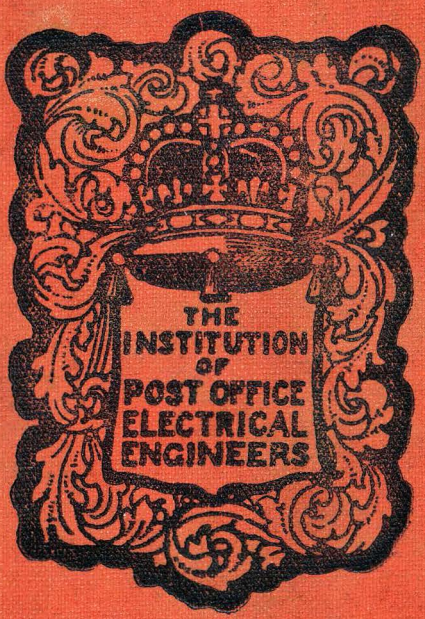
THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL



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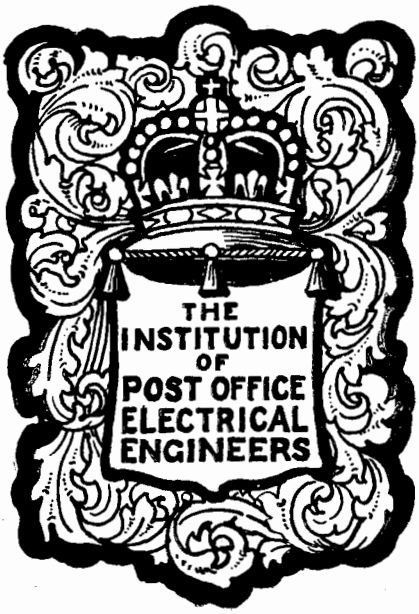


VOLUME I

APRIL 1908
TO
MARCH 1909

The Post Office Electrical Engineers' Journal.

THE ORGAN OF THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

A QUARTERLY JOURNAL DEVOTED TO:

Telephones, Telegraphs (Aerial, Underground, Submarine and Wireless) and all matters of interest to Communication Engineers all over the World.

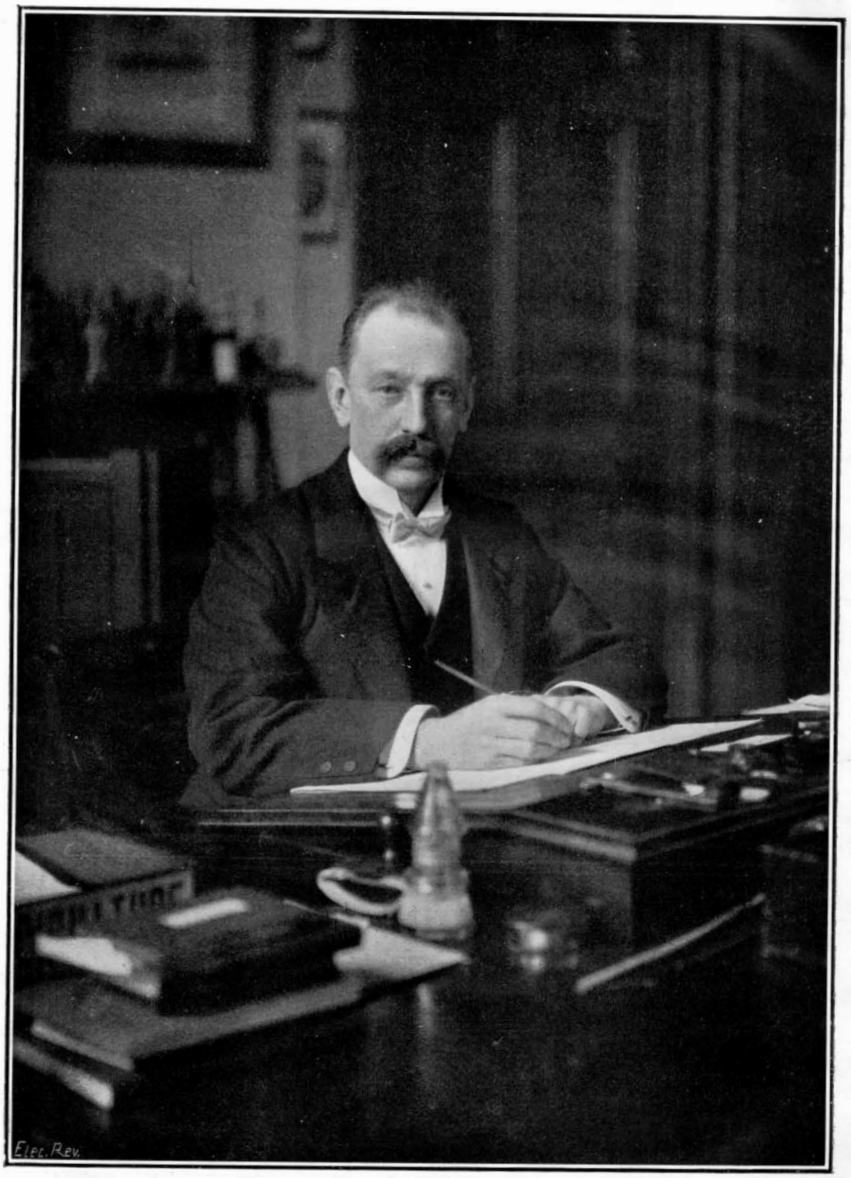
VOLUME I.

SUBJECT INDEX.

Original Articles are given in thick type; and Translations, Abstracts, Reviews, etc., in thin type.

The items marked with an asterisk are abstracts of papers read (and of the discussions ensuing) at the International Technical Conference held at Buda-Pest.

INDEX TO AUTHORS.



SIR JOHN GAVEY, C.B.

FIRST PRESIDENT

OF THE

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

1905

THE
Post Office Electrical Engineers' Journal.

FOREWORD.

The publication of this Journal is the result of the materialisation of ideas which have slowly but irresistibly permeated the minds of British Post Office Engineers during the last decade Like the Institution of which it is the organ, it is built on foundations which have been well and truly laid, and we have no fears as to its enduring success. The response to our preliminary announcement by contributors and subscribers, even before time has allowed of the receipt of replies from the colonies, has far exceeded anticipations, so much so that it has been necessary to increase the original order to the publishers by 50 per cent. Those to whom our Journal will appeal seem to us to be arranged in five concentric circles:

1st—The members of the Institution of Post Office Electrical Engineers;

2nd—All Post Office Officials of the United Kingdom connected with telegraphs and telephones;

3rd—All telegraph and telephone engineers of the United Kingdom other than "Post Office";

4th—Colonial Engineers; and—

5th—All inhabitants of this world who are interested in telegraphs or telephones.

The contributions to the first number have been drawn from the first two circles only; they will not, however, be found to be lacking in interest to those in the outer circles.

We hope that the vigorous action which has thus been generated at the centre will produce a healthy reaction on the part of our distant colleagues. In some future number the history of the birth and development of the movement which has reached the present stage will be put on record, but for the present it is sufficient to point out that the advantages which members of the Institution have enjoyed during the last two years are widened and deepened by the publication of the Journal. The mutual intercourse which has hitherto been confined to a district is now made common to all. The audience which the Institution provided for the man with a message is by means of the Journal increased a hundredfold. It shall be our earnest endeavour to keep our pages open for the free and healthy discussion of all subjects relevant to our profession, and at the same time to secure that nothing unworthy shall sully them. We desire that the 'Post Office Electrical Engineers' Journal' may soon come to be recognised in the lives of its readers as a real factor for good and for progress.

WORDS OF WELCOME

From Sir JOHN GAVEY, C.B., M.Inst.C.E.

