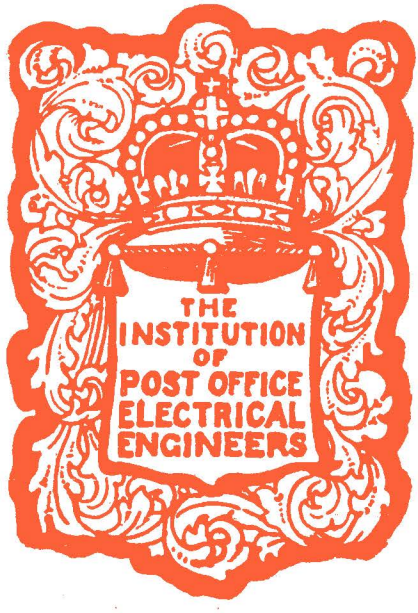
THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL



VOL. 14
PART 2

JULY
1921

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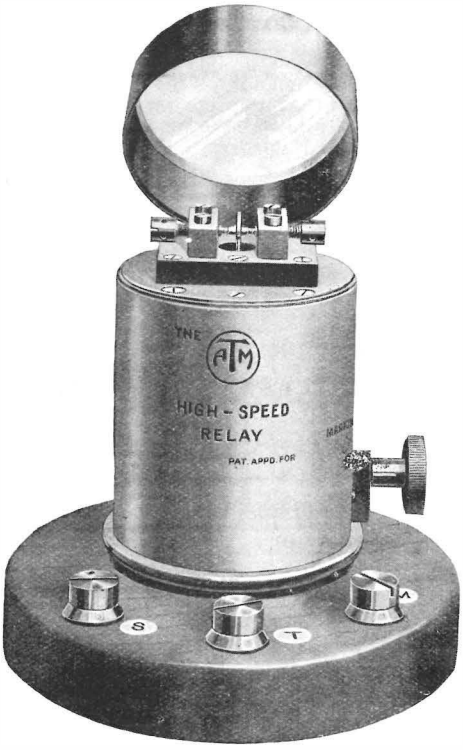

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A QUARTERLY JOURNAL.

CONTENTS FOR JULY, 1921.

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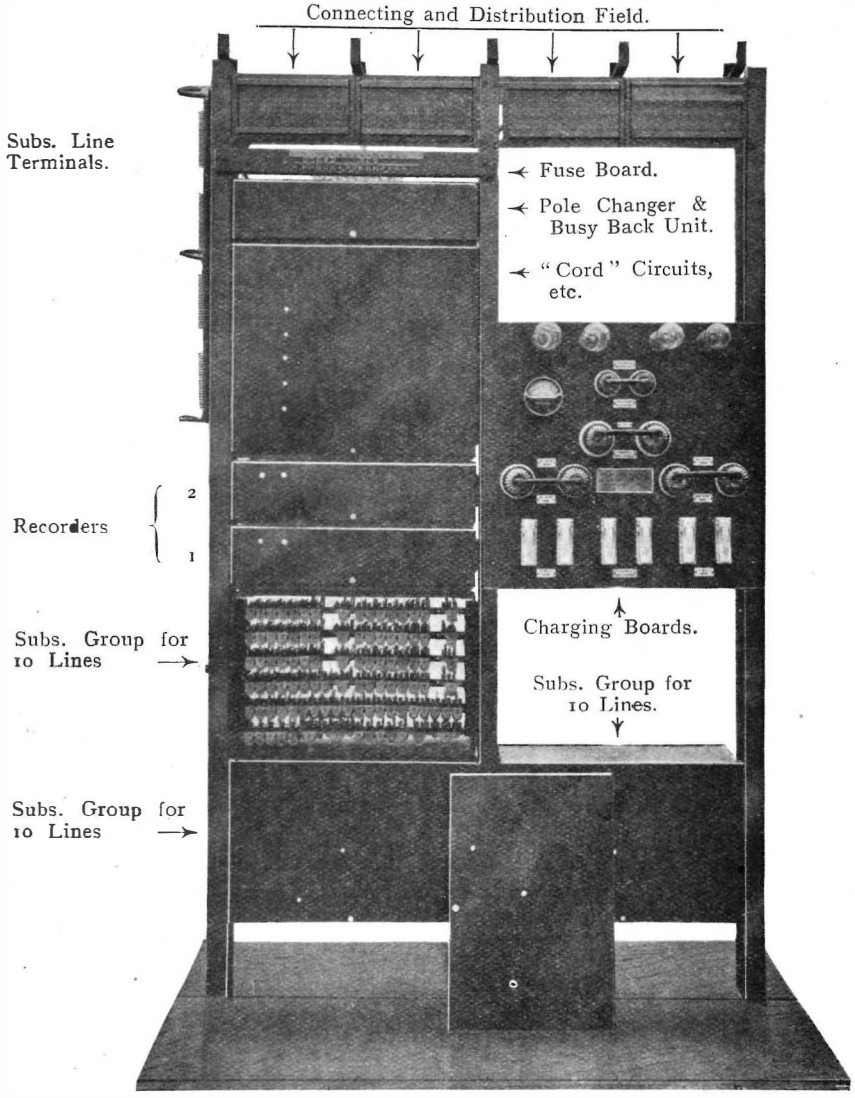
THE RELAY AUTOMATIC TELEPHONE SYSTEM.



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SUBMARINE CABLES OF THE WORLD.

As promised in our last issue, we produce on the following page the details of the cables of the Commercial Cable Company, and, in addition, we are fortunate in having received from the Western Union Telegraph Company particulars of their trans-Atlantic and Gulf of Mexico routes. For the latter information we have to thank Mr. A. E. Powell, Plant Engineer to the Western Union Company. In the preparation of these lists we have received every assistance from the great cable companies, without which it would have been difficult to obtain the information, and we are grateful for their co-operation in making the lists practically complete. There still remain certain Mediterranean and Baltic cables, details of which we hope to obtain later.

LIST OF CABLES GIVEN IN PREVIOUS ISSUES.

Imperial Cable, London—Halifax.
Anglo-Irish Cables.
Government Cables to Europe.
Great Northern Company's Cables.
Pacific Cable Board's routes.
Eastern Telegraph Company's Cables—
England to Shanghai viâ Suez.
England to Australia viâ Cape.

Cables owned or operated by the Western Union Telegraph Company.

Cable Sections.	Date laid.	Length in Nautical Miles.	Cable res. in ohms.	Cable capacity in mf.
Sennen Cove (Nr. Penzance)-	1881-1910-			
Bay Roberts (Nfld) No. 1	1913	2122	5191	785
,, ,, ,, 2 ...	1882-1910-1915	2127	4722	799
,, ,, ,, 3 ...	1910	2054	3231	837
Bay Roberts-Hammels (New York) ...	1910	1406	4432	479
Colinet (Nfld)-Sydney (NS) ...	1913	321	2235	103
Hammels-Canso Northern ...	1889	757	7285	238
Canso-Sydney	1891	117	1000	40
Hammels-St. Pierre Southern	1869-1889-1918	1062	9941	347
Valentia (Ireland)-				
Hearts Content (Nfld) No. 1	1873	1912	4514	714
,, ,, ,, 2	1874	1875	3995	708
,, ,, ,, 3	1880	1891	6482	628
,, ,, ,, 4	1894	1852	3116	777
Hearts Content-Rantem (Nfld) No. 1 ...	1873	26	220	8
,, ,, ,, 2 ...	1880-98	26	245	8
Island Cove-				
St. Pierre ... Northern	1873-1918	129	1073	42
St. Pierre-Sydney ,,	1873-1918	208	1968	66
Island Cove-				
Sydney Southern ...	1873	306	2779	97
Placentia-				
St. Pierre (Tricore) ...	1880	111	1116	32
St. Pierre-Sydney ,, ...	1880	185	1879	53
Placentia-St. Pierre	1920	135	520	54
Sennen-Valentia No. 1 ...	1918	275	1392	89
,, ,, 2 ...	1920	286	1442	91
Cuckmere, Sussex, Eng.-				
Havre, France ...	1900	81	707	27
GULF OF MEXICO SYSTEM.				
Punta Rassa (Florida) and Miami to Havana (Cuba) comprising the sections :—				
Punta Rassa-Key West ...	1889	123	1220	38
Miami-Key West (Tricore) ...	1899	131	1352	44
Key West-Cojimar				
(Nr. Havana) No. 1 ...	1886	104	1079	31
,, ,, ,, 2 ...	1899	98	701	32
,, ,, ,, 3 ...	1917	96	866	31

Cables of the Commercial Cable Company.

Cable Sections.	Date laid.	Length in Nautical Miles.	Cable res. in ohms.	Cable capacity in mf.
Waterville-St. Johns ...	1884	1806	5778	665
Waterville-St. Johns ...	1884	1841	5817	690
Waterville-Canso	1894	2169	5335	904
Azores-Canso	1900	1699	6760	647
Waterville-Azores	1901	1205	8300	420
Waterville-Canso	1905	2237	4452	931
St. Johns-New York	1909	1300	6173	442
St. Johns-New York	1909/12	1266	4863	470
Canso-New York	1884	836	12,587	247
Canso-New York	1900	889	6277	313
Canso-Rockport	1885	515	8938	165
New York-Havana	1907	1287	8533	435
Weston-Super-Mare-Waterville ...	1885	331	3664	106
,, ,, ,, ...	1901	329	1049	139
,, ,, ,, ...	1910	336	1802	113
Waterville-Havre	1885	522	7418	164

MORSE QUADRUPLEX.

ACTION OF THE "B-SIDE" LOCAL CIRCUIT.

Based upon Research Section's Report, No. 1722, of investigation carried out by Messrs A. B. MORICE and W. G. RADLEY, at request of the Telegraph Section.

A. C. BOOTH.

IT has been a well-known fact for many years that the trouble on the "B-side" of a Morse Quadruplex is caused by the reversal of the "Line" current at the distant "A-side" key, during the time that the distant "B-side" key is down. The momentary cessation of the Line current causes a break in the "B-side" signal, which has been masked with various arrangements with varying results. On short lines the duration of the break is short, but on long lines, or on lines having a fair amount of 'Capacity,' the effect is prolonged, until on very long lines the "B-side" becomes unworkable.

The Post Office arrangement for overcoming the trouble is that devised by officers of the Engineering Department. It has been in use for a number of years and has given very satisfactory results. Although the action of the condenser is thoroughly understood, it was considered advisable to ascertain the extent to which the Condenser acted. Hence, the Research Section was asked to in-

vestigate, by means of the Oscillograph, the actual currents in the various paths. Some 16 very instructive oscillograms were taken, but space will only permit of the re-production of four of the more important ones.

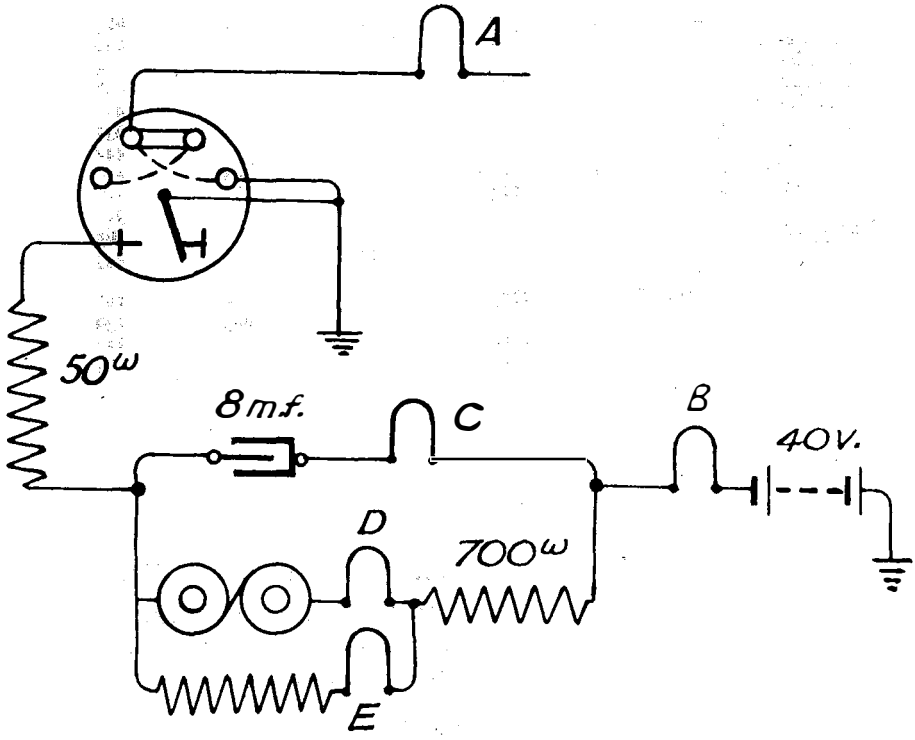


FIG. 1.—QUAD. "B-SIDE" LOCAL CONNECTIONS.

Fig. 1 gives a diagram of the "B-side" connections, showing the positions A, B, C, D, and E, where the Oscillograph was inserted.

Fig. 2 shows at curve '*a*' the current at point A, representing the line current through the coils of the "B-side" relay. There are periods of 'no-current,' representing the equivalent of the short-circuit by the "A" key in reversing. In this curve the times of 'no-current' are unequal, due to the fact that the transmitter in use for the experiment had a slight bias. This fact, although it made a slight difference in some of the curves, does not affect the results of the investigation. Curve '*b*' of Fig. 2 shows the current at C, *i.e.*, the condenser discharge followed by a pulsating charge due to the vibration of the relay tongue and terminating in a sustained oscillation of small amplitude, to be referred to later.

The discharge current from the condenser commenced on the cessation of the Line current with the consequent opening of the 'B' relay contact, and disconnection of the local battery circuit. The curve reached a value of about 20 milli-amperes and then gradually dropped until the point marked Z was reached. This point Z indicates the moment that the tongue of the relay again made connection with the marking contact and re-established the local battery circuit, when there was a heavy charging current into the condenser. This current was of a value approximating to 800 milli-amperes and deflected the Oscillograph mirror far beyond the range of the recording paper. It will be noticed that the line

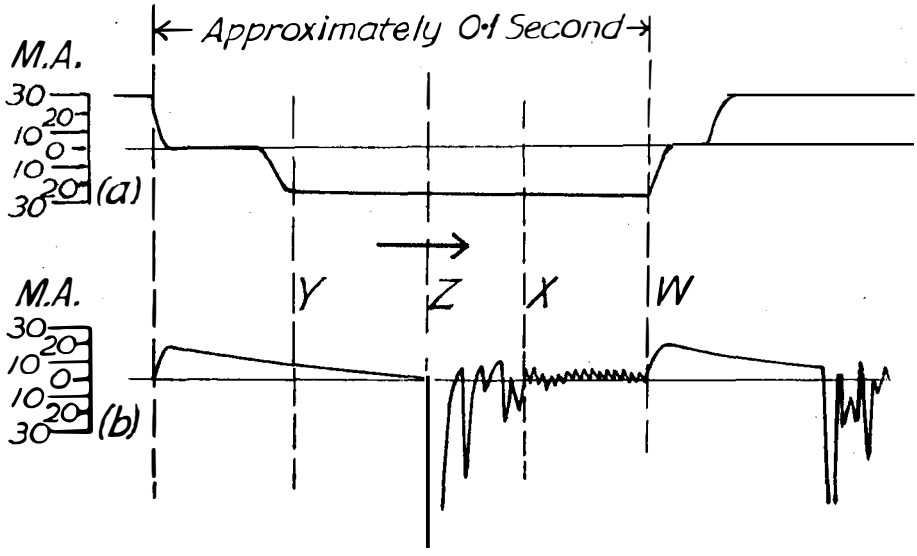


FIG. 2.—(*a*) LINE CURRENT; (*b*) CONDENSER CURRENT.

current is fully re-established at Y, and that therefore the time interval represented by the distance Y to Z is the time lag of the relay tongue in responding to the line current. The tongue had not made a complete contact and was vibrating or bouncing markedly for the time interval represented by the distance between Z and X, when it had practically settled down. The final period of oscillation of small amplitude shows a speed that, in the writer's opinion, cannot be due to the vibration of the relay tongue, but may be due to the charging circuit having sufficient inductance to produce oscillations of small amplitude.

Fig. 3 shows in curve '*a*' the current from the local battery with the Oscillograph at the point B. Again the first charge of the

8 mf. condenser deflected the mirror beyond the scale, while the relay tongue was vibrating, but at each contact charging the condenser to a certain extent and thus reducing the successive charging currents until the relay tongue settled down. The out-going current, however, was also slowly increasing due to the growth of current through the coils of the electro-magnet of the sounder, as shown in curve '*b*' given by the Oscillograph at point D. There is again in curve '*a*' the sustained oscillation of small amplitude.

Referring again to curve '*b*' it will be noticed that on the cessation of the current from the local battery the current through the sounder coils began to drop, but was prevented from doing so

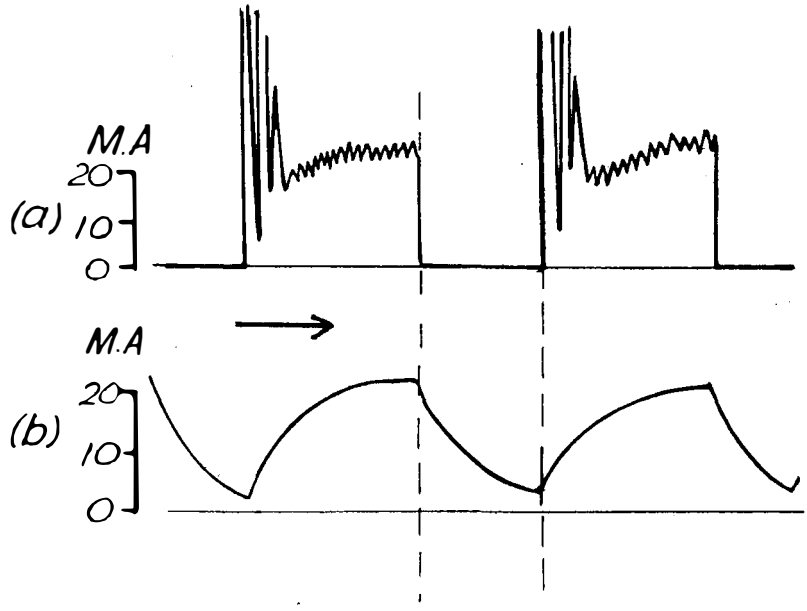


FIG. 3.—(*a*) LOCAL BATTERY CURRENT; (*b*) CURRENT IN SOUNDER COILS.

rapidly on account of the combined effects of the self-induction of the electro-magnet and the 8 mf. condenser. The current value did not reach zero before it began to rise again, making the period of low current value too short for the armature to rise. Hence the "B-side" signals were not disturbed.

In order to speed up the movement of the relay tongue, the contacts were closed as far as good working would permit, with the result that the time-lag Y to Z was practically eliminated. This had the effect of lessening the time and consequently the amount of the discharge of the 8 mf. condenser. Further, the current through the coils of the sounder electro-magnet did not reach such a low

value, thus showing that with close adjustment of the 'B' relay contacts, a lower capacity than 8 mf's. would suffice for satisfactory working on short and rapid circuits; but as the "B-side" disturbance increases with the length or difficulty of the circuit, due to the slower fall and slower rise of current through the line and consequently in the coils of the "B-side" relay, no reduction in condenser value will be made so far as the Post Office sets are concerned.

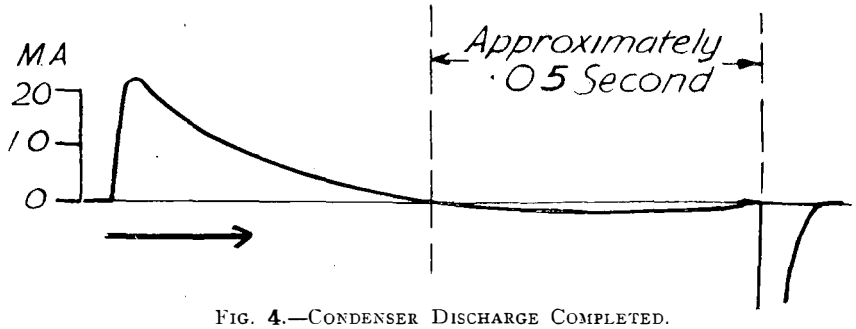


FIG. 4.—CONDENSER DISCHARGE COMPLETED.

As a matter of interest the 8 mf. condenser was completely discharged as shown in Fig. 4, and although Fig. 2 shows that the portion of the discharge used is uni-directional, the full discharge did actually pass the zero point, proving that it is unquestionably of an oscillatory character and having a frequency of about ten periods per second, but is very heavily damped. This oscillatory character does not militate against the efficacy of the arrangement.

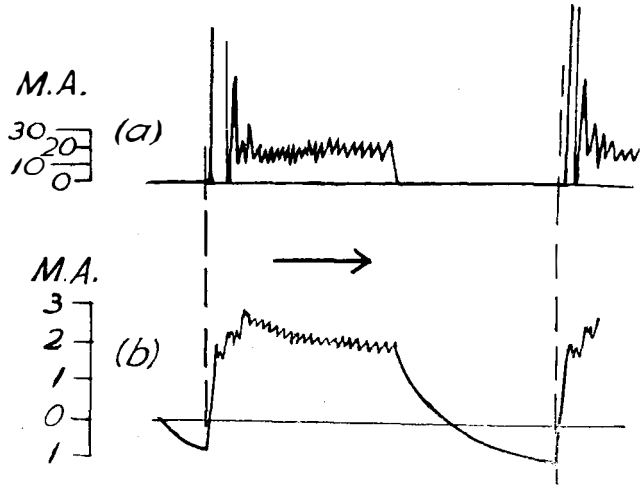


FIG. 5.—(*a*) LOCAL BATTERY CURRENT; (*b*) CURRENT IN SOUNDER SHUNT.

