINANCIAL POSITION OF THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

The Sub-Committee appointed by the Council to inquire fully into the financial position of the JOURNAL presented a comprehensive report, in which it was shown that as a business undertaking the JOURNAL had been conducted in a thoroughly satisfactory manner.

The report was accepted and adopted unanimously.

REPRINT OF LIBRARY CATALOGUE.

In view of the heavy expense involved in the reprint of the Catalogue, and the fact that all the members on the roll up to August last have been supplied with the last edition and all additions and amendments to date, it was decided to charge those members who required a copy of the new issue the sum of 6*d.*

All new members and associates will be supplied with a copy of the Catalogue free as formerly.

"PRESIDENT'S AWARD COMPETITION," 1913–14.

Mr. W. Slingo has kindly renewed his offer to present two prizes of three guineas each—one to the Clerical Staff and one to the Engineering—for the best essay on a clerical or engineering subject.

A circular has been issued to all members giving full details and the conditions of the competition. Notice of intention to compete must reach the Secretary before December 31st, 1913, and the essays must be delivered not later than February 28th, 1914.

MEMBERSHIP.

The Secretary reported that during the current year 73 engineering, 13 clerical, 16 colonial and foreign members and 160 associates had been enrolled.

The South Midland, North Midland, South Lancashire and North-Western Centres were to be congratulated particularly on their accession of associates.

The Council had the pleasure of meeting the members and associates of the South Midland Centre, when an excellent paper on "Comparative Methods of Distribution" was read by Mr. B. J. Beasley. Mr. J. McL. Robb presided.

There was a large attendance, and the lively discussion which followed the lecture proved that all ranks of the staff took a great interest in the matter under review.

T. SMERDON (*Secretary*).

LOCAL CENTRE NOTES.

LONDON CENTRE.

THE first meeting of the Session took place on October 13th, when Mr. A. B. Eason read an interesting paper on "Power Plant and Telegraph Traffic for Pneumatic Tubes in Post Offices," in which he gave the results of his investigations into pneumatic tube working at various offices. Mr. H. R. Kempe had a very cordial reception upon rising to open the discussion.

Mr. Harvey Smith—one of our colleagues of the ex-N.T. Co.—occupied the attention of the second meeting on November 10th with a paper on "Telephone Engineering Economics, with Special Reference to Underground Plant."

Members will be interested to learn that Mr. Trotter, of the Board of Trade, has very kindly consented to read a paper before the Centre, and the Committee hope the arrangements will be so far advanced as to admit of a special meeting early in the New Year.

A party of members visited the Metropolitan Railways Power Station at Neasden on December 2nd, and met with a very courteous reception from the Company's staff.

By arrangement with the London Telephone Society the members of the Society may attend meetings of the Institution, and our members may attend meetings of the Society.

The Committee desire to congratulate Mr. B. O. Anson upon his success in obtaining the Institution's senior silver medal for his paper, "Machine Switching in Telephony," and Mr. E. A. Pink for the Council's award of the junior silver medal for his paper on "Parallel Distribution."

W. G. O.

SOUTH-WESTERN CENTRE.

The first meeting of the current Session was held on November 3rd, when a paper on "Overhead Telegraph and Telephone Construction in France" was read by Mr. A. T. Kinsey, Assistant Superintending Engineer.

An interesting and instructive description was given of the differences in the methods of construction compared with British Post Office practice.

The paper was well illustrated by lantern views specially prepared, and by slides and drawings of telegraph construction in America, Denmark, Russia and Scandinavia, which had been loaned for this occasion.

Further meetings, details of which were not shown on the Display Card, have been arranged as follows:

1913.

December 8th.—"St. Just Wireless Station." Mr. C. G. Roach.

1914.

January 5th.—"Directive Wireless Telegraphy." Mr. F. Addey.

February 2nd.—"Local Underground Schemes." Mr. A. Rattue.

March 2nd.—"Early Experiments in Loading Cables." Mr. F. Tremain.

April 6th.—Short papers. To be arranged.

The meetings this Session are being held at the Merchant Venturers' Technical College, by kind permission of the Dean of the Engineering Faculty, Bristol University, and the opening meeting established a record for this Centre. The meetings of the Western Local Section of the Institution of Electrical Engineers are held in the same hall. On January 19th Mr. H. C. Gunton will lecture on "The Employment of Power in H.M. Post Office."

This Centre much regrets to have to record the death of Mr. N. S. Whittingham, which occurred on November 18th. Mr. Whittingham had been an active member of the Institution from its formation, and was the first Local Secretary of the North Wales Centre. In February, 1911, he contributed a paper on "Typical Wayleave Difficulties" before the South-Western Centre, and he served on the Local Committee for several years. He also took charge of the lantern arrangements on each occasion until the close of the 1912-13 Session.

NORTH WALES CENTRE.

The opening meeting of the Session was held at the George Hotel, Shrewsbury, on Wednesday, October 29th, when Mr. Cave-Brown-Cave read a paper on "Ineffective Time." There were about sixty members and visitors present. Mr. T. Plummer, the Chairman, opened the proceedings with a few brief remarks, in which he welcomed the Inspectors who had recently been admitted to Associate Membership of the Institution. Mr. Cave's paper was very interesting and instructive, and a large number of members took part in the keen discussion which followed. Special credit is due to Mr. Cave for the very excellent diagrams prepared in connection with his paper.

The presence of the Engineer-in-Chief at the meeting, and also at the usual smoker which followed, was much appreciated.

SOUTH LANCASHIRE CENTRE.

The following works are in progress in this district: Altrincham C.B. Exchange Extension, Heaton Moor Underground, Manchester-Stockport Underground, Manchester-Ashton Underground, Liverpool-Birmingham Underground, Manchester City Exchange Extension, and Stockport Automatic Exchange.

There has been a large increase in the membership of this Centre; the number of members and associates is now 105, which is considered very satisfactory.

So far three meetings have been held as follows: The first was held at Manchester on October 8th, at which the Chairman delivered his inaugural address and was followed by Mr. A. Magnall, who delivered a very interesting lantern lecture on the development of the telephone system of Constantinople.

The second meeting was held on November 3rd, when Mr. A. Ward read a paper on "Power Equipment."

The third meeting was held on November 12th, at Liverpool, the members and associates stationed at Manchester travelling to the famous port. At this meeting Mr. B. O. Anson delivered his lecture on "Machine Switching in Telephony"; the lecture was highly appreciated. This was a special meeting, and took the place of the meeting originally arranged for December 1st.