A NEW Electrical Journal is commenced to-day which we hope will not only have a long and prosperous career, but which is destined to have a potent influence for good on the large body of men whom it is intended to represent directly. In view of the large amount of special electrical literature, which is now published, in addition to the very considerable space devoted to the subject in most engineering and scientific journals, it may be asked whether there is room for an additional publication devoted to one special branch of this great industry. The answer can only be an unqualified affirmative. As an art expands, and widens its sphere of usefulness, the need for specialisation becomes more urgently felt, and institutions and literature devoted to individual branches become necessary. When engineers were a limited body, with limited spheres of influence, one parent institution met all their requirements, but now there are scores of engineering societies. So with our own branch; even as recently as forty years ago telegraphy was the only existing branch of electrical engineering, and when the present Institution of Electrical Engineers was founded in 1871, with the title of the Society of Telegraph Engineers, it fully represented the whole of our interests. The widening of the electrical outlook was foreshadowed in 1880 when the Society made the first change in its name, and began to devote so much of its attention to the new processes and inventions, which had so much interest for, and were of such importance, not only to engineers, but to the world at large; but this very extension of its work tended to crowd out much that would have been of interest to telegraph engineers, many of whom thought that they were not fully represented by the enlarged society. The ultimate outcome of this feeling has been the successful foundation of the Institution of Post Office Electrical Engineers, and the edifice is now crowned by the inauguration of its official mouthpiece the POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

The scope of the new JOURNAL is wide and liberal. In the matter of descriptive and scientific articles and engineering abstracts it should fill a much felt want, as everyone in active service has experienced the difficulty in finding time, even when the means exist, to wade through the English and Foreign professional literature in order to keep abreast of the most modern views.

The JOURNAL also should be of inestimable value as an incentive to authorship. It has often been said that the best way to learn is to teach, and everyone who has attempted the latter rôle has realised how much he has himself benefited in the process; so in endeavour-

ing to give a clear description of his experiences, and to marshal his ideas in logical sequence, every writer in our JOURNAL, in his efforts to impart his knowledge to his friends and colleagues, will find that he has widened his own horizon and that he has strengthened his own mental conceptions of the subjects that he has made his special study. Like the quality of mercy it may be said to be twice blessed, it blesseth him that gives and him that takes.

But, apart from these questions, in following the examples of other great national services by the establishment of our own professional JOURNAL, we shall do much to link up the widely-scattered officers of our branch, many of whom, owing to their isolation, are not only out of touch with their colleagues, but with the wider professional world, and are thereby debarred many opportunities of forming broad views on subjects immediately outside their own personal experiences.

In wishing hearty success to our new JOURNAL let us not forget that success will depend on our support, which should be given in an ungrudging spirit.

NOTES AND COMMENTS.

ENGINEERING DEPARTMENT ANNUAL DINNER.

THE fact that the Annual Dinner of the Engineering Department has reached its fifth consecutive year may be taken as an assurance of its continued success and, it is hoped, of its growing popularity. Owing to the wide area over which the staff are necessarily scattered, attendance at the annual gathering must necessarily be greatly restricted, but there is but one opinion expressed by those who have been able to be present, and that is one of great pleasure and enjoyment. The advantages of social intercourse of this kind are great in every way, and the simple fact of the exchange of a few words between those who would otherwise but rarely meet is by no means an insignificant matter; especially pleasant it is to meet those who, through the inexorable age-limit, are no longer of the fraternity, but yet have a warm feeling towards the Department in which they worked so zealously, and for so many years. On each occasion of the dinner some important announcement has been made (in the course of the usual complimentary speeches) and this has almost come to be looked upon as an arranged part of the evening's proceedings; in the present case the announcement being that of the

appointment of Sir John Gavey as Consulting Engineer to the Department. This appointment is generally recognised as being very necessary in view of the important issues at stake in connection with the coming transfer to the State of the National Telephone Company's system; the heavy every-day work of the Department, which is daily growing, requires unrestricted attention from the permanent Engineering heads, and this can now be given. Much appreciated will be the announcement that it is recognised that there has been a considerable amount of over-pressure of work amongst the staff, and that steps will be taken to largely alleviate it. Willing and loyal the members of the staff undoubtedly are, but there is, of course, a limit to physical endurance, and when this limit is passed work is bound to suffer, not only in regard to efficiency, but also in regard to economy.

The remark of the Postmaster-General that "I doubt if the enormous extent of the work carried on by the Engineering Department of the Post Office is appreciated outside" is unquestionably a true one. The general public have really but a very faint conception of the multifarious classes of work which the Department is called upon to perform; probably if they were told that the block signals on certain railways are maintained by the Department, the statement would be received with incredulity.

The Engineer-in-Chief, in responding to the toast of "The Engineering Department," expressed indirectly, but in no uncertain way, the necessity for members of the staff keeping well abreast of scientific progress. This might with advantage be taken well to heart.

Central Battery Telegraphs.

The articles on the Polarised Sounder and on the Common Battery Duplex contained in this issue will recall to our readers the rapid and striking development of central battery telegraph working which has been effected in the Post Office within the past few years. In the application of central battery working to telephony, we on this side of the Atlantic have been more or less humble followers of the practice of our American cousins so far as main principles are concerned, but in the telegraphic field the Post Office has the distinction of being the pioneer. It may be said that the "closed circuit" system of telegraphy, which has for many years been in general use in countries where the lines carry so small a volume of traffic that many stations can be grouped on a single wire, is, in a sense, a central battery system, since it is unnecessary to maintain a battery at each of the stations connected. But in the wider sense of working large groups of circuits, radiating from busy centres by means of centralised sources of energy, little or nothing appears to have been done outside this country.

The first step taken here was one on a scale of considerable magnitude, when it was decided to equip the new London Telegraph Intercommunication system on a Central Battery plan, and thus abolish at one stroke the scattered groups of batteries on more than 1000 telegraph circuits. About 12,000 primary cells were thus replaced by a single group of accumulators installed in the Central Telegraph Office, which served alike for switch circuits, direct C.B. simplexes, and C.B. duplexes of special design, with a consequent maintenance saving of more than £1000 a year. At the same time the polarised sounder was re-designed and introduced on all the circuits as an integral part of the scheme, since which it has ceased to be a plaything, and, as the instrument adapted above all others for central battery working, has taken its place in the everyday life of the British Telegraphist. Of the entire success of this bold experiment from an engineering standpoint there has never been the slightest question, and the simplification effected in the equipment and wiring of large telegraph offices throughout the wide-spreading Metropolitan Area has been a very striking one. In place of a basement filled with battery boxes and a mass of wires, we now have, in most large offices, a single lead-covered cable entering the building from the street, and running unbroken to the instrument tables, where its conductors are distributed to the various working instruments.

Equally satisfactory results are attending the introduction of central battery working on the shorter lines which radiate from all large offices throughout the country. At many of these offices secondary cells were already in use, and no further battery provision for central battery working was required, but at many others, where secondary cells are not available, the necessary power is simply and satisfactorily provided from a few groups of bichromate cells. The saving represented by the abolition of batteries in the small and relatively inaccessible provincial offices served from these centres has exceeded, many times over, that effected in London. The system of double current working from a single pole battery permanently connected to the line at the central office, and the method of producing reversing condenser impulses, whereby the polarised sounders at all stations on the line are actuated without any reversal of the battery itself, are features of decided novelty which are still being developed in new directions, and which are being copied by several other administrations which, like the Post Office, are devoting much time and thought to the reduction of cost of equipment and maintenance.

We hope to keep our readers in close touch with progress in these matters.

THE POLARISED SOUNDER.

By C. C. VYLE and E. V. SMART.