The current in the sounder shunt at position E is shown in Fig. 5, curve '*b*,' while the curve '*a*' shows the current from the battery at position B, already dealt with in Fig. 3. The lower curve is on a much larger scale, due to the small value of current resulting from the high resistance, viz., 10,000 ohms. It will be observed that the rise was comparatively slow, due to the heavy current into the condenser. The effect of the vibration of the relay tongue is shown by the few short movements just before the maximum current value of about 2.5 milliamperes was reached. After this point the current slowly fell due to the inductance in, and the consequent slow rise of current through the coils of the Sounder.

When the Relay tongue fell back the current through the shunt was maintained by the discharge from the condenser; but there was also an opposing E.M.F. from the Sounder coils which eventually took the curve past the zero point.

TELEGRAPH KEYBOARD PERFORATORS.

A. C. BOOTH.

ONE of the first practical instruments of this type for Morse characters to be tried by the British Post Office was that designed by the well-known Wheatstone telegraph engineer, F. G. Creed. It was brought into use in 1908, air pressure being employed to effect the perforations. Fair results were obtained, but the keys were arranged in three curved rows which made the width of the keyboard excessive and difficult for the operators. The telegraphists did not take to it and eventually it was abandoned.

Another instrument which made its appearance a few years later —about 1905—was the Gell Keyboard Perforator for Morse working. It has been very successful, and is still in use, but generally speaking it is not in such favour among operators as the later instrument made by the Kleinschmidt Co., of America, in about the year 1911. Both these instruments have a separate key for each Morse signal, as is shown in Figs. 1 and 2. The perforated slip shown below each figure in this article represents the word "Telegraph."

Of the Perforators using the 5-unit code the first is that by Carpentier, of Paris, made sometime during the latter part of last century. It perforated square holes, as shown in Fig. 3, and was what is known as a double case instrument, that is to say, each key was used for two characters, one a letter, the other a figure or symbol, but in both cases the one key perforated the same holes.

The difference in printing was obtained by a control key, of which there were two, one marked ' Letters,' the other ' Figures.' These keys also provided ' space ' signals. In Fig. **3** an extra row of keys

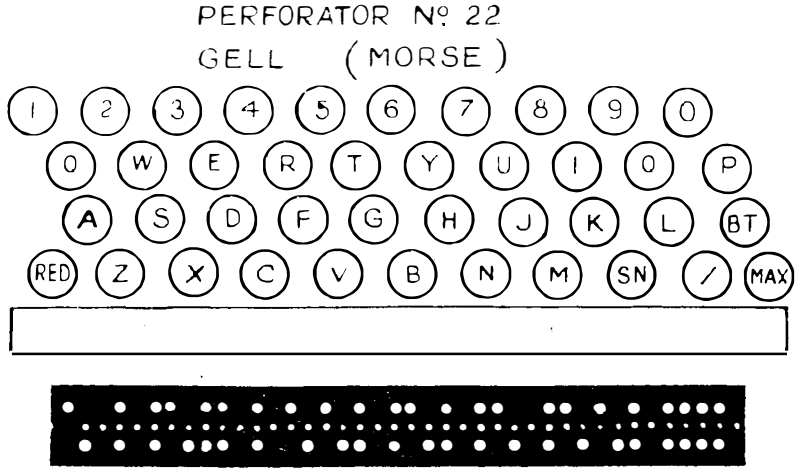


FIG **1.**

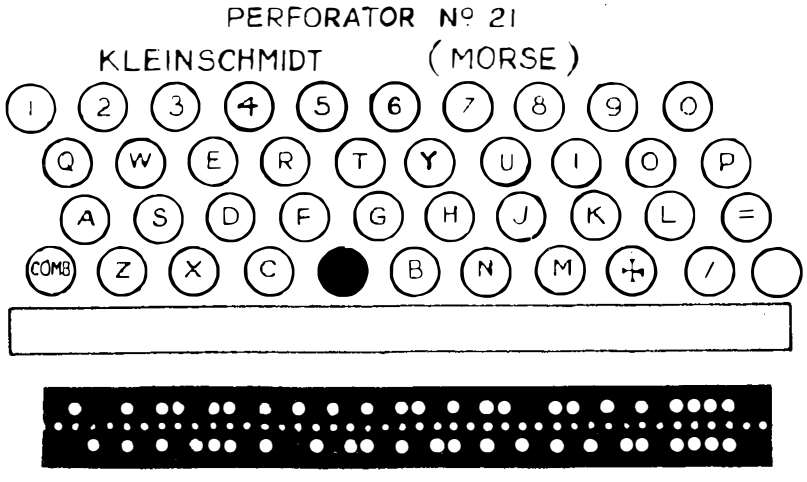


FIG. **2.**

is given for figures, because in the Baudot code they are scattered about the keyboard and would cause difficulty to trained typists. This code is termed for convenience the " 5-unit A," to distinguish it from other arrangements of the same code.

Next on the scene came Murray with a re-arranged Baudot code, the "5-unit B," bringing the secondary symbols into line with ordinary typewriter practice. Fig. 4 shows the arrangement of his

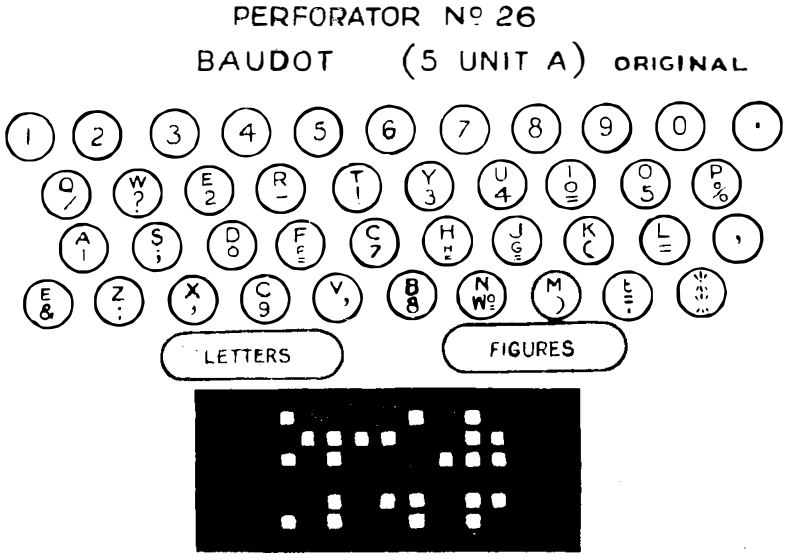


FIG. 3.

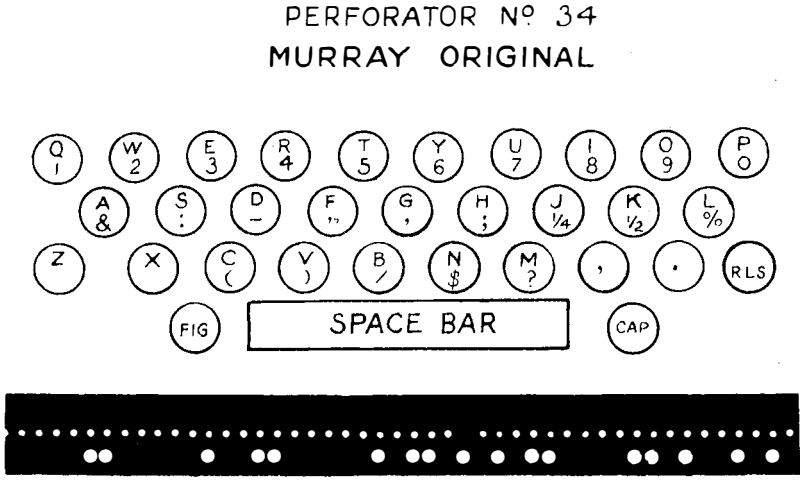


FIG. 4.

keys and the appearance of his perforated tape which is similar in size to that used with the Wheatstone, but the perforations are on the lower half only. It has the great disadvantage of feeding

forward the slip in jumps of half an inch for each letter. Later on, Murray followed the Carpentier-Baudot keyboard method in perforating across the tape, as shown in Fig. 5. In this keyboard he

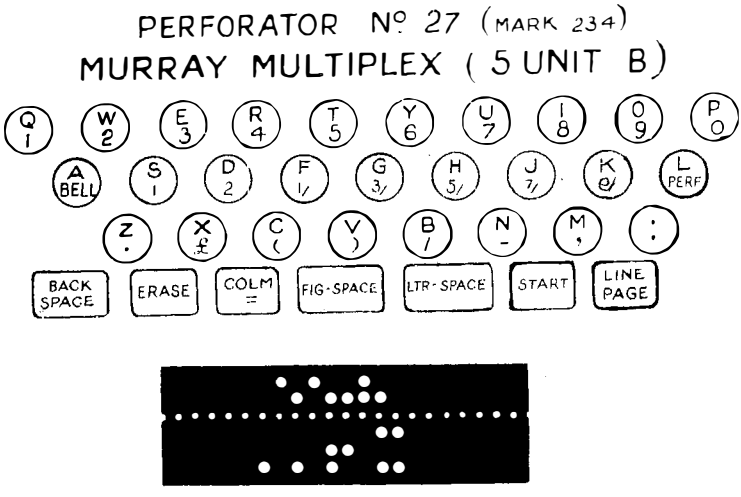


FIG. 5.

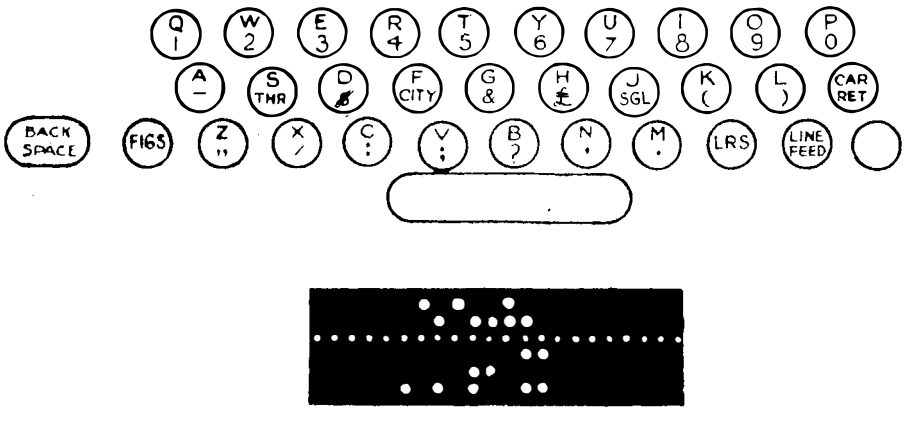


FIG. 6.

still used two signals when changing from words to groups of figures and vice versa, viz., a ' space ' and a ' change ' signal.

The Western Electric Keyboard Perforator uses the " 5-unit B " code, retaining the double signal for changing, but has some of its

secondary characters in a different position, as shown in Fig. 6. All keys except the space bar are confined to three rows.

The Morkrum Keyboard Perforator, made by an American firm,

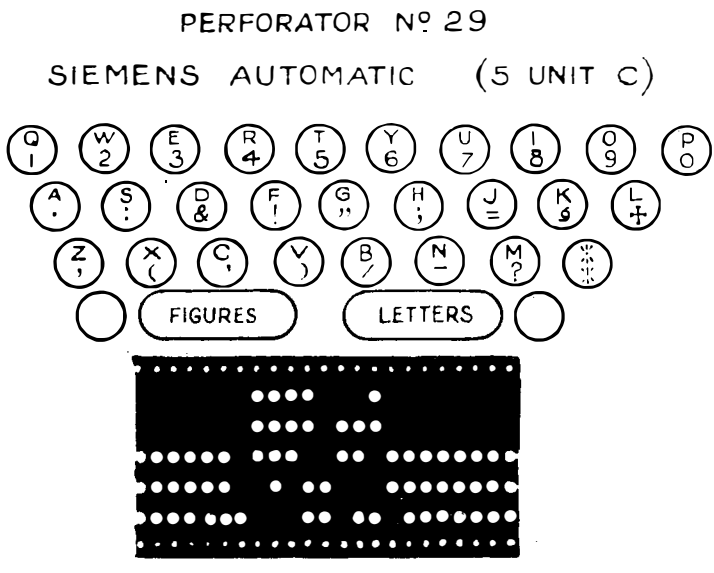


Fig. 7.

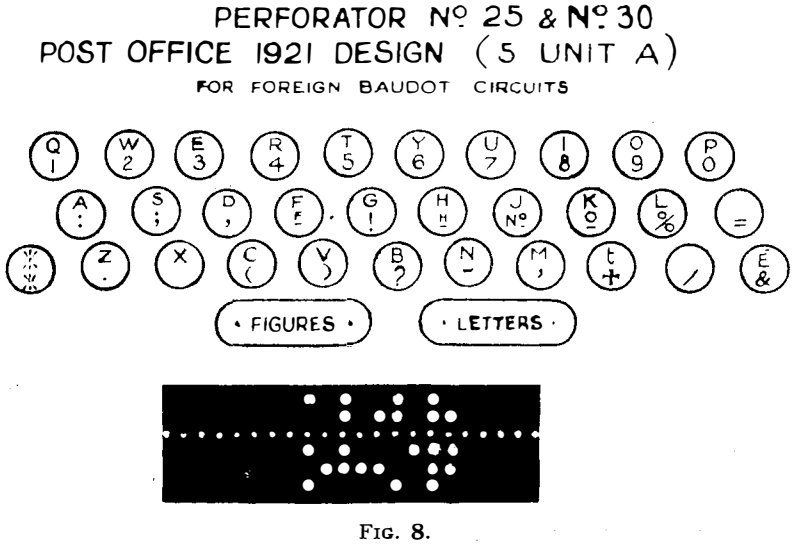


Fig. 8.

uses the "5-unit B" code and is similar to the Western Electric in its arrangement of keys, although it differs considerably in the mechanism employed.

The Siemens Keyboard Perforator, shown in Fig. **7**, uses the "5-unit C" code, differing in every character from either of the other two. It, however, follows the Carpentier-Baudot practice of a combined space and change signal, having two keys placed in front of the three rows of symbol keys. The letters and figures occupy standard typewriter positions, but the other two rows of secondaries occupy different positions to those in any other keyboard; the paper tape is also much wider.

Of all the keyboards used, preference is expressed for the arrangement of keys as shown in Figs. **8**, **9**, **10** and **11**, where the letters, etc., occupy three rows of approximately the same length, leaving only two front bar keys for the combined spacing and changing motions.

The arrangement of the secondary characters in a standard form, but suitable for use with the original Baudot code (5-unit A), is shown in Fig. **8**. The instrument uses mechanism designed by the writer and Mr. A. S. Willmot, a member of the Engineering Department of the Post Office. It provides for two different sets of perforations from each key.

The arrangement of keys and symbols for inland circuits is shown in Fig. **9**, but all the secondary characters have not yet been settled, as the Traffic Branch has under trial four different types of Baudot printing wheels. The special device also allows the provision of a double case Morse keyboard perforator, as shown in Fig. **10**, thus overcoming the disadvantage of the 'Reduce' and 'Combiner' keys on the Gell and Kleinschmidt instruments, which require the depression of three different keys in several instances to produce one Morse symbol.

From the operator's standpoint the Booth-Willmot device brings into line all types of keyboard perforators, whether they be used for Morse, Continental Baudot, Booth-Baudot Duplex, Murray or Western Electric Duplex Multiplex, or Siemens Automatic systems. On this account Mr. Murray has been requested to make his apparatus for Post Office use to the plan shown in Fig. **11**, corresponding to those shown in Figs. **8**, **9** and **10**. In this instrument also the original Baudot method of combining the 'space' and 'change' signals is embodied.

It will be noticed that both his second and third keyboards include numerators for fractions, put on at the request of the Post Office, but it is very doubtful whether their use is justified, giving as they do a second and different method for printing fractions. The numerators are necessarily smaller than the denominators, and consequently are not so clearly printed, thus increasing the liability to error.

The mechanism and perforated tape used by the Morse and the 5-unit codes of course differ radically, but identical paper tapes could be used by the 5-unit code instruments, and no doubt in time

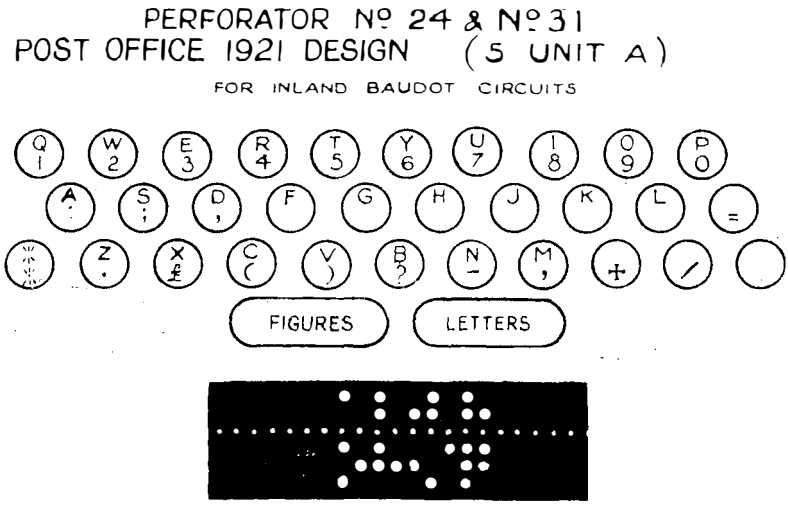


FIG. 9.

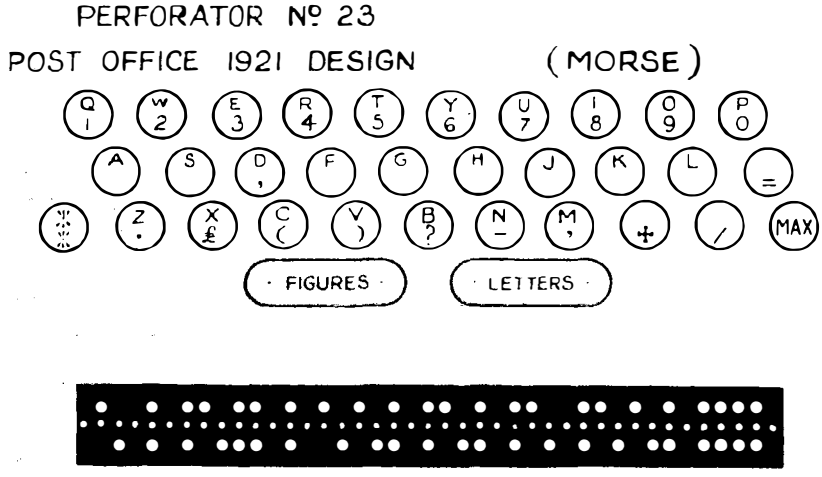


FIG. 10.

the various Telegraph Administrations will agree to a common allocation of signals for all letters, figures, and operating keys, leaving only a few special signals for exceptional characters used by different countries.

There is no reason why the Siemens perforator should not use the narrower slip with one row of progression holes. The adoption of this would of course mean some modification of the transmitters, but the cost would soon be saved by the lower cost of paper tape.

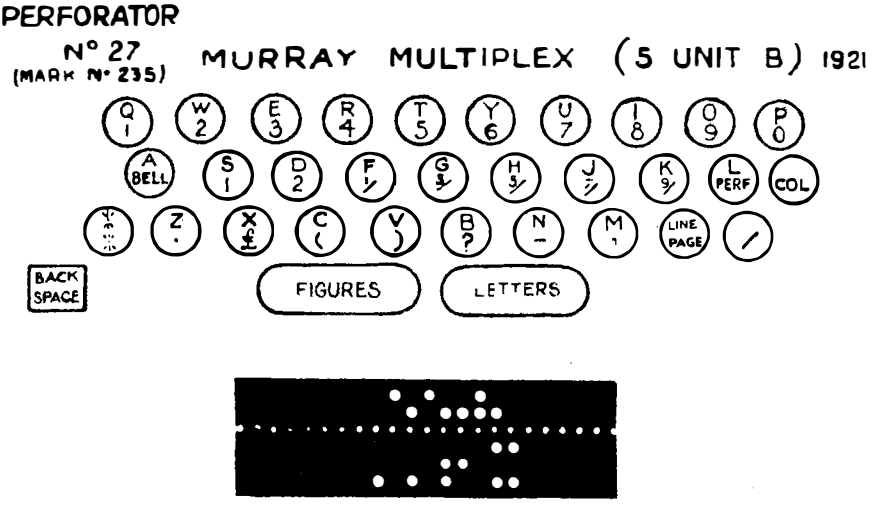


FIG. 11.

The Postmaster-General has granted permission for the Booth-Willmot device to be patented, hence a description cannot at present be given, but at a later date full details will be furnished.

IMPERIAL WIRELESS STATION AT LEAFIELD, OXFORDSHIRE.

