THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

VOL. 14
PART 1

APRIL
1921

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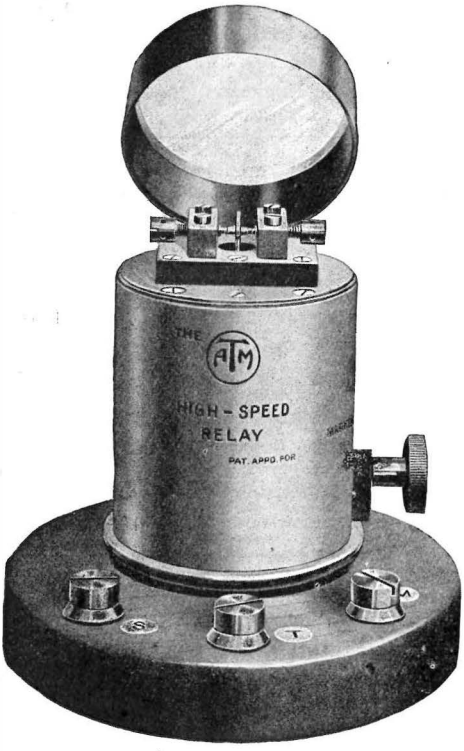

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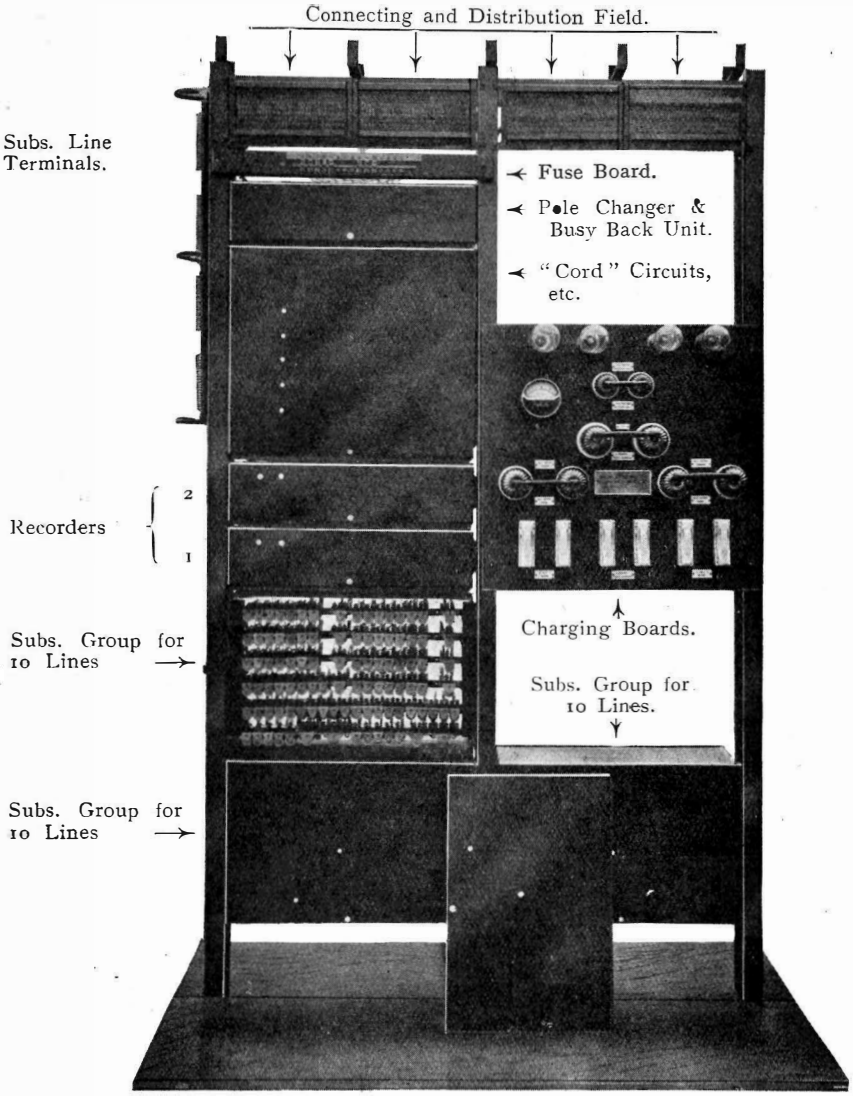

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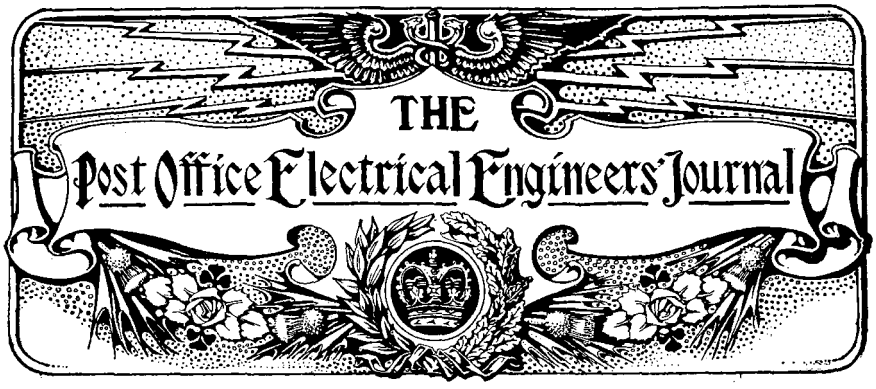


SUBMARINE CABLES OF THE WORLD.

WE have pleasure in continuing the list of submarine cables. In previous issues we have published details of the London-Halifax line, the Irish cables, the cables between this country and the continent of Europe, the Great Northern Telegraph Company's cables and those of the Pacific Cable Board from Canada to Australia and New Zealand. In regard to the latter, we have a correction to make. In the remarks column was stated " Syphon recorder working with repeaters and Cox's magnifier." The Secretary of the Board points out that Heurtley's Magnifier (not Cox's) is installed on the Bamfield-Fanning and Fanning-Suva cables; repeaters and Cox's magnifier are used only at Norfolk.

In the following pages we give details of the Eastern Telegraph Company's cables from Porthcurnow to Shanghai *viâ* Suez, and from Porthcurnow to Australia *viâ* the Cape. We are greatly indebted to Mr. F. Ryan, Chief Engineer of the Eastern Company, for these figures, and also to the Commercial Cable Company for information supplied regarding their Atlantic cables, which we hope to be able to publish in our next issue.

TABLE IV.—*Eastern Telegraph Company's Cables.*

PORTHCURNOW TO SHANGHAI VIA SUEZ.

Section.	Date laid.	Length in Nautical Miles.	Cable res. in ohms.	Cable capacity in mf.
Porthcurnow-Lisbon No. 1 ...	1870	861	6877	284
Lisbon-Gibraltar No. 1 ...	1870	366	2860	122
Porthcurnow-Lisbon No. 2 ...	1887	906	5098	335
Lisbon-Gibraltar No. 2 ...	1887	335	2003	120
Porthcurnow-Vigo	1873	623	4425	202
Vigo-Gibraltar	1897	621	5255	213
Vigo-Lisbon	1873	265	2257	87
Porthcurnow-Gibraltar ...	1898	1191	6627	424
,, ,, ...	1919	1172	3740	402
Gibraltar-Malta 1	1870	1150	10551	397
,, ,, 2	1887	1138	6396	412
,, ,, 3	1898	1118	3619	443
,, ,, 4	1912	1092	2082	423
Malta-Alexandria 1	1869	923	6558	315
,, ,, 2	1870	911	5848	310
,, ,, 3	1898	900	2972	356
,, ,, 4	1912	890	1702	345
,, ,, 5	1920	907	4170	298
Suez-Port Sudan 1	1902	766	3700	273
Port Sudan-Perim 1	1920 1902	609	2868	220
Perim-Aden 1	1920 1870	107	928	36
Suez-Port Sudan 2	1890	763	4370	267
Port Sudan-Perim 2	1920 1890	626	3546	218
Perim-Aden 4	1920 1890	100	605	35
Perim-Aden 5	1902	114	561	41
Suez-Suakim	1876	803	7738	246
Suakim-Perim	1876	670	6019	220
Perim-Aden 2	1876	144	1336	46
Suez-Aden 3	1883	1388	7029	490
Suez-Aden 5	1914	1406	4750	480
Aden-Bombay No. 1	1870	1856	4706	740
Aden-Bombay No. 2	1877	1870	9030	638
Aden-Bombay No. 3	1890	1850	5161	725
Aden-Bombay No. 4	1920	1831	3380	703
Aden-Colombo	1913	2263	4133	858
Colombo-Penang	1914	1407	3111	543
Madras-Penang 1	1870	1510	12012	500
,, ,, 2	1891	1387	7722	494
Penang-Singapore 1	1870	402	4168	132
,, ,, 2	1892	400	3951	133
,, ,, 3	1914	403	1000	150
,, ,, 4	1879	389	4124	125
Singapore-Hong Kong ...	1914	1522	3485	570
Singapore-Saigon	1871	627	6699	199
Saigon-Hong Kong	1871	955	8391	325
Hong Kong-Foochow ...	1883	475	2815	172
Foochow-Shanghai	1883	450	2726	162

TABLE V.—*Eastern Telegraph Company's Cables.*

PORTHCURNOW TO AUSTRALIA VIA CAPE.

Section.	Date laid.	Length in Nautical Miles.	Cable res. in ohms.	Cable Capacity in mf.
Porthcurnow-Maderia ...	1901	1342	3176	557
Maderia-St. Vincent	1901	1128	2480	475
St. Vincent-Ascension ...	1900	1775	3884	744
Ascension-St. Helena ...	1899	789	1879	328
St. Helena-Capetown ...	1899	1893	4134	781
(Capetown-Durban) (Landline.)				
Durban-Mauritius	1901	1731	3859	721
Mauritius-Rodriquez	1901	404	891	168
Rodriquez-Cocos	1901	2151	4715	890
Cocos-Perth	1901	1721	5696	666
Perth-Adelaide	1902	1546	6041	594

NEW POST OFFICE CABLE SHIPS, AND THE WAR.

By R. MYLES HOOK, M.B.E., A.M.I.E.E.

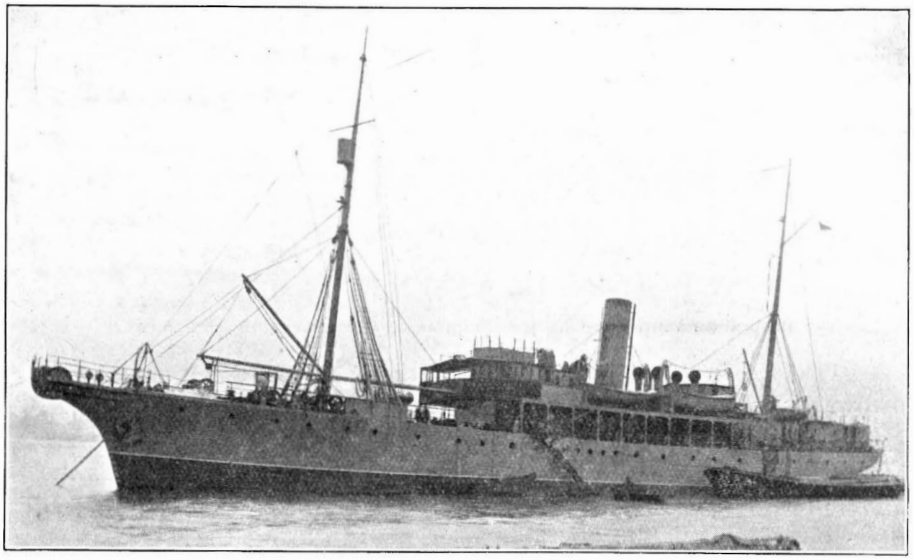
(late Commander-in-Charge, Submarine Cables, Forth Defences).

ONE of the peculiar features of the late war was the impulse towards increased importance it gave to many industries which had hitherto existed comparatively unknown to all but the few who were directly interested in them. Not the least in this category was the Submarine Cable system throughout the world.

The extent of the operations necessary during the war was so great that communication between remotely situated countries was of very vital importance, and this was fully realised by the Germans as shown by the cutting of the Pacific cable, and the raid on Fanning Islands, 1914. In this connection, a very interesting story of far distant cable work in connection with the War may be read in our contemporary "The Zodiac," the organ of the Eastern Telegraph Company, a British Company, upon whose shoulders fell a large duty in connection with overseas communications, the "Indo." system to the East being, of course, out of action. The importance of submarine communications was equally realised by the Allied Governments, who during the course of the War found it necessary not only to make use of cables—which had already been cut—hitherto belonging to enemy powers, but also to lay

many additional cables both at home and abroad. The result of these operations, so far as we are directly concerned, was a considerable increase in the number of cross-Channel cables between England and France, England and Belgium, a new cable from Scotland to Russia, and the conversion of a German cable to the Azores and thence to U.S.A. into what is now known as the Imperial Cable, connecting England with Canada, and so forming the link required to complete, in conjunction with the Pacific Cable Board's cable, the All Red Cable Route to Australasia.

It is worthy of remark that the foregoing operations inaugurated the beginning of a new era in Post Office Telegraphs, inasmuch as the working of Transoceanic cables, which had not previously



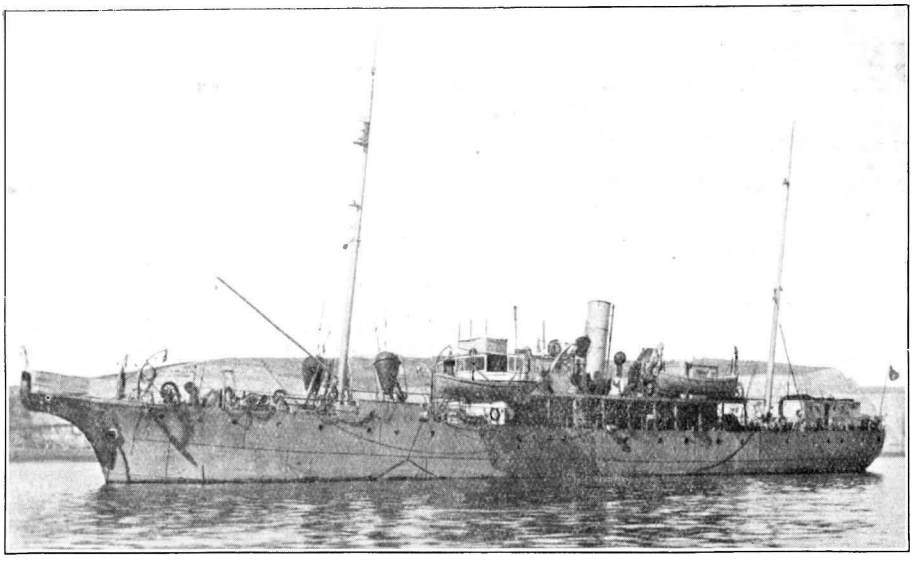
H.M.T.S. "MONARCH" (II.).

been within the ambit of the Department, became a very important factor, giving opportunity for the application of the very latest ideas in the hitherto, to the Department's officers, unexploited field of long-distance submarine transmission.

The foregoing operations led to a corresponding increase in the number of vessels required for the upkeep and maintenance of the cables during the War period, an aspect which was dealt with in a previous article by Mr. J. Bourdeaux, O.B.E., Submarine Superintendent. In this he referred to the old Post Office cable ship *Alert*, which, having become too old and decrepit for her

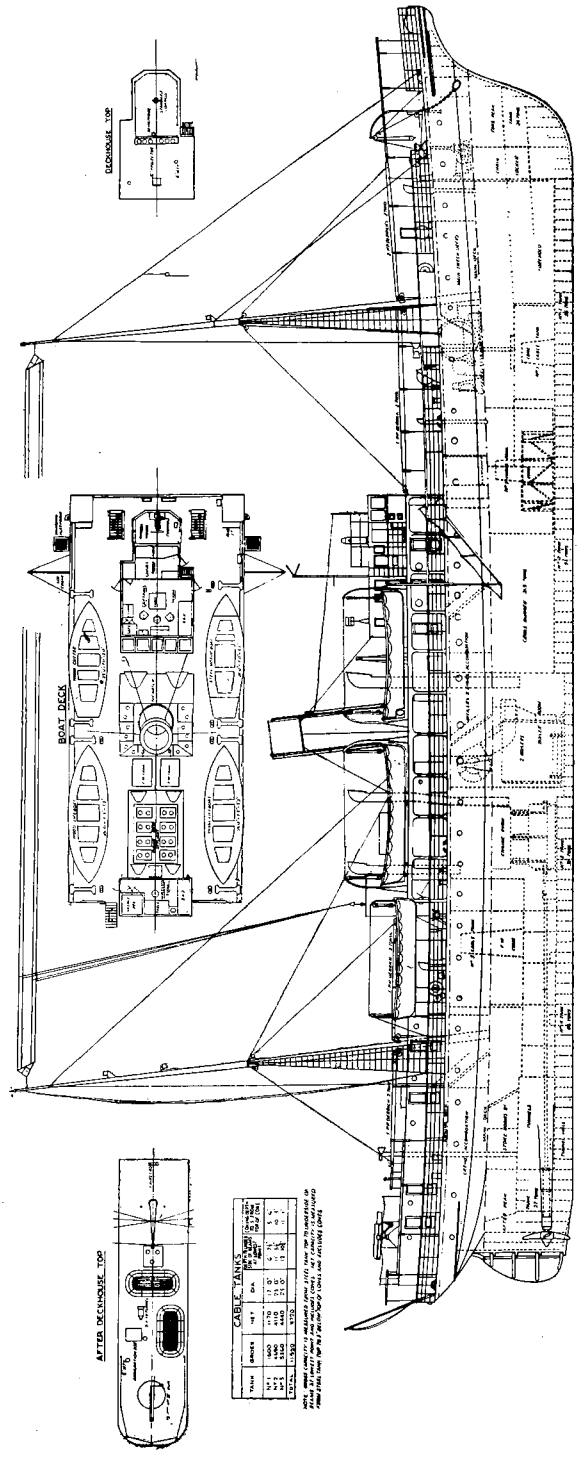
duties, had to be sold out of the Service during the War. The *Monarch*, too, as Mr. Bourdeaux mentions, was lost, owing to a mine explosion and now lies in the English Channel close by Folkestone.