IN the first days of telegraphy the sounder was placed in the main circuit. It was actuated by currents in either direction, positive or negative, *i. e.* it was single current in action. The strength of current required, however, was very great, and this limited the distance over which telegraphy was practicable. With imperfectly insulated lines an enormous voltage would have been necessary to ensure the requisite current passing through the receiving instrument. This difficulty led to the invention of the relay, which, similar in action to the sounder, but with the moving part of lighter construction and the coils possessing a greater number of convolutions of wire, was actuated by comparatively small currents. The moving part, when the armature was attracted, completed a local circuit in which the sounder and a battery were placed. The sounders used in the local circuits were generally wound to 20$^{\omega}$, but on the introduction of secondary cells it was necessary to increase the resistance of the sounders to 900$^{\omega}$, on account of the variation in strength of current when the number of local circuits closed was continually changing. A much greater distance was bridged over by the use of the relay.

Improvements in relays, to increase still further the working distance, followed, and among them was the double current or polarised relay. This was much quicker in action than the single current relay, and required even less current to work it. The armature of the polarised relay is inductively magnetised, and a negative current sent through the coils in one direction causes it to be attracted to one side, while a positive current sent through the coils in the same direction causes it to be attracted to the other side. When the armature is in one of these positions—a prearranged position—the local circuit is closed. Polarised relays, besides requiring local batteries in connection with their use, are delicate instruments for the unskilful to adjust, and it was to secure the advantages of a polarised relay that attention was turned to polarising the sounder itself, so that it might be used without relays in positions where skilled attention was not available, and to avoid the use of local batteries.

It will be noticed that the polarised sounder of to-day allows us to revert to the simple system of the early days of telegraphy with an efficiency which hitherto has only been obtainable by a comparatively costly equipment.

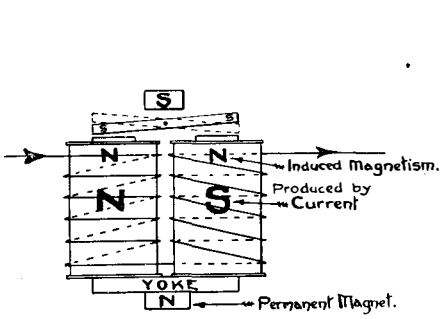
Before describing the latest form of polarised sounder it will perhaps be as well to refer briefly to the old form.

A sounder may be polarised in two ways: either the armature is

magnetised, or the core of the electro-magnet is magnetised. It has been the practice hitherto to magnetise the armature. This has generally been done by induction, it being well understood that a short magnet of such dimensions as a sounder armature usually is, would soon lose its magnetism if it were not for the protecting influence of some powerful magnet. In the latest form of polarised sounder however, the core of the electro-magnet has been magnetised with excellent results.

Polarised sounders of the former type are similar in appearance to the single needle instrument. The sounding pieces are fixed on a dial, and the striking piece moves to the right and left against them.

The armature is magnetised by induction by a powerful permanent magnet, one of whose poles is near the middle of the armature. This makes the extremities of the armature of similar polarity. A current passing through the coils in one direction causes one end of the armature to be attracted, the other repelled. A reversal of current causes the end formerly repelled to be attracted, and that formerly attracted to be repelled. A sketch will explain (see 1).



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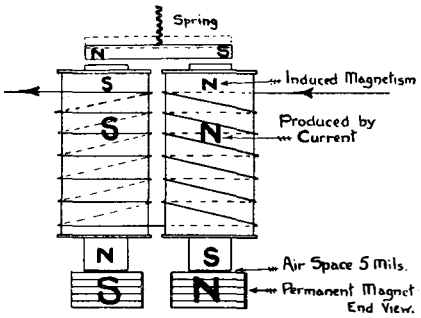

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This type had two objections urged against it:—

(1) The signals were liable to sound reversed.

(2) The sound emitted was said to be irritating.

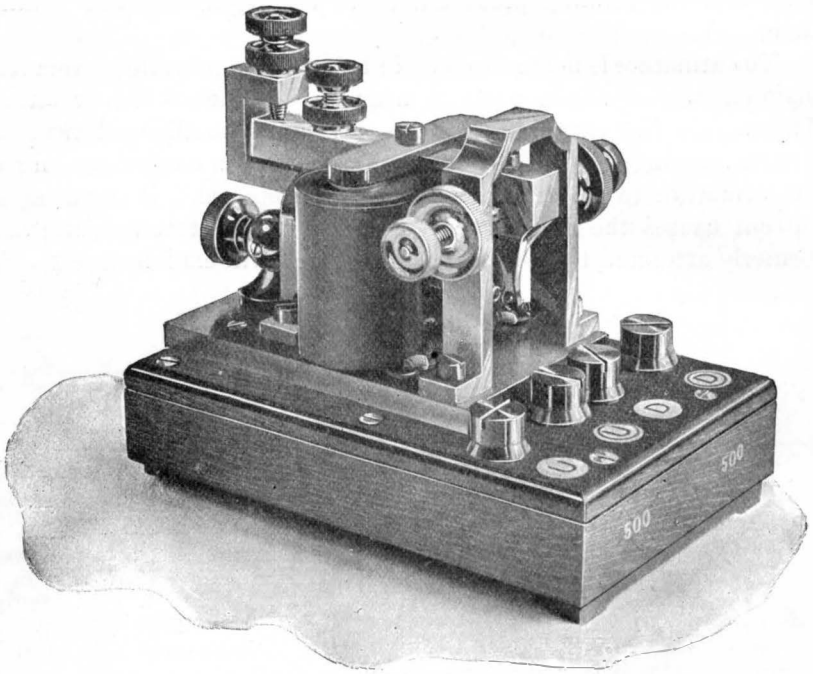
To overcome these objections a new polarised sounder was designed by Mr. C. C. Vyle. As previously stated, the cores of the electro-magnet are magnetised; these in turn, however, magnetise the armature by induction.

The instrument, in appearance, is identical to that of the ordinary pony pattern sounder (see 2).

A permanent magnet is placed in the base of the instrument and the cores are thus inductively magnetised. If, in looking at the instrument, the adjusting screw be placed on the left, it will be found that the north pole is the nearer to the observer. The magnet is made sufficiently powerful to withstand any tendency to reversal

produced by a current through the coils. An air space or non-magnetic disc breaks the magnetic circuit between the permanent magnet and the cores; this is essential for good working.

To illustrate the value of the induced magnetism the following may be considered:—The strength of the magnetism induced in the cores of a 500ω + 500ω polarised sounder is about equal to that which would be induced by a current of 18 milliampères through both coils. Tension must be put on the spring to make the instrument neutral, *i. e.* the armature must remain up or down when moved by hand. We now have the instrument in a very sensitive



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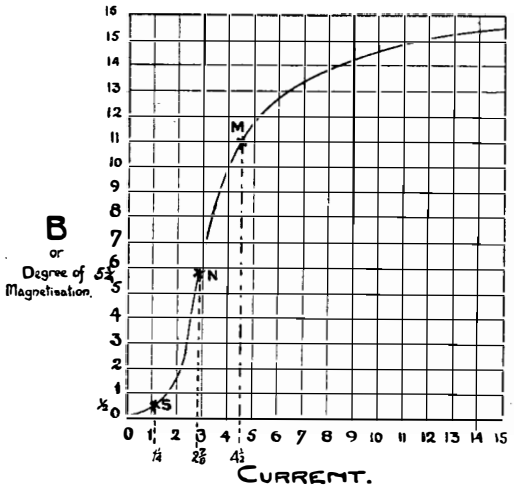
condition, and a glance at the curve of magnetisation (4) will show the effect of making changes within certain limits. A slight marking current, adding to the magnetism of the cores, will overcome the spring, or a slight spacing current, reducing the magnetism in the cores, gives the spring the mastery. The position may be likened to a pair of scales, magnetism in one pan and spring tension in the other, the magnetism to be used as the weights, but the beam is so balanced that the slightest alteration in the weights (increase or decrease) produces a pronounced effect.