The average attendance at the three meetings was 79.

On November 3rd and 4th, the members and associates visited the Chloride Company's Accumulator Works at Clifton, Lancs., and on November 11th and 12th a visit was paid to the Automatic Telephone Company's Works at Edge Lane, Liverpool.

NORTH-WESTERN CENTRE.

A meeting of the Centre was held in the Lecture Hall of the Preston Scientific Society on November 11th, 1913, when Mr. B. O. Anson, of the Engineer-in-Chief's Office, contributed a paper on "Automatic Telephony."

Mr. T. E. P. Stretche (Superintending Engineer) occupied the chair, and there was a record attendance.

The North-Western District Headquarters Staff, Preston.
The Group includes also Certain Members of the District Staff from the Sections.

The lecturer explained the mechanical and electrical details of the system, and built up a description on the basis that the function of the switches corresponds with the meanings of the digits forming the numbers. He showed how that, under the present conditions, subscribers' lines are often very long and lie idle for the greater part of the day, that is to say, the expensive copper circuits are probably not in use more than a total twenty minutes or half an hour daily. If automatic mechanism were introduced generally it would be possible to place apparatus much nearer to the subscribers' offices than is the case at present, and much more efficient use of the plant would follow.

The paper was profusely illustrated by means of an electric arc lantern, under the direction of Mr. H. B. Graham.

A most interesting feature of the proceedings was the demonstration of actual automatic apparatus, and those present made the most of the opportunities thus provided for becoming acquainted with the working details of the system.

A hearty vote of thanks were accorded to Mr. Anson for his excellent paper, and the numerous queries which had been raised were replied to *in extenso*.

A most successful smoking concert was held in the King's Hall of the Bull and Royal Hotel, Preston, on Monday, October 13th, 1913, when upwards of a hundred persons were present.

Mr. T. E. P. Stretche (Superintending Engineer) presided, and was supported by Messrs. Sullivan and Terras (Assistant Superintending Engineers).

Amongst the visitors were Mr. F. Oldfield (formerly Postmaster of Preston) and Mr. Haley (District Manager, P.O. Telephones, Preston). The whole of the sections of the District were also well represented.

A musical programme of exceptional merit was contributed by Messrs. Barratt, Dransfield, Atkinson, Adams, Field, Knowling, Bland, Southgate, and Thompson, and Mr. Terras very kindly officiated in the capacity of accompanist. Encores were freely demanded and responded to, and the high artistic standard attained on previous occasions was fully maintained.

NORTH-EASTERN CENTRE.

The first meeting of the Session was held at the Y.M.C.A., Leeds, on October 15th.

Mr. T. B. Johnson in opening the Session heartily welcomed the new members and associates, and expressed the wish that all members would consider that they are personally responsible for the success of the meetings. He laid stress upon the fact that the discussions following the reading of papers could only be of the greatest value to all present when expressions of opinion were freely forthcoming.

Mr. W. S. Tinsley read a paper on the "Transfer of Small Exchanges," and the discussion, which was opened by Mr. Tattersall, indicated that the Chairman's wishes were being met.

One of the pleasing features of the meeting was the free expression of opinion by our friends of the late National Telephone Company, and is a clear indication that now the Institution has been numerically strengthened not only by the entry of the late Company's staff but by the admission of associates, the meetings will be an even greater success than has been the case during previous sessions.

At the November meeting Mr. E. H. Farrand read a paper on "Short Cuts," which dealt with the present-day time-saving methods not only in the office, but on engineering works. The discussion which followed can readily be understood to have been very animated, as we all recognise that in the eyes of the commercial world we are looked upon as being clumsy in our methods. Had, however, any of the heads of the largest commercial concerns been at the meeting, they would have been convinced that at least the Post Office Engineering Department is fully alive to the requirements of the day, and that it was only the heavy burden entailed at this stage of the development of the telephone service that prevented its being, if not in advance of the outside commercial houses, at least well up to their standard.

NORTH MIDLAND CENTRE.

The first meeting of the Session was held at the Welbeck Hotel, Nottingham, on November 3rd, when Mr. T. E. Matthews, of the Superintending Engineer's Office, gave a paper on "Estimate Procedure."

The proceedings were opened by an address from the Chairman, Mr. E. J. Eldridge, who reviewed the work of the previous session and gave a cordial welcome to the large number of associate members who attended for the first time. Mr. Matthews' paper proved to be highly interesting and instructive and was much appreciated. About eighty members attended the proceedings.

A "smoker" was subsequently held under the genial chairmanship of the Superintending Engineer, and a long and varied musical programme was rendered by members of the staff. Everyone acquitted himself well, and it would be invidious to attempt to apportion the merit for the evening's enjoyable entertainment.

EASTERN CENTRE.

The first meeting of the Session was held at Cambridge on November 18th. The President, Mr. J. F. Lamb, in a short opening address expressed his gratification at the resumption of the meetings at this Centre with such an attractive item as "Wireless Transmitters and Receivers," by Mr. J. E. Taylor.

After the minutes of the last meeting had been read and confirmed, a vote of thanks to Mr. S. H. Deacon for his services as Honorary Secretary was proposed and carried unanimously. Mr. Lamb then called upon the lecturer, who dealt with his subject in a way which enabled a very great deal of ground to be covered in the short time available. Mr. Taylor said that he proposed to dwell rather on the physical side of the subject, as purely mathematical treatment without adequate physical conception of the various processes at work was apt to be unilluminative.

The theoretical principles of wireless communication, functions of essential parts of apparatus, principles of tuning and coupling, transfer of energy between coupled systems and Fourier principles were first briefly surveyed. Mr. Taylor then explained the characteristics of the various types of transmitters and receivers, their advantages and disabilities, factors affecting sensibility of receivers, etc.

Following on this was a very interesting reference to atmospheric electrical troubles, the paper concluding with some interesting remarks on "long-range" working. The discussion which followed, and which was taken part in by Messrs. J. C. Denton, J. F. Lamb, T. Lakey, E. T. Titterington, W. Scarr, and H. Wigg, showed that the paper had been followed with great interest.

At the close of the meeting the members were invited by Mr. Taylor to inspect an experimental apparatus with "tuned buzzer" and coherers; also many samples of receiver parts and materials—an appropriate conclusion to a most valuable and interesting lecture.

IRELAND CENTRE.

Arrangements have been made for papers to be read during the Session on the following subjects:

"Some Points in Aërial Construction Work." Mr. F. W. Robinson.

"Straight Trunk Telephone Circuits on Telegraph Routes." Mr. J. McCandless.