Anticipating the necessity for replacing *Alert* very shortly, the Department had already prepared plans and specifications for a new cable ship to replace her, but as it ultimately happened that the *Monarch* was lost before *Alert* was sold, the first of the new ships was named *Monarch*, and, built by Messrs. Swan, Hunter and Wigham Richardson, was launched on the Tyne in the middle of 1916. This vessel, of which a photograph is given, together with a small scale reproduction of the drawings, was specially



H.M.T.S. "ALERT" (II.).

designed for work in comparatively shallow waters around the coasts of the British Isles, to share the maintenance of the cables in that very large list which has appeared in previous issues of this Journal. Her lines are graceful, and for her size she has proved to be a very seaworthy little ship. Under the command of her first Captain (C. Lever), succeeded by her present Captain (F. J. Ramsay, M.B.E.), she has already done a large amount of very excellent work. Her dimensions are as follows:—Gross tonnage 1150, length 215 feet, beam 32 feet, draught 15′ 9″, and with her engines of 125 horse power, she attains a normal speed of 11.5 knots. Two



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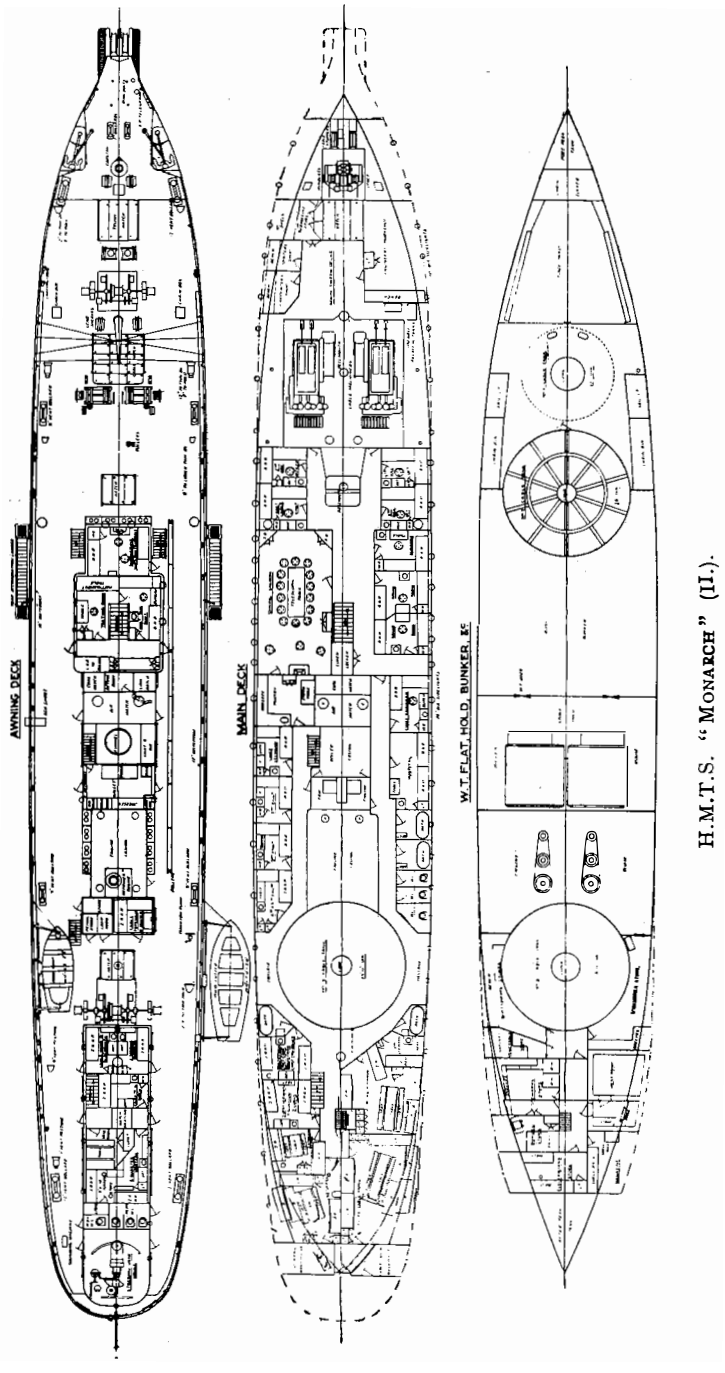

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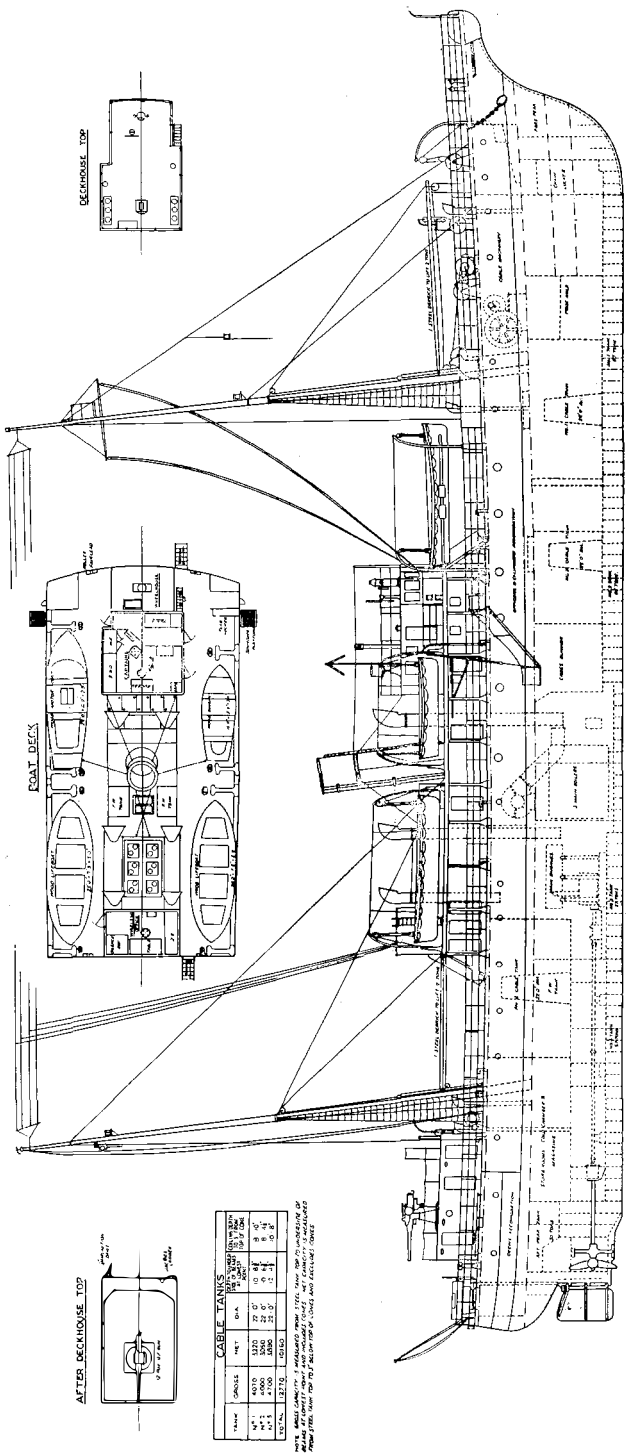
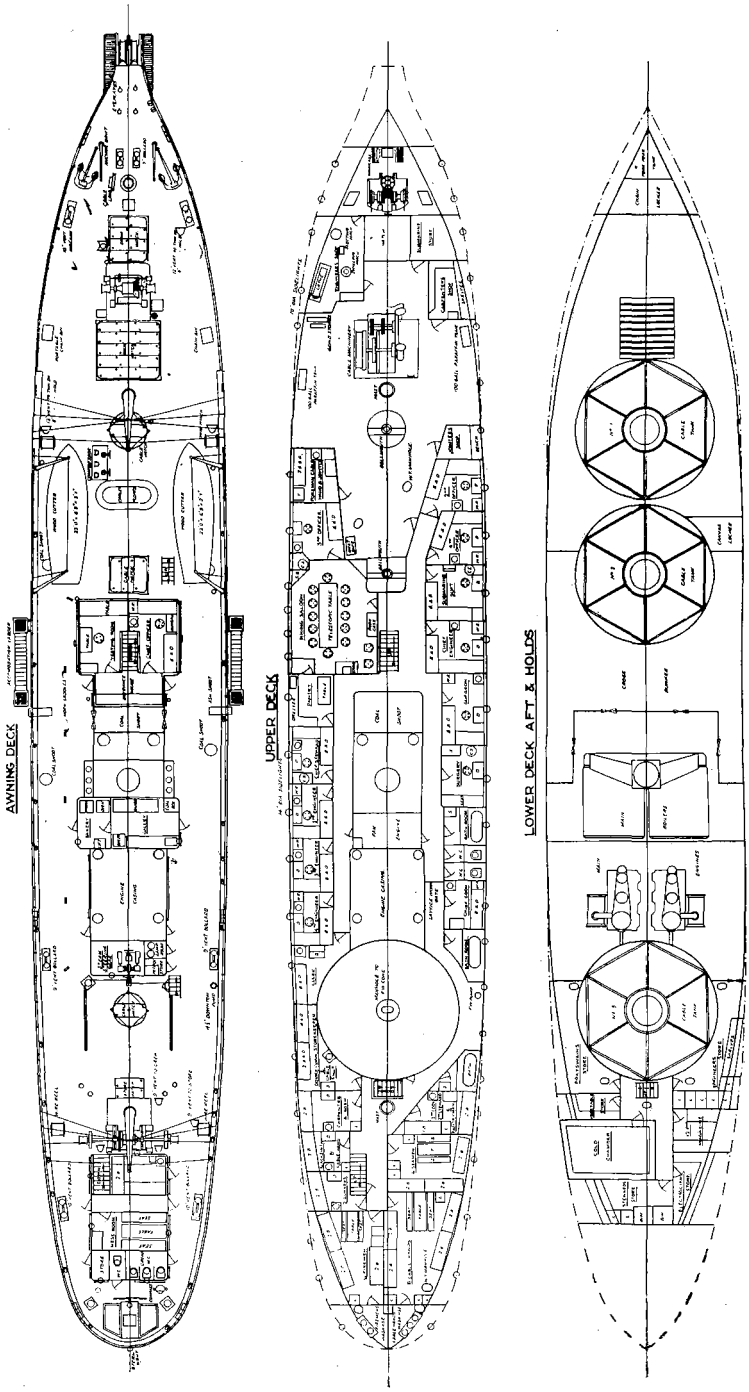


H.M.T.S. "ALERT" (II.).



H.M.T.S. "ALERT" (II.).

large and one small cable tanks are fitted, with a cubic capacity of 9720 feet, carrying approximately either 60 miles of single core cable, 43 miles of 4 core cable, or 21 of 6 or 7 core cable. Her cable machinery, provided by the Telegraph Construction & Maintenance Co., consists of two distinct engines with two drums, arrangements being provided for so cross connecting the machinery that both port and starboard drums can be driven independently, or worked from either port or starboard engines. This gear is capable of lifting a dead weight of 6 tons at 3.25 miles per minute, or 26 tons at 0.75 miles. The gear and drums are fitted on the main deck, but the Controls, Dynamometers, etc., are fitted on the upper deck, upon which are also fitted, close to the Bow sheaves, auxiliary telegraphs communicating with the Engine Room and Wheelhouse. Her total complement consists of 61 Officers and Men, including Deck, Engineering, Accounting and Stewards' departments, all of whom are well housed in comfortable quarters on board. This vessel burns coal, having bunker space for 255 tons, and is fully equipped with modern aids to navigation, etc., including a wireless telegraph installation, a searchlight and a range-finder, the latter being much used for obtaining distances at sea and as an aid to coastal navigation.

A second vessel, replacing the old *Alert*, built by the same firm, was launched in 1918, and a reduced reproduction of her principal drawings is also given. Although slightly smaller than *Monarch*, she is very similar in appearance except that the counter of the latter is replaced in the new *Alert* by a cruiser type stern. *Alert's* dimensions are as follows: — Gross tonnage 940, length 190 feet, beam 31′ 4″, depth 24′ 9″, draught 15 feet. Engines of 105 horse power give her a speed of 10.5 knots. She burns oil fuel, having capacity for 200 tons of oil. Three cable tanks of 10,160 cubic feet total capacity are fitted, in which either 81 miles of single core cable, 54 of 4 core or 35 of 6 or 7 core cable, can be stowed. Although, as stated, the latter vessel is not quite so large as *Monarch* and therefore not quite so comfortable in bad weather, her captain (Mr. H. F. Bourdeaux, O.B.E.) has been able to accomplish quite a large amount of important repair work since she was launched, and this despite the fact that up to the present date her operations have been very largely hampered by reason of the fact that owing to the exigencies of the War, she had to be equipped with the very old and almost broken down cable gear from the old *Alert*. At the moment of writing, however, this is being replaced by modern gear, similar to that on *Monarch*, by the Telegraph Construction & Maintenance Co., which will largely increase the efficiency of

the ship, and make her equivalent to *Monarch* in regard to equipment. Her complement of Officers and Men is 53. It is noteworthy that these ships, being designed for shallow waters only, are not fitted with stern gear for cable laying, as is usual in other cable ships. The *Monarch* is based on Woolwich, where the Department maintains a shore depot with 6 cable tanks, and a new depot for *Alert*, having 4 cable tanks, is now being built in the Royal Dockyard at Dover.

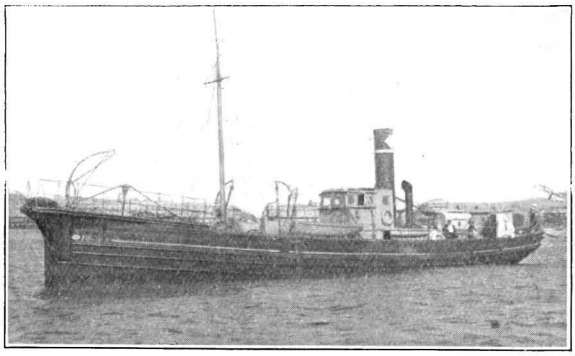
In Mr. Bourdeaux's article mentioned above, reference was made to the number of cable ships chartered or equipped for the increased demands of War communications. Apart from the chartered ships whose service was purely temporary, the writer thinks that the services of those ships which were specially equipped as auxiliaries for the greater period of hostilities, should be placed on record. The *Hodder* (Captains (1) F. G. Ramsay, M.B.E., (2) S. G. Gorton, M.B.E.), a passenger and cargo vessel of some 1,000 tons, specially fitted out for cable work, relieved the old *Monarch* just prior to the loss of the latter, in the maintenance of the very extensive cable system around the Orkneys and Shetlands and Northern waters generally.

The *Mersey* (Captains (1) H. F. Bourdeaux, O.B.E., (2) E. R. Hutchons), a slightly larger vessel, similarly equipped, was employed for several years continuously round about the English Channel and North Sea, on the repair of Continental Cables. Both of these ships belonged to the Lancashire & Yorkshire Railway Co., at the Port of Goole, and it is much to be regretted that photographs of each of them to illustrate the record of their War service are not available.

The *Sialkot* (under Mr. Chas. Leigh, of the Engineer-in-Chief's Office), a Trawler turned into a cable ship, carried out some deep water work in the Bay of Biscay, in the diversion of cables, which many had deemed beyond her powers, and laid and repaired cables under conditions which would have precluded any attempt in larger ships.

We have, however, a photograph of the last, and least of the cable fleet, H.M.T.S. *Madis*. Originally built at Lowestoft as a North Sea Drifter, she was modified into a complete miniature cable ship and did quite a large amount of work in connection with laying and repairing cables round about the shores and islands in the Firths of Forth and Tay. This little vessel (under (1) the writer, (2) Mr. J. H. Bell of the London Engineering District), 91 ft. long, probably the smallest cable ship in the world, and with a total complement of only 1 Officer, 15 Petty Officers and Men, together with a detached working party of 20 men (under Mr. F. H. Horner,

now of Scotland West District), in attendant craft, succeeded in creating what must be something in the nature of a record by accomplishing, apart from the laying of new cables, in 210 days commission a total of 127 repairs, repeating the performance in the following commission of 305 days by 279 complete repairs. This record was no doubt largely facilitated by the comparatively small area within which lay most of the work, so that there was but little time wasted in steaming between jobs. On the other hand, the repairs consisted of large multi-core cables, lengthy operations on 16 and 28-core repairs being very frequent. The writer, having already served on *Mersey* and on several other cable expeditions, feels very proud to have had this little vessel included under his Command. The performance of her duties in connection with communications



H.M.S. "MADIS."

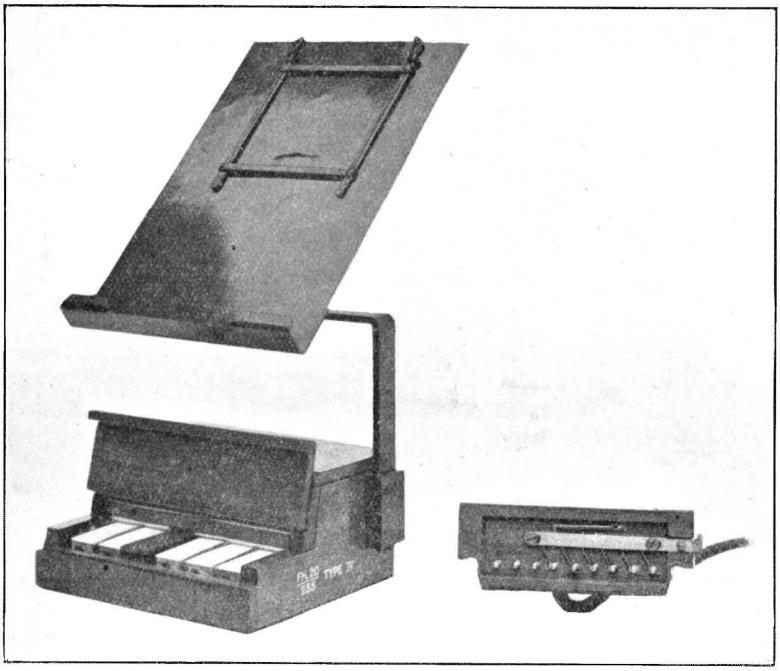
of the Grand Fleet during the later years of the War were deemed of sufficient importance and merit to warrant special mention in a despatch from the Commander-in-Chief. It is a pity that she is now lost to the cable service, having, after the Armistice, been sold to a salvage firm. One of the very last duties carried out by this little ship is worthy of mention, although but a minor item of an historic occasion. On 21 November, 1918, she awaited the arrival of the surrendered German High Seas Fleet and laid a cable from the War Signal station on Inchkeith Island to H.M.S. *Revenge*, the Flagship of the 1st Battleship Squadron to which was entrusted the custody of the German Fleet pending its despatch to Scapa Flow.