For comparison with an ordinary unpolarised sounder it is only necessary to quote the currents allowed for the respective instruments. The ordinary sounder (900ω) is allowed 20–26

milliampères to give working signals. The polarised sounder ($500^{\omega} + 500^{\omega}$) is allowed 10 milliampères to produce the same. An ordinary sounder is single current in action only; but a polarised sounder is actuated by single current or double current, and may be worked by condenser impulses. A polarised sounder $500^{\omega} + 500^{\omega}$ can be actuated by $\frac{1}{2}$ milliampère; 3 milliampères should produce Morse characters at twenty words per minute, and 10 milliampères gives strong, loud working signals. The standard adjustment is as follows:—The distance between the armature and cores when the armature is down should be 8 mils., while the distance between the lever and the upper limiting stop, with the armature in the same position, should be 16 mils., and with this adjustment the instrument can be worked with currents



N = Normal condition of magnetisation of the Polarised Sounder. M = Condition of magnetisation of Polarised Sounder when a marking current passes through the coils. S = Condition of magnetisation of Polarised Sounder when a spacing or demagnetising current passes through the coils.

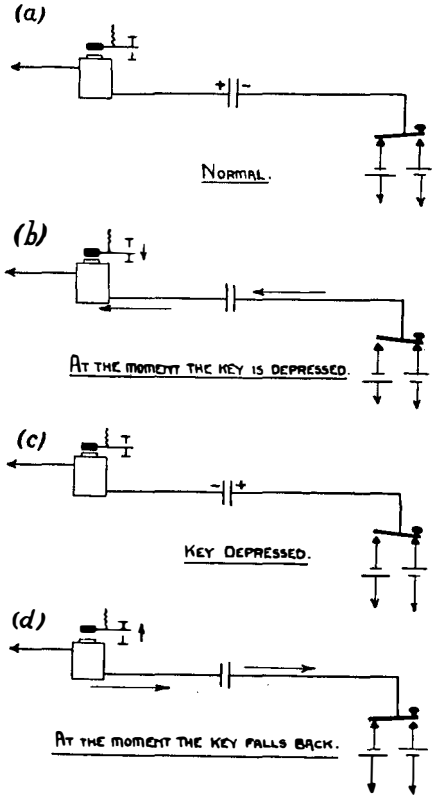
ranging from 3 to 40 milliampères without altering the adjusting screw. By increasing the tension the instrument will respond correctly to very high values indeed.

The inductance of the instrument is 62 henrys. This is a very useful property, especially in view of the great extension of underground work. Owing to its balancing the capacity of a great portion of the line it will enable many circuits, which previously were balanced by means of triple condensers and condenser coils, to be balanced by means of a single condenser.

When the first long underground circuits were established considerable difficulty was experienced owing to induction. The circuits running parallel for many miles reacted upon each other, causing

unpleasant chattering of the sounder when a circuit was idle, and mutilating to some extent the working signals. One or two arrangements to overcome this were tried, but the substitution of the standard relay and local circuit by a polarised sounder was found to be most effective and economical. Not only does this overcome the effects of induction, but it also allows the balance of a duplex circuit to vary considerably without necessitating a re-balance.

In one case it was found possible to work wheatstone at 150 words per minute on one wire of a pair in the northern underground from



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London to Liverpool, while a polarised sounder duplex circuit on the other wire was unaffected.

Condenser working.—One of the advantages of a polarised sounder is its applicability to condenser working. How this is accomplished may be of interest. The sounder is adjusted to the neutral position previously referred to (see 5*a*). The space between the limiting stops may be considered as being divided into two portions; the upper portion is under the control of the spring, the lower portion

under the control of the magnetism. When the key is depressed (5*b*) a momentary current flows, charging the condenser. This current produces a preponderance of magnetism and causes the armature to be brought sharply down, where it remains (5*c*), not by virtue of any current continuing in the coils, but by being within the space controlled by the magnetism. To terminate the signal, be it dot or dash, it is only necessary for the key to rise (5*d*), discharging the condenser or charging it in the reverse direction. This produces a momentary discharge current in a direction to reduce the magnetism; the spring asserts itself and retracts the armature.

At the present time the polarised sounder is in use on many long distance underground circuits, viz. London to Glasgow (400 miles), London to Liverpool, etc. It is used on the London Intercommunication Switch and the Metropolitan Central Battery duplex circuits; it is also used on Central Battery Condenser Omnibus circuits. Practically every slow-speed Morse circuit of reasonable length can be worked successfully with it.

As it is usual to provide a current of 15 to 20 milliampères to work a standard relay when the coils are in series, it will be seen that with the same allowance the polarised sounder has a margin of 50 per cent. for working signals.

To sum up the properties which commend the Vyle polarised sounder: First, its extreme sensibility, due to the value of the induced magnetism, this being in the middle of the steep part of the curve of magnetisation; and in a second degree to the large number of convolutions in the coils. Second, its great inductance. Third, its insensitiveness to fleeting currents that would operate relays. This is due to the mechanical inertia of the armature, the weight of which is very heavy compared with that of a relay armature.

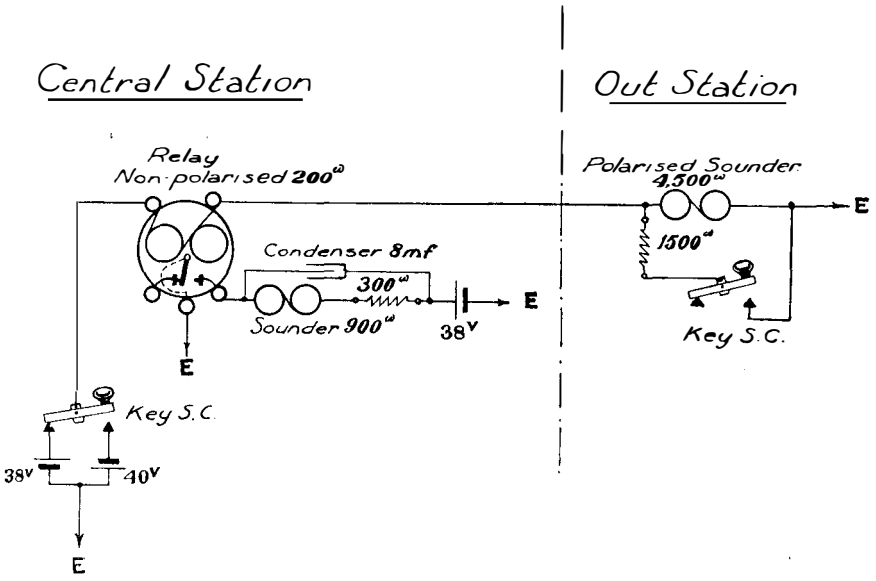
This manner of polarisation has also been adopted for polarising Morse printer instruments, double-plate sounders, relaying sounders, and other receiving instruments.

THE COMMON BATTERY DUPLEX.

By CHAS. E. HAY.

BEFORE entering into a description of the common battery duplex recently adopted by the British Post Office, it will be as well to review the system formerly in use in order to fully comprehend the difficulty presented by the problem of working duplex from a battery or batteries placed at one end only of a telegraph line, and to indicate the progress which has been made in this branch of common battery working since its introduction some few years ago.