"Work Returns." Mr. B. J. Maguire.

"Conveyors." Mr. J. Davidson.

"Conductors and Insulators." Mr. T. J. Monaghan.

"Acoustics." Mr. G. T. Fisher.

A visit will be made to Messrs. Harland and Wolff's ship-building works at Belfast early in February.

THE POST OFFICE TELEPHONE AND TELEGRAPH SOCIETY OF LONDON.

SESSION 1913-14.

SINCE the last Session the activities of the Telephone Society of London have been extended to include matters relating to telegraphs as well as telephones, and membership is now open to all members of the staff of the Post Office. The name of the Society has been amended as shown in the title of this article.

The first meeting of the newly organised institution of the Post Office was held in the lecture hall of the Institution of Electrical Engineers, Savoy Place, on October 27th last, under the presidency of Sir Alexander King, K.C.B., when the attendance was over 350.

In the absence of the Postmaster-General, who is President of the Society, the opening paper for this Session was delivered by the Chairman for the year, Mr. Alexander Moir, on "Some Features of the London Engineering District." After referring to some historical features of the Society, Mr. Moir dealt with the recent development of functional organisation in the London district, which has now to a large extent taken the place of territorial organisation, and he expressed himself as strongly in favour of the former. He also explained that the standard of efficiency in the London engineering district was measured by the number of faults, and described the method of showing the standard attained in each exchange district by means of curves and comparative schedules which are prepared periodically, and which engender friendly rivalry between the staffs of the different exchanges.

Mr. Moir was obviously in favour of the practice of treating supervision charges as a percentage on the fundamental costs of engineering works.

Mr. Moir dealt at some length on the great difficulties encountered during the last two years in the effort to bring into working harmony the telephone systems which had been built up separately by the Post Office and the National Telephone Company. He referred to the wholesale criss-crossing of subscribers' lines, and the difficulties of straightening out the system in such a way as to ensure that each subscriber was connected with his proper exchange by the shortest possible length of line. He detailed the steps which had been taken in reorganising and properly dovetailing the two staffs, and the strenuous efforts which are being made to secure greater efficiency.

He laid stress upon the need for maintaining a suitable balance between the supervising and working units. Insufficient supervision meant low efficiency and high labour costs, whereas excessive supervision led to waste, as high-grade officers were then employed upon work proper to a lower class.

Mr. Moir gave the following interesting account of the special arrangements for the training of workmen which have been made by co-operation between the London County Council, the Polytechnic Institutes and the Department. Under these arrangements the Post Office will pay the fees of the boy messengers and workmen in cases where they are successful in examinations or have made 80 per cent. of the necessary attendances. Theoretical teaching at the various institutions will be undertaken for the most part by the permanent and fully qualified staffs of the various institutes—a great advantage to the students; while the practical teaching will be in the hands of Post Office engineers and inspectors, who will for this purpose be specially employed by the educational authorities. Up-to-date types of telegraph and telephone apparatus will be lent by the Post Office for the purpose of illustrating the lectures. Over 1000 workmen and 54 boys have entered for the current Session, which is an increase upon last year's figures of nearly 100 per cent. The Regent Street Polytechnic and the Northampton Institutes have accepted 286 and 237 students respectively, and have both reached the limits of their accommodation. Well over 100 students have joined at Battersea and Tottenham, and large classes have been formed at the Borough, West Ham, Wimbledon and Chiswick Institutes. The launching of this scheme has involved a great deal of labour, which has been lightened by the hearty co-operation and help freely given by the officers of the County Council and the principals of the various institutes.

Not only in regard to technical education at evening classes, but in other ways, youths entering the service of the Engineering Department are helped to qualify as skilled workmen as early as possible. Separate courses of work covering a period of three or four years have been laid down for each of the distinctive types of duty carried out in the district, and as far as circumstances permit the boys follow the specified programmes. At the different headquarters of the workmen, facilities exist for testing young men in their practical knowledge of open-line construction and underground jointing and cabling, and specimens of the different types of outside plant are exhibited at these points for the instruction and guidance of the workmen. As regards internal equipment a central school has also been equipped with the different types of telephone apparatus, and instruction is given to "apparatus men" upon the practical difficulties that arise in connection with the tracing and removal of faults.

In dealing with the study of future development, Mr. Moir said that some interesting comparisons might be made between New York and London on the subject of telephone density. For instance, in New York, the number of telephones was evenly distributed over the city, and it was said to be possible to arrange for telephone development in large buildings where the principal financial houses are situated on an average basis of 4 or 5 telephones per 1000 square feet of floor space. In London, on the other hand, the variation in density was great, necessitating special studies which had been extended to some 3000 buildings. Warnford Court and Shorters Court in the corresponding district of London were quoted as cases where the number of telephones per thousand square feet of floor space reached 12 and 53 respectively. The following figures show the present and anticipated figures in London according to the latest development study, viz.

	Lines.	Stations.
1913	130,000	222,000
1921	267,000	432,000
1928	414,000	680,000

In the very congested portions of London, Mr. Moir pointed out, the exchanges are of the largest practicable size, namely, sufficient to accommodate 10,000 subscribers' lines, and in two cases it has been found economical to have two 10,000-line exchanges in one building. Since the whole undertaking came into the hands of the Post Office seven new exchanges have been opened and two others are nearing completion, providing additional capacity for 62,000 lines, and by December 31st next the exchange capacity in London will be 194,000lines—an increase for the two-year period of 31 per cent. Exchanges of the maximum size are also to be provided near the Charterhouse and the Tower, and proposals for others are well advanced.

Mr. Moir concluded his paper by exhibiting a slide showing the front elevation of the proposed new central building for the London Engineering Staff, who are at present scattered over the district, and said that they, like the Israelites of old, were longingly looking forward to the promised land.

The other speakers were Mr. Horne, Mr. Preston, Mr. Newlands, Mr. Dalzell, and Mr. Berlyn.

On November 24th, Mr. John Newlands, C.I.E., the Controller of the Central Telegraph Office, read an interesting address on "The Telegraph Service: Methods and Results."

Mr. Newlands commenced his paper by giving an historical survey of the telegraph service from its birth in Germany in 1833 to its prime of life at the present day. He traced its growth in the British Islands during the reign of the telegraph companies (1838–1870), when the methods of working were diverse, the system incomplete and the tariff prohibitive, during the early days under Post Office control (1870–1885), when the tariff was one shilling for twenty words, during the stress of the times immediately following the introduction of the sixpenny telegram in 1885, that concession so immortalised by 'Punch' in his cartoon entitled "Bang went saxpence," down to the last two decades when the competition of the telephone service for the short distance traffic led to a restriction of the sphere of the telegraph service.