RECENT IMPROVEMENTS IN BAUDOT APPARATUS.

A. C. BOOTH.

THE BAUDOT KEYBOARD was altered some years ago, to make it readily replaceable in case of a fault or suspected fault, by arranging for a tablet connector carrying all the connecting wires to be clamped to connecting springs on the back of the keyboard. This device served its purpose very well, but there was a loss of a few minutes in releasing the clamping nut situated beneath the instrument table, and in unscrewing and screwing up the two clamping nuts that fixed the connection tablet.

The latest type of keyboard has no clamping screw, but stands quite freely on the table, and on that account does not require the unsightly and inconvenient slot in the instrument table which was previously necessary to accommodate the clamping tube in various positions.



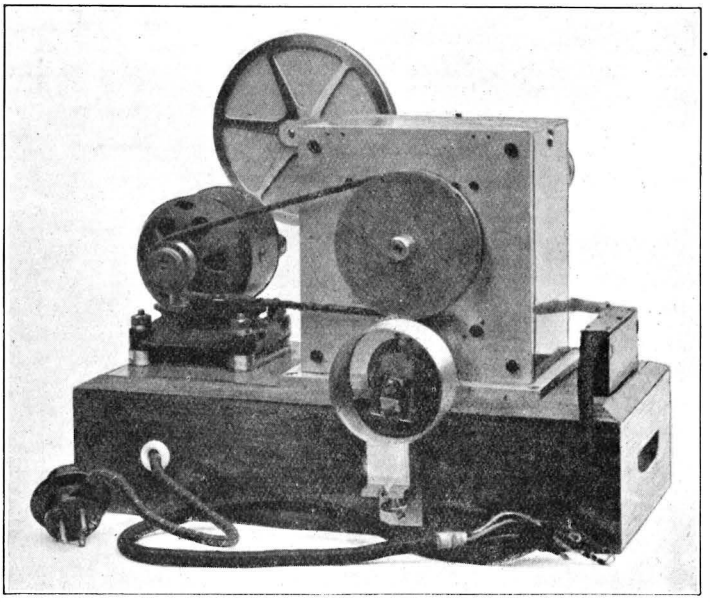
BAUDOT KEYBOARD AND TABLET CONNECTOR.

The removal of the clamping tube has rendered unnecessary the retention of the lower wooden base of the keyboard, which has been

replaced by a baize pad to avoid any scratching of the table. The consequent reduction in the height of the keys from the table by about half an inch is a great advantage from an operator's point of view.

The tablet connector has been cut away at each end, as shown in the illustration, to enable it to be slipped into position without the need for entirely removing the clamping nuts, which sometimes fell to the floor and caused loss of time.

The circuit of the cadence magnet has been taken through a spring contact, under the control of the cover of the keys, acting through a press button (shown in the figure as a small projection immediately above the rear end of the ivory of the 5th key). When the cover is up the cadence works, but ceases when the cover is



BAUDOT RECEIVER.

down, as the cadence circuit is then broken. This device was provided to avoid the noise of the cadence in small offices when only one or two channels are working. It also ensures the closing of keyboards when not in use, and thereby keeps out dust and also provides for the permanent locking down of certain keys when certain testing signals are required, such as for "reversals," or morse letter "F" on Double Duplex sets. The desk support has been placed in a more central position, so as to avoid any tendency to overbalance the keyboard.

The BAUDOT RECEIVER was fitted with a tablet receiver of the same design as that used for the keyboard, but this has been displaced by a plug connector, shown in position on the right of the illustration. This plug carried the connections to the receiver magnets as well as those for the power circuit of the motor working at 40 volts; on account of the large current taken, the motors were rewound for either 110 or 220 volts, which has necessitated the removal of the power leads from the oblong plug to a separate plug and socket, to avoid the risk of electric shocks to operators. This plug is shown to the left of the illustration, carrying three pins, two of which are for the power circuit and the other for an "earth" connection to the framework of the motor. By this means there is practically no risk of shock to the operators, even if they take hold of the motor frame when a contact fault exists between it and the windings.

The Receiver trainwork is now permanently screwed to the base of the instrument to avoid the all too frequent damage to gear-wheels. This damage was a costly maintenance matter when wheels had to be replaced, and it often caused bad working when the damage was only slight. The change has permitted the removal of the ebonite strips and springs on the right and left of the trainwork, which were often a cause of faulty connections. Finally, the limiting bar just above the five receiving magnets has been permanently fastened down to avoid interference by operators with the tension of the flat springs beneath the armatures.

These changes have made a great improvement in the working and have considerably lessened maintenance charges. Incidentally the weight of the instrument has been reduced from about 34 lbs. to 30 lbs.

The slide resistance has been replaced by a lamp resistance and the motor switch is now placed on the table close to the socket for the 3-point plug. The two doors and most of the woodwork in the base of the receiver thus become unnecessary and have been removed.

Criticism has sometimes been made in regard to the belt drive and the need for occasional adjustment, which would not be necessary if gear wheels were used.

The advantages of the belt drive far outweigh its disadvantages, or the advantages of gear wheels, for the following reasons:—

(1) The series-wound motor tends to over-run the brake of the receiver, because immediately the brake acts the motor takes more current. This effect is easily corrected by adjusting the tension of the belt so that the motor pulley can easily slip, and it will be found quite practicable to obtain excellent working results with a

very slack belt. This is due to the fact that the amount of work done in the receiver is small compared with the power of the motor, and one can afford to use a little more energy, or to polish a motor pulley to obtain an easily adjustable correct speed.

(2) With belt drive the motor may be situated quite clear of the trainwork, thus allowing better ventilation and greater accessibility than could be obtained if gear wheels were used.

(3) The belt is practically noiseless which would not be the case with gear wheels.

It is, of course, possible to use gear wheels, but in that case it would probably prove more advantgeous to change the brake action to a momentary disconnection or increase of resistance in the motor circuit.

Several suggestions have been made from time to time proposing the replacement of the flexible cord connector by direct connection to springs or studs fitted on the table, so that the action of placing the receiver in position also automatically made the necessary connections. These were fully considered at the time, but the proposal was not adopted because of the probability of damage to the springs or pins when the receiver is being placed in position. There is also the slight disadvantage resulting from the absolutely fixed position of the receiver.

A previous article on the improvements in the Baudot keyboard and receiver appeared in Vol. 6, pp. 324—336.

BOOTH-BAUDOT KEYBOARD TESTER.

A. C. BOOTH.

THIS instrument has been designed for quickly and accurately testing and adjusting keyboards, in order to obtain security of connection between the spring contact of the key leavers and the front and back contact screws between which they play; also for assuring that the locking and cadence release are functioning correctly.

The five galvanometers at the top of the board are connected to the five key-levers in similar order, viz., 5, 4, 1, 2, 3, while the sixth galvanometer is in the circuit of the cadence magnet. Positive and negative voltages of 40 are permanently connected to the instrument, and an "earth" connection is also provided. No current passes until a keyboard is placed in position, which action automatically makes all the required connections by means of the nine flat springs shown in Fig. 1.

If all keys are "up," the galvanometers give a deflection to the left, which is changed to the right as soon as any corresponding key is depressed. The cadence galvanometer shows no deflection until the cadence key, situated immediately to the left of the keyboard, is depressed; the galvanometer then deflects to the right and the cadence magnet is actuated, releasing any key that has been depressed.

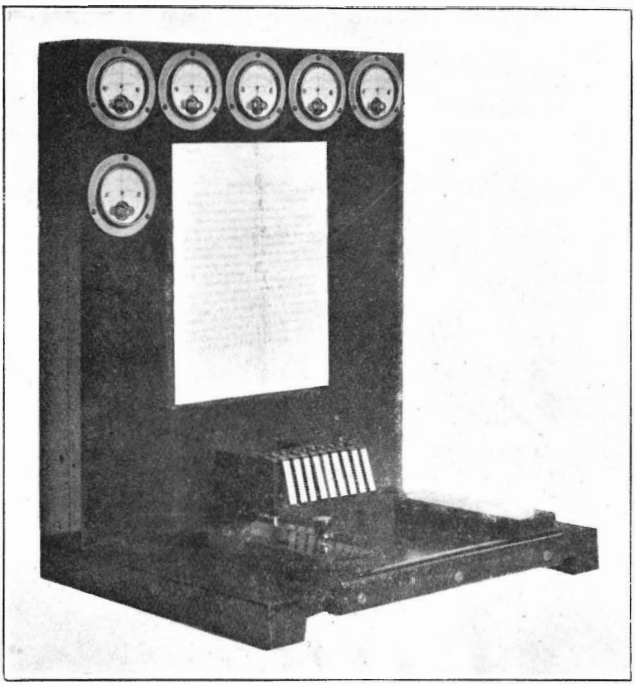


FIG. 1.—BOOTH-BAUDOT KEYBOARD TESTER.

When contact screws or levers have been cleaned or re-adjusted there is the possibility that one or more contacts may be insufficiently secure, that is to say, they may make quite good connection when everything is at rest, but may make intermittent disconnection due to table vibration or the jarring of the cadence magnet, or even by the movement of the operator's hand.

The Tester at once shows this fault, which can be easily remedied by suitably advancing the contact screw concerned.

Similarly the locking device should ensure a secure front contact when the key is held down only by the locking arrangement and not by hand. An expert operator can often send effectively when the locking device is not giving a secure contact, whilst a less skilled

operator is unable to do so, with consequent trouble and delay to the work of the circuit.

The keys should lock down securely with the lightest touch, provided only that the touch is sufficient to depress the catch of the key to a position just below the locking hook. There is no need for a heavy style of sending to secure this effect, and as the key contact is on a flexible spring the degree of pressure used makes no difference to the security of the contact. Where heavy pressure, or what is termed "firm sending," is necessary, it means that the locking device is not properly adjusted in relation to the front contact screws.

FIG. 2.—KEYBOARD TESTER. CADENCE KEY

One Tester is sufficient for several circuits, and by its use the control receivers become unnecessary, resulting in a great saving in first cost and also in maintenance charges. Operators who have been trained to the use of a control receiver do not like the change at first, but they quickly become accustomed to it and very soon gladly dispense with the control receiver on every opportunity, as they are then able to concentrate their attention on the work of sending and are not distracted by having to glance more or less

frequently at the control slip. Nor are they disturbed by the irregular click of the printing mechanism, which, although providing one beat per revolution of the Distributor, gives it at varying times according to the position on the type wheel of the letter that is being printed. This effect at one time caused operators who were excellent senders on Quadruples to be quite unreliable on Doubles, until the control receiver was shut off. They then sent quite correctly, proving that, instead of sending to the regular "cadence" signal, they had been sending to the irregular beat of the control receiver.

The Keyboard Tester is comparatively inexpensive, being approximately only one-fifth the cost of a control receiver. Its use will release the back plate of a Distributor, which can be utilised for a second circuit or for extending channels of one line to channels of a second line.

AUTOMATIC SIGNALLING OVER SUPERPOSED, RELAYED, AND LOADED LONG DISTANCE CABLES.

By R. T. KING, A.M.I.E.E., AND E. J. BARNES, A.M.I.E.E.

IN connection with the introduction of long distance small gauge cables equipped with thermionic repeaters and superposition, the need of providing suitable automatic signalling, giving a no-delay service, has arisen.

In order to avoid the introduction of complex signalling apparatus in addition to telephonic repeaters in the speaking circuits, experiments have been carried out by the authors, using standard multiplex distributors, to enable each speaking circuit in a group to signal independently over a separate common line.

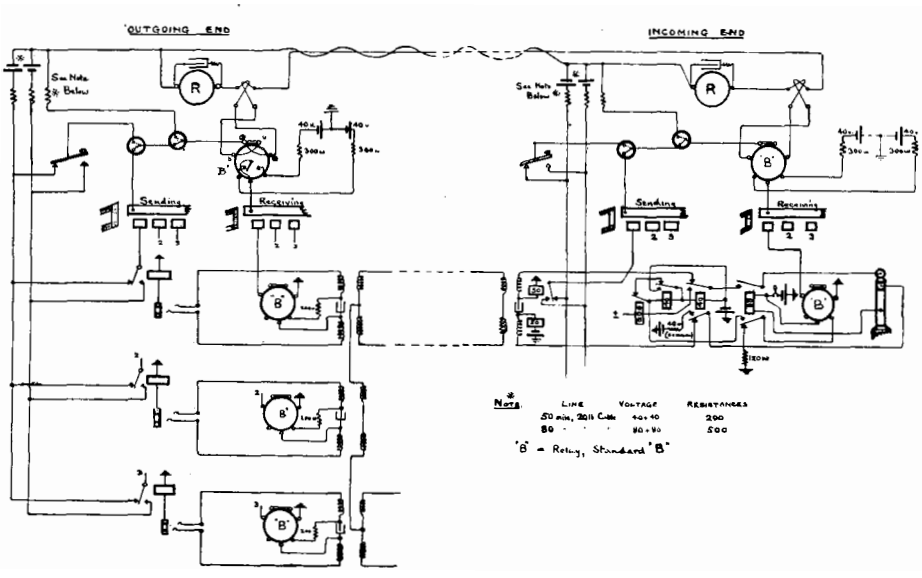
The requirements necessary to provide standard automatic signalling facilities are (1) means by which the "A" operator by inserting a plug in an outgoing multiple causes a lamp to glow at the incoming end, (2) to permit the "A" operator's supervisory lamp to glow until the call is extended by the "B" operator and answered by the wanted subscriber, (3) to permit the called subscriber to clear through to the originating exchange, and (4) for the originating exchange by withdrawing the plug to clear to the "B" operator.

For experimental purposes the circuit arrangements shown in

Ex. diagram 1401 was set up. A duplex arrangement is shown, as signals are required to be sent in both directions, and it was desired, at least for experimental purposes, to avoid the use of a second signalling circuit. Some instances may arise, however, where a simplex circuit may be desirable.

It will be seen from the diagram that a switch is provided at each end for cutting off the distributor and replacing it by a single current key for balancing purposes. A second switch is also arranged to cut off the battery and substitute an equivalent resistance. It is necessary for satisfactory working, of course, that as perfect a balance as possible be obtained.

When the distributor is brought into circuit normally all the "sending" segments at the "A" end have the positive pole of a battery connected to them, which is equivalent to a "spacing"



SIGNALLING CIRCUIT (EX. NO. 1401).

current. When a plug is inserted in any outgoing jack the associated sleeve relay is operated and substitutes negative battery, or "marking" current, on the particular segment with which it is connected. The marking impulse sent to line operates the signalling line relay at the far end, and if the distributors are in step a marking impulse will be sent *viâ* the receiving segments to the local relay associated with the line on which the call is being made. The impulse is repeated once every revolution of the distributors, but the relay being given a wide neutral adjustment remains in the

marking position. It will be seen that this relay when actuated simply completes the junction lamp circuit in the ordinary way.

When the called subscriber answers, the operation of the supervisory relay at the "B" end, reverses the current on the sending segment at this end and causes the line relay at the "A" end to operate. This gives a marking impulse *viâ* the particular receiving segment at the "A" end to the local relay, thereby closing a loop on the "A" cord and causing the supervisory lamp to be darkened.

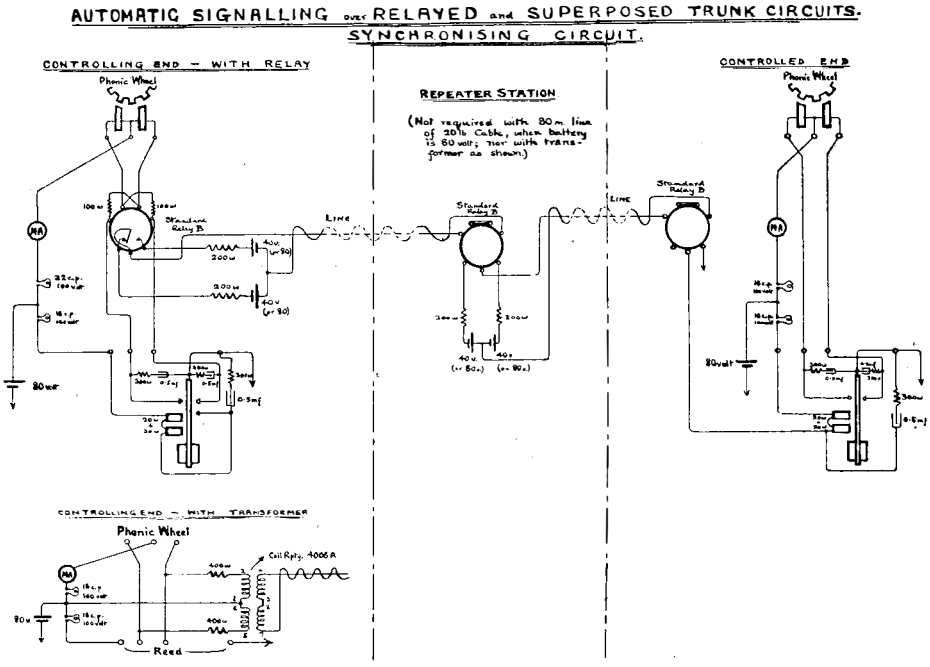
On clearing at either end, positive or "spacing" current is restored, which causes the local relays to open their circuits and give a clearing signal. The local relays shown are the Department's Standard "B" type. These were used during the preliminary experiments, but for practical purposes a telephone type of relay is preferable. A polarized type is necessary with the method of working used, but alterations in the connection of the circuit could be effected to permit of a non-polarized telephone type being utilized. A method adopted which give satisfactory results was to cause a steady current to flow through one winding of a $500^{\omega} + 500^{\omega}$ type 155 A relay of such a value as to retain the armature when once operated by current in the other winding, but insufficient to pull it up after a reversal through the latter. It will be seen from diagram Ex. 1401 that one sending and one receiving distributor ring is required at each end. At one end, however, the two may be fixed relatively to one another, but in order to provide means for adjusting for line retardation, it is necessary that at one end, at least, it shall be possible to orientate the "receiving" ring independently of the "sending" ring. For the purpose of the experiment the fixed rings were placed at the "A" end, the method of obtaining synchronism being as follows:—

At the distant or "B" end, a marking current was sent out on a prearranged "sending" segment, all the remaining segments being connected to spacing battery. On the corresponding receiving segment at the "A" end, a suitable galvanometer was connected in parallel (or in place of) the local relay.