In the original system, a theoretical diagram of which is given in I, a positive and a negative battery were required at the central



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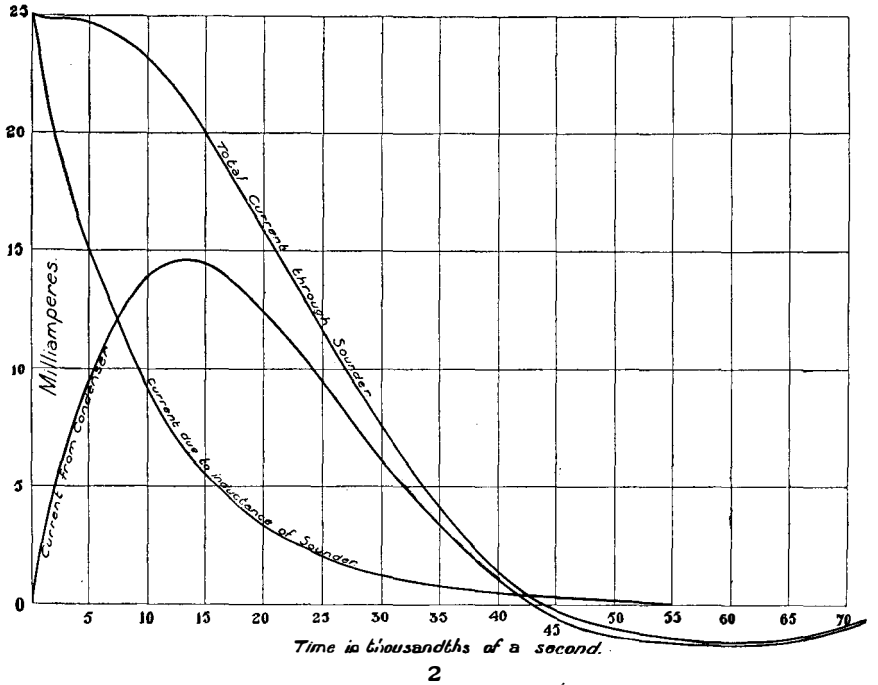
station for the purpose of sending to line reversals of current which operated the receiving apparatus at the out station, but were not of sufficient magnitude to operate the non-polarised relay at the central station, the armature of the relay being biassed against the currents by means of a helical spring. An increase of current effected by means of the key at the out station shunting the high resistance sounder with a resistance of 1500 ohms, created a magnetic force in the relay at the central station sufficient to overcome the force exerted by the spring, and therefore operated it. The current in the out station receiving apparatus was not sensibly affected when the shunt was applied, and in consequence the signals were satisfactory in both positions of the key at that station. At the central station, however, when its relay armature was in a "marking" position, a reversal of the current allowed the tongue of the relay to

" kick " off the marking stop, causing the current in the local circuit to cease for a short interval of time, and consequently breaking the signals on the local sounder. Obviously this defect was extremely serious, and presented a problem not easy of solution. The manner in which the defect was covered up—it has never been remedied—affords a remarkably interesting example of the value of a knowledge of the laws governing transient currents of electricity. On reference to the diagram (**1**) it will be seen that the local sounder is joined up in series with a resistance of 300 ohms, both being shunted with a condenser of 8 microfarads capacity. The condenser is charged when the tongue of the relay comes in contact with the



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marking stop, and remains charged as long as they are in contact, but when the tongue " kicks " the condenser is allowed to discharge, and sends a current through the resistance of 300 ohms and the sounder, thereby maintaining the continuity of the signal. Figure **2** represents a curve showing how the current in the local sounder varies with time from the instant the tongue leaves the marking stop. The curve has been worked out on the supposition that the voltage applied is 40 volts, the resistance in series with the sounder 700 ohms, and the inductance of the sounder 16 henrys. It will be seen that current flows through the sounder for 45×10^{-3} seconds after the tongue leaves the marking stop, and is of considerable strength for half that period of time. If, therefore, the time which elapses

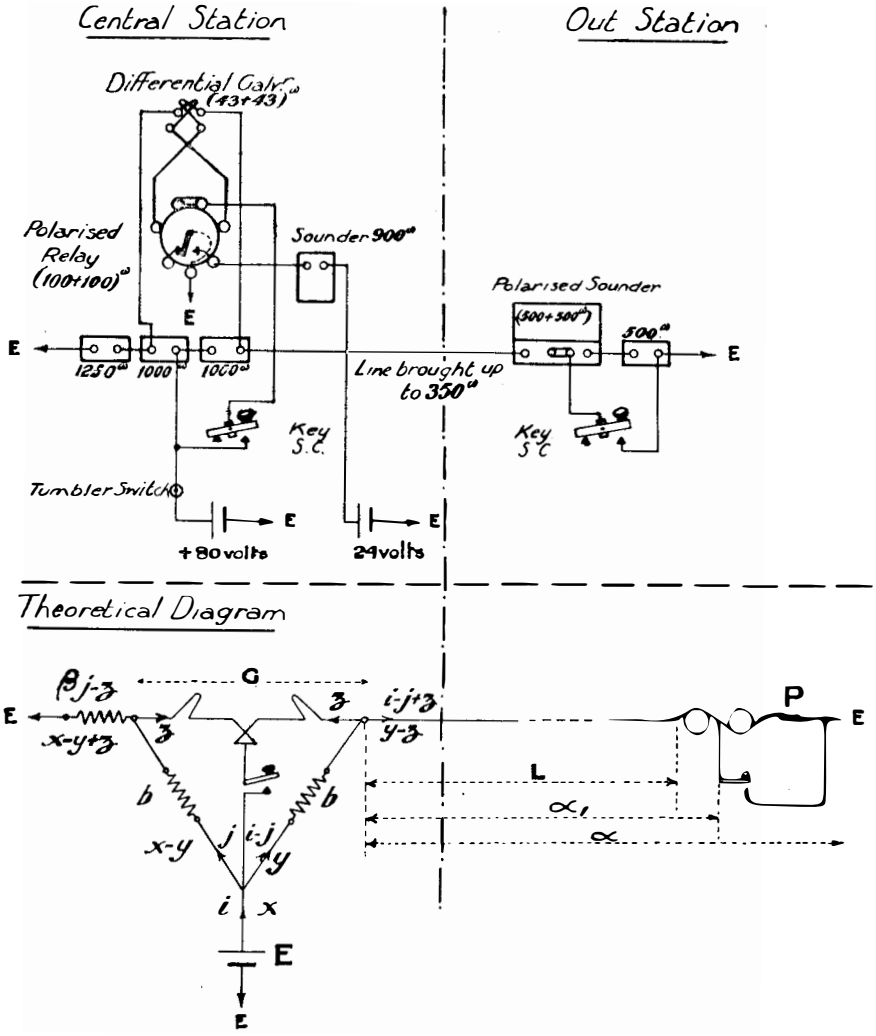
between the tongue leaving the stop and returning to it does not exceed about 30×10^{-3} seconds the continuity of the signal is not broken, and satisfactory working results. In practice, when the key at the central station is closely adjusted so as to make the time as short as possible in changing from a voltage of one sign to that of another and when the rate of sending is normal, no difficulty is experienced. Owing, however, to the objection of manipulating a closely adjusted key and the impossibility of obtaining a constant rate of sending, this system of common battery duplex was found imperfect, and it was recognised that some other principle of working must be discovered.

The following system devised by the present writer is free from the defect just described, and it has now almost entirely displaced the older system. It differs in every respect from the system it has superseded. Diagrams are shown in Fig. 3. One battery only is required, and it is joined up permanently when the circuit is in use. Tumbler switches are provided for cutting off the power when the circuits are shut down.