Mr. Newlands then compared the results obtained from the different types of telegraph instruments; and, after dealing with their respective idiosyncrasies, he expressed a decided preference for the "Baudot" type, which he justified by the following reasons, viz.:

It produces a clear printed slip at both ends, and no perforation is necessary beforehand. The received message is reproduced at the distant end in ordinary type instead of in Morse character, and the slip can be torn off and pasted on telegraph delivery forms while the transmission is proceeding. It can be worked duplex, as double Baudot, as triple, quadruple, or sextuple, and when thus elaborated, six, eight or twelve men can send or receive simultaneously on the same single wire or underground loop. The percentage of words in transmission involving "RQs" or corrections is small, and the mode of working admits of such corrections being made instantly. The risk of losing messages is infinitesimal. The manipulation can be learned more readily and efficiency obtained more quickly than with any other type of telegraph. The number of messages per operator is more constant and the average higher. In support of his views as regards a higher average of working, Mr. Newlands gave the following analysis, viz.:

Comparative Operating Costs at the C.T.O. of Various Systems of Telegraphy—One Week's Traffic.

System.	Circuits.	No. of lines worked.	Traffic.	Operator hours.	Average per operator hour.
Baudot	TS.–Birmingham	1	15,040	347·5	43
Wheatstone with Creed	TS.–Edinburgh	4	15,860	450	35
Hughes	TS.–Glasgow TS.–Manchester TS.–Liverpool	3	13,364	389·3	34
Morse Provincial Offices	TS.–Leeds TS.–Bradford TS.–Sheffield	3	5,911	191·5	31
Morse Metropolitan Offices	TS.–Boro' High Street TS.–S.W. District TS.–Aldgate	3	4,455	147	30
Wheatstone without Creed	TS.–Bristol TS.–Grimsby TS.–Southampton TS.–Dublin TS.–Newcastle TS.–Plymouth TS.–Aberdeen	16	67,208	2560	26

One Week's Traffic: Best Single Results for each System.

System.	Circuit.	No. of lines worked.	Traffic.	Operator hours.	Average per operator hour.
Baudot	TS.–Birmingham	1	15,040	347·5	43
Hughes	TS.–Glasgow	1	4,484	125·3	36
Wheatstone with Creed	TS.–Edinburgh	4	15,860	450	35
Morse Provincial Office	TS.–Leeds	1	2,064	63·75	32
Morse Metropolitan Office	TS.–Boro' High Street	1	1,421	44	32
Wheatstone without Creed	TS.–Bristol	2	13,231	476·75	28

Summary of Six Days' Wheatstone Working (Variable Periods).

Circuits.	No. of wires used.	Traffic.	Hours.	Average rate.	Percentage of delay.	
					Twenty minutes.	Over twenty minutes.
TS.-DN.	2	8,952	398	22·5	48·8	51·2
TS.-AB.	2	4,921	210	23·4	48·0	52·0
TS.-PY.	2	4,134	164	25·1	69·7	30·3
TS.-NT.	3	14,308	564	25·4	74·3	25·7
TS.-SO.	3	12,673	474	26·8	74·3	25·7
TS.-GY.	2	8,989	333	27·0	68·8	31·2
TS.-BS.	2	13,231	477	27·7	65·5	34·5
		67,208 Average	for above	25·6		
TS.-EH.	4	15,860	450	*35·2	43·3	56·7

* Higher average due to Creed Printers.

Compare with Traffic, etc., on One Baudot Circuit.

TS.-BM.	1	15,040	347	43	90	10
					Average results of 10 Tablet Check Returns in 1913.	

Comparison of Results, showing Output obtained.

Apparatus.	Circuit.	No. of wires.	No. of days.	Total traffic.	Average per operator hour.	Highest hour.
Duplex	TS.-BR.	2	(4 hrs.)	447	56	—
Quadruplex . . .	TS.-DN.	1	12	12,728	34·5	205
,, ...	TS.-BR.	2	4	10,347	37·7	360
Hughes	TS.-GW.	1	3	3349	44	144
Wheatstone (with Creed) .	TS.-EH.	3	1	3848	36·3	646
Wheatstone . . .	TS.-NT.	3	6	14,308	25	550
Murray Auto. . . .	TS.-LS.	1	1	1555	32·4	270
,, Mult. . . .	TS.-MR.	1	1	1637	40·9	231
Baudot	TS.-BM.	1	1	5130 }	46	608
,, ...	,,	1	6	24,025 }		

In dealing with punching apparatus, Mr. Newlands stated that experience in the Central Telegraph Office showed that the best results were obtained by the Gell perforator, and that the average rate of perforating during six days on eight representative circuits was 53·3, 34·8, 37·4 messages per hour for Gell perforators, Kotyra "tappers," and hand punching apparatus respectively.

The practice of typewriting messages received by sounder apparatus or by Morse printers of the various kinds is on the increase, and Mr. Newlands urges the need for a quieter, simpler and cheaper typewriter. He considered that a typewriter with four rows of ten keys each, one with figures from 1 to 0, and the remainder with capital letters of plain character and certain of the more usual symbols as secondary characters, would best meet the need provided the typewriting was clearly visible to the operator. In this connection he pointed out the advantages which would accrue from a standardisation of the keyboards of typewriters and perforators in use in the Central Telegraph Office having regard to the fact that rotation between ordinary operating and manipulation of perforators or typewriters is necessary in the interests of the staff themselves.

Mr. Newlands is in favour of the system of "urgent telegrams" which is so popular (if practical compulsion may be regarded as productive of popularity) on the continent; but on this point no doubt opinions are divided. Such a system would necessarily lead to delay in dealing with the non-urgent traffic; and the standard which Mr. Newlands and his colleagues have set for the ordinary telegraph service in this country is already as high as that of the "urgent telegram" in other countries.

Mr. Newlands laid great stress on the fact that there was no attempt at what is colloquially termed "speeding up." He pointed out that in 1893, the responsible telegraph officers—all of whom had been telegraphists who had risen from the ranks—were generally agreed that 30 telegrams an hour was fair, 35-40 was good and 50-60 indicated pressure. Since that date the rate of working at the Central Telegraph Office has been decreased by the introduction of the intercommunication switch, the telewriter and the phonograms and the acceleration of the news services; and has been increased by the adoption of mechanical inventions—such as the Baudot, Murray, Creed and Gell—which have not only revolutionised modern telegraphy, but have also relieved the staff of much key working with its attendant physical fatigues. Yet the actual returns furnished to the Secretary during the last ten years show that the average number of messages per operator varies from twenty to twenty-three per hour. This average figure in Mr. Newlands' opinion conceals much excellent individual work because it is an "average" covering a twelve-hour day from 8 a.m. to 8 p.m.; but he, not unnaturally, considers that there is a wide margin between such average and anything of the nature of over-pressure.