E. H. SHAUGHNESSY, O.B.E., M.I.E.E.

THE Leafield Wireless Station was originally planned for a 300 KW. spark installation in 1913. The site was obtained and ten 300 ft. tubular steel masts were erected by the Marconi Co. in 1914, after which work on the station was suspended. During the period up to 1918 the masts were utilised to support aerials for reception and for other experimental purposes. Early in 1919, the question of the completion of the English and Egyptian stations came under review. The great development of continuous wave generators which had taken place made it clear that high power spark installations were obsolete and the methods of high frequency

generation, such as the alternator, the time spark and the Poulsen Arc then available, were investigated. The Arc had been developed in America, and by the Admiralty, the Marconi Co. and Mr. C. F. Elwell in this country. Several powerful installations had been erected by Mr. Elwell in France. After a careful and continuous watch of the performance of various Trans-Atlantic services and the inspection of several high power continuous wave stations, it was decided that the most suitable high frequency

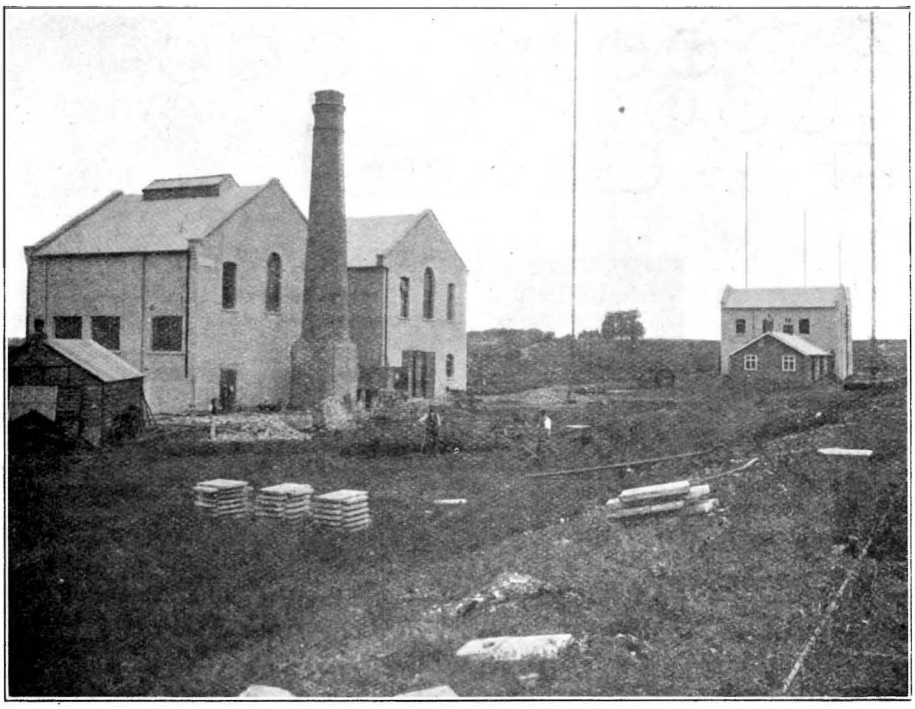


FIG. 1.—GENERAL VIEW OF STATION.

generator was the Arc. Rough plans and estimates for equipping the English and Egyptian stations with suitable power plant, arc generators and aerials, etc., were prepared by the Post Office Engineering Department in April, 1919, and authority to proceed with the work was obtained about July of that year. Detailed specifications were prepared, tenders invited and the orders for power plant were placed with various firms in November and December, 1919, and for the wireless plant in September, 1919. Under these orders the plant should all have been delivered last year, but owing to the moulders strike and general delays in makers

works the plant for the English station has only recently been delivered and its erection is now nearing completion, but the power plant for Egypt has not yet been despatched. As much valuable information will be obtained from the working of these stations the delay in the completion is very disappointing.

The English transmitting station lies near Leafield, Oxon., on an open tableland about 600 feet above sea level. The main buildings, constructed of local limestone, are the Power House, containing the boiler room, turbine room, condenser room, workshop,

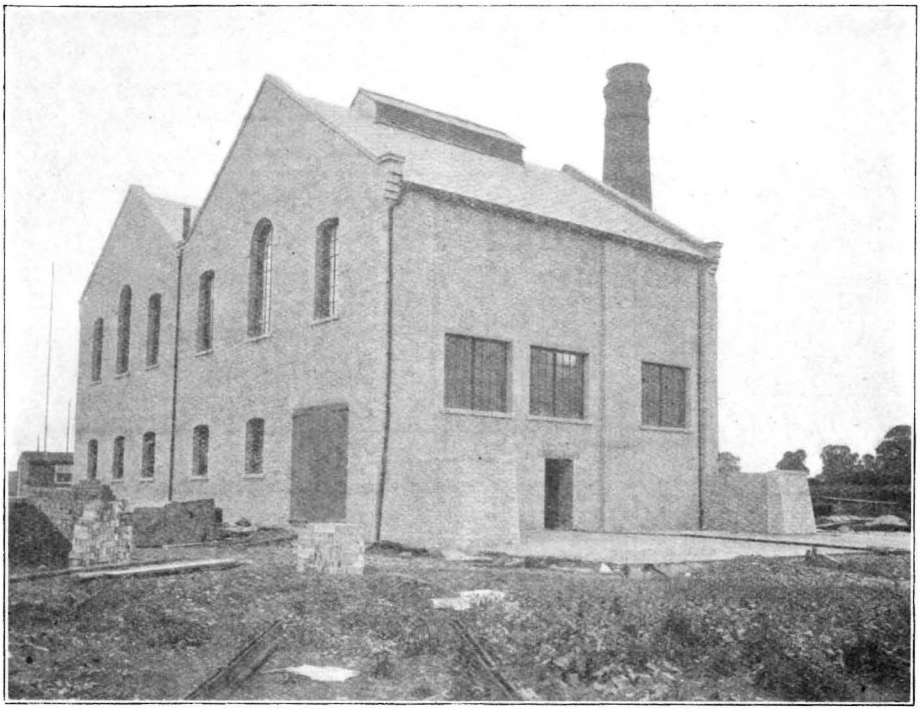


FIG. 2.—POWER HOUSE.

office, bathroom, etc., and, about 150 feet away, the Wireless Building, in which on the ground floor are the switch room, main store room and general offices, and on the first floor the arc room and the inductance room. On the site are also seven bungalows for the accommodation of the Station staff. All the building work was carried out by Messrs. Alfred Groves & Sons, of Milton-under-Wychwood, to the designs of Mr. F. C. R. Palmer.

The source of the water supply is a spring in a valley about a mile and a quarter distant from the Station, to which the water is

pumped by oil engine driven pumps; when the equipment is completed these pumps will be motor driven and controlled from the Station. The water is rather hard and is treated in a Lassen & Hjort softener before being fed to the boilers.

The isolated position of the Station necessitates holding an ample reserve of coal. From the main stack a supply sufficient for some days requirements is taken to a bunker, whence sliding doors open direct on to the firing floor of the boiler house, in which are installed two hand-fired land type Babcock and Wilcox boilers

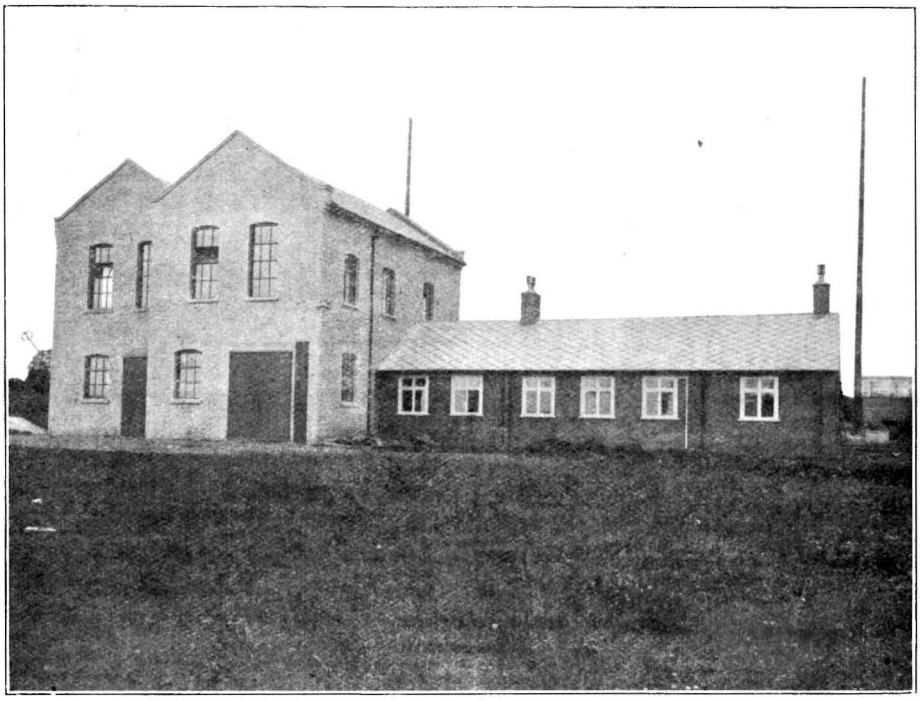


FIG. 3.—WIRELESS BUILDING.

fitted with integral superheaters. Each unit is rated to evaporate 10,000lbs. of water from and at 212° F., and is capable of meeting the demands of the whole of the prime movers. The working pressure is 200lbs. per square inch; the steam supplied to the turbines is superheated 200° F., but saturated steam can also be drawn from the boilers for the water softener and the steam-driven feed pump. A motor-driven feed pump is also provided, and the feed piping is in duplicate. The products of combustion leaving the boilers pass through a horizontal brickwork flue, 7′ by 3′, to

the foot of a brick shaft 60 feet high and 4 feet internal diameter at the top. A motor-driven Sirocco fan is installed with dampers so that induced or natural draught can be used as desired; the fan motor is controlled from the firing floor. The steam main, equipped with the usual control valves, runs behind the boilers, and branch pipes from it pass through the wall to the turbines on the first floor; the turbine room floor has been specially constructed to obviate vibration when the turbines are running.

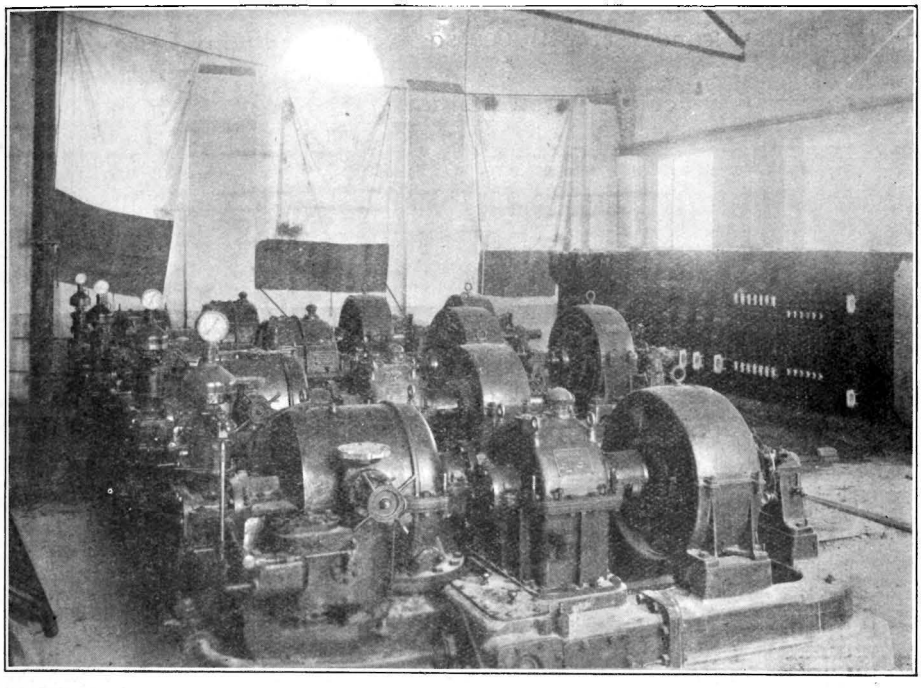


FIG. 4.—TURBO-GENERATORS.

The turbo-generators with their controlling switchboard, condensers, air pumps and other auxilliaries were installed by Messrs. W. H. Allen, Sons and Co., Ltd. Electrical energy is generated at two pressures, both continuous current; 750 to 1,000 volts for the arc supply, and 220 volts for the auxilliary motors and for lighting. Duplicate units are installed for each pressure and the switching arrangements allow the sets to be run in parallel when necessary. The turbines are of the Curtis type and run at 6,000 R.P.M., geared down to 650 R.P.M. for the 1,000 volt sets and to 1,000 R.P.M. for the 220 volt sets. The 1,000 volt sets are rated at 250 KW., and consist of two 500 volt machines coupled

mechanically and joined electrically in series, mounted on a common bedplate. To prevent possible trouble due to high frequency effects getting back to the machine from the arcs, the 1,000 volt generators are insulated from their bedplates and are driven through insulating couplings; this insulation has been tested with 5,000 volts A. C. The machines are excited from the 220 volt supply. The 220 volt units are of 60 KW. capacity. They are compound wound and the usual equaliser connections are provided for parallel running.

The exhaust from each of the 250 KW. turbines is joined direct to a surface condenser with 600 sq. feet of cooling surface. For each condenser a centrifugal circulating pump, an Allen Edwards air pump and a condensed steam force pump, all motor-driven, are provided, and the piping is so arranged that any combination of condenser, circulating pump and air pump desired can be obtained; the exhaust from either 60 KW. turbine can be passed through either condenser. Automatic atmospheric exhaust valves are fixed on all the sets, so that should the vacuum fail non-condensing working is reverted to immediately. The steam consumption is measured by passing the condensed steam on its way from the force pump to the hot well through a Lea recorder. The boiler feed is taken from the hot well so that losses only have to be made up from the water supply.

As all water used has to be pumped to the site, it is essential that economy be exercised with the circulating water for the condensers, and to this end a cooling pond has been provided. The pond was constructed by Messrs. Groves to drawings prepared by the P.O. Engineering Department, has a capacity of about 1,000,000 gallons, the circulating water is drawn from it and after passing through the condensers and becoming heated in the process is returned to the pond, but in a portion which is so separated from the circulating pump intakes by baffle walls that before the discharged water can again reach the suction pipe it must travel over a long and tortuous path, becoming cooled in the process. The main switchboard in the turbine room controls the whole of the generated energy; armoured cables from it carry the current for the arcs and auxiliaries to a two-panel board in the switch room of the Wireless building, at which Messrs. Allen's work ends.

The wireless equipment, consisting of two 250 KW. arcs and auxiliaries, was installed by C. F. Elwell, Ltd. In outline the arc method of generation of continuous waves consists of an oscillatory circuit shunted across an arc fed by continuous current. The arc burns between a copper anode and a carbon cathode in a powerful magnetic field and a hydrogenous atmosphere kept cool by water

jacketting the chamber in which the arc burns; the anode is also water cooled. The arc burns between the upper edges of the electrodes, and to equalise wear the carbon is kept in continuous slow rotation by a small motor. Fig. 5 is a view of the anode side of one of the Leafield arcs. A steel yoke passes through the concrete base, and adjustable pole pieces specially shaped at the inner ends extend from the enlarged heads of the upper ends of the yoke limbs (in which the pole pieces slide), through gas tight glands to the interior of the chamber seen in Fig. 5. The magnetic field

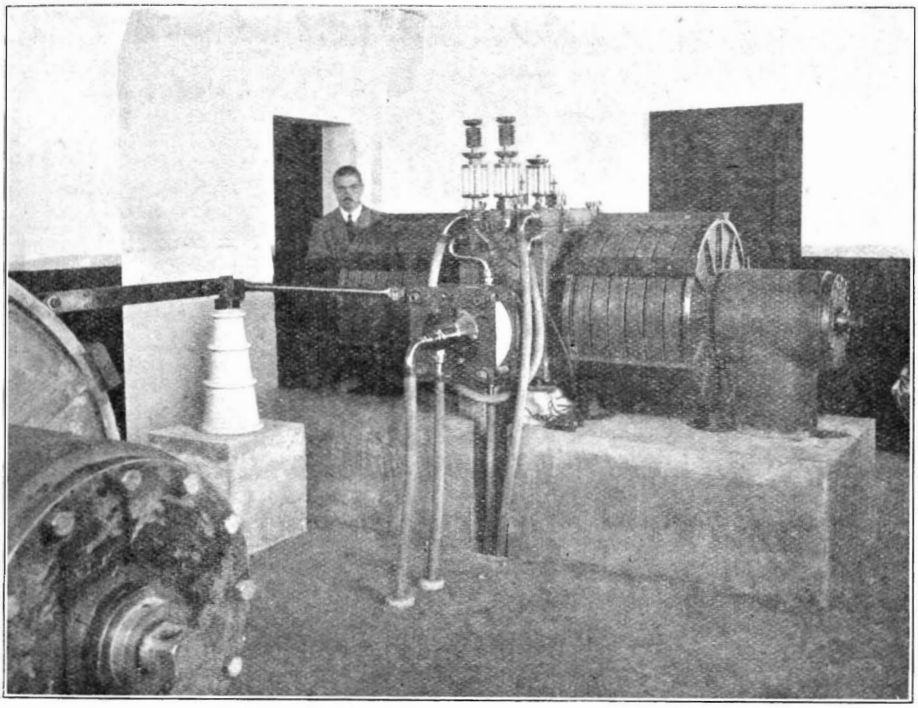


Fig. 5.—250-KW. Elwell Arc.

is produced by current flowing through the coils of copper strip encircling the pole pieces, seen to right and left of the chamber. This exciting current is the arc supply current in one of the windings, but through the other either the arc supply or current from a low voltage generator, which will supply up to 500 amperes, can be passed. The hydrogenous atmosphere is produced by dropping alcohol into the arc from the sight feed lubricators on the top of the chamber; see Fig. 5, in which the cooling water pipes are also visible.

The cathodes of the arcs are earthed, and the aerial oscillatory circuit is, starting from the anode, to key inductance, thence to the lower end of the aerial tuning inductance (which consists of stranded wire with the individual wires insulated from each other to prevent losses from skin effect with the high frequency currents) from the upper end of this inductance through the leading-in insulator,

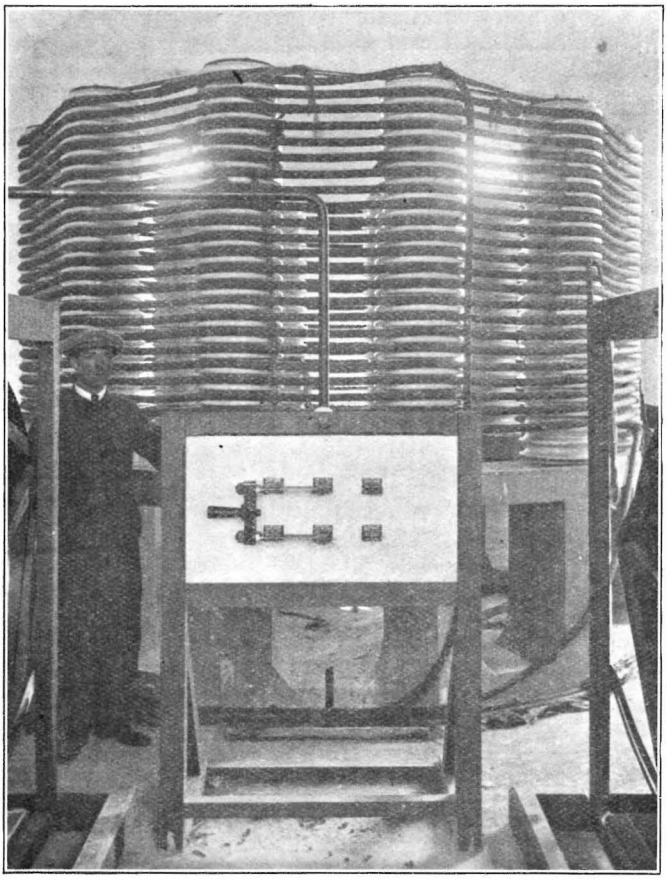


FIG. 6.—AERIAL TUNING INDUCTANCE.

which, to ensure adequate insulation, is fixed in the centre of a large plate of glass to the aerial system; the capacity to earth of the aerial completes the shunt circuit.

For signalling, a spacing wave is to be used, that is, during the spaces of the morse signals energy continues to be radiated, but on a wave length differing from that used for the marks. The change of wave length is effected by varying the inductance of the keying

inductance in which is a spiral of copper strip in series with the aerial. On each side of this spiral are two other spirals, adjustable in position and inductively coupled to it. During signalling these side spirals are shorted in one position of the operating key and opened in the other; the effective inductance of the central spiral is varied according as they are open or shorted and the emitted wave length changes with the change of inductance. The actual short-circuiting is done by the special Creed key seen in Fig. 8.

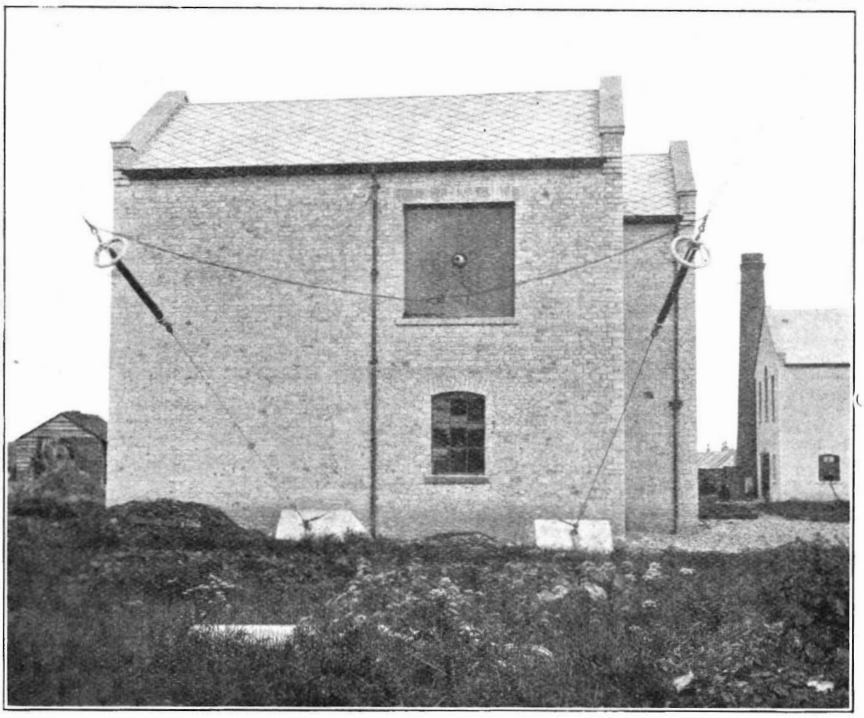


FIG. 7.—AERIAL LEAD-IN.