With the distributors running at each end, synchronism at the "A" end was obtained by mechanically retarding the brushes, by means of the star wheel used for ordinary Baudot correction, until the deflection on the galvanometer was a maximum in the marking direction—the best working position being finally obtained by slightly rotating the plate. To ensure that this has been reached, the galvanometer should be connected in turn to the segment immediately preceding and to the one immediately following, when maximum and equal "spacing" deflections should be obtained. This adjustment completed at the "A" end, positive and negative

signals are now sent out to the " B " end, where the receiving plate is orientated until a maximum deflection is received on a galvanometer similarly connected.

The two distributors can be maintained in synchronism by (*a*) correcting impulses sent over the Signalling Circuit as used with the Baudot printing telepraph; or (*b*) the use of a separate line, as shown in Ex. 1400. The latter method was used throughout most of the experiments.

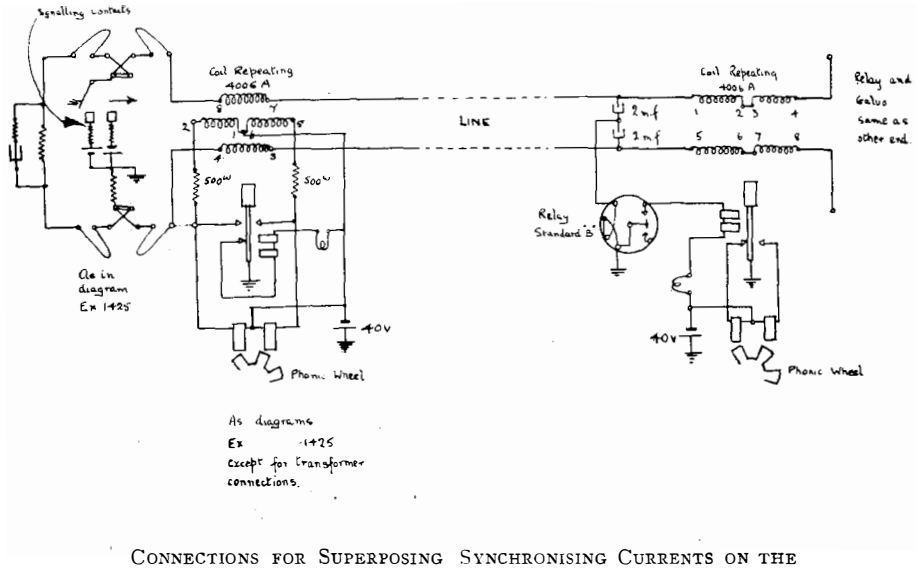


SYNCHRONISING CIRCUIT (EX. NO. 1400).

The reed at the controlling station drives the " phonic " wheel of the distributor at about 170 revs. per minute. In series with the driving magnets are the shunted coils of a Relay Standard " B." This relay operates a relay at the distant end over the synchronising line. In later experiments the relay at the sending end was dispensed with and the synchronising current obtained from the reed through a transformer. In the local circuit of the distant relay is the driving magnet of another reed, which, when suitably adjusted, vibrates at the same frequency as that at the controlling end. This reed drives the phonic wheel of the distributor at the controlled station.

It is possible to drive the distant phonic wheel off the local contacts of the relay, but in order to avoid change of phase from variations of the line and relays, and stoppages arising from an intermittent line fault, more satisfactory working is obtained by using a second reed.

A separate line for controlling the distant reed rather than adopting the correcting impulse method was used in order to simplify the maintenance of synchronism. Where two simplex circuits are used for signalling, the synchronising circuit can be superposed on them. In some cases it may be possible to use an earthed synchronising circuit superposed on the signalling one by the method shown in Ex. No. 1426. The line relay referred to in this diagram is dealt with later.

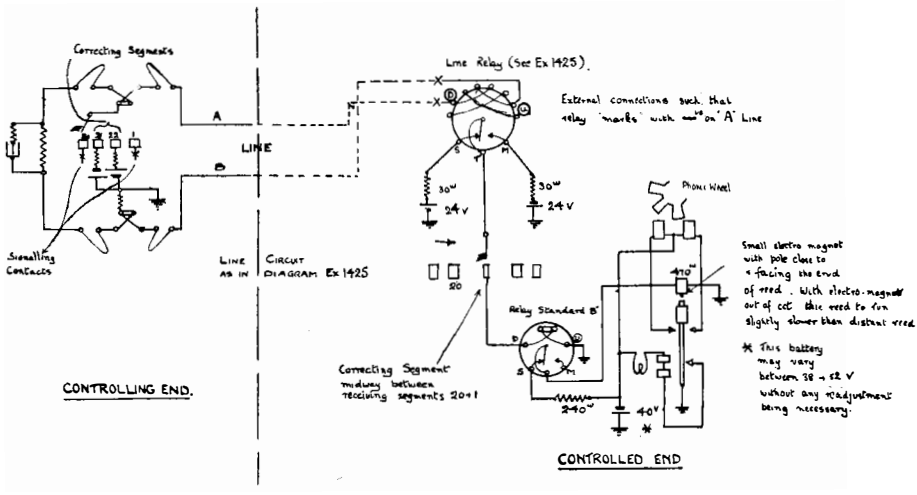


CONNECTIONS FOR SUPERPOSING SYNCHRONISING CURRENTS ON THE LINE USED FOR SIGNALLING (EX. NO. 1426).

Another method of synchronising, by means of correcting impulses, is shown on diagram Ex. 1427. When the correcting magnet on the reed at the controlled end is not energised, the reed should run slightly slower than that at the controlling end. When the magnet is energised, the controlling reed should run slightly faster than the other. In operation the correcting relay receives impulses intermittently from its receiving segment and thus controls the current through the correcting magnet.

In order to obtain synchronism the controlling station sends spacing current on all the segments except that used for correction. The adjustment of the reed can therefore be readily ascertained by observing the progression of this correcting impulse as it is received on successive segments around the plate. The correct adjustment is obtained when the direction of the progression changes as the contact of the correcting relay is held open or closed.

With regard to stability of operation, it was found that with a variation from approximately 40 milliamperes to 80 milliamperes through the correcting magnet there was no appreciable change of phase between the two distributors. Also, the nominal 40-volt battery supplying current to the reed driving magnet, to the distributor wheel, and to the correcting magnet at the controlled end was varied from 38 volts to 52 volts without affecting synchronism.



CONNECTIONS USED FOR CORRECTING IMPULSE METHOD OF MAINTAINING SYNCHRONISM (EX. NO. 1427).

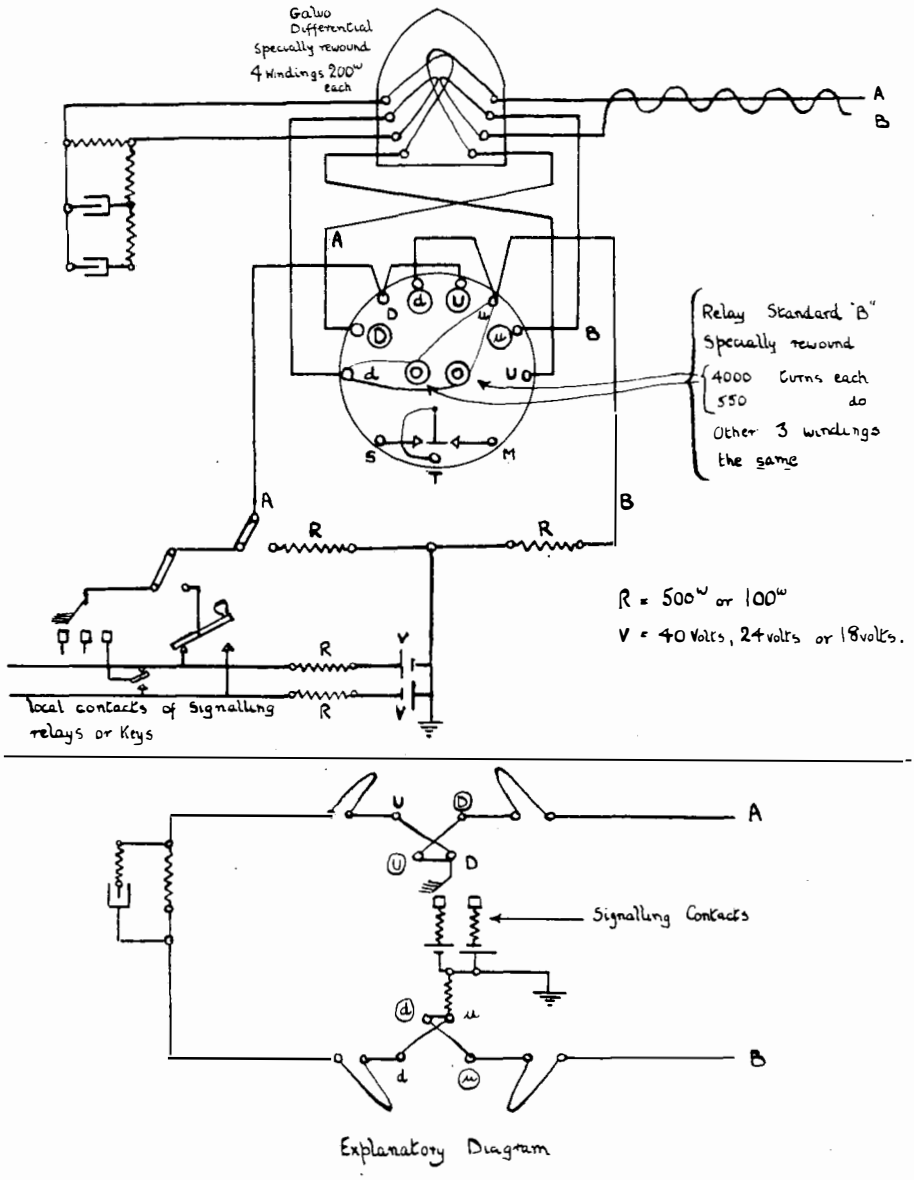
The above variations of current were made without altering the adjustments in any way. The figures quoted were approximately the limits between which the correcting device would operate satisfactorily without any readjustment of speed.

Owing to interference, it has been the practice when telegraphs are worked over conductors in the same cable to either use an earthed battery with low speed working, or to use isolated batteries for each circuit when higher speed is required.

In the preliminary experiments isolated batteries were used, as shown on diagram Ex. 1401. If earthed batteries were used, disturbing impulses from other working circuits in the same cable were received, owing to the mutual capacities between the conductors. These impulses pass to earth through the line coils of the relay and tend to operate it. They can to a certain extent be reduced by using the second wire of the pair as a screen by earthing it at both ends. If, however, a duplicate winding be provided on the relay, joined between the screen—or " B " wire—and earth, the induced impulses, which are received approximately equally from both wires, can be made to neutralize one another and thus have little or no effect upon the armature.

Two relays were therefore rewound with four identical windings on each core, and it was considered desirable to have two differential galvanometers similarly wound with four windings. The corresponding coils on each core of the relay were joined in parallel in the usual way, making a joint resistance of approximately 275$^{\omega}$ each. The galvanometer windings came out at a resistance of 200$^{\omega}$ for each winding.

With the modified apparatus the circuit was arranged as shown in diagram Ex. 1425. It will be observed that the " B " wire is permanently connected through the coils to earth, and that battery currents are only applied to the " A " wire. Such an arrangement, while being itself immune from interference, will however give rise to interference on other circuits in the same cable which do not happen to be similarly balanced. Should it be desirable to avoid such interference it would be necessary to apply to the " B " wire—a battery equal and opposite to that of the " A." There is, however, a considerable practical difficulty in doing this owing to the necessity of reversing the two batteries simultaneously. In actual practice, however, this difficulty need not arise as all circuits can have apparatus with balanced windings. It should perhaps be remarked that with balanced apparatus arranged as described no alteration in the duplex balance is required, whether the batteries be earthed or isolated. This arises from the fact that although the line resistances are halved with earthed batteries and that therefore the line current is doubled, this current, however, only passes through half the windings of the line relays and galvanometers and the effect is therefore unaltered. During the experiment balanced circuits joined up in this manner were operated on loops in working telephone cables without creating disturbance. In some cases the signalling was effected over a phantom circuit without causing noise on the side circuits which would have prevented their use for speaking purposes.



CONNECTIONS OF RELAY AND GALVANOMETER WITH 4 WINDINGS FOR CABLE CIRCUITS, USING UNIVERSAL BATTERIES (EX. NO. 1425).

The appartus described in the foregoing were tried over various circuits in the laboratory, as indicated in the attached schedule, with results which showed that when once properly adjusted the circuits operated satisfactorily for lengthy periods with very little attention.

Cable Conductor (dry core paper).	Mileage.	Approximate resistance, ohms.	Loop capacity approximate mfds.	Battery.		Type of line Relay.	Synchronising Circuit.	Remarks.
				Voltage.	Feed resistance, ohms.			
20 lb. Con.	80	7000 (loop)	5	80 + 80	500	Standard "B"	Ex. 1400 with relay	Isolated batteries.
20 lb. ,,	80	3500 "A" wire (earthed)	7	40 + 40 (earthed)	200	Standard "B"	Ex. 1400 with transformer	Earthed batteries; O.K., provided no other circuits working with earthed batteries in same cable.
70 lb. ,,	132	3500 (loop)	9.5	40 + 40 (earthed)	500	Rewound Standard "B," four coils	Ex. 1400 with relay	Earthed batteries; no interference from other circuits in same cable working off same battery.
70 lb. ,,	132 (phantom)	1700	14	40 + 40 (earthed)	100	,,	Ex. 1400 with transformer	Side circuits being used, one for Synchronising and the other as a listening circuit.
70 lb. ,,	88 (phantom)	1100	12	24 + 24 (earthed)	100	,,	,,	
70 lb. ,,	,,	,,	,,	,,	,,	,,	Ex. 1426	Synchronising circuit; earthed phantom on signalling circuit.
70 lb. ,,	88 (phantom)	1100	12	24 + 24 (earthed)	100	,,	Ex. 1427	Synchronising by correcting impulses.
70 lb. ,,	176 (loop)	4700	12	80 + 80 (earthed)	100	,,	,,	Ditto.
100 lb. ,,	100 (phantom)	1000	9	18 + 18 (earthed)	100	,,	Ex. 1400 with transformer	Circuits in London—Birmingham Telephone Cable (No. 3).

The 70-lb. conductors used were in a working telephone cable, several pairs being looped back to give the mileages required. Tests with two additional telegraph circuits in the same cable working from the same batteries showed that the balanced relay was immune from interference, as had been anticipated.

The two circuits (signalling and synchronising) in the London-Birmingham Telephone Cable quoted in the schedule were unloaded phantoms on 100-lb. loaded circuits. The four physical circuits concerned formed parts of circuits between London-Liverpool (two) London-Manchester, and London-Hull. The last had a two valve repeater in circuit at Birmingham. Listening tests were made during the running periods at all possible points on the physicals. In all cases, with the exception of the Hull circuit, no noise from the running distributor could be detected. On the Hull circuit it was possible to overhear the distributor running, but the noise was insufficient to interfere with through conversations.

Circuits outgoing from London Trunk Exchange to Birmingham Central Exchange (in the same cable) were connected to the experimental apparatus in order to obtain a trial under working conditions. The distributor system thus connected gave full junction signalling facilities to the London operator. The apparatus was in use for several days and worked satisfactorily.

TELEGRAPH AND TELEPHONE PLANT IN THE UNITED KINGDOM.

TELEPHONE STATIONS AND SINGLE-WIRE MILEAGES AS AT 31ST DECEMBER, 1920.

Telephone Stations. (a)	Overhead Wires: Mileages.				Engineering District.	Underground Wires: Mileages.			
	Telegraph.	Trunk.	Exchange.	Spare.		Telegraph.	Trunk.	Exchange	Spare
316,554	1,418	2,906	55,724	57	London	17,162	16,636	1,104,490	15,728
47,038	6,258	15,753	43,011	2,352	S.E.	2,471	7,417	144,196	16,516
39,664	8,495	18,714	36,550	1,435	S.W.	12,366	1,497	69,707	1,438
32,114	15,898	26,527	33,370	4,229	E.	15,237	20,350	34,790	16,031
55,159	16,015	39,066	41,054	2,625	N. Mid.	7,125	13,218	91,169	20,582
42,723	11,184	24,276	44,808	5,049	S. Mid.	6,459	7,102	96,302	21,451
35,043	7,966	23,469	35,468	3,213	S. Wales	4,638	9,169	58,170	13,065
50,834	12,510	20,261	33 705	5,509	N. Wales	11,337	16,311	90,296	10,305
94,376	4,596	16,022	43,960	3,466	S. Lancs.	9,515	30,965	223,052	29,967
46,614	8,756	23,637	35,045	2,709	N.E.	4,208	11,942	102,220	16,649
45,234	6,863	26,690	38,341	2,042	N.W.	9,209	13,310	92,078	14,342
30,736	3,906	13,465	22,845	2,388	N.	3,092	4,351	47,895	6,533
32,105	26,032	10,333	25,831	656	Ireland	834	100	50,242	453
41,893	11,611	16,981	27,889	2,642	Scot. E.	1,416	4,804	73,051	3,259
62,545	10,913	20,557	40,800	471	Scot. W.	11,138	8,114	159,617	14,630
972,632	152,421	298,657	558,401	38,843	Total.	116,207	165,286	2,437,275	200,949
955,910	152,501	294,609	561,110	38,512	Corresponding Figures 30th Sept. 1920.	108,454	154,176	2,355,910	192,541

NOTE.—(a) Exchange and Private, including Apparatus maintained by P.O.—Subscribers' Property.

THE USE OF A SPACING WAVE IN CONTINUOUS WAVE WIRELESS TELEGRAPHY.