Normally, owing to the bridge arms being equal, and the resistance of the line together with the resistance of the apparatus at the out station being greater than the 1250 ohms resistance at the central station, a current flows through the receiving apparatus at the latter; and the wiring is so arranged that this current is in a "spacing" direction. When the key at the out station is depressed 1000 ohms is cut out of circuit—one coil of the polarised sounder and the 500 ohm resistance coil—consequently the resistance of the line plus the remaining resistance of the apparatus is now less than the 1250 ohms resistance at the central station, hence the direction of the current through the receiving apparatus at that station is reversed, and, as will be shown presently, its magnitude remains approximately unchanged. The depression of the key at the out station causes the potentials at the terminals of the polarised sounder to change, but it is arranged that their difference remains constant. The receiving apparatus at the central station is therefore operated by reversing the direction of the current in it, while the receiving apparatus at the out station is unaffected. That there is no change in the difference of potential across the polarised sounder at the out station in all positions of the key there, is only absolutely true when the key at the central station is depressed. There is a slight change in the difference when the key at the central station is not depressed, but it is of no material consequence, as the out station apparatus is not then recording a signal.

The depression of the key at the central station joins the battery direct to the split of the polarised relay; the current in the line is therefore increased, and it is this increase which operates the

receiving apparatus at the out station. The direction of the resultant magnetic induction in the relay, due to the current splitting differentially through its coils, is not affected, as its components, which are proportional to the currents in the coils, depend entirely on the relation between the resistances on each side of the bridge arms, and, as already shown, this relation is controlled by the



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operator at the out station. In order to render it unnecessary to bias the polarised sounder at the out station against the permanent current which flows through its windings, it is joined up in such a manner that the magnetic induction in its cores due to the polarising magnetic force is in opposition to the induction due to the almost equal magnetic force created by the permanent current.

Having described the working of the system, perhaps it would now be of interest to indicate the reason for the selection of the different resistances which are used.

The line is banked up to a resistance of 350 ohms so that all lines within a radius of sixteen miles of the central station may be accommodated (22 ohms per mile being taken as the maximum resistance of wires running into large centres from places which would be worked from a common battery). If the resistance per mile is less than this amount greater distances can, of course, be covered, as the system can stand considerable line leakage and capacity.

In order to keep the difference of potential across the polarised sounder at the out station constant when the key there is depressed, the resistance P (see diagram 3) for the meaning of the symbols) must obviously equal $L + \frac{bG}{2b + G}$ when the key at the central station is depressed. It now only remains to determine the value of β, the key at the central station still being depressed. The work is rather laborious, but the relation which must hold, in order that the spacing and marking currents in G for a given voltage should be equal, is best expressed as—

$$\frac{a-\beta}{bG + a\,(2b + G)} = \frac{\beta-a_1}{bG + a_1\,(2b + G)}.$$

From this β should equal 1200 ohms; a standard coil of 1250 ohms is used.

When the key at the central station is not depressed the resistances that have just been determined must still apply.

By Kirchhoff's laws,

$$\begin{aligned} -bx + 2by + Gz &= 0 \\ \beta x - (\beta + a)\,y + (G + \beta + a)\,z &= 0 \\ by + (y - z)\,a &= E. \end{aligned}$$

therefore,

$$\frac{x}{2b\,(G + a + \beta) + G\,(a + \beta)} = \frac{y}{G\beta + b\,(G + a + \beta)} = \frac{z}{b\,(a + \beta) - 2b\beta}$$

From which

$$y = \left\{G\beta + b\,(G + a + \beta)\right\}\frac{E}{D}$$

$$z = \left\{b\,(a - \beta)\right\}\frac{E}{D}$$

$$y - z = \left\{G\,(b + \beta) + 2b\beta\right\}\frac{E}{D}$$

and $D = G\,(a + b)\,(b + \beta) + b^2\,(a + \beta) + 2ab\beta$.

From these equations the current in the relay and in the line may be calculated.

Again, when the key at the out station is depressed the currents in the various branches at the central station will change. We have, as before,

$$-bi + 2bj + Gz = o$$
$$a_1 i - (a_1 + \beta)j + (G + a_1 + \beta)z = o$$
$$b(i-j) + a_1(i - j + z) = E$$

therefore,

$$\frac{i}{2b(G + a_1 + \beta) + G(a_1 + \beta)} = \frac{j}{Ga_1 + b(G + a_1 + \beta)} = \frac{z}{b(a_1 + \beta) - 2ba},$$

and therefore,

$$i = \left\{ 2b(G + a_1 + \beta) + G(a_1 + \beta) \right\} \frac{E}{D_1}$$
$$j = \left\{ Ga_1 + b(G + a_1 + \beta) \right\} \frac{E}{D_1}$$
$$z = \left\{ b(\beta - a_1) \right\} \frac{E}{D_1}$$
$$i - j + z = \left\{ G(b + \beta) + 2b\beta \right\} \frac{E}{D_1}$$

and $D_1 = G(a_1 + b)(b + \beta) + b^2(a_1 + \beta) + 2ba_1\beta$.

In order that the difference of potential across the polarised sounder at the out station should not change, $i-j+z$ must equal $2(y-z)$, and equating the two expressions for these, substituting for a and a_1 we finally get—

$$P = L + \frac{\{G(b + \beta) + b\beta\}b}{(G + b)(b + \beta) + b\beta}.$$

The result is somewhat curious, as it means that whether the resistance β is joined to earth or to the positive pole of the battery the difference of potential across the polarised sounder at the out station remains constant in any position of the key there for any given position of the resistance β, and this fact affords an easy means of calculating the resistance of P.

It is not possible by any combination of resistances to keep the magnetic induction in the relay at the central station constant in strength for all positions of the key at that station, which may be easily seen by equating the expression for (z), to twice the difference between the currents in the relay when the key is depressed. The difference in the magnetic induction when the key is up or down may, however, be made as small as possible by reducing the value of b, and although a maximum current is obtained in G when

$$b = \sqrt{\frac{Ga\beta}{G + a + \beta}}.$$

yet the value of b is made 1000 ohms, so that a sufficient change is made in the line current to actuate the polarised sounder at the out station when the key is depressed.

THE TYPEWRITER AND PIECE-WORK IN TELEGRAPHY.

By DONALD MURRAY, M.A.(Sydney).

IF some magic carpet suddenly transported a British telegraph engineer into a large New York telegraph office he would at first be dazed by the extraordinary clatter of the sounders, which are tuned up to make about four times as much noise as the British variety. The next sound to catch his attention would be the click of typewriters. He would see typewriters by dozens and scores, every operator with a typewriter, and all telegrams being typewritten. The pen used to be mightier than the sword, but there are no swords and very few pens in American telegraph offices nowadays. Every operator has his "mill," as the typewriter is familiarly called. The telegraph companies do not supply the typewriters. Each man has to furnish his own machine, and a telegraph operator without a "mill" has now no chance of employment in any of the large cities of America. The typewriter manufacturing companies make special efforts to cater for the custom of operators, and dealers in second-hand machines do an immense business amongst the telegraph fraternity. When an American operator is out of work and hard up he sells his typewriter to one of these agencies, or if he gets a job he hires a "mill" until such time as he is in a position to buy it.

The use of the typewriter as an ally of the morse key and sounder is a very old story in the United States, but it was not till about 1890 that it began to come into general use, and now an operator in America is as helpless without his "mill" as a cowboy without his gun.