The striking of the arc and the necessary adjustments of the apparatus are done by an arc attendant, who has on a control cabinet in front of him instruments indicating the conditions through the installation and means of varying these conditions by remote control. All changes in the 1,000 volt circuits are done through contactors in the room below, operated at 220 volts from the control position. Numerous automatic safeguarding devices are fitted. To maintain a steady current in the arc D.C. supply, choke coils are provided; the field winding acts on the earthed side, while the coil is on the positive side.

The wavelength is varied by changing the amount of the main inductance in circuit, tapping points being cut into it for coarse adjustments, a sliding connection on a length of copper tube at the foot of the coil giving fine adjustment.

For operating the Creed keys and extinguishing arcing at the contacts an air supply furnished by two Reavell Air Compressors of 40 cubic feet capacity, driven by 9-H.P. D.C. motors, with automatic starters, has been provided and installed by the Department. The compressors are started from the arc controller. The

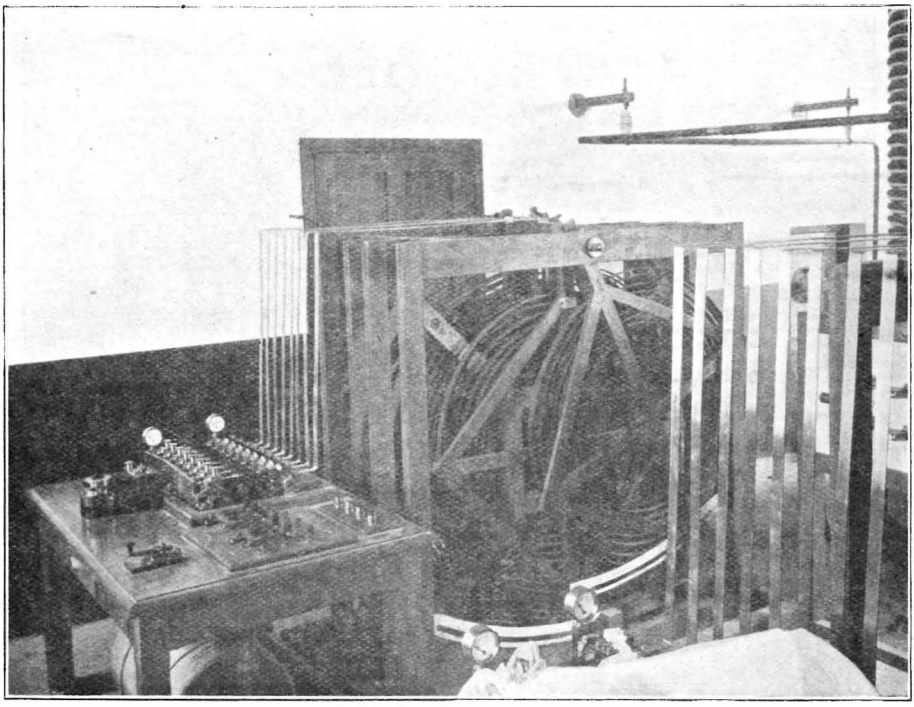


FIG. 8.—CREED KEY, ETC.

cooling water for the areas is obtained from the cooling pond, two motor-driven pumping sets having been installed by the Department for this purpose. These pumps are also started automatically from the arc controller. In addition, the Department have provided a low pressure air supply for cooling the arc field coils.

A separate aerial supported on 75′ poles is to be used for reception at Leafield. It is necessary for this aerial to be earthed and the receiving gear protected during transmission. This operation is performed by a remote controlled switch, designed by the Department, which is operated by the stop on the arc controller imme-

diately preceding the stops operating the 1000-volt contactors. The circuit of the control wires for these contactors passes through the "send—receive" switch, so that it is impossible to start the arc until this switch has operated.

The main aerial system is supported by ten tubular steel masts, 300 feet high. The earth wires are buried at a depth of about 9 inches. The wires were laid by the Oxford Steam Plough Co., using a modified drainage plough. The connections from the arc cathodes to the main earth are made by broad copper strips passing down outside the wall to just below ground level, where they join a

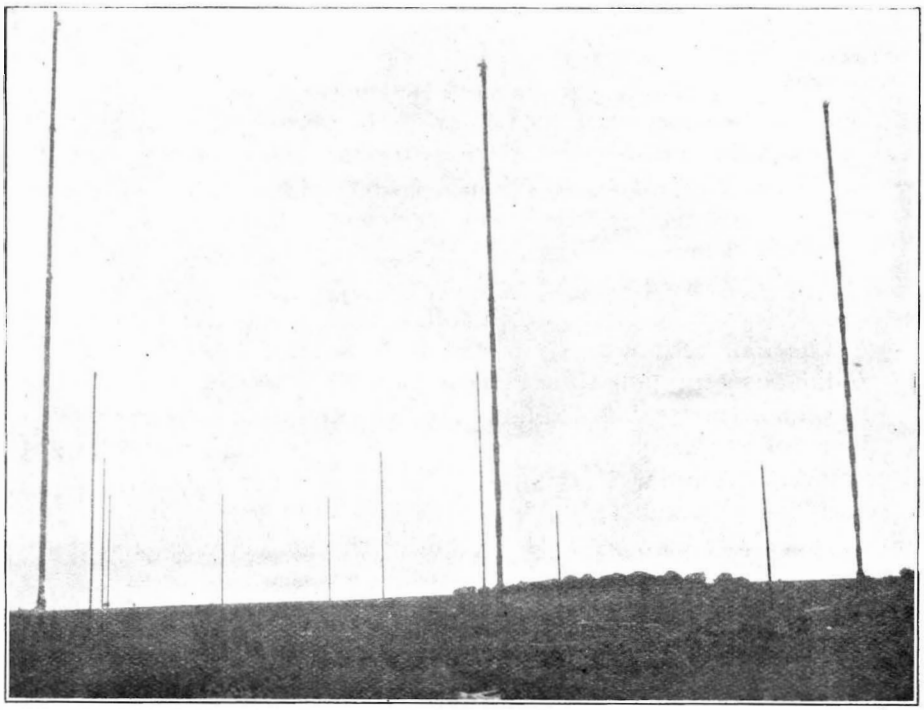


FIG. 9.—AERIAL MASTS.

similar strip running right round the building close to the walls. The radiating earth wires are soldered to this strip surrounding the building. Incorporated in the floor of the arc and inductance rooms, and extending over the whole of their area, is a zinc plate joined to the main earth system, thus screening the plant in the ground floor rooms from high frequency effects.

It is hoped that the station will be completed by the time the next issue of the Journal appears and data as to the results obtained will be available. The Receiving Station for working in conjunction with Leafield is being erected at Banbury.

THE EFFECT OF TEMPERATURE AND HUMIDITY ON THE CAPACITY OF INERT CELLS.

C. LAWTON.

Indian Telegraph Department.

IT has been recognised for many years in India that the capacity of the various types of Leclanche cells (both wet and dry) depends on the time of the year at which the tests are taken, and for many years it has been the practice to carry out tests which are being taken for comparative purposes at one particular period of the year and at one particular place only, viz., during the monsoon and in Calcutta. In 1919, it was decided to carry out a series of tests with a view to ascertain to what extent the capacity varied at different times of the year, and whether any relation existed between the capacity and the Meteorological conditions. Forty-eight cells of the Fuller inert type, size No. 19, were accordingly set aside from one consignment and these were tested in batches of four; one batch being tested each month starting from July, 1919, the tests being carried out in Calcutta.

The tests were conducted as follows:—

The four cells were connected in series and were discharged continuously through a resistance of 20 ohms (5 ohms per cell). As the cells became exhausted they were removed from the circuit and the resistance was at the same time reduced by 5 ohms for each cell removed. A cell was considered exhausted when its P.D. had fallen to •.75 volts.

Daily records were kept of the discharge current, and the E.M.F. and P.D. of each cell, records were also kept of the daily mean temperature, daily rainfall and humidity at 8 a.m. daily. From these records was calculated for each batch of cells tested:—

(*a*) The average capacity.

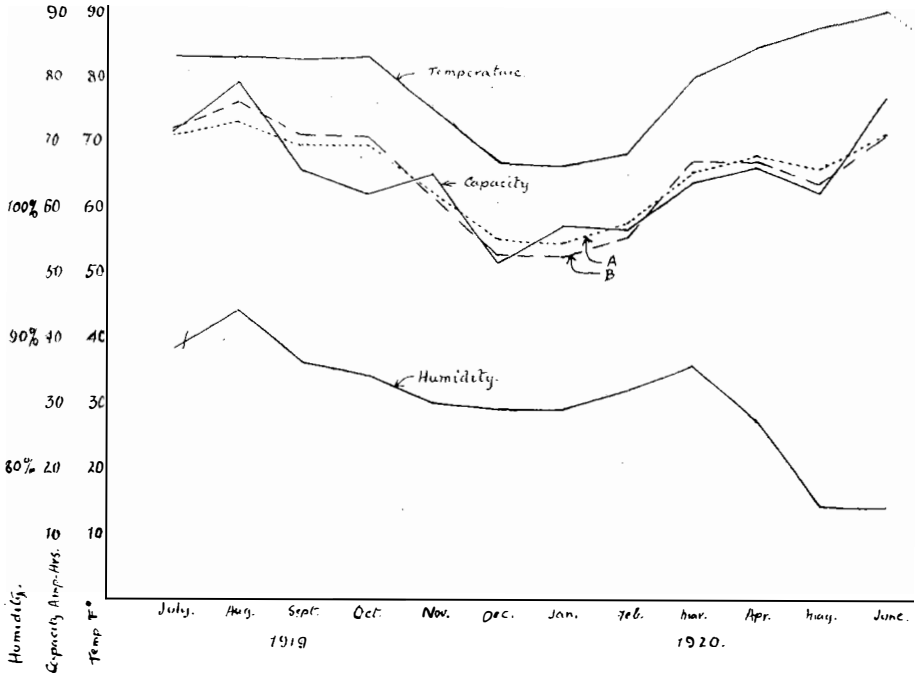
(*b*) The average temperature during the test.

(*c*) The average of the daily humidities during the test.

These are shown plotted in the Fig.

Examining the curves for Temperature humidity and capacity we see that in August the temperature remained steady, but there was an increase in the humidity, while the capacity shewed an increase; in September the temperature remained steady but the humidity fell, and the capacity also fell; in October there was no change in the temperature, but there was a further fall in both the humidity and the capacity; in November both the temperature and humidity fell, but there is an unaccountable rise in capacity in this month; in December temperature and humidity were at their lowest

as was also the capacity; in January there was very little change in temperature and humidity, but there was a rise in capacity; in February both temperature and humidity rose while the capacity shewed a decrease from January, but was higher than in December. March saw a further rise in temperature and humidity which was accompanied by a rise in capacity. In April temperature rose while humidity fell and there was a small increase in capacity; in May there was a slight rise in temperature and a big drop in humidity and the capacity fell; in June there was a further rise in temperature while humidity remained steady, and the capacity rose.



From these curves it would appear that both the temperature and humidity affect the capacity.

Assuming this to be the case dotted curves A and B have been drawn. A being drawn to the formula:—

$$\text{Capacity} = 0.8\,T + 0.5\,H - 58,$$

and B being drawn to the formula:—

$$\text{Capacity} = 0.9\,T + 0.007\,H^2 - 58.$$

T being the temperature in Degrees, F and H being the percentage humidity.

The 5 ohm test. A continuous discharge through 5 ohms has been taken in India as the standard test for this size of cell, as when

discharged continuous through 10 ohms the test is very long drawn out.

The capacity of these cells depends on the rate of discharge as well as on the seasonal conditions. The lower the discharge rate the higher the capacity. Tests carried out in India go to show that the capacity usually obtained on the 5 ohm test is about 2/3rds of that usually obtained on the 10 ohm test. So that to obtain an idea of the capacity of the cells on a 10 ohm discharge it would be necessary to increase the constants in formulæ A and B by 50%.

PAPER CORE TELEPHONE CABLES.

S. HANFORD, B.Sc., A.M.I.E.E.
Test Section. Engineer-in-Chief's Office.

IN Vol. 7, part 3 of this Journal, a description was given of a method of ascertaining quickly the overall size and lead thickness of paper core cables by curves, using as the fundamental unit the space per pair allowed for each weight of conductor in order to get the required capacity between the wires of each pair.

The purpose of this article is to bring up to date the standard data given in 1914, and to add a further feature which enables one easily to determine the best make-up of Composite Twin Cables.

If there are n pairs in a cable core, and each is allowed s square inches on a cross-section, then the area of the cross-section of the core is ns sq. ins.

If d inches is the diameter over this core, then the area of cross-section equals $\frac{\pi d^2}{4}$ sq. ins.

$$\therefore \frac{\pi d^2}{4} = ns, \text{ and } d = \sqrt{\frac{4ns}{\pi}} = \sqrt{\frac{4S}{\pi}}$$ where S equals total area.

For each diameter over the core there is a standard lead thickness and a standard maximum overall diameter of cable given by the following relations:—

$$t = .051 + .038\,d$$

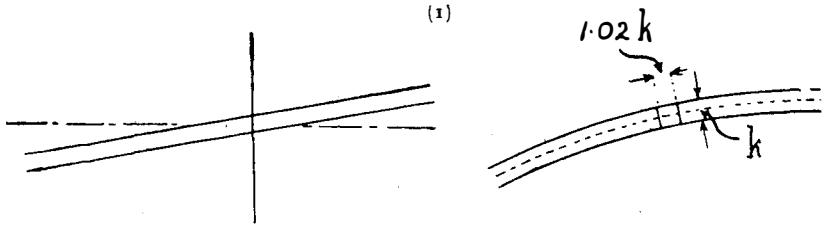
$$D' = 1.02\,(d + 2t) + .025.$$ All in inches.

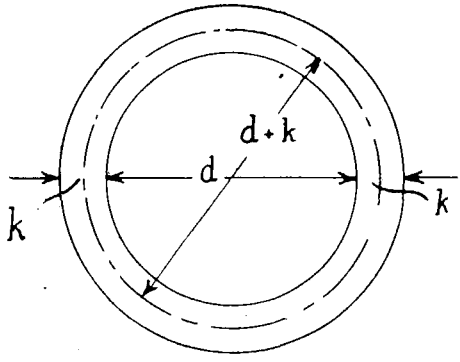
If one is frequently in need of determining cable sizes curves should be drawn connecting d and S, and also D' and S, according to the above equations.

The most useful and simplest conception of the space occupied by a pair in a cable is a small square tube which winds its way in a very open helix from one end of the cable to the other, always

keeping to its own layer, but revolving round the layers beneath it once in (say) every yard. If, due to this lay, the little tube is at such an angle to the axis of the cable that its increased length is 2%, then if a cross-section of the cable is made, the tube will not be cut at right angles and will show as a little rectangle with one side 2% longer than the other. If the little square unit tube has sides each k inches long, the rectangle will show on the cross-section with the side radial to the layer k long and the side circumferential to the layer (1·02) k long.

(1)





(2)

Its area = 1·02 k^2 sq. ins.

The area allowed per pair on the cross-section is the standard space per pair, therefore 1·02 $k^2 = s$, or $k = \sqrt{\frac{s}{1{\cdot}02}}$ inches.

Obviously k is the thickness of a compact layer of pairs.

The figure of 2% for lay is sufficient to cover the average increase due to lay in all cables, and for many of the sizes it is more nearly the value of the increase due to lay on the outer layer. It is at present used as an all round figure for calculations of this nature

Although the shape of an actual pair is by no means square, rectangular, circular or any other regular shape, yet our simple conception has allowed us to deduce a relation between the thickness of the compact layer of pairs and the distance round the circumference of the pitch circle of the layer concerned which each

pair occupies, and to connect these with the standard space per pair; and by a more intricate analysis it can be shown that the result $k = \sqrt{\frac{S}{1{\cdot}02}}$ holds good for any shape of pair, provided the whole of the space in the core is occupied by the n pairs and the pairs lie side by side round each layer.

The following table gives the up-to-date standard electrostatic capacities and space per pair values, and includes the value of k the thickness of a compact layer of pairs:—

Weight of Conductor. (lbs/mile)	Mean wire to wire capacity not to exceed. mfds/mile of cable	Space per pair. Sq. ins.	Corresponding mean thickness of compact layer. Inches
$6\frac{1}{2}$	·075	·0040	·0626
10	·075	·0057	·0748
20	·065	·0140	·1172
40	·065	·0275	·1642
70	·065	·0475	·2158
100	·065	·068	·258
150	·065	·102	·316
200	·065	·136	·365

It must always be remembered that with the single exception of the first layer round a centre of one pair, the number of pairs in successive layers should increase by 6. Thus the number of pairs on successive layers which make up into best cables are:—

1, 6, 12, 18, 24, 30, &c., giving in all 1, 7, 19, 37, 61, 91, &c. pairs.
2, 8, 14, 20, 26, 32, &c., „ „ 2, 10, 24, 44, 70, 102, &c. „
3, 9, 15, 21, 27, 33, &c., „ „ 3, 12, 27, 48, 75, 108, &c. „
4, 10, 16, 22, 28, 34, &c., „ „ 4, 14, 30, 52, 80, 114, &c. „

Centres of 5 or 6 are not used. They are not stable. The two centre is not so good as the 1, 3, or 4.

The extent to which this rule of adding sixes may be departed from in special cases will be dealt with in a later article, but one should not add less than 5 nor more than 7, and such a step should not appear more than once in a complete make up.

An example or two will show the use of the data in the table.

(1) What is the size of the core of a 200-pair/10 P.C. Cable? What is the best make up?

Area of core = 200 × ·0057 = 1·14 sq. ins.

Diameter of core = $\sqrt{\frac{4 \times 1{\cdot}14}{\pi}}$ = 1·205 inches.

If you have made your curves showing how d and D′ vary with total area, this value of d could be read off over the point in the S scale equal to 1·14.

A few trials will show that the best make up—*i.e.*, the one in

which the 6 rule is departed from least—is 4, 10, 16, 22, 28, 34, 40, 46.

(2) What is the size of 36-pairs/40 lbs. core? Make up?

Area of core = 36 × ·0275 = 1·35 sq. ins.

Diameter of core (formula or curve) = $\sqrt{\frac{4 \times 1{\cdot}35}{\pi}}$ = 1·31 inches.

Best make up: 1, 6, 12, 17.

Now take the general case of Composite Twin Cables. We have a core of diameter d inches already made, and the number of pairs of a given weight of conductor which will form the next layer is required to be known.

Let the space per pair for the new weight of conductor be s, and the thickness of one layer will then be $k = \sqrt{\frac{s}{1{\cdot}02}}$

Diameter of pitch circle of new layer = $(d + k)$ inches.

Circumference of pitch circle of new layer = $\pi (d + k)$ inches.

Each new pair occupies 1·02 k inches of this circumference, and therefore the number of pairs forming the new layer = $\frac{\pi(d + k)}{1{\cdot}02\, k}$

(3) Round a core of 30-prs./40 lbs. how many 20 lbs. pairs will go in the next layer?

Area of core = 30 × ·0275 = ·825 sq. ins.

Diameter of core = 1·025 ins.

Number of 20 lbs. pairs in new layer = $\frac{\pi(1{\cdot}025 + k)}{1{\cdot}02\, k}$

From the table k for 20 lbs. = ·117

and number of 20 lbs. pairs = $\frac{\pi(1{\cdot}025 + {\cdot}117)}{1{\cdot}02 \times {\cdot}117}$ = 30·1, say 30.

(4) Round a core of 7/pr./70 about 70 pairs of 20 lbs. are needed, and then the cable is to be filled to maximum size with 6½ lb. pairs What is best make up? (Max. overall diam. allowed is 2·75 ins.).

Area of core 7/70 = 7 × ·0475 = ·3325 sq. ins.

Diameter of core 7/70 = ·65 inch.

n/20 new layer = $\frac{\pi(·65 + ·117)}{1{\cdot}02 \times {\cdot}117}$ = 20·2, say 20.

Now apply the six rule, and following layers of 20 lbs. will be 26 and 32, making 78 prs./20 in all.

Area of core 7/70 + 78/20 = ·3325 + 78 × ·014 = 1·4245 sq in.

Diameter of core 7/70 + 78/20 = 1·35 inch.

n/6½ new layer = $\frac{\pi(1{\cdot}35 + {\cdot}0626)}{1{\cdot}02 \times {\cdot}0626}$ = 69·6, say 70,

and following layers will be 76, 82, 88, &c.

Total area available in 2·75 inch overall cable will be found from your curve for D′ and S to be 4·47 sq. ins.

Eight layers of 6½ lb. prs. will add 728 prs./6½.

Area of cable 7/70 + 78/20 + 728/6½ = ·3325 + 1·092 + 728 × ·004 = 4·3365 sq. ins.

sq. ins., which is too large; so that only eight layers of 6½ lb. pairs may be added.

If nine layers were added, the area required would be 4·8085

Make up 7/70 + 78/20 + 728/6½ is thus

$$\underbrace{1,\ 6}_{70}\ ,\ \underbrace{20,\ 26,\ 32}_{20}\ \cdot\ \underbrace{70,\ 76,\ 82,\ 88,\ 94,\ 100,\ 106,\ 112}_{6\frac{1}{2}}$$

and diameter over core = 2·35 and D′ overall = 2·71 inches.

This example will serve to show the difficulty often met with when Composite Cables are required, namely, that we cannot get very near to the required number of pairs. Suppose we had needed 58 prs./20 only, two layers would have given only 46 prs., and three layers would be 78 prs., and in order to meet this difficulty to some extent we must be prepared to squash the pairs either sideways and get more in a layer, or radially and get fewer in a layer and so run the risk of upsetting the capacity. This aspect of the matter will be dealt with in a later article. For our present purpose we must content ourselves with saying that 78/20 is the best make up; but it will be obvious that if the layer under the 20 pr./20 layer had been 20 lbs. it would have contained 14 pairs, and if we had availed ourselves of permission to depart from the 6 rule at this stage the next three layers would have been 19, 25, 31, giving 75 pr./20. This may be done. If it is, the number of 6½ lb. pairs must be recalculated, allowing for a core of 7/70 + 75/20 only.