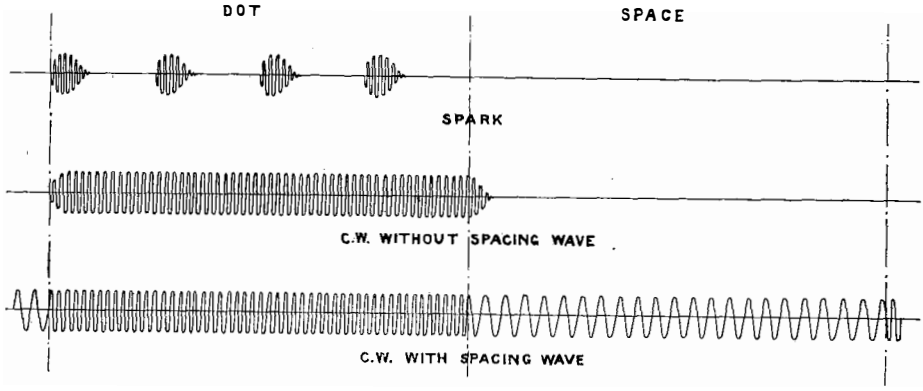
E. H. SHAUGHNESSY, O.B.E., M.I.E.E., M.I. Rad. E.

IN the early days of wireless telegraphy spark systems were invariably used, and despite their defects were the cause of commercially developing the art. The Marconi system, in particular in this country, was greatly developed owing to the energies of those associated with Marconi. Spark systems for anything but ship and shore work are now, however, decadent. The defects of any spark system may be briefly summarised as follows: firstly, that whatever the sparking rate, the aerial is only usefully employed for a proportion of the duration of a signal; and, secondly, as each spark discharge causes the aerial oscillations to grow from zero to a maximum and die away to zero, it produces impurity in the waves emitted. The rate at which this growth and fall takes place determines the impurity of the waves emitted and consequently the interference caused to other stations. In the case of Morse signalling at, say 100 words per minute, with a spark system having a sparking rate of 400 per second there would be approximately 4 or 5 sparks per dot.

Continuous wave generators are now well developed and are coming largely into use. No station for any fixed service would to-day be designed on any other method. The advantages of the method are that the aerial is utilised for the whole period of the signal, and except for the rise and fall of amplitude at the beginning and end of each signal the amplitude of the oscillations remains constant. Working continuous waves without a spacing wave at any speed produces an impurity disturbance equivalent to one spark train of once per dot and once per dash, but it will be seen when high speed continuous wave signalling is adopted that as the

number of dots or dashes per second increases so the impurities emitted due to the rise and fall of amplitude of aerial current increase, and at 100 words per minute the equivalent of about 80 sparks per second is produced. When dealing with large stations having 200 amperes in the aerial, the amount of disturbance created may therefore be considerable.

The first practical means of working continuous wave telegraphy was by the Poulsen Arc, and it is well known that for satisfactory working the arc must be kept burning under almost constant conditions during the intervals between signal periods. The early method of doing this was to keep the arc oscillating on the aerial during the spacing period at a frequency slightly different from the marking frequency--that is, sending out a spacing wave—and to short-circuit a small portion of the aerial inductance to alter the wave length for producing marks at the appropriate station, the



spacing and marking waves differing from each other by as much as 3 to 4 per cent. This was naturally considered a disadvantage, as such a transmitting station used up too many wave lengths. To overcome this defect a method of throwing the arc load on to a non-radiating compensation circuit instead of the aerial during the spacing period was developed. Whilst this was justified, as it avoided the use of a large band of waves permanently, and for key speeds was better than spark systems, yet it involves the building up of oscillations in the aerial from zero each time a signal is made.

During the past five years there have been great developments in large power arcs. No large power arc is worked on the compensation circuit method, but all use the spacing wave. The use of a spacing wave has many opponents, but it is suggested that what was considered a vice is indeed, with modern refinements, a virtue. If an arc is producing a current of 200 oscillating amperes in an

aerial, the energy swings twice in each oscillation to a static charge on the aerial, the amplitude remaining constant. Now if the inductance of the aerial be slightly altered, so as to make the wave length or frequency of the oscillation circuit slightly different, the new rate of oscillation occurs practically without change of amplitude and the disturbance created should be negligible as compared with that produced when the aerial energy is either sharply applied or sharply dissipated, as is done in the case when a spacing wave is not used. Unless, however, the percentage difference previously mentioned were very considerably reduced it is doubtful whether this advantage of a spacing wave would justify its use. The development of large power arcs, however, produced difficulties in keying, and in order to reduce these difficulties smaller differences in the oscillation frequencies of the marking and spacing waves were adopted. This called for more selective receiving apparatus, and to-day we find 200 kilowatt arcs, working with a difference of only .8 per cent. in the marking and spacing wave length with waves of the order of 15,000 meters, and being received satisfactorily 3,000 miles away. It should be noted that if the spacing wave is only .8 per cent. different from the marking wave, the marking wave cannot stray very far from its own normal value without producing bad signals at the distant receiving station.* For high speed working the use of a spacing wave close to the marking wave appears to be desirable for signalling on all systems of continuous waves. Moreover, as in changing from a spacing to a marking wave, the transmitted signal commences immediately with full amplitude on the aerial, the time taken to build up the required amplitude at the receiving station is reduced, so tending to higher speeds. Engineers used to land line systems will observe that the use of a marking and spacing wave preserves all the characteristics of double-current working, and will readily realise that these can be utilised in wireless working to produce higher speeds and multiple methods of working. It almost seems that if the spacing wave had not originally been used, to-day someone would be inventing it.

The disadvantage of consuming more power may be much more than outweighed by the possibility of crowding more stations into the total available zones of wave lengths and the higher speeds obtainable, especially as the fuel bill is by no means the largest item in the running of large wireless stations.

* The ill effects of not using a spacing wave for high speed continuous wave signalling are very clearly shown in a paper by Dr. F. W. Alexanderson, in the Proceedings of the Institute of Radio Engineers, Vol. 8, No. 4, Aug., 1920

BERLIN-LONDON WIRELESS SERVICE.

ON the 26th January a duplex wireless service was opened between London and Berlin for a period of three hours daily, from 4 till 7 p.m.

The Stonehaven Wireless Station (G.S.W.), being the only medium power station available, is used for the transmitting station on the British side, while Königswursterhausen (L.P.) Wireless Station is used on the German side, the respective wave lengths being 4600 and 5250 metres.

The transmitter at Stonehaven consists of an Admiralty 25-Kilowatt Arc, which is operated from London by means of the telegraph land line. The receiving station in England is situated in a special room in the G.P.O. West, together with the land line apparatus and Wheatstone Transmitter for operating the wireless key on the Stonehaven Arc Transmitter.

The signals from Berlin are recorded on an ordinary Wheatstone Receiver, which is introduced in the local circuit of a special form of sensitive " Bow—Contact " Relay actuated directly by the wireless signals. Trials are now being made of reception on the Creed apparatus.

Difficulties were at first experienced on account of the slight variations of Wavelength emitted by Berlin and Stonehaven, but the constancy of the waves of the two transmitting stations has been improved.

Atmospherics on these higher wave lengths are more violent than those experienced on the shorter waves below 2000 metres, but little interference is experienced on this account owing to the use of highly selective receiving devices. By these devices the high power station at Moscow, which uses a spark transmitter on approximately the same wave length, is effectively eliminated from the tape records.

The following example shows the traffic passed to and from London between 4 p.m. and 7 p.m. on the 25th February, which is a fair example of the normal working:—

	Messages.	Words.
Received from Berlin	120	2142
Sent to Berlin	85	1373
Total	205	3515

The average speed of transmission and reception varies between 25 and 50 words per minute. On account of the short period of the daily service greater reliability and quicker disposal of live traffic

is obtained at these speeds than would be the case if higher speeds were employed.

The service is now extended to cover the periods from 1 a.m. till 5 a.m., 6 a.m. till 8 a.m., and 2 p.m. till 7 p.m. in connection with the Reparations Conference.

HIGH-SPEED WIRELESS TELEGRAPHY BETWEEN ALDERSHOT AND COLOGNE.

COMMUNICATION by Wireless Telegraphy advanced further towards a position of accepted stability in the realm of commercial communications by the tests recently carried out by Post Office personnel between Aldershot and Cologne, utilising sets already installed at these stations by the Signals Experimental Establishment, Woolwich.

The trials were undertaken at the instance of the Engineer-in-Chief, and were caried out in collaboration with the Central Telegraph Office, who supplied expert staff at each end for the Wheatstone working. Three days' trials were arranged for, and slip was prepared for approximately 300 messages of about 20 words each for transmission each way on each day of the trials. Each station was further provided with a copy of the messages to be received in order to facilitate and confirm the checking of errors.

The actual trials, which were carried out at 100 words per minute, took place on Wednesday, Thursday and Friday, the 9th, 10th and 11th February, during the morning and afternoon of the first and last days and during the evening of the second. It was hoped to obtain some measure of the effects of atmospherics during the evening trial, but unfortunately from this point of view the atmospherics experienced on this particular evening were, with a not unusual capriciousness, very light and of not sufficient intensity to affect the reception. Indeed, during the latter part of this period, the clearest results of the trials were obtained.

An analysis of the results showed that 83% of the messages were received with perfect slip. Of the remaining 17%, 9% had errors which were readily corrected at sight and due primarily to slip errors and slight mal-adjustment of apparatus; the other 8% contained errors which necessitated repetition and which could be attributed to jamming, atmospherics, mal-adjustment of apparatus and other causes. Short trials undertaken at 150 words per minute also resulted in quite good slip being obtained.

At Cologne the Wheatstone Office was separated about three miles from the Wireless Station, reception and transmission being

effected through " B " relays located at the Wireless Station. At Aldershot an artificial line provided the separation.

The Wireless Transmitter consisted of a 1½ K.W. valve set of the usual make-up with valve grid leak. Actual transmission was effected by operating on this valve grid leak, virtually making and breaking, with a " B " relay, the relay itself being actuated by the Wheatstone Transmitter at the distant Office.

The Wireless Receiving Set consisted of a 3-Valve High Frequency Amplifier, Turner Valve Relay, Valve Amplifier, and Double Valve Relay all in cascade. The 3-Valve Amplifier was weakly coupled to the aerial circuit and the Double Valve Relay worked a " B " relay. This relay then actuated two Wheatstone receivers, one situated at the distant Office and the other at the Wireless Station. The latter enabled the Wireless Receiving apparatus to be adjusted during reception.

LONDON ENGINEERING DISTRICT.

198 MEMBERS of the Staff from the Headquarters and Sectional Offices were present at the Tenth Annual Clerical Supper held at the Bridge House Hotel, London Bridge, S.E.1, on Tuesday the 1st March. A. E. Cooke, Esq., the Principal Clerk, presided, and was supported by F. Freeman, Esq., in the Vice-Chair. The Superintending Engineer, A. Moir, Esq., O.B.E., was " The Guest of the Evening."

Mr. Cooke, in the course of his remarks, welcomed the presence of Mr. Heath and other visitors. He touched upon the subject of Reorganization and expressed the hope that the Post Office proposals would soon be published and would be entirely satisfactory to all concerned. He complimented the Clerical Staff on the manner in which they performed their duties, and stated that the report of the recent Audit had been entirely satisfactory.

In proposing the toast " The Guest of the Evening," Mr. Cooke spoke of the good feeling which existed between the Superintending Engineer and the Senior Supervising Clerical Officers, and made special mention of the successful manner in which Mr. Moir had organized the London Engineering District, which now has a staff of nearly 6,000.

Replying, Mr. Moir said that on the occasion of this their Tenth Annual Supper, he was glad to be able to assure them that during the decade just completed they had not been standing still. On the contrary, by persistent effort, they had greatly improved the maintenance of the engineering plant. This, he stated, was as much due to clerical as to engineering efficiency.

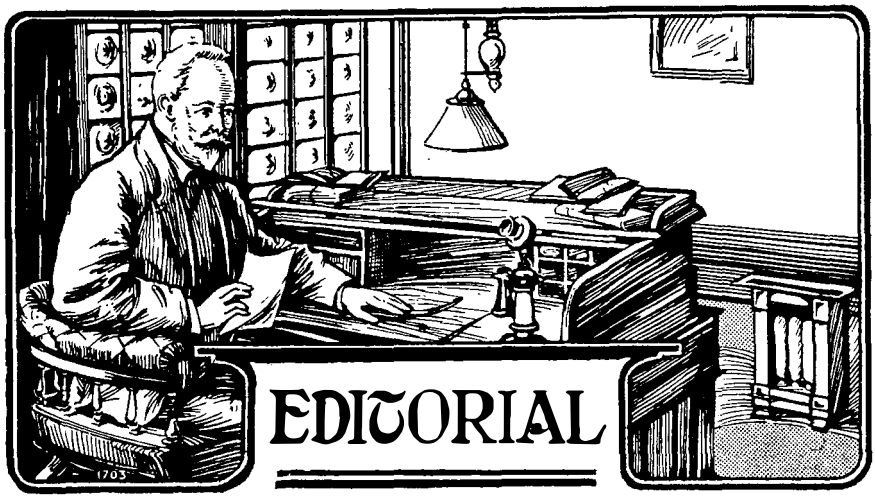
He regretted that delay had taken place in applying the improved reconstruction rates to some of the classes, but he had no doubt that their patience would shortly be rewarded.

Mr. Moir announced that Mr. Heath, who had a wonderful topographical knowledge of London, had promised to write an article showing that Denman Street was situated in the area surrounding Shakespeare's South London Theatre. From this the Staff would be able to recognise, as they took their walks abroad, when they were treading upon Shakesperian ground.

In conclusion, he thanked them most sincerely for the honour they had done him by inviting him there as their guest and for the way in which they had responded to the toast so gracefully proposed by Mr. Cooke.

As on former occasions a very creditable musical programme, all the items of which were contributed by members of the Staff, followed the supper. Mr. J. W. Kimber, the musical director, was assisted by Messrs. S. L. Bickerton, E. W. Casserley, T. A. Claydon, C. W. Cornwell, S. C. Edser, A. W. Edwards, C. A. Edwards, J. J. Gerke, H. Gilbert, E. F. Griffiths, Chas. Harris, A. E. Spears, G. H. Stanbridge, H. H. Thorne, A. A. Turner, and the L.E.D. Orchestra led by Mr. H. W. Gardener. Mr. H. Curtis was at the piano.

Mr. Freeman proposed a vote of thanks to the Artistes and the Committee who had organized a most enjoyable and successful evening, and the proceedings terminated with the singing of " Auld Lang Syne."



EDITORIAL NOTES AND COMMENTS.

THE debate in the House of Commons on "The Telephone Service," which opened on the evening of the 18th February with the moving of an amendment to the King's Speech by Mr. Remer (Coalition Unionist member for Macclesfield) "regretting the absence from the gracious Speech of any announcement that the telephone service will be placed under private enterprise, in view of the necessity for a cheaper and more efficient service," closed rather flat without a division. The Attorney General agreed to the appointment of a Committee to inquire into the organisation and administration of the telephone system, but in his summing-up he pointed out that there had not been in the course of the debate a word to show that the remedy proposed in the amendment to the Speech would go any distance towards removing the alleged inefficiency in the existing service. With this statement we agree entirely. The reasons for the deterioration which admittedly appeared during the last stages of the war and immediately after the Armistice have been explained fully elsewhere—by Sir William Noble in his speech at the Livery Club luncheon on the 17th January and by letters in the *Times* and *Telegraph*, and there is no necessity to repeat them here. The P.O. administration has nothing to fear from an inquiry by a Parliamentary Committee. No one claims that the administration is perfect, but it is doubtful whether a Select Committee is the agent best fitted to inquire into its operations. The main fault of the administration, it appears to us, lies in neglecting to raise the rates earlier, when private firms

and public companies were merrily running up the charges for their own enrichment, and when the Country would have accepted the increase for its true cause, another penalty due to the war. The Government is to be congratulated on its firm stand against the postponement of the application of the new rates. In face of the enormous increase in the cost of raw material, of cable and apparatus, it would have been disastrous to allow the old subscriptions to be carried forward. The only results would have been a larger loss, a bigger subsidy and another weapon in the hands of those who, honestly or otherwise, believe that the British Civil Service is incapable of running a business to the best advantage of the nation.

Throughout the debate it was evident that the small user had been bluffed by the deliberate inaccuracies of the press campaign, and that the real causes of the outcry were, firstly, the enforcement of the decision to make those who used the system most pay proportionately for their service, and, secondly, an organised attempt to throw discredit upon a nationalised service which has carried a heavy burden uncomplainingly and successfully for the last seven years.

The following account of the position of the services in Germany is not without a certain aptness at the moment:—

> "In a lecture, delivered last October, before the Reichsbund deutscher Technik (German Technical Union), Dr. Bredow outlines the financial position of the German telegraph and telephone service (2,000 million marks deficit in 1920), and suggested remedies for improving the position. The large deficit is due to the extraordinary rise in the cost of materials and labour; the prices for iron wire have increased 3,000 per cent., for copper wire 1,200 per cent., for underground cable 2,000 per cent., cable and flexible for internal connections, 3,000 to 4,000 per cent., and telephones 2,000 to 3,000 per cent. Both systems are at present strained to their highest possible capacity, and extensions must be undertaken at once.
>
> "Prior to the war, the cost of a telephone line in Berlin was Mk.800, and is now Mk.11,000, while the cost of working and maintaining a line has increased tenfold.
>
> "Although the telephone fees have increased to about four times the pre-war, further drastic alterations are contemplated: the unlimited service rate will be abolished, and a tariff introduced based on the number of calls made—the subscriber having the greatest number of calls paying the highest fees. The cost of installing the telephone has already been increased, and increased revenue is expected from that direction, owing

to the large number of prospective subscribers. A compulsory loan is also contemplated, and it in expected that as the result of this and the other measures to be taken, the financial situation will improve in time; but it will be many years before the services reach their pre-war level of efficiency. (*Mitteilungen des Reichsbundes deutscher Technik*, Oct. 30, 1920)."

We shall be told no doubt of two reasons for the above state of affairs—one, the failure is due to State control, and two, this is only another attempt to prove that Germany is unable to meet the Allied indemnity. The facts, however, speak for themselves.

We have received from Mr. M. J. Bowes, Traffic Superintendent, Egyptian State Telephones, Cairo, some interesting details of the service in Cairo and Alexandria.