Mr. Newlands made several other suggestions, some of which perhaps are counsels of perfection which in this imperfect world it may be difficult to realise, such as: The use throughout the service of a code of abbreviations habitually used by press correspondents; the compulsory inclusion of an indicator word in every registered telegraphic address in London; the use of typewriters by the public for writing out telegrams; the reduction in length of service instructions and the discontinuance of needless service telegrams; and the revision of the arrangements for transmitting figures. In addition, he advocated strongly the institution in the Telegraph Service of such periodical conferences between the chief executive officers as those which have proved so useful and generally advantageous in the Telephone Service.

The other speakers were Mr. V. M. Dunford, Mr. W. H. P. Smith, Mr. G. Jessup, Mr. W. Noble, Mr. J. J. Tyrrell, Mr. J. Bailey and Mr. Gell. Over 500 members and visitors were present.

On December 15th, Mr. P. W. H. Maycock, of the London Telephone Service, gave an address on Telephone Traffic Statistics. Mr. Maycock, who has studied the question of traffic statistics for several years both as exchange manager and as an expert attached to the traffic staff of the Controller's Office, considered that traffic statistics must be applied in such a way as to form criteria of the efficiency of the service under the following headings, viz.:

(1) The point of view of the subscriber.
(2) The efficiency of the operators.
(3) The efficiency of the subscriber.
(4) The arrangements for estimating and dealing promptly with traffic pressure.

The results of the statistics he thought should invariably be expressed in the form of curves. The curves which Mr. Maycock presented to the audience no doubt convinced them on this point if in this year of grace such conviction is not already an established fact. I sometimes myself wonder whether some of the fondness of statisticians for curves is not due to the unfortunate label which has been attached to "statistics" and their progenitors. Certainly a curve does look simple and trustworthy.

In dealing with complaints from the point of view of the subscriber Mr. Maycock gave reasons for his view that the relation of the number of complaints to the total amount of the traffic was the true index of the service as it presents itself to the subscriber, and not the relationship of the number of complaints to the number of lines or some other factor. In view of the doctrine of the measured rate that the Post Office is selling telephone service and not telephones, there is much to be said from this point of view.

Under Mr. Maycock's scheme written complaints only were to be considered in the standard "complaint" curve, owing mainly to the impossibility of getting a uniform standard of differentiation as between "complaints" and "inquiries." He suggested, however, the desirability of a supplemental curve giving "complaints" and "inquiries" together in relation to traffic, justification for the combination being found in the fact that "complaints" and "inquiries" alike arise from service difficulties. Of the suggested "complaint" curve the basis chosen was "complaints per thousand originated calls." Mr. Maycock also gave reasons for the view that any study from the traffic point of view of the number of faults reported in a given time to the Engineering Department should also be on a traffic basis; and he considered that a curve—to be plotted daily—showing the reported faults per thousand originated calls is a necessary adjunct to the "complaint" curve and a useful complement to the fault statistics outlined by Mr. Moir in his paper at the beginning of the Session.

In respect of the efficiency of the operator, Mr. Maycock dealt with the matter from the two points of view of (*a*) speed of operating and (*b*) accuracy of operating. He obtained much of his information from the observation tables, and proceeded to project various curves showing speed of answering calls, percentage of calls answered within standard of four seconds, speed of answering "flash" signals and speed of connection As regards the accuracy of operating, he required curves representing the percentage of completed calls, percentage of operating irregularities, the percentage of calls in which no operating irregularities occur, *i.e.* calls handled correctly from start to finish, and accuracy of registration. Cogent reasons were given why efforts to obtain in individual cases a speed of answer higher than the standard rate should not be encouraged.

Mr. Maycock pointed out that the "efficiency of the subscriber" was an all-important part of an efficient telephone service, and he expressed the view that the education in matters telephonic of the subscriber was imperative. He acknowledged that at first sight accepted statistics seem to show that, as measured by operating irregularities, the telephonist in London is worse than the subscriber; but he pointed out that the same standard of severity is not applied to operators and subscribers alike, and that if the same measure be employed the subscribers' faults are twice as numerous as those of the telephonists. He gave the following figures in justification of his statements, viz.:

	Nominally.	Actually.
Relative percentage of irregularities of operator and subscriber	30·1 : 11·3	63·6 : 30·1

As evidence of the need for the systematic education of the subscriber, the following statistics were given, viz.:

	Percentage of total calls.
Subscriber passes number incorrectly	14·9
,, speaks indistinctly	6
,, asks for wrong number	1·29
Called subscriber fails to announce his identity promptly	8·46
Subscriber fails to clear or delays clearing	5·86
,, fails to give number promptly	3·81
,, leaves telephone and caller becomes impatient	2·51
,, calls Exchange unnecessarily	2·23
,, fails to answer interrogation "Have they answered?"	1·59
,, called does not wait for conversation	1·22

Perhaps some of the audience recognised the faults to which they were most prone. Mr. Maycock urged that in the criticism of service an equal standard should be applied to telephonists and subscribers, and that the curve of subscribers' irregularities should be based on such data: that such a curve should be kept in each exchange and used with a series of instructional leaflets.

On traffic pressure, Mr. Maycock considered that quarterly and monthly peg counts were inadequate, and that daily peg counts by aid of position meters should invariably be taken, the readings being taken at half-hourly intervals between 9 a.m. and 12 noon. These statistics would also show the relative "loads" at the operating positions, and should be used with predetermined maximum and minimum limits for equalising the loads of the operating positions.

With regard to traffic pressure, Mr. Maycock submitted evidence that, for the purpose of indicating the true requirements of the busy hour, daily busy hour records must be taken if the Post Office standard of service is to be maintained. The inadequacy of quarterly and even monthly peg counts for the purpose of supervision of the busy hour load of the exchange was demonstrated, and the systematic plotting of curves showing the daily busy hour load of the exchange and the loads of individual operators in relation to minimum and maximum load limits was advocated. The necessity for close supervision of junction traffic pressure was pointed out, evidence being given of marked fluctuation in the main factors determining junction requirements—factors frequently regarded as constant. Suggestions were made as to frequency of junction records and the graphic analysis of the results.