For anyone interested it will be found very useful indeed to work out, as indicated in examples 3 and 4, the best number of pairs of various standard wires which form the next layer round each of the best cores of 10, 20, and 40 lbs. pairs; that is to say work out

7/20 + *n*/10, 19/20 + *n*/10, 37/20 + *n*/10, &c.
10/20 + *n*/10, 24/20 + *n*/10, 44/20 + *n*/10, &c.
12/20 + *n*/10, 27/20 + *n*/10, 48/20 + *n*/10, &c.
14/20 + *n*/10, 30/20 + *n*/10, 52/20 + *n*/10, &c.

Repeat for *n*/6½.

Repeat for 40 lb. cores + *n*/20, and + *n*/10, and + *n*/6½.

Repeat for 10 lb. cores + *n*/6½.

Such information arranged in a table for reference will show at a glance the best first layer of various gauges round a full range of cores from 7-prs. upwards, and will enable one to fix one's mind without preliminary trials on the most likely combination to meet requirements.

TELEGRAPH AND TELEPHONE PLANT IN THE UNITED KINGDOM.

STATEMENT SHOWING MILEAGES AND TELEPHONE STATIONS FOR EACH ENGINEERING DISTRICT AS AT 31ST MARCH, 1921.

Telephone Stations. (a)	Overhead Wires: Mileages.				Engineering District.	Underground Wires: Mileages				*Submarine (Land miles).
	Telegraph.	Trunk.	Exchange.	Spare.		Telegraph.	Trunk.	Exchange	Spare	
318,699	1,282	2,944	54,237	216	London	17,172	16,658	1,138,225	15,556	
47,670	6,150	15,808	42,212	2,723	S.E.	2,308	8,059	147,073	16,272	
40,226	8,437	19,055	36,728	1,592	S.W.	12,210	1,552	70,859	1,574	
32,402	15,501	27,274	33,808	4,060	E.	15,238	20,541	35,573	15,761	Telegraphs 14,876 (b)
55,868	15,863	38,992	41,351	2,682	N. Mid.	7,253	13,095	91,158	20,616	
43,227	11,136	24,594	44,735	4,827	S. Mid.	6,495	7,279	99,732	33,457	
35,513	8,021	23,830	35,826	3,100	S. Wales	4,698	9,394	60,330	13,619	Trunks 1,575
51,831	12,530	20,531	34,004	5,794	N. Wales	11,361	16,292	91,276	10,313	
95,248	4,736	16,068	43,910	3,442	S. Lancs.	9,541	149,661	227,157	31,155	
47,210	9,162	24,480	35,200	2,590	N.E.	4,244	31,257	102,710	20,649	Exchanges 2,440
46,016	6,985	26,540	38,191	1,861	N.W.	9,213	12,030	95,035	14,238	
31,111	3,898	13,834	21,157	2,361	N.	3,092	13,943	49,626	6,302	
32,321	26,029	10,684	25,451	892	Ireland	840	4,740	50,504	487	Spares 328
41,743	11,654	17,634	28,014	2,685	Scot. E.	1,406	100	74,205	3,238	
62,938	10,910	20,718	40,309	470	Scot. W.	11,139	4,826	162,019	15,104	
982,023	152,294	302,986	555,133	39,295	Total.	116,210	8,157	2,495,482	218,385	19,219
917,905	150,339	290,170	558,168	37,833	Figures on 31st March, 1920.	107,630	167,923	2,244,960	180,953	

NOTES.—(a) Exchange and Private, including Apparatus maintained by Post Office—Subscribers' Property.
(b) Includes Imperial Cable, 3,985 land miles.
* The Submarine figures represent the position as at 31 March, 1920.—Later particulars are not yet available.

POST OFFICE ENGINEERING DEPARTMENT ANNUAL DINNER.

THE Annual Dinner of the Engineering Department was held on the 22nd April, in the Connaught Rooms. Among the guests present were the following:—W. H. Allen, O.B.E.; L. B. Atkinson; Sir H. Bunbury, K.C.B.; Sir Tom Callender, K.B.E.; M. C. Conner; F. Gill, O.B.E.; Lt.-Col. N. Harrison, C.M.G., D.S.O.; Dr. Jewett; W. W. Lackie; E. A. Laidlaw; J. Lee, M.A.; F. A. Lord, C.C.; G. Morgan, O.B.E.; Sir E. Murray, K.C.B.; G. H. Nash, C.B.E.; Col. Sir A. McJ. Ogilvie, K.B.E.; H. M. Pease; The Rt. Hon. H. Pike Pease, M.P.; G. F. Preston, O.B.E.; C. C. Sanderson; A. M. Sillar; Sir J. Snell; Sir J. Stewart, Bart.; and Dr. Mullineux Walmsley. Messrs. Eldridge, Elliott, Johnson and Stretche, Superintending Engineer, and H. A. McInnes, were present from the provinces.

After an excellent dinner, promptly served, the Chairman, Sir Wm. Noble, proposed the Royal Toast.

The Rt. Hon. HERBERT PIKE PEASE, M.P., Assistant Postmaster General, in the course of his speech proposing the toast of "The Engineering Department," said:

Gentlemen,—As one who has had the opportunity of going to France during the War and has some little knowledge of the work which has been done by your Department, I feel that I am not exaggerating when I say that if it had not been for the extraordinary accomplishment of the Engineering Department of the Post Office, the war would never have been won. I therefore esteem it a special honour to propose this toast to-night, and I would like to say this:—That as far as the work which has been accomplished by this Department is concerned during the greatest war in the history of the world—and this does not apply only to the work abroad but, to a very marked extent, to that which has been accomplished at home—when the history of the war is written (if it ever is) I am sure that a brilliant page will be that page describing the history of your work.

The other day I heard a story of Mr. Balfour playing golf and he had rather an intelligent caddy. He asked this caddy to where he could hit the ball and the boy said, "Well, if you hit it just to the bunker you will get nicely beyond the green." He placed the ball in the right position just in front of the obstacle and turned to the caddy, in the delightful way characteristic of his adaptability to everything in this world, and said: "Well, I have done everything you told me. It was very good advice"; to which the caddy replied, "Sir, if you had my brains and I had your strength we should make a good pair." (Laughter.)

I should like to say a few words in regard to the present position as far as our Department is concerned, and also in regard to the possibilities of the future. It is not wise to prophesy, unless you know. I believe it is just a hundred years ago since two men—William Cook and Professor Charles Wheatstone—first thought of sending signals, I think somewhere near Euston Station, for commercial purposes, and out of that fatherhood has grown the extraordinary possibility which we see to-day. The development is increasing day by day, and may I say that those whom I am now addressing are contributing in a marked degree to the development of telegraphy, and possibly more so than in similar departments in any other country in the world. In 1870 there were 49,990 miles of wires; to-day, including telephone wires, there are 3,739,000 miles of wires. Of course, that is not quite sufficient yet, but at the same time, it means a very great stride, and great development has been made in many directions, especially when you take into account the difficulties with which we have had to contend during the war.

I have had considerable experience lately of the telephone question in the House of Commons, and as one who has sat there for nearly a quarter of a century I do not know that there has been any subject that has aroused the same high and sentitive opinion as this question of the telephone, and I must say that there are occasions on which it is very difficult to contend with the difficulties which arise.

I think we might be proud of the fact that the British Post Office inaugurated the first wireless service, I am told, from Skerrys Rock Lighthouse to the Island of Anglesea. Everyone knows that rapid communication is the life line of successful industrial development, and I am quite sure that the work which has been recently done has contributed very much to that end. Now, with regard to wireless, we have been very successful lately in many directions. The new continuous wave station at Devizes, with 300 feet masts and daylight range of 1200 miles to ships at sea, is a step forward in the right direction. The possibility of the wireless of the future is very great. I remember very well, as an absolute novice when I joined the Post Office about six years ago, being very much struck with what may seem to you a very simple matter. I went into one of our wireless stations and the operator asked me if I would like to listen, and then I heard a little scratch which I could not think meant much, and I was told that was from Madrid. I said "How do you know?" "Oh, that is the way the operator works," was the reply. Well, I wonder what the future may be with regard to wireless telephony. It may be that in the years to come we may have the opportunity of hearing our relations sing in Australia just as

plainly as we heard the lady sing to-night. There are also the interesting results obtained by multiplex high frequency telephony. Then I should like to congratulate to-night those who have been responsible in the Post Office experimental laboratory for the great work which has been done. It is a secret work to a great extent and very few know what has been accomplished, but those who do know appreciate the value of the work.

I believe there have been more wires carried underground in this country than in any country in the world, and as far as charges for the telephone is concerned, people hardly seem to realise that you cannot make a 4d. loaf with wheat at the present price. When we consider what the position of the Engineering Department was years ago, we realise what enormous expansion has taken place. A few years ago there were only a few hundred, I believe, in the Engineering Department; to-day there are about 23,000 people, and I think you are altogether a happy family. Of course, there is always disappointment in the Civil Service, and that is very natural because promotion is so slow. There are always men who consider they ought to be promoted instead of others.

Now, one serious word in regard to those who were in our ranks in the Post Office a few years ago, but owing to the exigencies of war are there no longer. I think we should all remember the services they rendered to their country in those difficult and trying times. We must pull together with one accord for the maximum development of the British Empire. I hope sincerely, if ever I have the opportunity of addressing you again, that it may be in happier times when the sky is not quite so overcast as it is to-day. May the memory of those splendid men who gave their lives for their country be an inspiration to us, a precious memory which will never die.

I have the greatest pleasure in proposing the health of the Engineering Department of the Post Office, and I wish specially to couple with the toast the name of Sir William Noble and to thank him for the work he has already accomplished since he has been the head of that Department.

Sir HENRY N. BUNBURY, K.C.B.: Sir William Noble and Gentlemen,—In rising to support this toast I should like to say first how very much I appreciate, on behalf of myself and of my Department, the honour which you have done me in asking me to speak to this particular toast. I can conceive no toast at such a dinner as this which I appreciate more having to take a part in. Now I suppose I am the junior member present of the staff of the British Post Office. I appreciate that position. I know very little of your work. I know less, in spite of what the newspapers have attributed to me, of the way in which you do it. But I make bold

to say that I do know your distinguished chief, and I feel I should like to say so here and now, that so far as the Accountant General's Department and the Engineering Department are concerned, Sir William Noble and I have much in common and have the same end in view. I was reading to my younger children not long ago some nursery rhymes and there was one, familiar no doubt to all of you, which seemed very apposite to the Department to which we belong, and in particular to the Secretary's Office. You will appreciate the reference when I quote the rhyme. "There was an old woman who lived in a shoe: she had so many children she didn't know what to do. . . . " Well, I don't know whether I need go on, but we, the Engineering Department and the Accounts Department, are two of those children. And like other children, we sometimes have our own family difficulties. I should like to seize this occasion —perhaps it is a little out of the ordinary course—to say just one word on that topic. You and we are aiming at a common end. We have the same interest. Our interest is the efficiency of the Postal Service of this country, to which we are proud to belong. As between colleagues animated by a common interest, there is only one possible policy—that is, complete co-operation, and cards on the table, and so long as I am head of the Accountant General's Department I mean to follow that policy. We want to help you—we don't want to make difficulties, for we are as proud of the success which the Engineering Department achieves as you, I know, will be proud if we turn out proper, correct and satisfactory accounts. If, sometimes, as is inevitable, we have our little differences and you may sometimes feel perhaps a little irritated at the things we want you to do, may I commend to your notice this piece of advice from that wise American citizen, Mr. David Harum, who said: "A reasonable amount of fleas is good for a dawg; prevents him from brooding on being a dawg." Well, gentlemen, we in the Accounts Department will try not to be more than reasonable!

Now that is all which it would be right for me to say, because there are other speakers to follow. Therefore I join with Mr. Pike Pease in asking you to drink the health of this very great and efficient Department, coupled with the name of Sir William Noble.

Sir WILLIAM NOBLE: Mr. Pike Pease, Sir Henry Bunbury and other visitors,—One of the friends I asked to come to the dinner to-night expressed the pious hope that the speeches would not be long and tedious, as they were at many such functions. I assured him that at our dinner the speeches were never long and they were never uninteresting. Having given that assurance it is necessary for me to be brief, if I am not interesting!

I would like to say that I am sure we are all sorry that Mr. Kellaway, our new political chief, is not present to-night. I under-

stand that he is very busy in his constituency, and we can only express the hope that he will be satisfied with his labours of the past few days.

On behalf of the Engineering Department, I have to thank Mr. Pike Pease and Sir Henry Bunbury for their appreciative remarks. I am sure that we are all pleased that two gentlemen who have a knowledge of our Department speak so kindly of us. There are some people who have not such a good knowledge of the Department, who do not speak so nicely! Mr. Pike Pease has probably had as long, if not longer, service as one of the Parliamentary chiefs of the Post Office as any preceding Postmaster General or Assistant Postmaster General, and therefore speaks with some knowledge of the work which the Engineering Department has done, and this makes his remarks more valuable.

I am sure my colleagues were very pleased indeed to hear Sir Henry Bunbury to-night. We, who have met him officially, are not only satisfied that he is an able officer with a thorough grip of the work which he controls and is endowed with a large amount of common sense, but he has personal characteristics which will ensure that so long as he presides over the Accountant General's Department there will be no friction between that Department and any other Department of the Post Office—certainly not with the Engineering Department.

There is one feature about Sir Henry Bunbury that personally I like, and with respect he is a man after my own heart. He is not too much attached to so-called sacred precedents and he uses very little red-tape in his official work.

Mr. Pike Pease has told us about some of the work that has been done by the Engineering Department, and some of my predecessors in this chair have usually supplemented the remarks of the proposer of this toast by a good deal of detail and a great array of figures. I am not going to follow that precedent, but will content myself by saying that we, in the Engineering Department, are content to know that we have done the best that we possibly could during the past year, under somewhat adverse circumstances. We have had some difficulties to contend with during the past twelve months, mostly brought about by the war. One of these is the fact that there has been a great shortage of raw materials and there has consequently been delay in completion of the orders we have placed. I am glad to say that recently matters have greatly improved, and we are now getting better delivery of the goods ordered. There has been a pleasing feature just recently, and that is the downward tendency of prices. Also during the past few weeks we have been able to get firm prices for certain contract work, a thing which, six months ago was out of the question. This is a welcome sign of the

present situation. Another adverse condition with which we have had to contend is the fact that we have had three committees—first, the Official Committee which dealt with telephone rates, then a Parliamentary Committee and now another. Now all these committees mean a good deal of ineffective time on the part of the officials in our Department and a reduction of the normal output of officers in the discharge of their duties. We all hope in the Engineering Department and, I expect in every other Department that is concerned with telephones, that this Committee will finish its labours early so that we may get on with the business of bringing the telephone up-to-date. The telephone service has, of course, suffered greatly during the war and all we want to do now is to devote the whole of our energies and our abilities to making the telephone service worthy of this country. There will be nothing wanting, so far as the Engineering Department is concerned, in doing so. If we were allowed to give the present Committee any advice it would be to ask them to widen the scope so far as witnesses are concerned. If they would call as witnesses such men as Mr. Gill, Mr. Atkinson and other Engineers, and get those gentlemen to say what they think of us so far as the technical side is concerned, it would be serviceable. Then I would like them to call such business gentlemen as Sir Tom Callender and Mr. Hirst—men who have been doing work for many years for the Post Office—to ask them what they think of the business capacity of the Department. I would be willing to stand by the verdict of these gentlemen, and I am sure all my colleagues would. Then we have with us to-night a very distinguished telephone engineer from America, Dr. Jewett, who, if he were willing, would no doubt be a valuable witness.

I told you I would be brief. I have no other points except this: that though the members of the Engineering Department work very hard during official hours (and those official hours are not the usual so-called Civil Service hours) yet, after hours, they do a little recreation and this year with some tangible result, for I am informed to-day that the Engineer-in-Chief's Chess Club has won the Civil Service and Municipal Championship of the Chess League in the Second Division.

Just one other matter: I am sure all my colleagues will be pleased that I should refer to the fact that to-night, two of our members who have been with us for many years and who are highly respected, are attending the dinner to-night for the last time in their official capacity; I refer to Messrs. Stubbs and Moir. I am sure that the friends of these gentlemen in the Engineering Department and the other Departments in close touch with the Engineering Department, will wish that Mr. Stubbs and Mr. Moir will long enjoy their well-earned relief from official work.

Mr. A. MOIR: Sir William Noble and Gentlemen,—I have the honour to propose for your acceptance the toast of "Our Visitors." We are all very sorry to know that Mr. Illingworth has been obliged to relinquish his office owing to ill-health, and I am sure that we all reciprocate very much the kindly message which was published in the Post Office Circular the other day giving his farewell remarks to the staff.

Sir William Noble has already referred to Mr. Kellaway, and I would only add that had it been possible for him to have been here to-night we could have offered him a safe seat, and we trust that the electors at Bedford will be equally considerate to-morrow.

The political side of this gathering is represented by Mr. Pike Pease. Mr. Pease has been so long with us as one of our political chiefs that we begin to regard him as a member of the family, and we hope that that pleasant relationship will long continue.

I come now to Sir Evelyn Murray, who holds his position permanently apart from the ups and downs of politics. The waves of political change and movement surge round him in vain; he sits tight, and that is all to the good. We are pleased to see Sir Evelyn here not only for his own sake, but because we know that busy man though he may be he is able to take, not an occasional and perfunctory interest, but a deep, close, and managerial interest in all that appertains to the Engineering Department, its works and its staff.

I am told that it is usual for the proposer of this toast to make passing reference to the spirits of the staff. Well, I am glad to be able to say that they are fairly good, not unduly elated, and not unduly depressed, but I understand that a small but important proportion of them have been passing through a period of "Great Expectations"; I ought rather to say "moderate" expectations. (Laughter). They have recently been keeping company with Mr. Micawber; they have been "waiting for something to turn up," but I would say for their consolation that at one time Micawber was able to write a letter which began—"My dear Copperfield—You will not be surprised to hear that something *has* turned up." (Cheers).

We are very glad to have with us this evening the President of the Institute of Electrical Engineers. When Sir William Noble delivered his paper on "Long Distance Telephones" to the Institute of Electrical Engineers, to an audience in which the Post Office Engineers were well represented, and which, by the way, overflowed the capacity of the lecture hall of Civil Engineers, Mr. Atkinson was unavoidably prevented from being present, and so we are glad to see him here to-night. What we have "lost on the swings" we have apparently "gained on the roundabouts."

Some time ago it was necessary for the Engineers to form a separate society of their own because of the number of problems connected with the development of the telegraph and telephone which came up for discussion. That did not, however, mean that there was any slackening in our allegiance to the parent institute. On the contrary, the Post Office Engineers have always recognised that they could only obtain the hall-mark of professional attainment through membership in the parent institute.

We have also with us here this evening the Chief Electricity Commissioner, in the person of Sir John Snell. This age will be known in history as the "electricity" age, and we must therefore realise that the position of Chief Electricity Commissioner, although it carries with it great honour, also means very heavy responsibility. Sir John is not unknown to Post Office Engineers, and therefore I would take this opportunity on their behalf of congratulating him on his selection for so high and honourable an office.

We have with us this evening Dr. Jewett, Engineer-in-Chief of the Western Electric Company in America, who is also head of the huge Research Department of that Company in New York, consisting of 1,500 Engineers and 1,000 Accessory Workers, all housed in one building. We wish to extend to Dr. Jewett the full measure of international good fellowship and hospitality. (Cheers).

Colonel Harrison, Engineer-in-Chief of the South African Union, is also one of our guests, and shows by his presence here that the Post Office Engineers are able to keep in sympathetic touch with all parts of the Empire.

Mr. Gill, well-known to you all, is also a welcome guest. I would just like to make one remark about Mr. Gill from the point of view that open confession is good for the soul. As Superintending Engineer in charge of and responsible for the Engineering side of the London Telephone System for the past nine years, I have frequently had occasion to congratulate myself upon the fact that the late Company had in its employment during the closing years of its existence, probably eight or nine, an Engineer of Mr. Gill's undoubted ability. (Cheers).

We must also extend a hearty welcome to Mr. Lackie, one of the Electricity Commissioners, and Mr. Sillar, our Consulting Engineer for Railways. There are present also a large number of representatives from other Departments of the Post Office, showing the cordial good-feeling which prevails throughout the Service. Excepting for two of these gentlemen, who are here for the first time, it will not be possible for me to make individual references. Sir Henry Bunbury, the Accountant General, came to us with a great reputation, and from what we already know of him we feel sure that he will have no difficulty in sustaining that reputation as

Accountant General to the Post Office. Our other first-time visitor is Mr. Sanderson of the London Postal Service, who provides us with a most efficient Letter Service at 2d. a time. I often wish that amongst the pioneers of the telephone there had been a man of the foresight of Rowland Hill. When he brought forward his proposals for the Penny Post he did not include any suggestions of a flat rate for the large users. He realised that if you never give anybody something for nothing nobody will be disappointed, because of course there will be nothing for anybody to take away from somebody! (Laughter).

Before concluding I would like to say that we have with us this evening, Sir Tom Callender, Mr. H. M. Pease, and Mr. Conner. I had intended to pass to them a very agreeable message, to tell them that a new dawn was about to break, that something extraordinary was about to happen, something which has never happened since August, 1914, so far as I know; I mean that contractors were henceforward to deliver the goods on the appointed date (laughter), but unfortunately the coal strike had broken in upon the spirit of my dreams. We trust that it may be of short duration, and that the improvement in deliveries, to which the Chairman has referred, will be maintained and improved upon, for until dates for delivery can be relied upon it will be impossible for Post Office or other Engineers to carry out their works promptly, economically, or satisfactorily.