"The system is magneto with lamp calling and clearing. The calling rate is 14.2 and 15.6 per line per day, and the working subscribers are 99.5 and 101.0 per position respectively.

"The value of a call in Alexandria is 1.0 and in Cairo 1.1 owing to the large number of native and smaller proportion of business subscribers in the latter city.

"The operators are required to operate in four languages, viz., Arabic, Italian, French and English.

"The percentage is as follows:—

Arabic	40 per cent.
Italian	30 ,,
French	25 ,,
English	5 ,,

"In order, however, to keep the operators practised in English all order wire and junction working is in that language."

SERVICE FOR MONTH OF DECEMBER, 1920.

	Month of Dec. Cairo.	1 month ending 31st Dec.	Month of Dec. Alexandria.	1 month ending 31st Dec.
Answer	3.5	4.2	3.9 secs.	4.2
Clear	5.3	6.2	4.0 secs.	4.7
% answered in 5 secs. or less	83.3	77.5	82.9%	80.5
,, ,, ,, 10 ,, ,, ,,	95.5	92.3	96.5%	94.8
,, ,, ,, 20 ,, ,, ,,	99.4	98.4	99.7%	99.5
Time taken to ans. flash ...	4.0	4.7	3.1 secs.	5.0
% No reply	2.7	2.7	2.1%	2.8
% Number engaged ...	11.2	13.1	10.5%	12.0
Time taken to report No Reply	102.0	101.4	85.1 secs.	100.8

On the 11th October we replied to a communication from "Mehmed Emin, Engineer-in-Chief, G.P.O., Constantinople," dated the 31st August. Our letter has been returned by the British P.O., endorsed, "Unknown." Perhaps our correspondent will oblige us by giving a fuller address.

We have to acknowledge the receipt of a copy of the review "Svensk Trafiktidning," the joint organ for the Swedish Railways, Post, and Telegraph officials, and also a copy of the new technical magazine, "Sindri," issued by the Technical Society of Iceland and sent to us by our esteemed correspondent, O. B. Arner, Reykjavik.

Patrick T. Carey, who superintended the installation of the present telephone system in China, has been made a member of the Fifth Class of the Joy Ho, the Chinese Order of Merit, as a reward for his services. The medal signifying his membership in the order was presented to him recently by Tseng Yu Chun, minister of communications. Mr. Carey has been acting as instructor in telephony at the government university in Pekin since 1917. In addition he is superintendent of installation of the China Electric Co., the Chinese subsidiary of the Western Electric Co.

In 1909 he installed the south and east exchanges in Pekin. These were the first common battery installations ever introduced into China. In 1912 he made additions to the service in Pekin and also erected exchanges at Tientsin and Tsinanfu.

In the early days of the work of installing C.B. exchanges in London Mr. Carey was well known to many of our readers, as installer for the Western Electric Company. Mr. Carey's friends will appreciate the appropriateness of his being created a member of the Joy Ho!

HEADQUARTERS NOTES.

MANUAL EXCHANGES.

The following orders have been placed for New Exchanges:—

Exchange.	Type.	No. of Lines.
Luton	No. 1	1800
New Barnet... .	No. 1	1600

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

Exchanges.	Type.	No. of Lines.
Bromley	—	785
Walthamstow ...	No. 10	80 and rearrangements
Belfast	—	480 and 6 "A" positions
Cambridge	No. 1	400

AUTOMATIC EXCHANGE DEVELOPMENTS.

The following orders have been placed:—

Extension of the Paisley Full Automatic Exchange by 500 lines. (Automatic Telephone Manufacturing Co.).

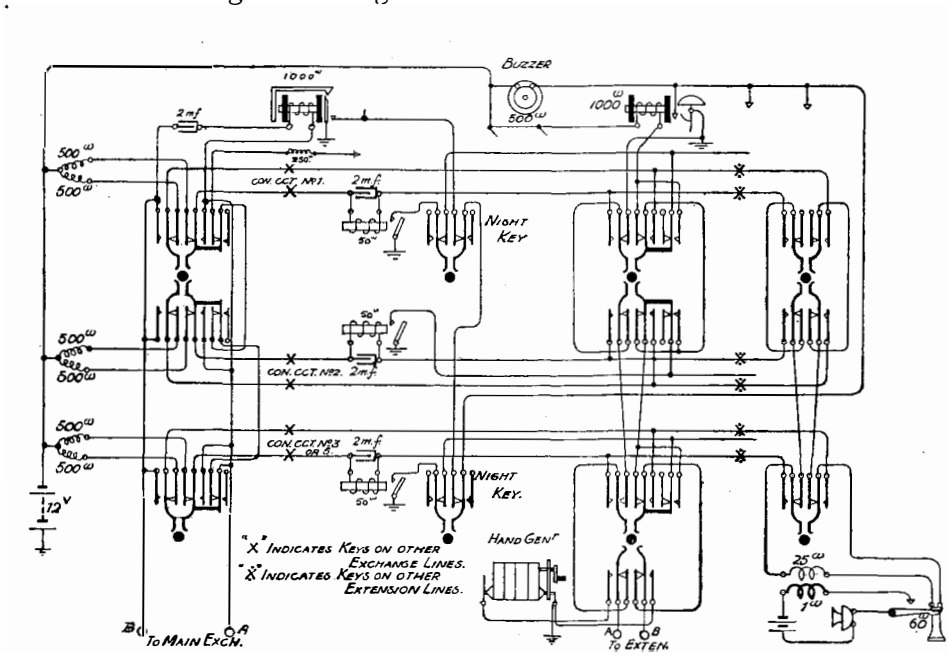
Private Automatic Exchange for the Wallasey Corporation. Initial equipment 25 lines. Ultimate capacity 50 lines (Automatic Telephone Manufacturing Co.).

C.B.S. CORDLESS P.B.X.'S.

The large increase in the number of Common Battery Signalling Exchanges to be installed in smaller towns has emphasised the necessity for an improved type of private branch exchange switchboard for use on lines connected to these exchanges. At present there exists only C.B.S. magneto boards, the extensions on which call and clear to the board by generator but clear direct to the main exchange by the restoration of the receiver on the hook, the A line being earthed through the bell similarly to the method on direct lines. This arrangement required the fitting at the extension points of telephones equipped with generators, and embodied an ingenious way of connecting the exchange line drop indicator to serve both as a calling and a clearing signal. The indicator has two windings, 500 ohms each, which are connected in series differentially between the inner A spring of the Exchange jack and earth. Across one winding is connected a 4 mf. condenser, so that the differentiality of the windings is upset to magneto ringing, while retaining that property to direct battery currents. When a plug is removed from the exchange jack, the indicator coils provide a path for the clearing current from the main exchange earthed battery in the centre of the cords to earth, without causing the shutter to drop.

The success of cordless boards, both as regards first price and

maintenance costs and their undoubted popularity with subscribers, has led to the design of cordless P.B.X.'s for use on C.B.S. exchanges. The sizes to be adopted will be identical with those of the C.B. patterns, viz., $\frac{1+3}{4}$, $\frac{2+4}{6}$ and $\frac{3+7}{12}$. The latter will be fitted for three Exchanges and seven Extension lines, with a capacity for nine extensions. The physical dimensions of the C.B.S. boards, their structure and external appearance, will be practically the same as the existing C.B. types. A diagram of the circuit arrangements is given below.



CIRCUITS ON C.B.S. CORDLESS P.B.X.'s.

It will be seen that the Exchange line is bridged by a 1000ω indicator in series with a 2 mf. condenser for calling purposes. Teed off from an inner spring on the A side of the key is connected a 250ω retardation coil to earth, to provide a clearing signal to the main exchange when the key is restored to normal. As this coil is joined in parallel with the indicator, condenser and exchange B line, when ringing from the main exchange is in progress, its impedance should be sufficiently high to ensure that a large enough proportion of the ringing current should pass through the alternative path of indicator, condenser and B line and cause the indicator shutter to drop reliably. This object has been attained by

making the retardation coil similar in dimensions to the 165$^{\omega}$ coil fitted in a C.B. operator's primary circuit. It is metal cased and will be mounted on the plate with the connecting circuit relays and bridging coils.

The Extension lines normally have their A wires earthed at the board, and their B lines carried through 1000$^{\omega}$ eyeball indicators to the negative side of a 12-volt battery, which will be fitted external to the switchboard. Calling is done automatically in the ordinary C.B.S. fashion. Ringing from the board will be on A line and earth.

Inserted in each connecting circuit, which are teed to the outer springs of the keys horizontally, is fitted a double-wound bridging coil with tap to the negative of the 12-volt battery; in series with the A winding is fitted a 50-ohm single make relay, shunted by a condenser for speaking purposes. The make contact of this relay is joined through the outer auxiliary springs of the line key to the line eyeball indicator. When a connecting circuit is in use, both pairs of lines are looped and no current passes through the relay; when the subscriber hangs up his receiver he earths his A line through the bell and a current passes from the 12-volt battery through the connecting circuit relay, which operates and brings down the "eye" of the line indicator. The indicator serves thus as both a calling and a clearing signal, and the latter is of a positive character.

The night extension arrangements of the C.B. board are applied to the C.B.S. boards in exactly the same way. Any exchange line can be extended to any extension by throwing the connecting circuit keys of the two lines in the same direction. The local buzzer on the Exchange line drop is controlled by a night extension key, which also renders innocuous the operation of the connecting circuit relay at night time.

The operator's telephone will consist of the standard C.B.S. pedestal telephone (Telephone No. 4), the induction coil for which will be inside the board. A tap is taken from the 12-volt battery for speaking.

Local Line Development.

The provision of underground plant to meet the requirements of prospective subscribers still lags behind the demand, although a considerable amount of progress has been made during the present financial year. The conditions have been rendered difficult owing to a serious shortage of ducts during the earlier part of the period under review, but supplies are now more satisfactory.

The following statistics show the number and value of schemes wholly, or partly, carried out by contractors between the 1st April, 1920, and January 31st, 1921. In addition, there are many schemes, particularly in London, which have been done entirely by the Department's staff.

Number of Development Schemes approved 190.
,, ,, ,, ,, for which orders have already been placed with the Contractors ... ... 159.
Approximate total value of schemes authorized ... ... £2,005,100.
Approximate total value of orders placed with contractors ... ... £1,656,000.
Length of duct laid (single way) 650 miles.
,, cable ,, ,, 100,500 circuit miles.

LONDON DISTRICT NOTES.

Telephone Lines and Stations.—During the thirteen weeks ended December 28th, 1920, 4,816 exchange lines, 6,062 internal extensions and 630 external extensions were provided. In the same period 1,720 exchange lines, 2,551 internal extensions and 299 external extensions were recovered, making net increases of 3,096 exchange lines, 3,511 internal extensions and 331 external extensions.

Maintenance of Telephone Plant.—On the reorganisation of the District in 1912, it was decided that an ideal standard of maintenance which might reasonably be arrived at would be a maximum of one fault per station per annum. The following figures for the District as a whole show how the ideal is being gradually attained. In some of the Sections of the District the standard has already been reached.

Year.	Fault per station per annum.	Remark.
1912	3.52	
1913	3.52	
1914	2.31	
1915	1.77	
1916	1.81	Great snowstorm March, 1916.
1917	1.55	
1918	1.39	Stagnation in trade.
1919	1.54	
1920	1.51	

INTERNAL CONSTRUCTION.

Extensions of the plant at a large number of the Exchanges in the London Engineering District have either been completed recently or are in progress. Since the last issue works affecting Avenue, Bank, Barnet, East Ham, Hornsey and Victoria have been carried to completion. Work is proceeding at twenty Exchanges.

The first of the relief exchanges—Langham—was opened early in March. This has rendered much needed relief to Mayfair. Further relief to this exchange will be afforded by Berkeley, the work in connection with which is proceeding. The operations connected with two other relief exchanges at Chancery and Minories is well in hand, and the provision of an Exchange at Kilburn to relieve Hampstead is under contemplation.

The erection of the Clerkenwell Permanent Exchange and the new Toll Exchange in Norwich Street is progressing, but completion is not yet within measurable distance.

Private Branch Exchanges.—The demands for multiple type P.B.X.'s for commercial houses still continues. At the present time 14 cases of this kind are in hand. Within the past three months, 7 installations, involving 25 positions in all, have been completed, whilst additions to 2 existing installations, involving a total of 7 positions, have been handed over for working. In addition, a special 10-position lamp-signalling board, installed by the Peel Conner Co., has been provided at the General Electric Co.'s new premises in Kingsway. One position, making 5 in all, has been added to the Denman Street P.B.X.

Amplifiers for Operating School, G.P.O. South.—Following upon the practice of the New York operating schools, arrangements are in hand for providing a 1-way amplifier circuit, using a Valve, Thermionic, No. 2, which will permit of 12 to 18 students listening simultaneously on actual working positions.

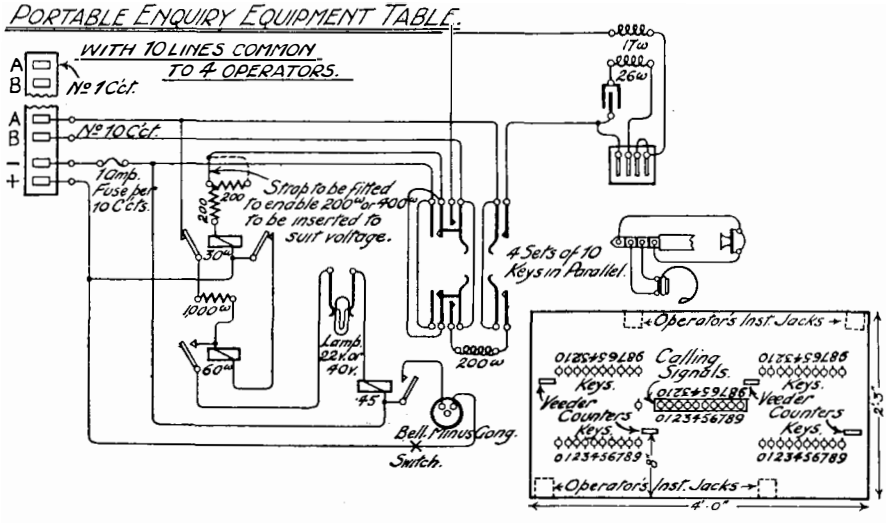
Electrophone Exchange.—Preparations are being made for the installation of 10 sets of Telephonic Repeaters. Repeaters, Telephonic, No. 5A, will be used. Special precautions to guard against "cross-talk" will be necessary.

Western Electric Co.'s Panel Automatic Exchange (Blackfriars).—Steps are being taken to clear the space required for the new equipment. In the meantime the preliminary work to be carried out by the District Staff is proceeding.

Allied Conference in London.—A circuit has been provided at the request of the London Correspondent of *Le Matin* for the electrical transmission of pictures in connection with the Conference.

A circuit has been provided to Berlin from the Savoy Hotel for telegraphic purpose. The line is equipped with Hughes apparatus.

Portable Enquiry Tables.—When lines are transferred in large blocks from one exchange to another a considerable amount of enquiry work at the losing exchange has to be dealt with. Every call made for a transferred line under the old number has to be intercepted and the caller advised of the change. Such action gradually breaks down the incorrect demands. If there is ample spare accommodation at the losing exchange A positions can be used temporarily for the enquiry work, but unfortunately spare plant is not always available. To meet the demand which will be a heavy one for some years to come in London, a number of Army tables have been equipped as 4-position portable enquiry units. They are so arranged as to be readily connected to spare multiple jacks at the losing exchange.



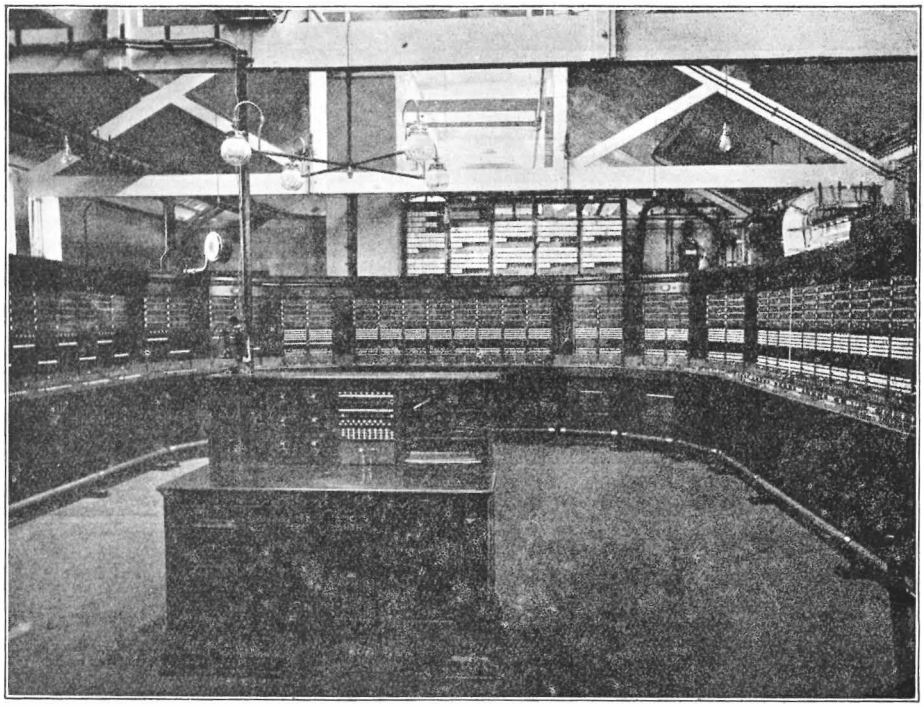
Telegraphs.—A Siemens-Halske fast speed set, which has for some time been in use between London and Liverpool, has been brought into use between London and Berlin.

LANGHAM EXCHANGE.

On the signing of Armistice it became necessary to consider the best means of providing relief to those Exchanges in London, the capacity of which had become exhausted, in order that demands for telephonic service which had to be refused during war-time might be met. The difficulty of providing the necessary buildings, together with the inability of Contractors to undertake the erection of new Exchanges within a suitable period, rendered necessary a

departure from the usual course, and it was eventually decided that the Engineering Department should itself take in hand the construction of a number of C.B. No. 10 Exchanges, to accommodate 2000 lines each, located in structures of a more or less temporary character. These exchanges have become known as Relief Exchanges, and the first of this kind, known as "Langham," was opened at 2 p.m. on Saturday the 5th March last, by transferring 1240 subscribers from the Mayfair Exchange. New lines to the number of 150 were also provided for additional subscribers in readiness for the opening.