In conclusion Mr. Maycock reviewed the general case for systematic statistical records at Exchanges, urging the necessity of preparing for the possibility of decentralisation by laying down a standard system which would, in the ordinary course of its use, familiarise all Exchange controlling officers with some of the main principles of scientific traffic control.

CHESS CLUB.

THE Engineering Department Chess Club opened its tenth season on October 7th, 1913, and with Arbitration proceedings, which last season deprived the Club of many of its players, now happily a thing of the past, a more successful season is anticipated.

The Club is again competing in the First Divison of the Civil Service and Municipal Chess League, and at the date of writing these notes, losses have to be recorded in respect of matches with Somerset House and the L.C.C., while a draw was effected with the War Office.

The Club Championship and Tournament have attracted numerous entrants, and as the "cup-tie" system has been adopted keen contests are resulting.

RETIREMENTS IN 1913.

MR. J. W. GROVES.

Mr. J. W. Groves retired from the position of Superintending Engineer on May 31st under the age limit, after having completed forty-five years' service.

Mr. Groves entered the service of the United Kingdom Telegraph Company at Bristol in 1863. A year later he was transferred to Leeds, at which office he was stationed, when his Company's circuit, and those of the Electric and International and the British and Irish Magnetic Companies were concentrated at the Post Office. In 1870 Mr. Groves was transferred to Newcastle, where he had experience of submarine cable working, and became acquainted with Mr. Oliver Heaviside, the famous mathematician and electrician, and Mr. J. W. Swan, the inventor of the carbon process of obtaining permanent photographic prints and of the incandescent electric lamp. After a stay of eight years on Tyneside Mr. Groves was promoted to the position of repeater clerk at Haverfordwest. While at Haverfordwest he received the thanks of the Engineer-in-Chief for designing a short-circuit detecter, and also for a non-polarised relay to be used in place of the electro-magnetic switch.

In 1885 Mr. Groves was selected for the position of Inspector at Cambridge. On the occasion of the illness and death of the late Duke of Clarence he was in charge of the engineering arrangements, and, with Mr. T. Mason of the Special Staff, was quartered in the Bachelors' Cottage.

MR. J. W. GROVES.

In the "old days" Mr. Groves's section extended from a point south of Harlow to the mouth of the Wash, a distance of over 100 miles.

After passing through the grades of 2nd Class and 1st Class Engineer and Assistant Superintending Engineer Mr. Groves was promoted to the position of 1st Class Staff Engineer. During three years on the Headquarters Staff Mr. Groves inspected and reported upon practically every trunk telephone exchange in the country. During the same period he was responsible for the application of the

Unit Cost System. The establishment of lineman's loads also came under his review. Mr. Groves was subsequently promoted to be Superintending Engineer of the North-Western District, since rearranged so as to include Liverpool, and now known as the South Lancashire District.

Mr. Groves took great personal interest in the local branch of the I.P.O.E.E., and under his chairmanship the programmes were satisfactorily filled during successive sessions.

On his retirement the good wishes of a number of his personal friends in the Engineering Department were expressed in tangible form by the presentation of several pieces of silver plate suitably engraved.

MR. T. JENKYNS.

By the unavoidable flight of time, which brought on the age-limit, Mr. T. Jenkyns, Assistant Superintending Engineer in the South Wales District, recently retired from the activities and anxieties of official life. After a service of forty-three years it is felt Mr. Jenkyns fully deserved the leisure which he has earned by the conscientious and careful carrying out of the duties of the various positions he has filled. His genial and generous nature made him an officer greatly liked and looked up to by his fellows. It is impossible to imagine a case in which he could or would do harm or hurt to anyone, and, as was said at a farewell gathering years ago in regard to a colleague of Mr. Jenkyns, so it can be truthfully reiterated in respect of the latter, "He never saw nothing he didn't ought to." The best—the humane—side was always seen, and men of all ranks honour his name, and reflect that his attitude was ever considerate, and at the same time candid. It was always a matter of measuring, remembering and estimating circumstances, and rarely would there be a repetition of the offence. A great heart and a sympathetic spirit characterised all his dealings with men. Yet he ever held with dignity and satisfaction to his superiors his official position. All were sorry when they knew he must take off the official armour. He passed through years of strenuous toil and incessant grinding. When the Department started "competition" in telephone matters in the South Wales District Mr. Jenkyns was at Newport (Mon.), and in that area he had his hands full, and more than full. There are those left who remember those days of stress and strain, and are only too glad to know that the end of the days of great pressure has come to him. Mr. Jenkyns goes out of harness not to be forgotten, but to be in frequent recollection. His old colleagues express a sincere hope and wish that his freedom from official cares will enable him to enjoy many years of quiet and rest. He will not, it is thought, be idle altogether, for probably he will now have time to play bowls occasionally and opportunity to read more of those standard works with which he has for many years stored his mind and enlarged his vision of men and affairs. C. J. Y.

MR. J. J. HARDIE.

Mr. Hardie commenced his established career as a telegraphist in Aberdeen, although he had acquired the rudiments of the art at Lerwick, in the Shetlands, where his uncle, Mr. Stout, performed the dual duties of postmaster and engineer—an unique combination which ceased on the death of Mr. Stout, some fifteen years ago.

He was appointed a junior clerk at Glasgow in 1897, and in 1899 he entered the technical side proper as a sub-engineer in the same district, being located in the Superintending Engineer's office. During that period he acted as relief engineer and subsequently performed the duties now proper to the post of estimates engineer for the district. Passing the departmental examination for second-class engineer in 1903 he was appointed to the Engineer-in-Chief's office, and for seven years he was engaged in the Designs Section. During that period he was largely concerned with the installation and standardisation of secondary cell equipments for telegraph offices, was responsible for the provision of apparatus supplies and the execution of special requisitions, and was of considerable service in the preparation of the rate-book and the codification of stock nomenclature.

Mr. Hardie was promoted to the rank of First-class Engineer in 1910 and in the following year he was made an Executive Engineer. For about a year he was in charge of the Central Metropolitan East Section, but his wide knowledge of telegraphs led to his transference to the C.T.O. Section. He was nominated for examination as Assistant Staff-Engineer, but unfortunately he was unable to attend the examination owing to a serious illness. He resumed duty at the C.T.O. after six months' absence, but at the end of a similar period he was again compelled to rest and in September last he was placed on the retired list.