In conclusion, let me refer to what I may describe with all respect as the old brigade, including one of the staunchest friends the Engineers ever had—Sir Andrew Ogilvie, Mr. George Morgan, and Mr. Henry Hartnell. They are here this evening bearing upon them many outward and visible signs of the advantages of retirement. (Laughter). They may be regarded as encouraging beacon lights for those who are about to pass over into the domain of leisured and less active performance, in which connection I desire to acknowledge the kindly reference which the Chairman has made to Mr. Stubbs and myself. (Cheers).

MR. LLEWELLYN B. ATKINSON,—President Institution of Electrical Engineers,—Sir William Noble, Mr. Moir, and Gentlemen,—May I say fellow engineers.

A great responsibility has been put in my hands this evening in asking me to respond on behalf of your many guests, to the many kind words that have been said by the proposer of this toast, and in introducing it to you I thank you for the way in which you have received it. There are many men who, each in his own sphere, occupy more learned or distinguished positions than I do, but perhaps this toast has been put into my hands because, much as they have enjoyed your hospitality, I have enjoyed it more. When, at

the beginning of my career as President of the I.E.E., I also commenced a career as a professional diner-out. (Laughter). I was under some alarm as to what would take place with my digestive organs, but I found a new pleasure in a very large number of dinners I was asked to attend. It gave me the opportunity of meeting on each occasion new men and new groups of men, and I now go to these dinners not only to receive choice viands but also to study the next type which I have brought before me, because all these dinners are dinners of groups of men each of whom by some process of selection has come to be in a typical group, and it may be that when I come to write my recollections I shall give some very interesting information on the facts I have learned.

May I say (not on behalf of the other guests, who won't share this opinion with me) that I deeply regret your Society ever existed? (Laughter). The reason is that as President of the I.E.E., I feel that that ought to have been the only Institution which contained Electrical Engineers in its portals. After all, at the commencement, it was the Society of Telegraph Engineers, and I can only say that in my opinion there must have been some grave mistake or error of judgment in allowing the condition or situation to arise that made it necessary, as Mr. Moir has pointed out, to form an independent society. It has been a great source of gratification to me personally, and to the Council and to the rest of the engineers in the Institution, that we have had such a great accession of members of the Post Office Engineering Staffs. That has been very largely through the kind help of your Chairman, Sir William Noble and others with you, and I venture to say that that help and sympathy was a great act of statesmanship both for the Institution and the Post Office Engineers. For the rest, it will remain for those Post Office Engineers, who are now in such large numbers in the Institution, to see that they make and get the full benefit of that membership; that if there are directions in which their particular work requires particular methods of presentation, whether by separate meeting or otherwise, they take the opportunity of putting it before the Council as to what is the best way in which their interests may be served. I am satisfied the Council are only too anxious to have any suggestions in that direction. The task of Post Office Engineers, to a very large extent, almost entirely perhaps, lies in the facilitating of rapid communication and unless they achieve rapid communication, then they are failing in the task set to them. Now, gentlemen, at the present time I venture to think that there is much left to be desired in the matter of rapid communication through the Post Office. I find on an average that it takes more than three hours to get a telegram from any part of England into my home. On an average two hours are taken

between the sending and receiving station. It is true that I, fortunately or unfortunately, live three miles from a railway station, but when you think that the actual transmission of that message, which it is your task to perform, is a matter of seconds or minutes, there is some great failure somewhere to achieve the rapid communication which we and you as engineers have worked to achieve. When I was about 30 years of age I began to have the telephone in my home. It cost me £5, or thereabouts, a year. Now the amount is nearer £40 than £30 a year. I do not use it for business and it is not worth £30 a year to have it in my home, so it has gone out. I often say to myself that I who have worked all my life to cheapen electricity now do not think it is worth while having it in a home where business is not being conducted. That is another failure. We engineers are in some way or another being cheated of our victory over time and space. The fact is that all we are doing in the way of cheapening and speeding up transmission is being lost somewhere or other. This not only happens in this country. I overheard a conversation the other day between two gentlemen nameless; eminent in their own ways, as to the advantages of automatic switching or hand switching in telephones. The opinion was this: that probably the best hand switching was quicker than the best automatic or machine switching, but it was impossible to obtain in ordinary practice the best hand switching, and that consequently we must go in for machine switching though it is not as good as the best hand switching. We are slipping backwards in our power of organization or, at least, of carrying out work. It seems to be a very great outrage, if I may say so, that here to-night, where we used to have electric light, we dine by oil lamps. (Laughter). God be thanked it isn't gas, but it is oil. This is only another step in that sliding back of efficiency. It is up to the engineers to say where is the leakage; where is the loss?

Your Chairman, in speaking, has suggested to you a scheme where Sir John Snell and myself and, I think, Sir Tom Callender, are to appear before some committee. And what shall we say? Well, I am saying some of the things that I shall say if I ever get there. (Laughter). As for Sir John Snell, I don't know, but I understand from those who were connected with the old Company that when the Post Office took over the telephones, that whatever was paid for them, they were worth nothing! As to my friend Sir Tom, a picture flitted before me the other day. I heard he had appeared in the costume of a Chinese mandarin. I suggest that he appears in that costume to disguise the fact that he is a Scotchman and repeats the wails and bleats which I have heard him repeating during the last year or two of the impossibility of making contract-

ing profitable. At the same time I have discovered that those who preach a sermon give a presidential address and those who speak after dinner may choose their own subject and there is no reply, consequently the only reply that exists is that they do not ask the same speaker again.

Well, gentlemen, I am happy to return thanks on behalf of your guests for your very kind reception of us to-night, and I am sure I am expressing all their views in saying we have had a very enjoyable evening, in coming to meet your Chairman and all you gentlemen of the Engineering Department of the Post Office.

Sir EVELYN MURRAY proposed the toast of "The Chairman." He said:—Gentlemen; a year ago I had the honour of proposing this toast of the Chairman, and I think I predicted then that Sir William Noble's reign as Engineer-in-Chief of the Post Office would be not less successful than that of any of his distinguished predecessors. That was a prophecy that even Mr. Pike Pease would regard as justifiable, because I knew. And the experience of the last two years has amply confirmed it. For the last few months, the Post Office has been something of a storm centre. The storm has differed in some respect from those with which you, gentlemen, constantly have to deal. In the first place, I think this storm was "made to order," and I am inclined to think it will not leave any serious damage in its tracks. But in spite of the turmoil which has been proceeding outside, Sir William Noble has pursued the even tenour of his way, unmoved by the squealing of the 'flat rater'; unruffled by the ministrations of the amateur expert. I am told that some members of the Post Office staff feel a personal grievance at the criticisms which have been passed on the Service. Those of you who feel most venomous I would ask to remember the plight of the editor of a daily newspaper. He has to produce 20, 30 or 40 columns every day for six days in the week. If I were in his position I should regard a brand new ramp every month as absolutely essential. And if a suitable ramp was not to hand, I should take steps to manufacture it, and if I was going to manufacture it, I should certainly choose as a target a government department. It has obvious advantages. In the first place the law of libel does not apply. Certainly the critic is not handicapped and need not spoil his case by any pedantic regard for truth or accuracy. If I had to choose a motto for our Chairman to-night, I think I should say "get on with the job," and for the last year he has got on with the job. In spite of very serious obstacles, I think it is remarkable the progress which has been made towards restoring the telegraph and telephone services to their pre-war efficiency. I should like also to thank Sir William Noble for his efforts in common with other heads

of the Post Office Departments towards maintaining the domestic harmony which I believe exists. I don't know that there has ever been any time in the history of the Post Office when there was less controversy between the Departments which form it.

In the new capacity which has been put on me to-night of a senile and decrepit mother of a large family—(laughter)—that is a thing for which I am devoutly thankful, and I say in all seriousness that nothing militates more against the efficiency of a department than internal dissension.

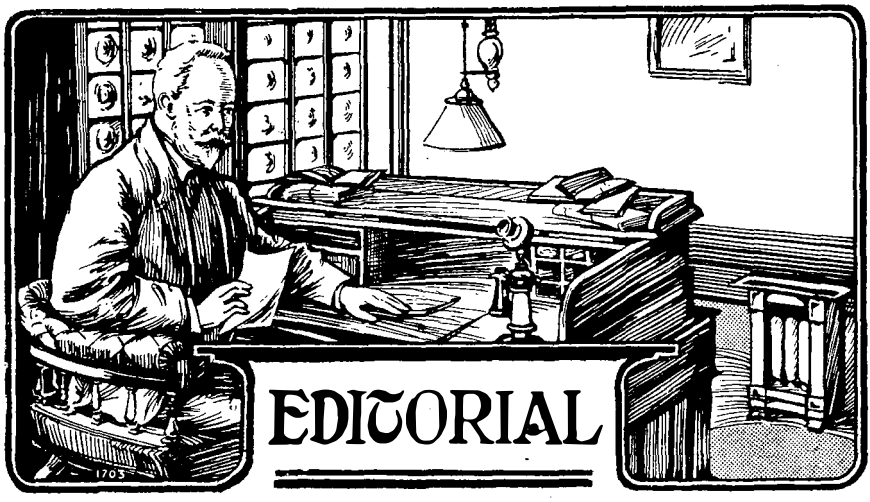
I think I ought to congratulate Sir William Noble on this, the first dinner after the signal honour which His Majesty has conferred upon him. (Applause). It is an honour which, as everybody in the Post Office Service knows, was thoroughly deserved, and redounds not only on himself but on the great department over which he presides.

Sir WILLIAM NOBLE: Sir Evelyn Murray and Gentlemen,—Mr. Atkinson is right in saying that speeches at dinners are or should not be replied to and I am not to break a good rule. It will not, I hope, be out of place if I make only one comment. You cannot expect the telephone rates to remain at pre-war figures if an exchange which previously cost £78,000 now costs a quarter of a million, a cable which previously cost a thousand pounds is now costing three times that amount, and a job which previously could be done in one year now takes two and a half years.

I should like to thank Sir Evelyn Murray for his very kind remarks with regard to myself. He has referred to the honour conferred on me by His Majesty. I was under no misapprehension about that. I attributed it mostly to the fact that I was head of the Engineering Department. My success in the position is largely due to the great loyalty which the staff has shown towards me. Sir Evelyn Murray rather hinted that I have not worried about the campaign against the Post Office Telephones. Well, I never have worried about anyone or anything; I never worry myself and I never worry anyone else. We are all doing the best in our power for the Department. We know that no one else could do any better than we are doing. And we do not mind what Parliamentary inquiries there may be with regard to the work of the Department. We are serving the Government faithfully and well, and I can say that any inquiry has no terrors for the Engineering Department.

I thank Sir Evelyn Murray for his appreciative remarks and you, gentlemen, for the way in which you have received the toast.

The gathering was a most successful one, and the Committee is to be congratulated on the result.



EDITORIAL NOTES AND COMMENTS.

WE publish on another page the usual quarterly return of the Telegraph and Telephone plant in the United Kingdom, and in this instance we have added the figures at the corresponding period of last year, the end of that financial year. The figures are interesting in several respects. The telephone stations are approaching a million in number, and show an increase for the year of 6·5 per cent. While the increase per cent. in not up to the pre-war figures it should be remembered that last year—and this year as well, we are afraid—was a period of great industrial and commercial depression and telephone business suffered accordingly. The moulders strike and the shortage of metals hampered progress in the engineering trades; over-production at big wages, with little or no demand from impoverished Europe and an adverse exchange rate with America brought profitable business almost to a negligible quantity in the textile and leather industries. The small business man, the single liner, was struggling to re-establish himself and tried to get along for the time without a telephone. Our contractors were unable to deliver equipment in anything like reasonable time and all through the period under review there was a large waiting list, which even now cannot be appreciably reduced. The press, suffering from a shortage of big gooseberries and a lack of tales of blood from their Shanghai correspondents, maligned the Department wholeheartedly and depreciated the value of the nation's

property as low as they could. In the circumstances, therefore, the increase is satisfactory, we think, but it would have been much higher had deliveries kept pace with the demand. The figures for next quarter, the first to be influenced by the new telephone rates, will be noteworthy.

The line mileage in every direction save that of overhead exchange lines shows a very appreciable advance, the miles of wire being now well over four millions. The decrease of 3,000 miles in subscribers overhead lines is more than balanced by the increase of 250,000 miles of exchange underground wires. Underground construction, at least so far as distribution in non-congested areas is concerned, has been cheapened and the practice will tend to produce a more stable system, with less liability to breakdown during stormy weather. In this connection it is interesting to notice in the "Telephone Review" that the last telephone roof fixture in New York has just been removed. London and other large cities on this side were bad enough in the old days, but we cannot follow the imagination of the American writer when he says: "In the halcyon days of roof fixtures the sunshine rarely penetrated to the sidewalks and streets in downtown New York. With strand after strand of wire strung along poles or stretched from roof to roof there resulted a giant web which produced a semi-twilight, even in the middle of the day."

The lecture and experimental demonstration at the Institution of Electrical Engineers on the 26th May, by Messrs. Alfred Johnsen and Knud Rahbek, two Danish engineers, on the subject of the electro-static attraction which takes place between certain semi-conductors and metals when their surfaces are placed in contact and a current is passed across the surfaces, has created a considerable amount of interest among signalling engineers. It is stated that ground and polished surfaces fitting accurately give the best results. This is what would be expected, since such surfaces permit their being placed in very intimate contact. Amongst the materials exhibiting the phenomenon are lithographic stone, flint, agate, some species of slate, many other minerals and salts, as well as many organic substances such as animal membranes, skin, gelatine, bone, etc. No effects are obtained from true insulators such as glass, mica, hard rubber. It would appear that the surfaces of the materials mentioned offer a very high resistance, and the surface of one, facing and in actual contact with the surface of a metal plate, form in combination two plates of a leaky condenser, the distance between the plates being extremely small. Since the attraction for a given P.D. is proportional inversely to the square of the distance, the force acting along the electrostatic field of infinitesimally short

length is much greater than could be obtained from any other source by the same small expenditure of energy. A voltage of about 440 was used and the current amounted to only a small fraction of a milliampere. The discovery gives promise of commercial application in the form of an electrostatic non-inductive relay, suitable for use with small currents of high frequency. In the "singing fiddle" experiment the action reminded one of the Edison chalk and platinum strip receiver of early telephone days, but the process is reversed. In the Danish arrangement the loose metal band sticks or binds to the revolving semi-conductor when a current is passed between them, whereas in the earlier device the friction between the revolving chalk cylinder (which was treated with a suitable electrolyte) and the brush or strip was reduced, the strip slipped and released the tension on the diaphragm. Loud speaking effects are produced by both devices, even without the use of valves.

Having had occasion to summarise our circulation list of foreign and colonial subscribers, we think our service readers will be interested to see how far-flung the list extends. It covers the following countries:—

Europe.—Norway, Sweden, Finland, Denmark, Holland, Belgium, Spain, Portugal, Italy, Switzerland, Germany, Czecho-Slovakia, Turkey, Malta, Iceland.

Asia.—Palestine, Mesopotamia, India, Ceylon, Malay Straits, China, Japan.

Africa.—South Africa (all parts of the Commonwealth), British East Africa, British Central Africa, British West Africa, Portuguese East Africa, Egypt, Mauritius.

Australasia.—All parts of the Australian Commonwealth including Tasmania, New Zealand.

North America.—Canada, United States.

South America.—Brazil, Argentine, Peru.

It is worthy of note that more Journals go to Japan than to certain engineering districts at home. Russia was on the list before the War, and a bookseller in Poland is our debtor to the extent of five shillings!

Mr. Ernest Henry Bennett has been appointed Manager of the Guernsey States Telephone Department in place of the late Mr. R. McLean. Mr. E. H. Bennett has had 20 years' experience in telephone engineering in all its branches. He was apprenticed to his uncle, Mr. A. R. Bennett, the States Telephone Department's Engineer, at Tunbridge Wells, and subsequently had three years with the Portsmouth Corporation Telephone Department as Inside Inspector, and then three years with the Brighton Corporation Tele-

phone Department as Test Room Inspector. He next had five years with the Post Office—gaining there a thorough knowledge of outside construction and maintenance. For the last seven years he has been Engineer to the Oriental Telephone Company at Singapore, having charge in that capacity of the switchrooms and all work inside and outside, including underground and submarine cables.

The unfortunate death of Mr. T. E. Gatehouse, of the *Electrical Review*, occurred just after we had gone to press with last issue. Even at this late period we should like to express our deep sympathy with the firm in the loss they have sustained. His keen business instincts were relieved by a genial bonhomie and an intense love of music, and his place will be difficult to fill, not only in the firm of Alabaster, Gatehouse and Kempe but in the electrical world generally.

The following letter from Mr. Dumjohn, of Siemens Bros., was received too late for publication in the April Journal. The article he refers to appeared in conjunction with one written by Mr. Dumjohn in our January issue:—

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

Dear Sir,

In Mr. Eason's article "Ringing Machines in Small Exchanges" he gives a second method on the basis of "Probability Theory." In this method he takes the formula given in my article as applicable to the case of manual exchanges. I have pointed out that it applies to Automatic Exchanges and not to Manual Exchanges. The basis of my formula assumes that an unlimited number of demands may be made on the Ringing Machine, which condition is very closely obtained in Automatic Exchanges since switching equipment is provided to deal with calls as they originate, only a very small percentage of the peaks not being dealt with.

In the case of manual exchanges, the number of operators limits the number of simultaneous demands, also calls are delayed in manual operation. Both these factors need to be considered in determining the output on probability. In Mr Eason's example of Stroud Exchange there is no possibility of exceeding 8 simultaneous demands and the probability of 8 simultaneous rings would not be the same as given by the basic theory on which my formula has been determined

I am, Sir,
Yours obediently,
F. P. DUMJOHN.

HEADQUARTERS NOTES.

Orders have been placed for the following New Exchanges:—

Exchange.	Type.	No. of Lines.
Wallasey Corporation P.B.X. ...	Auto.	50
Edinburgh Museum	No. 1	1400
Inverness	No. 10	780
Liverpool Courier P.B.X.	Auto.	100

Orders have been placed for extending the Equipment at the following Exchanges:—

Exchange.	Type.	No. of Lines.
Stockport	Auto.	950
Leeds	Auto.	2600

LONDON DISTRICT NOTES.

TELEPHONE lines and stations added and recovered during the thirteen weeks ended March 29th, 1921:—

	Exchange Lines.	Internal Extensions.	External Extensions.
Provided	3931	4256	437
Recovered ...	1707	2545	338
Increase	2224	1711	99

The total figures for the District on June 1st were as follows:—

Direct Exchange lines	159,097
Internal Extensions	146,700
External ,, ...	10,903
Working stations (speaking sets)... ...	303,077

External Construction.—During the three months ended 30th April, 1921, the Telephone Exchange wire mileage showed an increase in underground of 29,866 miles and a decrease in open wire and aerial cable of 513 and 1,076 miles respectively, the nett increase for the period being 28,277 miles.

The Telephone Trunk wire mileage increased during this period

by 15 miles open and 32 miles underground. There was no alteration in the open wire in use for Public Telegraphs, but that in underground cable decreased by 14 miles.

Pole line during this three months increased by 22 miles to 2,898 miles and pipe line by 92 miles to 3,932 miles.

The nett increase of underground cable was 105 miles, making a total to date of 7,795 miles.

The total single wire mileages, exclusive of wires on railways maintained by companies, now stand at—

Telegraphs	17,746	miles.
Telephone (exchange)	1,201,664	,,
,, (trunks)	18,870	,,
Spare wires	15,713	,,
	1,253,993	,,

C. T. O. Telegraphs.—Multiplex sets still continue to oust the old style Morse system. A circuit to Belfast has recently been fitted with Murray high speed apparatus.

Air Ministry House Tubes.—A system of power worked brass house-tubes has been installed in the Air Ministry premises, Kingsway. The diameter of the tubing is $2\frac{1}{2}$ inches and the circuit length is 850 feet.

Official Exchange.—The earlier arrangement at the Official Automatic Exchange of relieving the traffic on the line switchboards by removing a certain number of line switches from each Unit, and placing them together on what was known as a Relief Unit, has now been modified.

Additional outgoing Selector trunks have been provided to each line switchboard, and the line switches which had been transferred, have been replaced in their original position. This scheme left vacant two 50 position line switchboards. These two boards have now been equipped with a later improved type of line switch known as the "Two Coil Line Switch," and together provide for 100 new subscribers.

It is hoped that this plan will, besides providing for additional subscribers, remedy the congestion of traffic at the Exchange.

Internal Construction.—Since the April issue of the Journal extensions and alterations at East, Enfield, Hampstead, Park, Streatham and Tottenham Exchanges have been completed, and a large number of such works is in progress.

A new No. 10 C.B. Exchange was opened at Harrow on March 30th. The new Exchange provides accommodation for 1,400 subscribers and is housed in an extension of the old Exchange premises.

The plant was installed by Messrs. Siemens Bros., and, in common with the usual practice of this firm, is supplied with a 40-volt battery.

Chancery, the fifth "Relief" Exchange, was opened on May 28th with 524 subscribers, transferred from Holborn, Central and City. The exchange is situated at 55—56, High Holborn, W.C.1. It consists of a suite of switchboards comprising 26 "A" and 11 "B" positions, which were manufactured by Messrs. Ericssons, and provides accommodation for 1,500 subscribers. The arrangements are similar in all respects to those obtaining at Langham Exchange, a description of which was given in the last issue of the Journal. The work in connection with the two Relief Exchanges at Grosvenor and Minories is nearing completion, and these will, it is anticipated, be brought into operation shortly.