As the arrangements are in the nature of a new departure, a brief description of the Langham Exchange may be of interest.



LANGHAM EXCHANGE.

The Exchange is situated above the Western District Office, Wimpole Street, W.1., in a structure provided by the Office of Works on the lines of the emergency buildings erected in various places during the War. The whole of the plant is located on one floor, and this has permitted of the adoption of an economical cable

scheme. The accommodation provided for both Engineering and Traffic requirements is most compact and satisfactory. The switch-room, a view of which is given, presents a very pleasing appearance, and the conditions under which the working of the Exchange will be carried on leave little to be desired. The suite of switchboards, comprising 24A and 10B positions, with the usual Test and Plug-ging-up positions, Monitor's and Supervisor's Desks, was manu-factured by Messrs. Ericssons at their Nottingham factory, and has been arranged along three sides of the room. Provision for 20 Electrophone connections is made by means of a canopy fitted over the last A position.

The present day No. 10 equipment is identical to that of a No. 1 exchange, except that larger plugs and jacks are used and the sections are each of one position. The equipment is of the 40-volt type, and the condenser and impedance coil system of transmission is employed.

The increased size of the jack gives improved facilities for mark-ing, with a consequent advantage in operating. The multiple field allows for 2,000 subscribers, and a full multiple has been installed. The four-panel multiple is of the branching jack type. An out-going junction four-panel multiple of 400 is fitted.

The position meters are mounted in the cable-turning section at one end of the line of switchboards. The result is entirely satisfactory and a considerable saving in floorspace has thereby been effected.

A combined Main and I.D. Frame is fitted, accommodating a total cable equipment of 4,600 pairs. The street cables are con-nected to the lower portion; the upper portion comprises the I.D.F. Above the line side of the Main Frame are fitted horizontal blocks for the answering equipments. The multiple is accommodated on vertical blocks placed immediately above the protectors on the Exchange side of the Main Frame, and the cabling of the multiple and out going junctions is reduced to a minimum. This type of frame has marked advantages from the point of view of cable economy.

In connection with the battery installation a counter E.M.F. battery of six cells is fitted to allow current to be fed to P.B.X. switchboards at 24 volts. These cells consist of plain lead plates immersed in sulphuric acid and are inserted in series with the negative pole of the battery and the 24-volt bus bar on the fuse-board.

It may be mentioned that an exchange, similar to "Langham," to be known as "Berkeley," which will afford further relief to May-fair, is in course of construction, as is also a relief exchange to

Holborn, to be named "Chancery," and a relief exchange to Avenue, to be called "Minories."

G. E. WOOD.

EXTERNAL CONSTRUCTION.

During the three months ended 31st January, 1921, the Telephone Exchange wire mileage showed an increase in underground of 47,029 miles and a decrease in open and aerial cable of 492 and 1,028 miles respectively, the nett increase for the period being 45,509 miles.

The Telephone Trunk wire mileage increased during this period by 38 miles open and 129 miles underground. Wires in use for Public Telegraphs decreased by one mile in open wire and increased 208 miles in underground cable. Pole line during this three months increased by 29 miles to 2,876 miles and pipe line by 110 miles to 3,840 miles.

Underground cable increased by 185 miles, making a total of 7,690 miles.

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

Telegraphs	17,760 miles.
Telephone (exchange)	1,173,387 ,,
,, (trunks)	18,823 ,,
Spare wires	15,756 ,,

River Crossing.—In connection with the opening of the new Stratford Telephone Exchange, it is necessary to carry a number of cables across the Channelsea River, a small tributary of the Thames. The first proposal was to erect a ferro-concrete bridge over the river, the steel pipes to form part of the reinforcing. It was, however, subsequently decided to try a hydraulic thrust boring system with the object of laying the pipes under the bed of the river. The boring can only be performed in clay and it was necessary to excavate to a depth of 25 feet to get suitable soil. At the time of the preparation of these notes 8 of the 9-4″ pipes required had been successfully got through. A detailed description of the system will be given in a future issue of the Journal.

Subaqueous Cable.—On Sunday, the 16th January, a 250 pair double armoured submarine cable was laid across the Millwall Dock at Glengall Road. The cable, 150 yds. long, was taken to the bottom of the dock in chases cut in the side of the dock. At the bottom, which is 30 feet below the quayside, it was laid in a trench cut in the bed of the dock so that ships' anchors should not damage it. The laying of the cable was carried out by 12 of the Depart-

ment's men, and two divers. The drum was placed in a barge and as the barge moved forward the cable was uncoiled and dropped into the water, where it was taken by the divers and placed into position.

The laying took about eight hours. All went without a hitch and everyone engaged was satisfied with the experience.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

AT the last two meetings of Council the question of finance has been thoroughly investigated, and a proposed re-organisation scheme has been under consideration.

The details of the scheme have been placed before the members of the Institution, and the various local Centres will express their opinions in due course for the final decision of the Council.

LOCAL CENTRE NOTES.

LONDON CENTRE.

A VERY gratifying feature of the work of the Session is the large attendance at the general meetings, and it is to be hoped that this sign of activity will not be merely a passing phase but will long continue.

Meetings were held in November and December of last year, and in January, February and March of this year.

In November, Mr. G. F. Odell read a paper on "Telephone Traffic." Mr. J. Lee, Controller of the Central Telegraphs, made a striking contribution to the debate.

An interesting lecture on "Recent Developments of Wireless Telegraphy" (with demonstration) was given by Mr. E. H. Shaughnessy at the December meeting. This lecture was of absorbing interest, all the more so as Mr. Shaughnessy has the necessary "flair" for lecturing. Unfortunately, time did not admit of the Lecturer completing his programme.

At the January meeting Mr. C. A. Robinson read a paper on "Four-wire Telephonic Repeater Systems." Mr. Erikson of the Western Electric Company, and Mr. Grinsted of Messrs. Siemens', took part in the discussion. It is a matter for congratulation that visitors to meetings never fail to express their great pleasure which the privilege gives to them.

As a sequel to Mr. Shaughnessy's lecture, Mr. F. W. Davey

read a paper at the February meeting on "The History of the Development of Thermionic Valves for Wireless Purposes." A letter from Prof. Fleming was read, and will no doubt be published along with the paper.

At the March meeting Mr. H. D. Dipple gave a paper on "The Relay System of Automatic Switching."

On the afternoon of Wednesday, 26th January, a party of 40 members attended the Morgan Crucible Works, Battersea. The Company is mainly concerned with the manufacture of carbon brushes. The visit was extremely interesting. Brushes are made from the size used on small motors and carbon buttons for Magnetos up to those used for large Dynamos, Electric trains, etc. Particularly interesting was the method of connecting the flexible wire to the carbon block. This is a patented method of the Company. A hole is drilled and recessed in the carbon. The flexible copper wire is threaded through a special tool and then placed in the hole. Copper dust mixed with another suitable ingredient is rammed into the hole by the special tool, which flattens out the end of the flexible and at the same time solidifies the copper dust mixture. Many thousands of such joints have been made and there have been no complaints of failures. Where heavy currents are carried two flexibles are fitted. The visitors were shown the entire process, beginning with the graphite dust being placed in the hydraulic press and formed into slabs of the required size. Thence the slabs are passed into the kiln and given a very careful and steadily progressing rise in temperature. They are afterwards ground, shaped and cut to the required size. In another shop was shown the electrical deposition of copper on the outside of the carbons.

The visit was a great success, and the thanks of the Institution are due to the Representatives of the Company who received the party.

W.G.O

SCOTLAND WEST CENTRE.

A GENERAL Meeting of the Scotland West Centre was held in the Lecture Room, Technical College, on Tuesday, 14th December, Mr. Waring in the chair, when Mr. de Wardt read a paper on "Motor Transport." The features of the paper were—Principle of centralised control of running arrangements and reasons for adoption of centralised control in the Scotland West District, comparison of costs, selection of unit of comparison, comparative statement of mileage costs, points arising from returns received, directions in which use of Motor Transport might be extended.

Interest in the paper was sustained throughout, and the subsequent discussion elicited several suggestions as to the possibilities of increased usefulness of Motor Transport facilities, and Mr. de Wardt was heartily thanked for his interesting paper.

An ordinary General Meeting of the Centre was held in the Technical College on 31st January, Mr. Waring presiding.

In opening the meeting, the Chairman made feeling reference to the death of our late Chief Clerk, Mr. Goodman, and the local Secretary was instructed to write to Mrs. Goodman expressing the sympathy of the Centre with herself and family in their bereavement.

Mr. Geo. Brown then read a paper on "High Resistance Underground Faults." Discussion ensued and questions were replied to by Mr. Brown. A vote of thanks to the lecturer was heartily responded to.

The meeting was then thrown open for discussion of the Council's Memorandum *re* increase of subscription and revision of organisation, and the feeling of the Centre was obtained for communication to the Council.

A very largely-attended general meeting of the local Centre was held in the Technical College, Glasgow, on 7th March—Mr. Waring in the chair.

The Inst. of Electrical Engineers and the staffs of the District Managers for Glasgow and for Scotland West Districts were represented, and the Chairman of Council—Sir William Noble—was also present.

Mr. A. B. Hart, of the Engineer-in-Chief's Office, delivered a lecture on "Telephone Repeaters and Repeater Stations."

Interest was intense throughout, the subject being ably dealt with by the lecturer and illustrated by lantern diagrams and by graphs.

Fresh items of interest and information were elicited by the lengthy discussion which ensued. A hearty vote of thanks was accorded to the lecturer, and on all sides the feeling was expressed that any future visit to the Centre which Mr. Hart may be able to make will be no less heartily appreciated.

H. C. MACCALLUM,
Local Secretary.

We regret to record the death on the 20th January last of Mr. Albert Goodman, 1st Class Clerk, Scotland West District. With his passing at the comparatively early age of 49 years, the district loses an efficient officer and much esteemed personality. Mr. Goodman entered the telegraph service at Cork in 1886, transferring

to the Engineering Department there five years later. In 1902 he was appointed to the position of Senior Clerk, Glasgow. At that time the clerical staff, which is now approximately 100 strong, numbered only 14. The term of his office has been one of expansion and marked by periods of difficulty and anxiety. The chronic understaffing and pressure of past years, the ex-Corporation and ex-N.T. transfers and finally the War—all these, no doubt, laid heavy toll on the energies and health of the late clerical chief, with the result that when he was finally laid aside four months ago his breakdown was rapid and complete. Mr. Goodman was a loyal and devoted servant to the Department and was held in affectionate regard by the staff. He is survived by Mrs. Goodman and two daughters.

SOUTH LANCASHIRE CENTRE.

THE third meeting of the Session was held on the 7th February.

In the afternoon a visit was paid by a party numbering about 70 to the cable works of Messrs. W. T. Glover & Co., Ltd., Trafford Park, Manchester. Special arrangements were made by the firm to conduct the party over the Works in small groups in order that the various stages in the manufacture and testing of the different types of wire and cable might be easily followed. The excellent arrangements made were much appreciated, and resulted in a thoroughly interesting and profitable afternoon being spent.

At the evening meeting the chair was occupied by Mr. Medlyn, and Mr. Rolfe, of Preston, read a paper on the "Transposition System of Running Wires." About 60 members and associates were present, and a good discussion followed.

The memorandum of the Central Committee, dealing with the proposed increase of subscriptions and alteration in the organisation of the Institution, was then brought before the meeting, and, while all the proposals as set forth were not regarded as acceptable, certain suggestions were made which, it is thought, would find acceptance with the various classes affected, and these have been communicated to the General Secretary for consideration.

NORTH WALES CENTRE.

THE activities of the Centre have been well maintained during the present Session and the meetings which are now held in the Technical School, Shrewsbury, have been well attended.

The first meeting was held on 2nd November, 1920, with two subjects down for discussion. Mr. G. C. McDonald gave his views on "The merits of Alternating and Direct Current for Power

Purposes," and an open discussion took place later on the Transposition System of erecting wires.

Mr. McDonald explained in detail the advantages and disadvantages of both alternating and direct current, and tested his opinions from the practical and economic points of view. Interesting questions were put to Mr. McDonald in subsequent speeches.

The opening of the discussion on the Transposition System was in charge of Mr. R. G. Masaroon and Captain N. F. Cave-Brown-Cave.

Mr. Masaroon took the Engineer-in-Chief's Circular on the subject as his text and referred to the questions which had been raised since the issue of the Circular.

Captain Cave-Brown-Cave explained, with the aid of diagrams, the solutions which had been offered to surmount the difficulties.

The time available was inadequate for a full discussion, and it was decided to carry the matter forward to the next meeting.

At the meeting on 7th December Mr. G. H. Carrier read a paper on "Contract Work," dealing with the various classes of work and the forms used. He dealt exhaustively with the methods of preparing tenders and the treatment which accounts required to safeguard the Department's interests. A useful discussion followed.

For the deferred discussion on the Transposition System the meeting had the advantage of the presence of Mr. J. Sinnott, of the Engineer-in-Chief's Office, who kindly offered to anticipate some of the objections to the system. He stated that the decision to abandon the twist system was only arrived at after careful consideration and that there was much experience to draw upon in America, India and elsewhere. The practical advantages were freedom from faults combined with satisfactory speech.

Several speakers raised doubt as to the practical results of the system. Mr. Sinnott in his reply hoped that any real difficulties which were met with would be reported to Headquarters.

The third meeting of the Session took place on 11th January, 1921, when a paper was read by Captain N. F. Cave-Brown-Cave on "Telegraph Line Construction in the B.E.F."

Captain Cave illustrated his remarks with numerous maps and diagrams and outlined the differences in the constructive methods adopted by the British, French and German armies. The organisation of the Signal Corps, the training of Signal Sections, and the psychological effects of army discipline were touched upon. He pointed out the improvisation which war conditions necessitated and the lessons which could be drawn therefrom.

At the meeting on 1st February, Mr. W. C. Burbidge read a

paper on "Output," which touched on many questions of current interest including the use and handling of material, supervision, the decentralisation of gangs, motor transport, and the simplification of estimates.

The final meeting of the Session takes place on 8th March, when papers will be read on—

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

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

The accession of new members and associates during the Session has brought the total membership to 111.

BOOK REVIEWS.

"Wireless Telegraphy and Telephony." By L. B. Turner, M.A., M.I.E.E. (Cambridge University Press. 20s. net.)

Mr. Turner's qualifications for writing a book on this subject are of course well known to readers of this Journal, and a perusal of the book confirms the opinion previously held of his lucid and clear exposition of technical matters.

The book is written primarily for engineers with some knowledge of the mathematics and principles of alternate current work so as to enable them to read and digest the problems on wireless which are presenting themselves almost daily in the technical press. Its secondary object is to serve as a textbook for engineering schools and colleges where tuition in wireless telegraphy is given.

The book is mathematical, but not unduly so, and no one who is conversant with the ordinary mathematics of alternate current work, or of long distance telephoning, should have any difficulty in following the text. More important perhaps than the mathematics is the practical nature of the book, which indicates in a number of different ways the author's working acquaintance with the problems presented. The book however claims to deal with methods and principles and deals only with details of practice where these are necessary to explain points under discussion.

The subjects dealt with in the book cover the theory of electromagnetic radiation and ordinary oscillatory circuits, with the usual diagrams to show the effect of coupling in modifying the form of the current in the secondary circuit. The production of high frequency alternating currents by the various systems, spark, alternator, arc and valve are then fully and clearly discussed, and this is followed

by a description of the theory of the various methods of detection of high frequency currents. As is natural, in view of the present importance of the thermionic valve, both as an oscillation generator and receiver, quite one half of the book is devoted to the theory of the thermionic valve as amplifier, rectifier, and oscillation generator, and the author has collected and condensed the theory of valve circuits in a very simple, concise, and clear manner.

To any one taking up the subject of wireless who has a preliminary grounding in alternate current work, the book can be highly recommended as a clear and effective exposition of the fundamental points of this most interesting science. To those who are, or have been, engaged in wireless work it will prove a most useful volume.

E. H. S.

" Wireless Telegraphy : with special reference to the quenched spark system." By Bernard Leggett, A.M.I.E.E. (Chapman & Hall. 30s. net).

This work is mainly of a descriptive character, with sufficient scientific explanation to make it useful to those who desire to study the subject. As the author states, the quenched spark system has been very inadequately dealt with in English books on the subject of wireless telegraphy, and as this volume deals at great length with the subject, giving details of ship stations of various sizes and of several types of land stations, it is welcomed as serving to fill an undesirable gap in the literature. It is, however, unfortunate that the volume did not appear much earlier, as the use of any large power spark stations on long wave lengths is now obsolescent. The book, however, includes chapters on the intensification of weak signals on valves and on the methods of generating continuous waves by means of arcs, valves, alternators and frequency changing plant. The subject of wireless telephony is also dealt with in a descriptive manner. Very useful chapters on the maintenance and operation of wireless apparatus, with special reference to ship Telefunken sets are given, and the work should prove valuable to engineers and operators who have any dealings with quenched spark gear. A very useful and valuable feature of the work is the many bibliographies attached to chapters dealing with specific branches of the art which readily show the serious student where to look for fuller information. On page 44 the author talks of oscillations which are radiated instead of oscillations which cause waves to be radiated. On page 234 he derides the common explanation of the misguiding of Zeppelins in 1917 as due to " electrical storms," and

purports to give the real reason of their losing their way. The reason he gives is, however, quite as incorrect as that commonly given.

On the whole the book is quite readable and interesting, although mainly devoted to emphasising the advantages of the quenched spark system.

E. H. S.

"Elementary Telegraphy." By H. W. Pendry. Second Edition. (London: Pitman & Sons, Ltd. 7s. 6d. net).

In this edition the author has eliminated many errors which reduced the value of the first issue. The book was primarily written as a first text-book in Telegraphy and fulfils this object admirably; it should appeal also to those students who desire to cover the entire syllabus of the City and Guilds by means of a single text-book. At the same time the author is well advised in referring his readers to Technical Instructions for further details on line construction.

Chapter II. deals well and very fully with primary batteries, but it would have been of added interest to both the home and colonial readers to learn that as a result of prolonged trial the British P.O. had almost entirely abandoned the use of the Daniell and Bichromate types of primary cell, having found the Leclanché more efficient and economical for general service. It is not clear why the author should have found it necessary to go across the Atlantic to enable him to secure figures as examples of economies effected by the use of secondary cells when there were so many examples much nearer home.