So far as the telegraph companies are concerned the direct pecuniary saving through the employment of the typewriter has been small, but the companies have derived various indirect benefits. The public have gained by getting clear typewritten telegrams, and the competition between the two great telegraph companies has made the use of the typewriter absolutely unavoidable. The typewriter also has resulted in considerable speeding up of telegraph work. The great gainers from the use of the typewriter, however, have been the operators themselves, and it is no doubt for that reason that the cost of providing typewriters has fallen on the operators. The increase of output by the use of a typewriter compared with a pen is nothing like so great as is generally supposed, and the real advantage of the typewriter does not lie so much in increased output as in rescue from pen slavery. The nervous strain and muscular drudgery of rapid writing is enormous compared with

the same work done on a typewriter. When using the pen or pencil one group of muscles and one set of nerves have to perform a very complicated series of motions for each letter. With the typewriter, on the other hand, one simple motion of one finger is sufficient, and even this great reduction of muscular and nervous strain is again reduced eightfold by spreading the work over all the eight fingers of both hands. It is this complete release from pen servitude that has made the typewriter such a boon to telegraph operators in America, and it is surprising that telegraph operators in this country have not long ago recognised the "mill" as a friend and helper.

Roughly speaking, in America the effect of the typewriter has been to lighten the work of the receiving operator and to increase his efficiency. Operators who ranked only as second class on account of slowness or defects of penmanship have become first class. Formerly the sending operator on the morse key could make the receiving operator "sit up." With the advent of the typewriter, however, the position is now reversed, and the receiver can take with ease all that the finest star operator can send. In America this has led to the extensive use of word contractions, and these have been standardised and published in a manual known as *Phillips Code*. All good American operators use this code, and, although the sending operator can no longer make the receiving operator "sit up," the former can at least keep the latter busy even on the typewriter. Of course, contractions are employed by telegraph operators all over the world, but not to anything like the same extent as in America. Here, for instance, is an example of the way in which Press messages are sent on the Morse key in the United States :—

Mems o cx Cgs rptg und cv cmns o eno cap wo krp xgn ifo thr adhts wi cmb aga ay emt to t crpns, bt cujx es dtmd efo qpt peo f sq stas wi efy dmz ay osn.	Members of Congress representing under cover combinations of enormous capital who corrupt legislation in favor of their adherents will combine against any embarrassment to the corporations, but courageous and determined effort on the part of the people of the separate states will effectually demoralize any opposition.

In the first column is given the coded message, and in the second column the translation as it is typewritten by the receiving operator direct from the sounder. Of course, operators have to brush away the cobwebs from their intellects to do work of this kind, but they are very well paid for it. An American operator, writing on this subject, says:—"With an intelligent sender matter of this sort can be transmitted at the rate of fifty-five words per minute with but very little effort, and, at the same time, with reduction of the strain on the receiver to a minimum."

As regards Press messages, the effect of this combination of "code" sending and typewriter receiving has been remarkable. It is now not a rare thing for two first-class Press operators in America, one sending "code" and one receiving on the typewriter, to handle 20,000 words of press in one night. The record is said to have been 24,000 words transmitted and received by two men in eight hours. That is roughly about twelve columns of the London *Times*, an astonishing feat of endurance to anyone practically acquainted with such work.

The code contractions for common phrases are works of art. Here are a few examples:—

Fapib—Filed a petition in bankruptcy.
Dbf—Destroyed by fire.
Cats—Created a tremendous sensation.
Ckx—Committed suicide.
Asaph—A speculative demand with prices higher.
Bsql—Business small and quotations lower.
Herdam—Heavy receipts depress the market.
Utc—Under the circumstances.

I do not know what the rule is now, but a few years ago the telegraph companies encouraged the use of code for press work, and strictly forbade but winked at its use in handling commercial messages. As both the Western Union and the Postal Telegraph Companies have a large number of "bonus" circuits on which the operators are paid a halfpenny per message for all that they send over about 300 per day, the operators naturally code wherever they can, and some of the records made with the Morse key, code, sounder and "mill" are surprising, especially when it is borne in mind that in American messages only the text is paid for, the address going free, and that, therefore, American messages average about thirty words compared with the British twenty; also that about half of American messages are code messages in the ordinary sense, and that, therefore, the Phillips contractions are not applicable to them. Under these circumstances a speed of 40 messages an hour is quite ordinary, a speed of 60 messages an hour is regarded as very good, and 80 messages an hour have been transmitted for hours at a time.

In Canada and other new countries the typewriter is also being quite freely used in telegraphy. On the Continent of Europe there is but little scope for it, as the bulk of the traffic is handled by the Hughes, but in Russia the large telegraph offices employ dozens of typewriter girls to type up messages from the received Wheatstone slip, the Wheatstone being extensively used in Russia, owing to the immense distances covered by the telegraph network.

In conclusion, a paragraph in regard to the bonus system and typewriters from a letter written by Mr. Minor M. Davis, Chief

Engineer of the Postal Telegraph-Cable Company in New York, may be of interest. It is as follows:—

"Replying to your questions about the bonus, or piece-work, system:—A minimum, intended to represent a good day's work, is determined upon by observation. The typewriter enables a capable receiver to comfortably transcribe 'anything that comes clear,' and the stress of fast work has been shifted to the sender by that machine. Observation, checked by experience, shows that between 8 and 5.30 a good man will handle about 300 on a New York-Boston circuit, 325 on a New York-Philadelphia circuit, 280 on a New York-Chicago, and so on, the allowances being made for more interruptions to the longer circuits. There is no science in the proportions; as stated above the minimum is arbitrarily determined after observation. With the above figures to be reached between 8 and 5.30, each operator on these piece-work circuits is allowed one cent per message for each message handled in excess of the minimum, or if he prefers to cease work when he reaches the minimum he is excused and paid his regular salary for the full day. There are comparatively few circuits that can be operated in this manner (we have only about twenty-five of them). The increase in speed is considerable. It is not uncommon for an operator to handle a hundred messages more than the minimum, and sometimes operators handle 500 messages in a day. I have known one or two cases where 600 have been handled. Operators are not required to work at these very high speeds; but usually they are applicants for these circuits. It takes 'good men' to work them, and operators like to be known as capable of the work. They are required to do good, clear, accurate work, and they are held to the usual accountability for errors. Abbreviating the text (coding) is prohibited. The bonus system, like every other, fails to manage itself. There is temptation to do this, that, and the other thing that cannot be permitted; but, instead of sitting at a 'busted' wire perfectly content to do nothing, the bonus operator co-operates with the chief in making stops as few and short as possible. With proper supervision, and provided that the operator gets regular pay (minimum) that insures to him a fair income, I believe the system to be a good one for both employee and employer. Tendencies to kill the goose by overworking should be discouraged. This Company certainly does not ask or wish its employees to overwork. There was no special trouble in introducing the typewriter. It makes the receiver's work easier. It brings in a few errors of its own, but, on the whole, is beneficial to the service. It has probably added something to the speed—no one knows how much; but, in message work, the chief gain is probably due to the fact that operators who are not expert with the pen can readily 'keep up' when they use a machine."

THE TELEPHONING OF LONDON.

By W. NOBLE, A.M.I.E.E.

(*Superintending Engineer, Metropolitan Central District.*)

THE telephoning of London by the Post Office is now an old story, comparatively speaking, yet the connection between that great work and the *Post Office Electrical Engineers' Journal* is so obvious as to afford ample justification for a reference to it in these pages; for, had there been no telephoning of London by the Post Office, the present large engineering body in London would not have been brought into existence—(many, perhaps the majority, of the "Metropolitan Centre" would now be enjoying a life of ease in the Provinces!)—without that large body there would have been no Post Office Institution of Electrical Engineers, and without the Institution there could have been no magazine. Since, therefore, this JOURNAL owes its birth to the telephoning of London, it is only fitting that an outline of the work from its inception should appear in its early issues.