The new Toll Exchange in Norwich Street is making rapid progress towards completion, and will probably be brought into service shortly after the issue of this number of the Journal.

The demand for Private Branch Exchanges of the multiple type is still very heavy, and several important installations are in progress.

PRESENTATION TO Mr. MOIR BY THE STAFF OF THE LONDON ENGINEERING DISTRICT.

WHEN the impending retirement of a Superintending Engineer is announced there is naturally much comment and conjecture. It is well known now that Mr. Moir, the Superintending Engineer of the London Engineering District, will terminate his official connection with the Post Office on July 31st of this year. When this fact was made public the staff of the District soon made it known that they were not prepared to allow their Chief to depart without marking the occasion suitably.

Nearly 3,000 members of the staff of the District contributed towards the purchase of a token which will, no doubt, serve to remind Mr. Moir of the regard in which he was held by them. The presentation was made by Sir William Noble, the Engineer-in-Chief, on behalf of the staff, on Tuesday, May 31st. In view of the time of the year, and in order that no contributor should be debarred from being present, it was decided that the presentation should be made at a self-contained function rather than that it should be associated with a farewell dinner or smoker. The ceremony proved to be a very pleasing one to all who took part in it.

The chair was taken at 5.45 p.m. by Mr. Greenham, Assistant

Superintending Engineer, who pointed out that, although the function was a purely District affair, they had asked the Engineer-in-Chief to grace it with his presence, which he had kindly consented to do. Before calling upon Sir William he was going to ask one or two members of the staff, representative of the different grades, to say a few words. He suggested that, like a landscape, which, if viewed from different vantage points presents different aspects to the observer, so the opinions held by the staff concerning its Chief would vary according to the particular place in the organisation from which they viewed him. His daily association with Mr. Moir had placed him in an excellent position to study his characteristics. Assuming himself to be in the Engineer-in-Chief's difficult position of having to choose a successor to Mr. Moir, he outlined a specification which he would expect the newcomer to conform to, as undoubtedly the present Superintending Engineer does. The principal requirements of a candidate for this important post were that he should possess a personality which would enable him to uphold the dignity of the position, be a man who, having climbed the ladder of success rung by rung, knows the business thoroughly, and is capable of entering into the feelings of every member of his staff. He would have to be a good organiser, a keen and sympathetic student of human nature, capable of taking broad views, keep a cool head in times of emergency, just, tactful, and of unassailable integrity, devoid of pettiness, show no favouritism and have a keen sense of humour.

The Chairman took this opportunity of thanking Mr. Moir publicly for the even way he held the balance between the two Staffs after the transfer of the ex-Company's business to the State. It was due to his influence that the two groups in London were welded together into one efficient whole in so short a time. The thing that struck him most about Mr. Moir of late was the energy he continued to display in face of his impending retirement. He believed it was not uncommon for men in such circumstances to let their interests in the future of the service with which they were connected abate somewhat toward the end—not so Mr. Moir. He still took an absorbing interest in schemes and plans which could not mature till long after his period of office had terminated, and this was an indication of the disinterested outlook which had always characterised his work. His vigour of mind and body justified the hope that he might enjoy many happy years of retirement in the company of his wife, whose beneficial influence had undoubtedly aided him in performing the duties of his great office. In conclusion, the Chairman quoted the following words from Othello, which he considered that Mr. Moir might truly say of himself—" I have

done the State some service, and they know it"—and for the benefit of succeeding speakers he gave the remainder of the quotation—"Speak of me as I am, nothing extenuate, nor set down aught in malice."

Mr. Gibbons was then called upon to speak on behalf of the Executive and Assistant Engineers. He came to the point at once by wishing Mr. and Mrs. Moir the best of health and long life. He said that the Chairman had rather taken the ground from under his feet by outlining Mr. Moir's characteristics. There was one matter that had not been referred to by the previous speaker, and that was that at one time there were three Superintending Engineers in London, and that now although the work had grown considerably the three men's work devolved upon one man. It was the Department's practice to get one man to do three men's work. He was curious to know how Mr. Moir was going to occupy his leisure. He had noticed that other retired officers had taken up various hobbies, such as controlling the Postal Service of Peru, pig-keeping, golf, etc.

Mr. Cooke, the Principal Clerk, who spoke next, regretted that the time was at hand to bid Mr. Moir an official goodbye, and wished to convey to him the best wishes of the Clerical Staff. He said that although Mr. Moir had a certain amount of reserve, yet when that reserve was broken through it was found to cover a very large heart. He paid tribute to the Superintending Engineer's strong sense of justice. He referred to the strenuous days of 1912 and 1913, when the London Engineering District was being moulded into its present form, and to the tremendous capacity for work that Mr. Moir displayed in those days. He stated that the head of the District had high ideals which he expected the staff to live up to. He expressed the hope that the shadows might fall lightly on Mr. and Mrs. Moir, and that they would continue to have good health, long life, and much happiness.

Mr. Boulton, speaking on behalf of the Chief Inspectors and Inspectors, said that in his opinion Mr. Moir combined in his personality some of the finest qualities which go to make up character. He suggested that it was more important that a man holding a great administrative post should possess a knowledge of men than that he should have great technical abilities. Mr. Moir could pride himself on being a successful organiser, which fact was proved by data and statistics compiled in the District. Mr. Moir had managed to do what many had failed to do, to win the esteem and warm regard of the staff over which he had presided. He suggested that a knowledge of this fact would be more satisfactory to the Chief than the bestowal of any gift or honour. He

joined with the other speakers in wishing Mr. and Mrs. Moir long life and happiness.

Mr. Rose, representing the Skilled Workmen's class, had learned to respect Mr. Moir as a Superintending Engineer and to love him as a man. He had searched his reference books but had not been able to find anything therein to help him on the present occasion, and so he had put them on one side and would say what was in his heart. He pointed out that a great deal of the trouble in the industrial world was due to the failure on the part of senior officers to get into personal touch with the staff, but that so far as the Department was concerned this difficulty was being overcome. He was referring to the Whitley Committee meetings, which enable the staff to meet their Chief at frequent intervals at round table conferences. He said that there was a strong feeling amongst the workmen that if they were in difficulties they had only got to see Mr. Moir to have their troubles removed. The men found that although they did not always get their own way they were satisfied that they got justice. He had always been guided by the desire to leave the world a little better than he found it, and he had come to the conclusion that that was also the guiding principle of his Chief.

Sir William Noble at this stage asked Mr. Moir to accept from the staff of the London Engineering District a grandfather clock, a silver salver and a gold-mounted walking stick, and Mrs. Moir a diamond and platinum brooch. He said that although many present had known Mr. Moir for a long period and Mrs. Moir for a longer period still, yet he had known him longest of all, for Mr. Moir and he were boys together in the same office over forty years ago, and it gave him great pleasure to testify to his high character and great ability. He had been a huge success as head of the London Engineering District, and because of his able administration he had been relieved of the necessity of paying much attention to it himself. He agreed that Mr. Moir conformed with the specification prepared by Mr. Greenham. He said that Mr. Gibbons had stated that Mr. Moir was doing the work of three men, but he was doing more than that, as not only had he taken over the work of three Superintending Engineers but at the same time had taken over the staff of the National Telephone Company in the area. Referring to Mr. Boulton's remarks concerning the relative importance of technical and administrative ability, Sir William stated that he had a favourite saying that in the early career of a man in the Engineering Department it was well for him to have 70% of technical knowledge and 30% of business capacity, which percentages should be gradually reversed as he climbed the ladder of success. A Chief, who himself endeavours to attempt to deal with

the various intricacies of the work over which he has charge, is a failure as a Chief. Dealing with the question of the need for closer contact between the Chief and Staff raised by Mr. Rose, Sir William looked to the Whitley Committee to aid considerably in this direction. He had just come back from Scandinavia, and had learned that the age for retirement there used to be 60, was increased to 65, and now stood at 67. He was sorry that it was not 65 in this case, because he would have liked Mr. Moir to have stayed in the Service until he himself retired.

Mr. Moir, in thanking the staff on behalf of himself and his wife, said that he found it difficult to express in adequate words the great kindness that had been shown to him by the presentation of such handsome mementoes. He had been in the Department's service for something like 47 years, during which time great changes had taken place, both in men and things. Since he entered the Service 16 Postmasters General, 8 Secretaries, 7 Engineers-in-Chief, and 38 Superintending Engineers had retired. He referred to the great strides that had been made in the business of the Engineering Department, and to the coming strain that would be placed upon the staff in connection with the introduction of the Automatic Telephone System. He felt sure that the energy displayed by the staff in the past would overcome all the difficulties that would be met with in the future.

He referred to the great improvement that had taken place with regard to the welfare of the staff, principally in connection with the accommodation which was provided for it. He himself, when a young Engineer, was at one time located in a cellar which had been used as a beer vault. He considered Denman Street headquarters admirable from all points of view. The whole of his service in the Post Office had been very agreeable service, and if he had to begin again he would probably choose the same career.

Although all the interviews men had had with him had not been of a satisfactory nature, yet there had been many occasions when he had had to see men for the purpose of complimenting them on satisfactory work or presenting them with medals in the King's name. He thought, perhaps, that he had not always expressed his appreciation of the efforts of the staff so freely as he might have done, but he had been brought up in the Victorian Age, and had been taught that "Virtue is its own reward." He found that today this maxim should have added to it "provided that you keep the big drum going all the time." He thought that the Engineering Department was a little shy and modest about its performance, and he commended to the Engineer-in-Chief a larger use of the big drum.

He was looking forward with satisfaction, but with some regret, to the fact that one morning in a few weeks' time he would wake up and find himself not in control of a staff of 6,000 men and women, but only one, viz., his wife, and the least he said about the control in that case the better. Nevertheless, it had been a co-partnership which had yielded quite satisfactory results, and his friend Mr. Rose would be glad to hear that it had been conducted on the highest principles of Whitleyism. In again thanking the staff on behalf of himself and his wife, he expressed the hope that the future might hold much prosperity for them all.

AUTOMATIC STAMP-VENDING MACHINES.

H. J. LONEY.

AUTOMATIC devices for meeting common and repeated needs are quite a feature of the ordinary life of to-day. That the principle should be applied to the sale of postage stamps is a natural development, and is one that has engaged the attention of inventors for some time past. As was inevitable, much ingenuity and labour have been spent in discovering the lines on which such a machine could be made practicable. In the case of railway ticket machines, it was soon found that the issue of tickets must be limited to those classes or prices for which the demand is very great, viz., penny and twopenny tickets. It is obvious to us now that automatic delivery is quite unsuitable for tickets of varying values—say for main line needs. This, however, was not clear to the pioneers of such machinery.

Applying this principle to the case of stamps, it is easily seen that it would be impracticable to deal with widely varying values, and that we must restrict ourselves to the lower denominations of stamps, halfpenny, penny, and twopenny. The end in view, the provision of two or three classes, being settled, the mechanism has to be considered. In this connection a legion of machines has been devised; in fact, for many years past inventors have been devoting their ingenuity to create an automatic machine for the sale of postage stamps. Some of these machines were of such complexity that they would need the skill of an engineer to operate them, while others were so crude as to render them perfectly useless. The problem is a difficult one, on account of the flimsy nature of a postage stamp, and heroic efforts have been made to overcome the difficulties. An examination of several of the devices suggested will illustrate some of the difficulties to be overcome in producing

what at first sight might appear to be a very simple machine, but which in reality is a very difficult problem.

Perhaps one of the most ambitious pieces of mechanism of this type was of American origin. The intention of the inventor was to sell various denominations of stamps, from one penny up to 2s. 6d., and at the same time give change for any denomination of coin inserted in the machine, after deducting the value of the stamp required. Needless to say, even if the machine could be depended upon to work perfectly, there are other considerations which would easily bring about its downfall in commercial use. It would be an exceedingly dangerous experiment to distribute such machines in public places, owing to the considerable sum of money they would contain in order to give change, to say nothing of the value of the supply of stamps. There is little doubt that such machines would be very consistently robbed.

One of the simplest types of machine is a box containing a revolving wheel, around the periphery of which little pockets are formed to carry the stamps. The insertion of a coin revolved this wheel a certain distance so as to bring one of these pockets containing a stamp opposite an aperture from which it could be extracted.

A similar machine was submitted by an inventor. His apparatus consisted of a small number of miniature drawers arranged along the front of the machine, each to contain one stamp. Each drawer was provided with a coin aperture, and a coin race at the back of the machine. The coin race had a glass front, so that the coin could be seen. One coin only could be inserted in each. This operation released the miniature drawer, the purchaser withdrew his stamp from the drawer, and the operation was completed, the coin being left in view to indicate that the stamp had been withdrawn. Without giving further details, it is very obvious that such a machine would have a very limited capacity, and that the filling operation would be troublesome, take a considerable time and need much care.

To overcome some of these difficulties, another inventor provided a magazine in which single stamps were stacked, one on the other, and each stamp to be delivered was lifted from the top of the stack by means of a pneumatic sucker and transported by the same means to a delivery chute.

In order to overcome the irregular action of the public in turning or pulling a handle, some machines were provided with clockwork or electric motors, but these features introduced further drawbacks. If the motor be clockworked, it must of course be regularly wound, otherwise there will be no energy forthcoming to

deliver the stamp; if electricity be employed the current is liable to fail at any time. Even when there is no failure of power in the motor, there is still another grave danger. The escapement mechanism, which liberates the power for the purpose of issuing each stamp, might fail to act, and after freeing the motor, might fail to check it again. The machine would then continue to operate, and deliver samps in a regular stream until it exhausted the supply.

The machine which has withstood all the tests and is now being adopted by the British Post Office overcomes all these difficulties. The device was originally invented in New Zealand, and has been developed by the British Automatic Stamp and Ticket Delivery Company. It was first placed on trial in the Threadneedle Street Post Office and in the Lobby of the House of Commons, where its success was sufficient to justify the Postmaster General in ordering more machines for an extended trial. These were placed in the General Post Office, Eastern District Office, Western District Office, West Central District Office, and provincial offices at Dublin, Edinburgh, Glasgow, Belfast, Liverpool and Manchester. They were installed in 1907, and were in use until 1911 with such success that an agreement was entered into with the Company for the installation of further machines in London and the Provinces.

In the meantime the late Sir William Preece, retired Engineer-in-Chief of the Post Office, became interested in the invention and was very largely instrumental in forming the British Company dealing with the British Patent rights. He was Chairman of the Company until his death. Sir William apparently had always the greatest admiration for the simplicity of the mechanism and faith in the utility of this stamp vending machine. In the course of time and with a wider experience the machine has been much improved, so that the present model is somewhat changed from that originally submitted to the British Post Office. It was subsequently introduced to the Postal Administrations of France, Canada, and Switzerland. Each of these Administrations entered into agreement with the Company for its adoption, and it is still in operation in these countries.

Its measurements are small, the machine being only about 12 inches high, 3 inches wide, and 9 inches deep, which makes it suitable for fitting into small cases for Post Office counters or other convenient positions. It is equally suitable for fitting into Post Office windows or doors, or even on letter boxes for the sale of stamps after closing hours. This will be a great boon, as everyone must have experienced the difficulty in obtaining a stamp after hours.

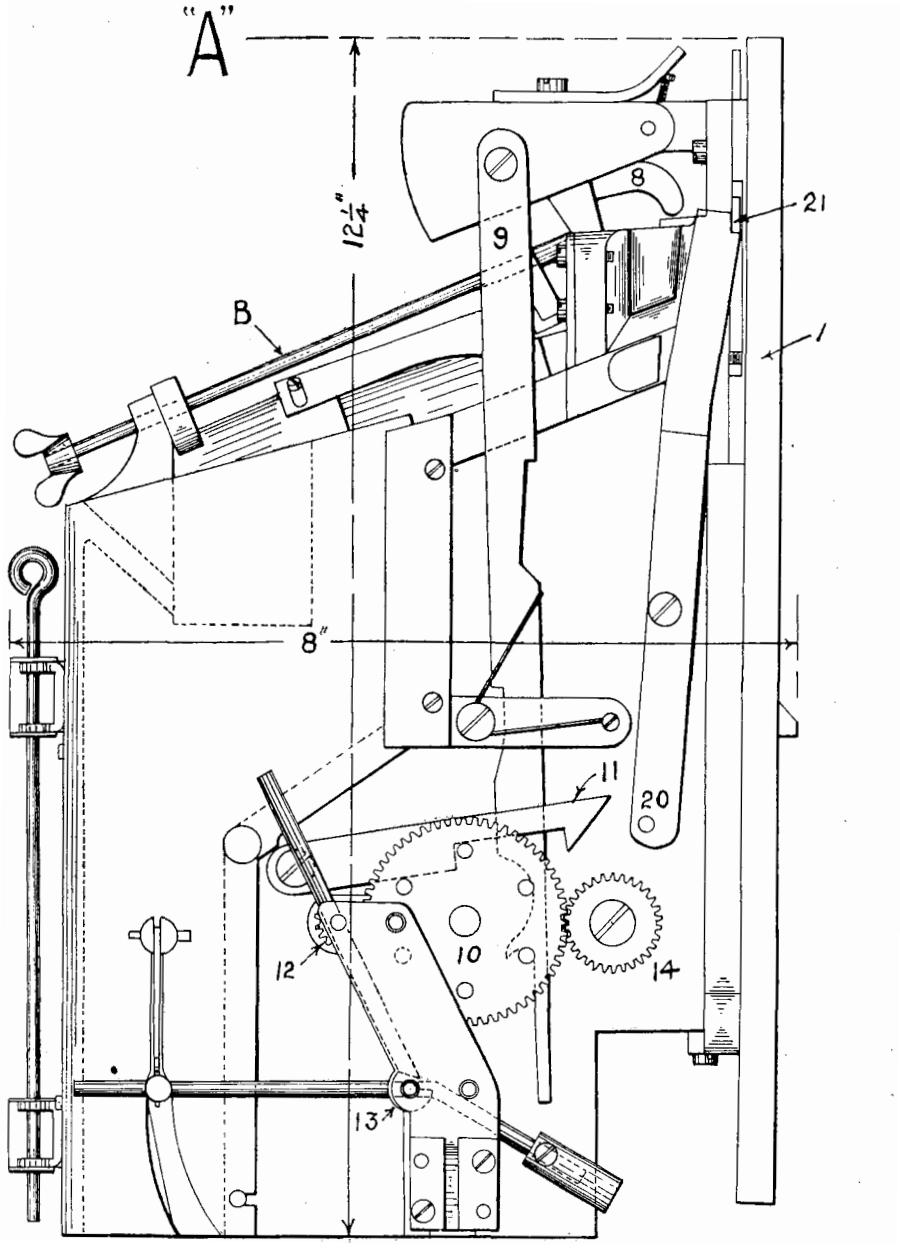
The feeding of the stamps is accomplished by means of a pinned feed drum, the pins of which engage the perforations of the stamps, as cogs of a wheel engage a chain. The machine takes a coil of 500 or 1000 stamps. These can be placed in position in the course of a few seconds, and are delivered one by one to the purchaser with unfailing precision, or, if desired, it will deliver as many as are paid for in one strip. The simple act of inserting the coin or coins is all that is necessary to operate the machine. A slight push in the process of inserting the coin raises a weight conveniently situated, which is linked to the feed-wheel and controlled by an escapement mechanism. By this arrangement it is impossible to get more stamps than those paid for. When the machine is empty, or should the strip become broken, the coin aperture is automatically closed, and the word "Empty" is displayed, indicating the fact to the public.

Fig. A is a wide elevation of the mechanism; Fig. B is the opposite side elevation; Fig. C shews the front elevation and Fig. D a general view of the complete machine. The machine is made for the sale of halfpenny, threehalfpenny, or twopenny stamps as may be required; in fact it can be so adjusted as to issue any of the lower denominations of stamps. The machine is intended to be mounted either singly or in duplicate in suitable cases or pillars, in mahogany cases for indoor use on the counters or other suitable places in Post Offices; for outdoor use in iron cases or pillars. The front plate (1) in Fig. "B" is provided with a coin insertion aperture marked (2), a stamp discharge aperture (3), and a rejected coin aperture (4), through which the rejected coins are returned to the public. The stamp delivery aperture is protected by a dropping door (5), intended for use when the machine is placed in a very exposed position. In the average position this door can be dispensed with altogether, making the delivery of stamps a much easier matter, as the door has to be lifted before the stamp can be obtained. The front of the machine gives the necessary instructions to would-be purchasers, and also gives the denominations of the stamps sold.

Immediately behind the coin aperture commences the coin chute (6), for conducting the coin to the coin tester (7), which is provided with correctly spaced guide rails. These separate coins of small diameter, bent, or otherwise defective, and return them via a special channel to the rejected coin aperture (4). It will be understood that the coin aperture prevents coins of larger diameter being inserted, whilst correct coins will be passed on through the proper channel to operate the machine.