In dealing with telegraph tests it would have been useful to record that the Tangent galvo. has disappeared form Post Office instrument rooms, and that specimens are confined to the departmental museum for the benefit of future generations, and also that the Bridge Megger was restricting the sphere of usefulness of the Wheatstone Bridge.

Chapter IV. The amount of space devoted to Telegraph Lines is hardly in keeping with the importance of the subject, and it is suggested that in further editions this space might be increased by reducing the size of many of the illustrations and omitting others. The Langden insulator has not been purchased by the P.O. for over 15 years, and the Sinclair-Aitken type is quickly disappearing, having been superseded by improved types more suitable for the present day character of the leading-in wires. In dealing with the methods of preserving timber, mention might have been made of the

Ruping process whereby the amount of creosote required per cubic foot of timber is reduced by one half

Page 129. The earth wire is securely stapled to the base of the pole and not loosely coiled as stated.

Iron Poles. It is thought that the author's remarks as to the advantage of iron poles would be modified considerably with experience of such poles, especially in this country.

Page 158. Testing for contact. It is not necessary to disconnect both the wires for this test; economy in the use of circuits dictates that only one wire should be stopped, the other being utilised to carry traffic under normal conditions and only subject to temporary interruption at the moment of each test.

Some of the applications of the C.B. system may very well be omitted and the attention of the student confined to standard systems in view of the desirability of extending the information in other subjects.

Figure 179 is very poor, and figure 180 indicates an obsolete type of protector.

H. W.

"The *Practical Engineer* Electrical Pocket-Book, 1921." (The Technical Publishing Co., Ltd., 1, Gough Square, Fleet Street, London, E.C. Cloth, 2s. Best binding, 2s. 6d.)

The pocket-book has been revised and increased in size. The wireless section has been enlarged and includes details of the thermionic value and some of the circuits in which it is employed. A list of technical terms in French, Spanish and Russian is given at the end.

"The Practical Electrician's Pocket-Book and Diary, 1921." (S. Rentell & Co. Ltd., 36, Maiden Lane, Strand, London, W.C. 2. 3s. net.)

This book, now in its twenty-third year, has grown from small dimensions to its present size of 522 pages, and is of a very practical character. It is recommended by the City and Guilds Examiners as a text-book of reference.

"Telegraphy, Telephony and Wireless." J. Poole, Wh. Sch., A.M.I.E.E. Price 3/-. Sir Isaac Pitman & Sons, Ltd.

This book, totalling altogether 117 pages, is intended to give only an introduction to each of the above-mentioned subjects. It cannot be recommended to our readers as a text-book, but will be of value to those who desire to obtain an elementary general knowledge of the principles and applications of electrical science to the art of signalling.

We have received a copy of Circular No. 92 from the U.S.A. Department of Commerce, prepared by the Bureau of Standards in conjunction with the Construction Division of the Army, War Department. The subject of this Circular is "The Operation and Care of Vehicle-Type Batteries." It deals with the lead-acid type as well as the nickel-iron, giving excellent illustrations and information regarding the construction, working, testing and maintenance. Illustrations are also given of the methods for dismantling and carrying out repair work. Very instructive graphs are shown of the performance of cells under charge and discharge. There are also copies of War Department specifications, dated May 1st, 1919, for such cells required for use on industrial trucks and tractors, also for a battery charging equipment. Finally, a number of forms for recording the working of cells and a glossary of terms are provided. The price of the work is quoted at 30 cents, a reasonable price for the 94 pages of matter.

THE SPIRIT OF THE HIVE (P.O. ENGINEERING).

There is one thing we have ever been proud of in our Department and that is, we can "Shift the work." In the old days, the days before the darkness fell on the earth, we counted not the labour,—it was joy, we counted not the hours, nor the cost to ourselves, we simply thought of our Department, we were proud of it, we boasted of it, it was in our opinion the one Department of the P.O.

Each of us thought that our Section was the one section in the Country, where new construction work could be taken as a standard, where maintenance was as near perfection as possible and consequently the number of faults at a minimum. We looked upon the plant as growing children, nursed it carefully, making certain it was not overstrained, that there was sufficient nourishment given to enable it to meet the trials it would be called upon to bear. The lines stood as sentinels along the country side, challenging the fiercest storm that dared to come along, appearing conscious of their strength, their stability, their power to resist. They stood as worthy guardians of the spirit which created them.

In those days the Spirit of the Hive was recognised by all members of the Section, making it a genuine delight to work for the good of the hive. Each member took an interest in each other in particular and in the Section in general. Each proud of the fact that they were co-creators of the efficiency of the Section and jealous that that efficiency should not in any direction be impaired. They were too proud to scamp any work and gave only of their best, and

so throughout every corner of the Section the Spirit of the Hive was indeed manifest . . . . . and the hive prospered.

In late 1914 the Hive swarmed. The familiar hum of the workers ceased.

Five long lean years passed, then one day in November the sun shone again and there was a steady return . . . . . but many of the nobility of the hive had fallen during the flight in strange lands. All had encountered the storm, and of those returning many were broken in body, but most of them had a greater affliction, their spirit was shattered, and the Hive during their absence had fallen upon evil days. The sentinels no longer stood proud and erect, their labour too had been great and their nourishment too meagre to enable them to withstand the strain, and they bent under their tasks.

For five years the swarmers destroyed, pulled down instead of creating and building up, their interests were fleeting, they had no abiding place and their whole outlook on life has changed as a result. They once looked along the road of life; they had hopes and ambitions, now they see only the cinder path at their feet and tread it wearily.

They cannot be blamed; the swarming was necessary but is now past. They have not yet thrown off the ill effects of the storm, but, with the exercise of patience, the Spirit of the Hive will return and ere long the sentinels will once again confidently send forth their challenge . . . . . and the Hive will prosper.

"X."

A FEW HOWLERS FROM THE ARMY SIGNAL SCHOOLS.

COLLECTED BY A P.O. INSTRUCTOR.

IN one of Ian Hay's war books he tells an amusing story of an Army signaller listening-in on a Buzzer Switch Unit to a conversation taking place between an irate but anxious O.C. and an officer who had taken a long time to report himself after an excursion into No Man's Land. Beyond the humour, one can admire the efficiency of the signaller and his tenacious attention to duty. Elsewhere the author sketches the interior of a signal dug-out, and with a deft touch draws attention to the D.C.M. ribbon on the tunic of the man with the telephone.

A large proportion of the rank and file drawn to the Signal Service proper were men who had undergone some sort of technical

training and were already experts in the use of telephone and telegraph apparatus, but not so the Infantry and Artillery signallers. Men of all sorts and conditions, miners and barbers, clerks and small business men, were drafted into the units—one gunner, who had obtained a sleeping-out pass, was usually met at the camp entrance by his wife at the wheel of a 40-horse power car. The task of imparting the requisite knowledge of the apparatus in the short time available before the drafts went out was strenuous, but it is doubtful whether the greater credit is not due to the learners than to the instructors. Anyhow, it was astonishing how quickly the men acquired the knowledge and manipulative ability to meet the tests demanded at the signal schools.

Now that the war is over we may smile again. In the following paragraphs we shall see how the gallant fellows tackled the intricacies and probed the mysteries of electrical science in the early stages of their training. The spelling is not mine.

One man defines a conductor as "a metal which electricity cannot pass through." Another does not quite agree with him; he says "A conductor attracts the current along or outside it." Opinions differ as to the properties of an insulator. "An insulator is 1 or more wires covered in a cable." "An insulator is a cable with 3 wires attached." Why 3, we wonder?

The make-up of the Inert Cell interests them, and every man is anxious to render at least one cell active before his test. A young Canadian informs us that "the cell is made of sal-ammonia and exodite, with a cabon in the centre which is called the positive." A second man from the same brigade does not think so—"A cell is made up of zinc and waterproof covering covered with oxtride." Exodite and oxtride may be valuable materials in Canada, but the terms require translating. A third man is anxious that the cell should not become dry—he may have come from a province suffering from the same disability and would not inflict the disease even on a cell! At any rate he "would fill the tank with water, becos if it is kept in too dry a place it will evacuate." "Testillated water must be used." "Each cell with a carbon diploma has a reflection of 1.5 v." Due, no doubt, to that diploma!

The Induction Coil has no terrors, though it possesses a "lamented iron core." "The soft iron cores are used because soft metal is a better conductor, and iron being cheapest is used. Because the electric waves cling better to a softer metal." "It vibrates the current, so as to be able to read it and can be read clearly in the microphone."

One learned lance-corporal in a Home Counties regiment, who could never understand why the current "did not come out at the

zinc" because it was bigger than the carbon, headed his examination paper with the erudite but gratuitous information that static electricity was invented by the Greek scientist Statos, 1000 years before Christ. It was a great effort, and dwarfed completely the answers he gave to the actual questions.

Descriptions of the telephone parts and their functions were peculiar. "The receiver is composed of a metal capsule with an ebonite disc fitted. A screw terminal is fitted at the back attached by a lead to the battery and when current is connected it causes the sound waves to press the granuals together and then the disc (which is very thin) vibrates by the action of the horse-shoe magnet." Another student thought the receiver had "a metallic diaphragm which expanded and contracted by alternating current passing through its granules. The sound waves cause the granules inside the receiver to vibrate on to diaphragm." This is very good, but the transmitter is also a wonderful piece of apparatus. "A transmitter consists of a piece of carbon with granules with a mica plate for sounding purposes; *also a brass screw*. See sketch." "The sound goes out through the terminal at the bottom of the micro case, through the wire to distant end. Through the granulated crystals." A grocer, when at home, evidently!

A much more scientific explanation of the action of the transmiter is attempted by a navvy from the Midlands, one in which the principle of the conservation of energy is brilliantly enunciated. "On pressing the pressel switch a steady current strikes the carbondia, causing the shot to rise and making electrical waves into sound waves. Releasing the pressel switch causes the shot to fall, thus making sound waves into electrical waves."

An old-time signaller, proud of his knowledge of the adjustment and alignment of the duplex helio and a keen believer in the smelly Begbie, has his doubts about the Lucas electric lamp. "One disadvantage it has, you don't know when the cells are going to run off." There's the rub, they might run in the direction of the enemy's lines, and then the fat would be in the fire.

Induction between adjacent single earthed lines is a profoundly mysterious subject. I had to check an army instructor at a well-known school, shut down early in 1917, for telling his men that the way to prevent induction between two single lines on a route was to run one as straight as possible and to drape the other up and down on it. Only by making him listen on the draped wire while someone spoke on the other could he be convinced that the arrangement was not the same as a twisted pair. A pupil from the same school has the notion of the trouble, although he does not say exactly what he means. "The advantage of a metallic circuit

is that if you had earth the earth may be bad, and that a current of electricity will flow better in the air than in the ground."

The Stevens, the D III., the Vibrator, the C_2 (all types), and the 4-line field exchange were bad enough, but when the Fullerphone and Switch Units came along the situation became desperate. The former impressed the men. "The Fullerphone is secretcy. You cannot be heard by the enemy, only by a Q. and I. dector," replies a miner from the Forest of Dean. We recommend the following to the Telegraph Section; it bears promise of a new duplex. "The use of a potentiometer is for when there is more current going one way than the other, the potentiometer is used to equal the current going both ways." The cuteness of the potentiometer is astounding. "The potentiometer is used for drowning out all the different sounds which happen to be picked up and drives them to earth, and therefore they do not bother you." A veritable De Saute sucking up the current!

A bright youth from Houndsditch connects his earth pin to the Earth of the lightning protector on a C_2 telephone and nurses it all day on a scheme, while the lineman "petrols" the line looking for a dis.; but the practice is not so serious as the man who would join up his D III. to a Buzzer Switch Unit in this wise: "I would connect the positive to the negative and the negative to the positive and then on to the telephone."

It was the ardent and amorous youngster who advanced the right contact of a D III. to get a "buss" that wrote the parody "Milly Farad's sewing ohms for soldiers," and declared that the current in the circuit depends upon the ambition of the cells. Enough, perhaps, has been said to indicate that the regimental signaller, although not possessing the polish of the Signal Service, is yet "no armature, and his Don R. proceeds by leaps and bounds."

PROFESSIONAL, SCIENTIFIC, AND TECHNICAL CIVIL SERVANTS ENQUIRY.

AT the meeting of the National Whitley Council held on the 29th January, 1921, it was agreed that an enquiry should be instituted into the pay and conditions of service of the Professional, Scientific and Technical Staffs of the Civil Service. Three group Committees are to be appointed as follows:—

Committee A. To consider Civil, Mechanical, Electrical and Sanitary Engineers; Ship Constructors; Architects; Draughtsmen and other grades allied to these professions.

Committee B. To consider Valuers.

Committee C. To consider Analytical Chemists.

A Demarcation Committee is also to be appointed to consider allocation of marginal cases and formation of fresh group committees if necessary. Either side to have the right of submitting any class not already provided for in one or other of the group committees.

These Committees will start work at an early date, and it is desirable that any class coming within the above categories desirous of having their claim considered should communicate as early as possible with the Staff Sides of these Committees. Communications may be addressed to the Staff Side Secretaries of the National Whitley Council, Parliament Mansions, Victoria Street, S.W.1, or:—

Committee A. Mr. A. O. Gibbon,
160, Hammersmith Road, W.6.

Committee B. Mr. F. J. Line,
18, Shoot-up-Hill, Brondesbury, N.W.2.

Committee C. Dr. Herbert Smith,
Natural History Museum,
South Kensington, S.W.7.

The above Committees have now been set up as follows:—

Group Committee A.—Chairman: Mr. F. Bryant; *Secretary:* Mr. A. O. Gibbon; Messrs. F. L. Mayer, G. C. Blair, J. H. Salmon, H. E. Seccombe, L. J. Hartley, G. Chase and H. Dive.

Group Committee B.—Chairman: Mr. J. H. Salmon; *Secretary:* Mr. F. J. Line; Messrs. S. Martin and W. Townend. 1 Vacancy.

Group Committee C.—Chairman: Major A. G. Church, *Secretary:* Dr. Herbert Smith; Messrs. Prof. J. S. S. Brame, J. H. Oates, Dr. S. W. Smith, F. Wade. 1 Vacancy.

Demarcation Committee.—Chairman: Mr. J. H. Oates; *Secretary:* Mr. H. Dive; Messrs. F. Bryant, J. H. Salmon, Major Church, G. C. Blair, H. Verney, A. O. Gibbon, and Dr. H. Smith.

Executive of Co-ordinating Committee.—Chairmen of Four above Committees, Secretaries of Four above Committees and Mr. F. L. Mayer.

G. CHASE,
Staff Side Secretary,
National Whitley Council.

STAFF CHANGES.

POST OFFICE ENGINEERING DEPARTMENT.

PROMOTIONS.

Name.	District.	From.	To.	Date.
Foulger, E. ..	E. in C.O. (Research)	Junior Engr.	Assist. Engr.	12 : 1 : 1921

TRANSFERS.

Name.	Grade.	Transferred.		Date.
		From.	To.	
Bramwell, J. T. ...	Executive Engr.	Carlisle	Lancaster	As from 1 : 1 : 21
Whetton, S. F. ...	Assistant Engr.	Cardiff	Leeds	18 : 1 : 21
Tissington, H. G.	,,	Manchester	Coventry	23 : 1 : 21

COMMUNICATIONS.

All Remittances and Communications should be addressed to the MANAGING EDITOR, P.O.E.E. JOURNAL, Engineer-in-Chief's Office, G.P.O. West, London, E.C.1.

Binding covers and copies of the Contents Index for Vol. 3 to 13 are available, and may be obtained from the local agents for 1*s*. 6*d*. and 3*d*. respectively. Subscribers can have their copies of Vol. 13 bound, with index included, at a cost of 3*s*. by sending the JOURNALS to the local agents. Orders should indicate whether the original binding with black lettering, or the later pattern in gold, are required.

A supply of copies of the Station List of Engineering Officers, down to Assistant Engineers, is in stock, and may be obtained on demand, price 3*d*. each.

The Council of the Institution of Post Office Electrical Engineers has decided to raise the price of the JOURNAL to 2*s*. (2*s*. 3*d*. post free) per copy. This price applies also to annual subscribers, the subscription being 9*s*. per annum, post free. All back numbers 2*s*. each. The Board of Editors is anxious to repurchase copies of the following parts: Vol. 1, Part 1; Vol. 5, Part 2; Vol. 6, Part 1; Vol. 7, Part 1; Vol. 9, Part 2; Vol. 12, all Parts. Two shillings each part will be paid for clean copies in good condition.

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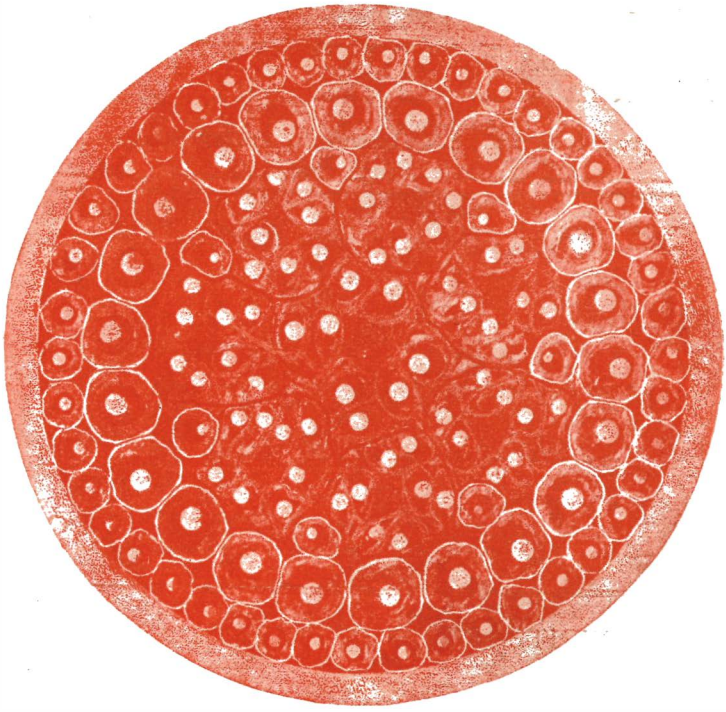

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