A typical Shetlander, one half Scot, one half Norseman, Mr. Hardie possesses within a frame that has never been robust an indomitable dogged perseverance and a very acute intellect which is ever seeking fresh problems to solve, and which many times has carried him beyond his physical safety limit.

He is by nature rather reserved and he never sought the limelight, but to his credit stands a vast amount of sound, solid work, conscientiously carried out with a single eye to the interests of the Department and to the honour of the profession.

His many friends will be pleased to hear that he is now convalescent, and that there are prospects of his being able to enter into active life again. "J. J." was never content to watch others doing the work, except perhaps at Stamford Bridge.

Mr. Nelson Bathurst.

Mr. Nelson Bathurst was one of the few remaining members of the old Metropolitan Engineering staff.

Mr. Bathurst commenced his career in the service at Redhill, Surrey, in the memorable year of the Telegraph Transfer, 1870. He was later transferred to the Central Telegraph Office, and in 1880 he was appointed a clerk to the Metropolitan District under Mr. Eaton, who was then Superintending Engineer, with Mr. T. H. Hill as his assistant. At that period the total clerical force of the Metropolitan District was eight! The engineers being Messrs. Fleetwood, Banker, Hook, Trott, Porter and Houston. Of the engineers none remain in the Service, and only two of the clerks, Messrs. E. J. Wood and W. Heath.

Mr. Bathurst has been absent from duty, owing to ill-health, for about a year, but his many friends will be glad to know that he has recently recovered his normal condition, and he will be followed into retirement with the good wishes of all for a long and happy enjoyment of his well-earned pension.

REFERENCES TO CURRENT TECHNICAL LITERATURE.

'Telephony' (U.S.A.), September 6th, p. 23 *et seq.*—"Tale of the Telegraph and Trials of the Telephone Re-told." G. W. Foster.

——— September 13th, p. 31.—*Ibid.*

'Elec. World' (U.S.A.), September 6th, p. 477 *et seq.*—"Data Concerning Incandescent-Lamp Reflectors." Stickney and Powell.

'Engineering Mag.' (U.S.A.), September, 1913, p. 793.—"Motor Trucks in Engineering Work." R. W. Hutchinson, jun.

——— September, 1913, p. 822.—"Air Compressors and Compressed-Air Machinery." Prof. R. L. Streeter. The first of a series of six articles.

'Engineering Mag.' (U.S.A.), September, 1913, p. 843.—" Power Applications of Diesel Engines in Industrial Plants." C. Van Langendonck.

'Elec. World' (U.S.A.), September 20th, p. 586.—" Graphic Solution for Illumination Problems." N. S. Dickinson.

'Telephony' (U.S.A.), September 20th, p. 26.—" Prevention of Electrolytic Corrosion of Lead Cable." B. C. Groh.

'Cassier's Eng. Monthly,' October, 1913, p. 215.—" The Gas Turbine." L. Venton-Duclaux.

——— October, 1913, p. 229.—" Modern Developments in Fire Preventive Design and Construction." H. G. Holt.

——— October, 1913, p. 259 —" The First Diesel Locomotive." P. R. Allen.

——— October, 1913, p. 265.—" The Hours of Labour Problem." T. Good.

'Telephony' (U.S.A.), September 27th, p. 33.—" Telephone Stations of the World at the Beginning of 1912." W. H. Gunston.

'Electrician,' October 10th, p. 14.—" Sine-wave Transmission in the Submarine Telegraph Cable." H. W. Malcolm, D.Sc.

'Scientific American Supplement,' October 11th, p. 232.—" Accident Prevention." Jas. B. Douglas.

'Engineer,' November 21st, 1913.—" Boiler and Economiser Efficiency and Design, III."

'Engineering Mag.,' November, 1913.—" Handling Mail-Bags at a Rapid Rate."

LIBRARY NOTES.

THE following surplus copies are to be disposed of to members of the Institution. The books are in good condition. Offers for same should be forwarded to The Librarian, Room 50A, G.P.O. West, E.C.

'Electric Wave Telegraphy,' 1906 edition. J. A. Fleming.
'Wireless Telegraphy,' 1907 edition. J. E. Murray.
'Handbook of Telephony,' 1906 edition. J. Poole.
'Telephony,' 1905 edition. K. B. Miller.
'Internal Wiring of Buildings,' 1903 edition. H. M. Leafe.
'Applied Mechanics,' 1904 edition. A. Jamieson.
'Wireless Telegraphy,' 1904 edition. C. H. Sewell.
'C.G.S. Units,' 1902 edition. J. D. Everett.

Mr. A. E. McCLOSKEY.

Mr. A. E. McCloskey, who returned from India in March, where he had been on loan to the Bombay, Baroda, and Central India Railway for a period of three years, has been appointed Engineer-in-Chief, Postal Telegraphs, Ceylon, and sailed for Colombo on November 8th. His duties will be comprehensive, as they include not only the installation and maintenance of the telegraph and telephone systems on the island, but also the maintenance of the Colombo wireless station and the railway signalling arrangements over the entire service.

His experience in India will stand him in good stead in connection with the last-mentioned portion of his duties. It is understood he was in sole charge of the electrical portion of the railway company's equipment during the journey of the Royal party from Bombay to Delhi to hold the Durbar, and for his services in that connection he was awarded a handsome bonus and the thanks of the railway authorities. Before leaving for England he was presented by the staff with a magnificent embossed silver salver and an illuminated address contained in a silver casket supported on crossed rifles.

While in India Mr. McCloskey underwent a severe attack of enteric fever, which incapacitated him for several months. We hope the seasoning he received during his first trip "east of Suez" will enable him to keep clear of all similar troubles, and thus secure to the Colony the uninterrupted services of an excellent engineer, capable and prompt in emergencies, with a wide and varied experience, and withal of an unfailing humour which rises superior to every adversity.

STAFF CHANGES.

POST OFFICE ENGINEERING DEPARTMENT.

Promotions.