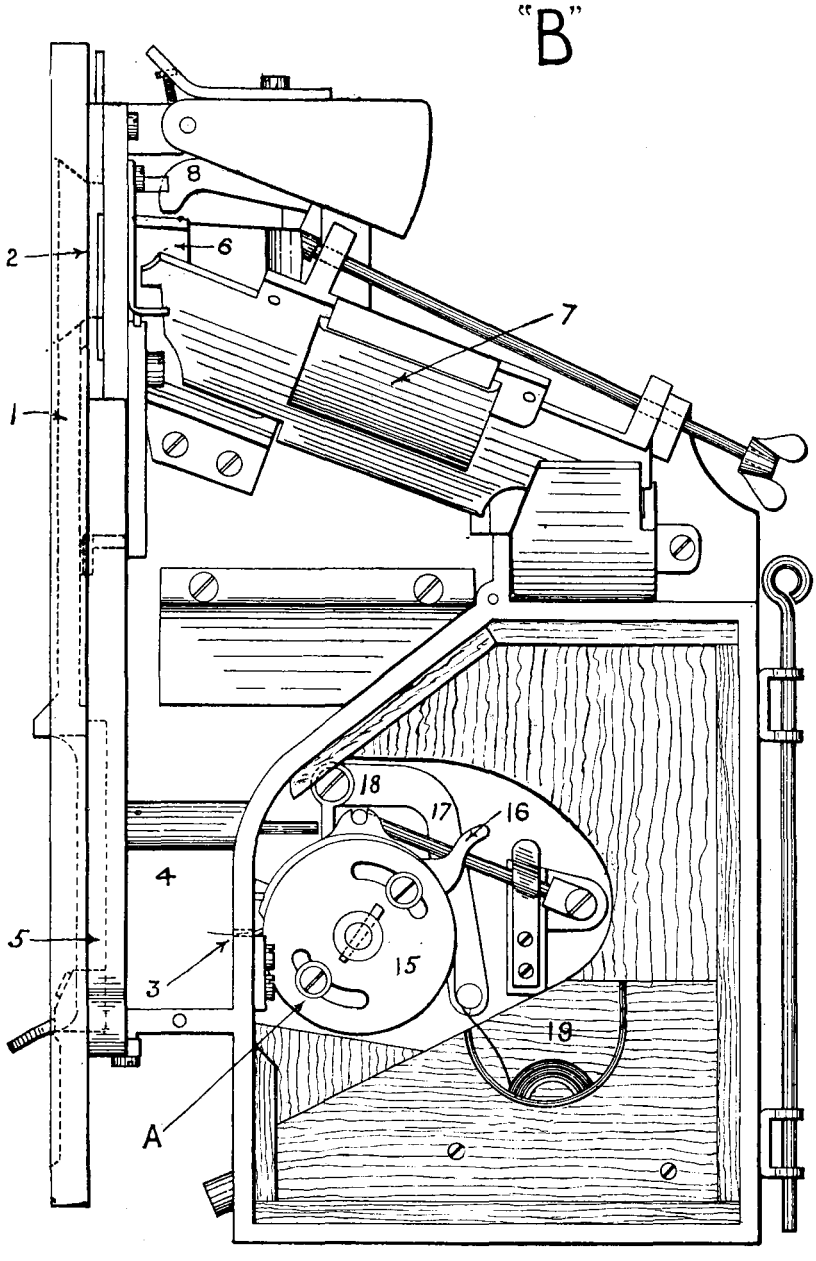
As the coin is being inserted into the coin aperture it encounters

a small arm or lever (8), fitted rigidly to a pivoted weight which is raised as the coin passes and so sets the machine for the delivery of



one stamp. To the pivoted weight is connected a lever (9), See "A," engaging with a geared wheel (10), provided with a series of

lateral extending pins which are engaged by the aforesaid lever secured to the weight. The lever is provided with a hook at one end



to engage with the pins. A pawl (11) is provided to prevent the gear wheel turning in the reverse direction. Meshing with the

geared wheel is a pinion (12), carrying an arm which engages an escapement mechanism (13) of the pallet type suitably pivoted. An arm is secured to this pallet, and is provided at one end with a counterbalancing weight, the opposite end being bent at right angles to pass under the coin channel. The pinned gear wheel also meshes with a larger pinion wheel (14), fitted rigidly on a shaft, which passes through to the opposite end of the machine and carries the spocket feed wheel (15), See "B," also rigidly fitted to the shaft. The function of this sprocket wheel is to propel the stamp strip forward to the delivery aperture. To enable it to do this correctly spaced rows of fine pins are provided to engage with the perforations in the stamp strip. The sprocket wheel is also fitted with a segmental cover (16), secured at its forward end by a spring. This cover is grooved on its inside to enable the pins on the sprocket wheel to pass freely underneath it. The front edge of the cover is serrated in order to give assistance in detaching a stamp from the strip fed through the aperture. The stamp being drawn by the fingers will cause the serrations to enter the perforations of the stamp strip for the purpose of severing it. The feed wheel is also grooved between the pins to enable the fingers to enter therein for the purpose of directing the postage stamps towards the stamp discharge aperture when feeding the machine. (17) is an arm or lever pivoted at (18) and dropping to the front of the stamp container (19), and between the latter and the sprocket feed wheel. Above the lever pivot this arm supports another lever (20), which in turn supports a sliding plate (21) for closing the coin aperture should the stamp strip break, or the stamps run out, displaying the word "Empty" to the public.

The operation of the machine is as follows:—A coil of stamps, with a weight in the centre, is placed in the stamp container, care being taken to bring the end from underneath the roll and not over the top of the roll. The end is led over the feed wheel and under the segmental cover, care also being exercised to place the perforations of the strip upon the pins. The cover should then be replaced and secured with the locking spring.

On the insertion of a coin of correct diameter into the aperture it engages with the aforementioned lever, and on a slight amount of pressure being applied on the side of the coin, it will raise the weight upwards. The weight in its turn will raise the lever attached to it, so that the hook at the further end of the lever will engage an upper pin on the gear wheel. The backward rotation of the latter is prevented by a pawl, thus setting the machine for operation. The coin after this operation falls into a chute, and if it be of the correct size it passes the coin tester and on to the proper

channel, where it presses the escapement lever and releases the arm attached to the escapement pinion. The weight is now free to fall, and in doing so it revolves the feed wheel a pre-determined distance equal to the length of one postage stamp, feeding a stamp partly through the delivery aperture. The stamp may be detached by pulling, or additional coins may be inserted in the machine until the required number of stamps has been released. The detachment

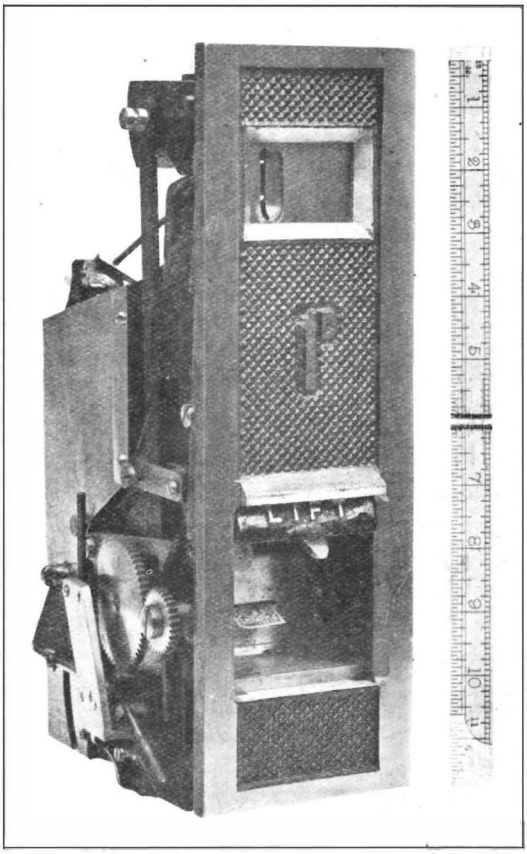


FIG. C.

of the stamps is assisted by the serrations as before described on the front of the cover for the sprocket wheel.

When the last stamp leaves the coil in the stamp container, the small weight which had been inserted in the centre of the coil liberates the stamp strip and allows the lever holding the closing plate to go free. This plate falls, thereby closing the entrance slot for the coins and shows in its place the word "Empty." The

sliding plate is locked in its lower position by a hooked pawl engaging in an abutment, so that it cannot be raised from outside the mechanism.

The machine herein described and illustrated is that employed for outdoor use. The one for inside post offices is identical in operation in all respects, but the distribution of the parts is somewhat different and the stamp container, etc., is not enclosed.

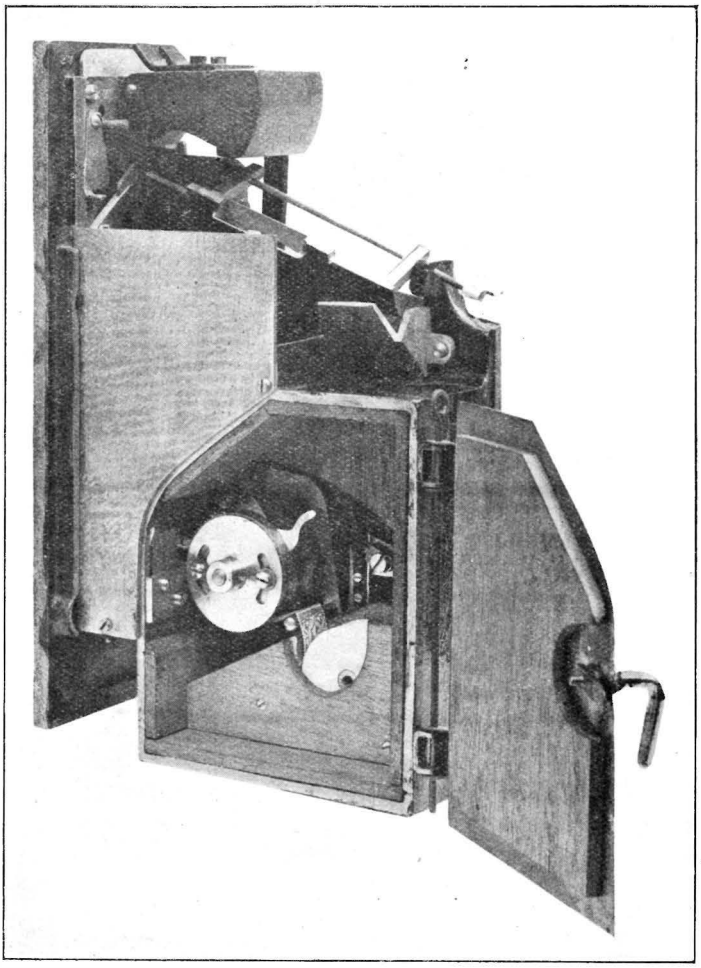


FIG. D.

In the out-door machine the mechanism is enclosed in a metal cover, and the stamp container and feed-wheel compartment is encased in a mahogany lined metal box provided with a door to give access for feeding purposes. The wood lining has been pro-

vided to prevent any possibility of condensation from outside changes of temperature.

The machines are made right and left-handed to cater for the various positions in which the machines will be required to be placed and to facilitate the feeding of the machines when placed side by side in one case.

For the easy running of the machines it is advisable that the stamps be coiled with the printing inside, as it seems to be the general impression that a stamp should be delivered face upwards. Coiling the stamps with the printing outside would probably lead to the coil being placed in the machine back to front, and cause a considerable drag on the mechanism.

Broadly speaking, there are three systems under which the stamp machines may be installed, namely:—

(1) Inside post offices.

(2) Outside post offices; inserted in zinc posting plates or inserted in the windows of post offices, or secured to an outside door or wall of a post office.

(3) Attached to the outside of Pillar Boxes in a small iron case suitably shaped for the purpose.

The first proposal has already been adopted and has given good results in a large number of Post Offices in London and the provinces.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

ANNUAL MEETING.

THE Annual Meeting of the Institution, which is also the last meeting for the session of the London Centre, was held at the Royal Society of Arts on Tuesday evening, the 24th May. In the unavoidable absence of the President, Mr. A. J. Stubbs, Vice-President and Chairman of Council, took the chair.

Mr. T. Smerdon, Secretary, read the annual report, which, apart from the financial side, indicated that the Institution was in a flourishing condition. The chief item of importance was the Council's proposed scheme of re-organisation, which had received the heartiest support of the members, the result of the ballot showing that the great majority of the members were in favour of the Council's proposals. As already announced, the Institution will now consist of Members, Associates, and Associate Members, similarly to the constitution of the parent institution.

The Foreign and Colonial membership showed a very pro-

nounced increase during the year. This fact shows that the benefits of the Institution were becoming more and more appreciated overseas, the Journal and the issue of printed papers, which together constitute a record of the progress of the Home department, forming a very valuable connecting link between our own service and those of the Colonies.

The total membership stands as follows:—Members (Engineering), 674, (Clerical), 193; Associates, 445; Colonial and Foreign Members, 149; Submarine Members, 3; Honorary Members, 6. Total, 1470; an increase for the year of 230.

Papers in press and approved for printing:—Some Notes and Views on Telephone Fitting Work: A. C. Greening; Telegraph and Telephone Engineering in the United States: Sir William Noble; Secondary Cells: R. G. De Wardt.

The Chairman moved the adoption of the report and Mr. J. W. Atkinson seconded. It was agreed to without discussion.

Mr. A. O. Gibbon then moved the adoption of the Financial Report, copies of which had been circulated at the opening of the meeting. Owing to the heavy cost of printing and the grants in aid to the Journal, the usual satisfactory balance was less than usual, but subscriptions were coming in well and with the increased rates now due it was anticipated that the financial position was secure. The Journal report gave promise of a more satisfactory state of affairs than had existed for the past year or two, and it was hoped that the Magazine would not require so much financial assistance during the coming year. Captain J. G. Hines formally seconded the adoption of the report, which was agreed to unanimously.

The Chairman announced the results of the voting for offices on the Council, which will be constituted as follows for the current year:—

Headquarters Representatives—J. G. Hill and S. C. Bartholomew.

Executive Engineers.— London: J. G. Hines
,, ,, Provinces: H. Kitchen

Assistant Engineers.—London: F. E. Mitton.
,, ,, Provinces: A. W. Gardiner.

Chief Inspectors.—London: W. A. B. Romaine.
,, ,, Provinces: A. Bates.

Clerical Classes.—London: W. J. A. Payne.
,, ,, Provinces: F. McMullen and W. Miller.

Treasurer: A. O. Gibbon. Secretary: T. Smerdon.

Major T. F. Purves, Assistant Engineer-in-Chief, has been appointed Chairman of Council, in place of Mr. A. J. Stubbs, and

Lieut.-Col. A. C. Booth Chairman of the London Centre for the current year.

Votes of thanks to the retiring Members of Council were passed unanimously. Special reference was made to the fact that Mr. A. J. Stubbs, who had acted as chairman for the greater part of the life of the Institution, was due for retirement from the service in the coming year, and Major Purves, in moving that the Institution records its warmest appreciation of the long and valuable services rendered by Mr. Stubbs, paid a gracious and touching tribute to his fine character and to the sense of personal loss the speaker would sustain at his departure. The Council had unanimously agreed to confer upon Mr. Stubbs the honorary membership of the Institution. Mr. Stubbs feelingly replied.

The Chairman announced that Lt.-Col. Booth had presented to the Institution the sum of £100, which would be converted into an annual Institution prize of £10, to be awarded for the best improvement in Telegraph apparatus or system made during each year. The award will be known as the "Booth-Baudot Duplex Award," and the allocation will be determined by the Council of the Institution. Fuller details will be published in due course.

Mr. E. Lack, of the Telegraph Section, Engineer-in-Chief's Office, then read a paper on "Apparatus in use on Long Submarine Cables." The writer dealt exhaustively with the various types of apparatus, and explained the salient features of the Muirhead and the Judd-Fraser transmitters, the Gulstad and G relays, the undulator and syphon recorder, the Eastern Telegraph Company's interpolator or repeater, and the Cox, Orling, Heurtley, and Hinton and Shaughnessy amplifiers. A hearty vote of thanks was paid to the lecturer at the close.

LOCAL CENTRE NOTES.

SOUTH LANCASHIRE CENTRE.

THE fourth and final meeting of the session was held on the 7th March, with Mr. Medlyn in the chair.

A very interesting paper was read by Mr. T. E. Herbert on the "Principles of Scientific Management." The subject was ably dealt with by the lecturer and evoked a lively discussion, in which the matter was approached from various points of view. The lecturer having replied at some length to the queries raised, the meeting terminated with the usual vote of thanks.

The work of the session, as a whole, has been satisfactory and encouraging, in spite of the hindrances due to the after effects of the

war, etc. The meetings have, without exception, been well attended, and the discussions following the lectures have been of a high order.

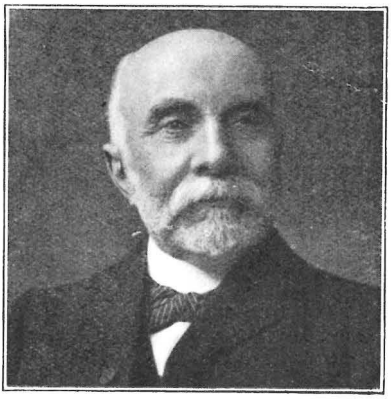
It is hoped to have a fuller programme next session, and even better attendances at, and interest in, the meetings.

SCOTLAND EAST.

Death of Edward Campbell.

Another of the few remaining links with the pioneer days of telegraphy has been broken through the passing away of Mr. Edward Campbell, at Edinburgh, on 25th March, 1921.

Mr. Campbell was born at Perth in 1844 and joined the service of the Electric and International Telegraph Company there in 1858. After a few years he was promoted to the Company's Head Office at 68, Princes Street, Edinburgh, where he remained as Clerk and Relief Superintendent until the Transfer in 1870. He remained in Edinburgh as Assistant to the then Superintendent until 1872,



THE LATE EDWARD CAMPBELL.

when he was promoted to the post of First Class Inspector in the Engineering Department at Edinburgh, and was transferred in a similar capacity to Glasgow in 1878.

In 1892 he returned to Edinburgh as Assistant Superintending Engineer, and on the death of Mr. James Gibson, in February, 1902, he was promoted to the vacant Superintending Engineership at Edinburgh, where he remained until his retirement in 1905.

Mr. Campbell in his early days was an expert double needle clerk and was also experienced in all other pre-transfer instruments.

Since his retirement he has been a regular attendant at the social gatherings of the Scotland East District and also at the meetings of the I.P.O.E.E., and it came as a shock to those who

had seen him at the meeting of the latter on March 8th to hear that he had not recovered from a chill caught when gardening.

His funeral at the Grange Cemetery, Edinburgh, on Easter Monday, was attended by such members of the Old Guard as Messrs. Andrew Gray, Ex-Controller, Edinburgh, and Mr. Campbell's former Superintendent and life-long friend, still looking vigorous at 86; Mr. Machugh, late Superintending Engineer; Mr. Robert Scott, late Secretary's Office and Ex-Controller, Postal Service, Edinburgh; Mr. J. B. Hegarty, Ex-Postmaster, Aberdeen; Mr. Cowans, late Sectional Engineer, Glasgow, and a goodly turn out of the present Engineering Staff, led by Mr. Taylor, Capt. Crompton, O.B.E., and Mr. Gilbert, who laid to rest all that remained of one of the truest of gentlemen, who always tried to make the most of his subordinates good points and was a guide, counsellor and friend to the staff who had the privilege of working with him. F.H.M.

NORTH WALES CENTRE.

The final meeting of the 1920-1 Session was held in the Technical School, Shrewsbury, on the 8th March, 1921, when papers were read on:—

"The Distribution of Official Literature," by Mr. W. H. Ferguson.

"Estimates and Economics," by Mr. E. A. Pearson.

Mr. Ferguson in his paper commented on the numerous types of instructions which were issued for the guidance of the staff and the necessity for some form of comprehensive index. He referred to the issue of amendments to Regulations, etc., and the laxity observed in keeping them up-to-date, also to the desirability of limiting the number of personal copies owing to the labour involved in dealing with amendments. Finally, he suggested that Sectional Libraries of the Workmen's pamphlets might be created with advantage in order that an officer could obtain on loan any pamphlet he wished to study.

Mr. Pearson commenced his paper by pointing out that the estimate was the basis of engineering costs, and as it was an estimate only every effort should be made to exclude excessive detail in order that the total cost could be obtained expeditiously. Capital, annual charges on capital, depreciation, interest, and maintenance were referred to.

He called attention to the vital necessity for development forecasts, and the loss entailed by inadequate and inaccurate forecasts. The paper was concluded with economic comparisons of open plant and underground plant, and of bronze wires and aerial cables. Considerable discussion followed.

IRELAND CENTRE.

ON the 10th May, 1921, the first meeting of this Centre since 1914 was held in Aldborough House, Dublin. There were about 40 in attendance, including several members of the Clerical staff

A paper on "Valves" was read by Mr. J. W. O'Neill, who dealt with the subject in a very clear and interesting way. The paper was illustrated by large diagrams, and a demonstration of the magnifying powers of the telephonic repeater was given by means of apparatus kindly lent by the Engineer-in-Chief.

The Chairman, in conveying to Mr. O'Neill the cordial thanks of the meeting, complimented him on his treatment of the subject. He was very pleased that the Ireland Centre had resumed its activities, and he hoped a full programme for next Session would be arranged and that conditions would permit of its being successfully carried through.

STAFF CHANGES.

POST OFFICE ENGINEERING DEPARTMENT.

RESIGNATIONS, ETC.

Name.	Grade.	District.	Date.	Remarks.
Harper, E. ..	Asst. Engr.	S. Western	22 : 6 : 21	Seconded from Home Service as Superintending Engineer, Ceylon.

RETIREMENTS, DEATHS, ETC.

Name.	Grade.	District.	Date.	Remarks.
Goodman, A...	1st Cl. Clerk	Scot. West	21 : 1 : 21	Deceased.
Bowen, J. H....	2nd Cl. Clerk	South Wales	21 : 3 : 21	Do.
Parker, C. G.. .	Do.	N. Western	3 : 3 : 21	Retired.

PROMOTIONS, ETC.

Name.	District.	From.	To.	Date.
Elener G. A. ..	Scotland West	2nd Cl. Clerk	1st Cl. Clerk	21 : 2 : 21
Jones, J. W. ...	South Lancs.	3rd Cl. Clerk	2nd Cl. Clerk	21 : 2 : 21
Taylor, G.	Scotland West	Do.	Do.	16 : 3 : 21
Allcock, R. G. ...	North Western	Do.	Do	21 : 4 : 21

TRANSFERS.

Name.	Grade.	Transferred.		Date.
		From.	To.	
Byrne, D. J. ...	2nd Cl. Clerk	South Lancs.	North Western	1 : 4 : 21
Allcock, R. G. ...	Do.	North Western	South Wales	22 : 5 : 21

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