Name.	From.	To.	Date.
Chapman, A. E.	Exec. Engr. S. Western Dist.	Asst. Supt. Engr. S. Western Dist.	17 : 11 : 13
Barber, J. W.	Exec. Engr. N. Eastern Dist.	Asst. Supt. Engr. S. Lancs. Dist.	22 : 10 : 13
Terras, J. S.	Exec. Engr. N. Wales Dist.	Asst. Supt. Engr. N. Western Dist.	1 : 7 : 13
Gilbert, A. B.	Exec. Engr. Scotland W. Dist.	Asst. Supt. Engr. Scot. E. Dist.	7 : 11 : 13
Wolstenholme, C. S.	Exec. Engr. S. Lancs. Dist.	Asst. Supt. Engr. N. Eastern Dist.	13 : 11 : 13
Baldwin, F. G. C.	Exec. Engr. London Dist.	Asst. Supt. Engr. Northern Dist.	1 : 12 : 13
Cardrey, A. G.	Asst. Engr. London Dist.	Exec. Engr.	—
Wells, R. A.	Asst. Engr. E. in C.O.	"	—
Bramwell, J. T.	Asst. Engr. Northern Dist.	Exec. Engr. S. Lancs. Dist.	17 : 11 : 13
Cameron, J.	Asst. Engr. Scotland W. Dist.	Exec. Engr.	—
Jenkins, I. H.	Asst. Engr. E. in C.O.	"	—
Thompson, H. S.	Asst. Engr. E. in C.O.	"	—
Francis, E. S.	Traffic Supt. Liverpool	"	—
Newton, E. W.	Asst. Engr. S. Eastern Dist.	"	—
Shea, J.	Asst. Engr. S. Lancs. Dist.	Exec. Engr. S. Lancs. Dist.	6 : 11 : 13
Ryall, J. B.	Asst. Engr. London Dist.	Exec. Engr.	—
Gardner, A. W.	Engr. 2nd Cl. Eastern Dist.	Asst. Engr.	To be fixed later.
Fewtrell, J. W.	Engr. 2nd Cl. E. n C.O.	"	"
Golding, W.	Engr. 2nd Cl. S. Wales Dist.	"	"

PROMOTIONS—*continued.*

Name.	From.	To.	Date.
Everatt, W. C.	Engr. 2nd Cl. N. Eastern Dist.	Asst. Engr.	To be fixed later.
Dawson, A. E.	Engr. 2nd Cl. Ireland Dist.	,,	,,
Waters, E. W.	Engr. 2nd Cl. London Dist.	,,	,,
Bell, R. W. S.	Chief Inspector N.W. Dist.	Asst. Engr. S. Lancs. Dist.	24 : 11 : 13
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Stone, A. E.		Asst. Engr. on probation	1 : 5 : 13
Morris, A.		Asst. Engr. on probation	7 : 7 : 13
Harris, W. T.	3rd Cl. Clerk Lond. Dist.	2nd Cl. Clerk Lond. Dist.	24 : 11 : 13
Cole, G. G.	Do.	Do.	24 : 11 : 13
Gell, E. R.	,,	,,	24 : 11 : 13

TRANSFERS.

Name.	Rank.	Transferred from	To	Date.
Barber, J. W.	Exec. Engr.	N. E.	S. L.	12 : 9 : 13
Nimmo, R.	,,	N. W.	S. W.	12 : 11 : 13
Blight, W. ●.	Asst. Engr.	London.	E. in C.O.	16 : 7 : 13
Murphy, F.	,,	,,	,,	1 : 10 : 13
Gadsby, G. J.	,,	,,	,,	2 : 11 : 13
Warren, A.	3rd Cl. Clerk, London.	S. M.	London.	1 : 11 : 13
Doe, G. D.	Ditto	,,	,,	17 : 8 : 13
Paine, F. J.	,,	S. E.	,,	1 : 10 : 13
Pethurst, A. E.	,,	E.	,,	19 : 10 : 13
McNally, W. J.	,,	S. M.	,,	16 : 8 : 13
Bristow, A. W.	,,	S. E.	,,	9 : 11 : 13
Eadie, J. L.	3rd Cl. Clerk Provs.	N. W.	Sc. W.	7 : 9 : 13
Howarth, H.	Ditto	Sc. W.	N. W.	,,
Quigley, P. J.	,,	London.	Sub. Woolwich	14 : 9 : 13
Davies, A. A.	,,	N.	S. M.	21 : 9 : 13
Bott, J. T.	,,	,,	,,	1 : 7 : 13
Winton, T.	,,	Sc. E.	S. E.	28 : 9 : 13
Palk, E.	,,	S. L.	S. M.	,,
Powell, S. A.	,,	N.	,,	26 : 10 : 13
Blower, A. W.	,,	Sc. E.	N.	,,
Cairns, T.	,,	N.	S. M.	2 : 7 : 13

Retirements.

Name.	Former.		Particulars.	Date from which to take effect.
	Rank.	District.		
James, W. G. . . .	Engr. 2nd Cl.	Lond. Dist.	Superannuated	8 : 9 : 13
Hardie, J. J. . . .	Exec. Engr.	,,	,,	7 : 9 : 13
Bathurst, N. . . .	Engr. 1st Cl.	Eastern Dist.	,,	14 : 8 : 13

Deaths.

Name.	Rank.	District.	Date.
Heather, T. . . .	Exec. Engr.	Met. Power	27 : 10 : 13
Whittingham, N. S. .	Clk. 2nd Cl. Provs.	S. Western	18 : 11 : 13
May, H. C. . . .	Junior Engr.	E. in C. O.	24 : 10 : 13

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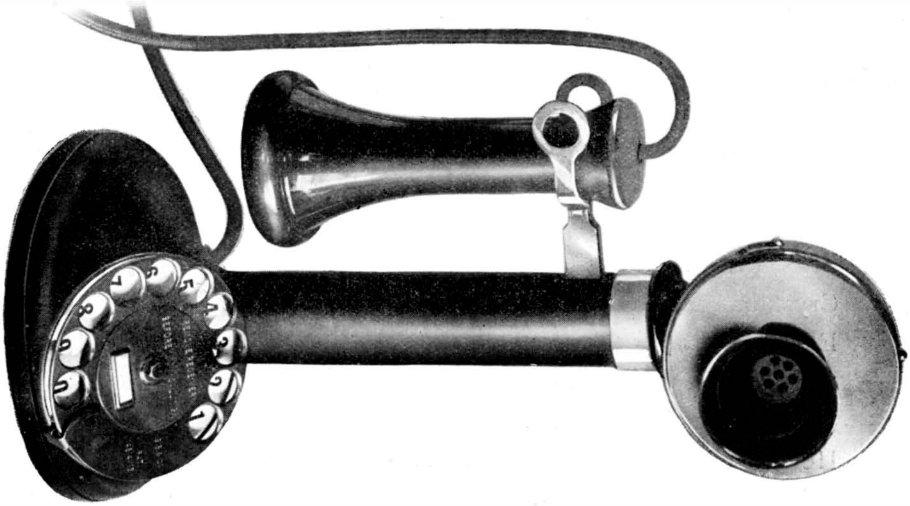

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