The Survey.—The initial step was the survey of what was known as the metropolitan area—no small task, seeing that the area in question embraced about 640 square miles. Briefly, the procedure was as follows:—

Number of Subscribers.—A large scale map indicated the location of the then existing subscribers of the National Telephone Company. This map was divided into suitable square sections, their size depending on the density of the subscribers as indicated by dots, and the number in each section was counted. Every street was traversed, and the number of new subscribers that might reasonably be expected within a period of, say, seven years was estimated, regard being had to the class of buildings in the streets, the additional provision varying from 10 per cent. to 100 per cent. or more, of the existing subscribers. The survey of the metropolitan area was carried out satisfactorily on the whole, but as showing the difficulty of estimating the growth in London, one instance that came under my notice, typical of not a few, will serve to illustrate the extraordinary development which may take place in London in a very short period. In a small city area the provision estimated as necessary to cover a period of years was for 63 subscribers: to-day there are considerably over 400 subscribers, and the number is rapidly increasing. Certain small houses that once stood in different parts of the area have been superseded by palatial buildings, four of which alone represent a total of 2,035 rooms, let mostly to influential and wealthy firms.

Main Routes.—The survey included the selection of main routes for the conduits. The principal thoroughfares generally were selected as being not only the best "feeders" for the side-streets, but as ensuring the shortest mileage from the exchanges to the busiest areas to be served. Economy in the length of the main cables was an important factor.

Number of Conduits and Sites for Manholes.—Embraced in the survey was the calculation of the number of conduits to be constructed so as to cover a period of years; and the selection of the sites for manholes. These sites were usually selected at or near the point of junction of two or more streets and the main thoroughfare, in order to simplify and cheapen distribution.

Let it be remembered that London was the first city in which a purely underground system of telephone distribution was laid down, and the work was therefore pioneer work.

Conduits.—To the form of conduit that was to be used much consideration was given. For heavy routes the use of cast-iron pipes was out of the question: their cost was great, and the space required for spigot and socket pipes could not be found on the congested routes. The Post Office adopted, for the first time, the now well-known octagonal earthenware duct, which has proved eminently satisfactory, and has been largely adopted by other bodies, the London County Council, for example, having used it for its extensive underground works for electric tramways. In 1900 the current prices made it economical to use ducts when six or more conduits were required; for a smaller number there was economy in using pipes. Ducts have the further advantage, apart from the question of cost, that they are less liable to damage by excavators than are cast-iron pipes, on account of their being encased in concrete 4 to 6 inches thick. Indeed, a spare cast-iron pipe may be damaged without the fact being discovered until a cable has to be drawn in.

Another point in favour of the earthenware duct not to be overlooked by "prime cost" economists, is that its life is to all intents and purposes unlimited, that of a pipe being limited and varying with the nature of the soil in which it is laid.

The employment of multiple ducts was considered, but it was recognised that the advantage lay with the single duct, in that it lends itself to a variation in grouping when obstructions are met with, and "folding over" has to be resorted to. Perhaps the most interesting case of folding over took place in Queen Victoria Street, and deserves to be described. From the front of the General Post Office (South) a group of 90 ducts in six tiers of 15, resolves itself at three different points, a few yards apart, into three sets of $3\frac{1}{4}$ in. cast-iron pipes grouped in six tiers of five. These three groups fold over into one nest of two layers each of 45 pipes, which again split up into

three sets of 30 ducts in six tiers of five. Later the three sets of six tiers resolve themselves into one nest of nine tiers of 10 ducts; and this group in turn becomes one of six tiers of 15 ducts each. Had multiple ducts been used a jointing chamber would have been required at each point of re-grouping.

Connection between earthenware ducts and cast-iron pipes is made by means of cast-iron coupling pieces of two classes, one having a socket, and the other a spigot end to fit the pipes, the other end in both classes being octagonal and of similar dimensions to the earthenware duct.

Jointing Chambers.—Jointing chambers are divided into two main classes, manholes and boxes. Prior to 1900 manholes were non-existent in the Post Office service, the largest chambers being double junction boxes measuring about 4 ft. by 2 ft. To-day, in the Central Metropolitan District alone, there are no fewer than 602 manholes, varying in size from about 4 ft. long by 3 ft. wide and 5 ft. deep to 8 ft. long by 7 ft. wide and 6 ft. deep, to say nothing of a few special ones of much larger capacity.

Means had to be devised to meet the requirements of roadways and footways, but it is needless to describe here the various types designed; a brief description of the general principles of construction will suffice.

The roadway manholes are of 14-inch brickwork on a well-prepared foundation of 9-inch Portland cement concrete, in which are embedded stout wrought-iron ring-bolts for use in manipulating the cabling tackle. The roofs are of rolled steel joists and half-inch boiler plate covered with Portland cement concrete, the whole being waterproofed with three-quarter-inch mastic asphalte. The manhole frames and covers compare favourably in the matter of strength with those used by other bodies.

Footway manholes have walls of 9-inch brickwork on a 6-inch concrete foundation, and a roof of York stone resting on steel joists.

The bricks used in the construction of both classes of manholes are of the highest grade red wire-cuts, undoubtedly the best class of brick for this purpose, being capable of resisting a great tensile strain and having a very low power of absorption.

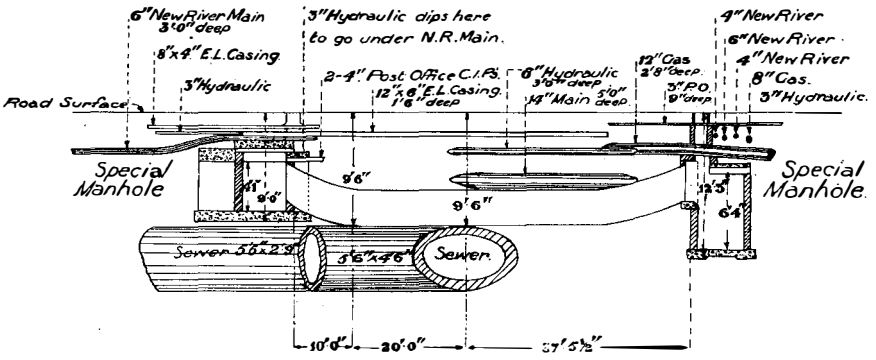
There can be no doubt that the Post Office manholes are the most substantially built structures used in any class of underground work.

Nothing need be said about boxes beyond this: that the telephoning of London brought about the introduction of the channel frame form, as well as an increase in the number of types of boxes.

Specifications and Drawings.—The classes of conduits and the type of manholes and boxes once determined, there remained the preparation of specifications and drawings. This was no light task,

as will be realised by those who are now acquainted with the specifications for underground works, and the varied auxiliary plant, as well as with the numerous drawings pertaining thereto. A detailed examination of Specification Forms Nos. 18 and 74 alone will make this abundantly clear. That it was done thoroughly is evidenced by the fact that the forms have been amended in no essential detail, and that Contractors generally regard them as the most complete and binding forms to which they have to tender.

Construction.—It was recognised, prior to the commencement of street operations, that great difficulties would be met with in laying heavy duct-lines in the London streets which, it was well known, were already congested with mains—water, gas, electric light, and hydraulic. Those only who took an active part in the work can fully realise the enormous difficulties that were actually encountered and overcome. In not a few cases portions of trenches had to be kept open for a month whilst diversions of existing mains and



I

alterations to sewers had to be effected in order to admit of the laying of the Department's ducts in a straight line.

There exist no means of conveying the faintest conception of the obstructions encountered, but some idea may be formed from I, which depicts the obstructions met with in a street where sixty-four ducts had to be laid. On the ground being opened, those not responsible for seeing the work through might have been pardoned for declaring the task an impossible one, but it was accomplished as well as many similar tasks.

In the numerous and extensive excavations many interesting relics were unearthed. Space permits of reference to one only, but it is of most general interest. A duct-line along London Wall, from Moorgate Street to Bishopsgate, was, for a portion of its route, constructed in the centre of the lower portion of the old Roman wall.

The trench, which was 2 ft. 6 ins. wide and about 9 ft. in depth, was cut through the Roman masonry.

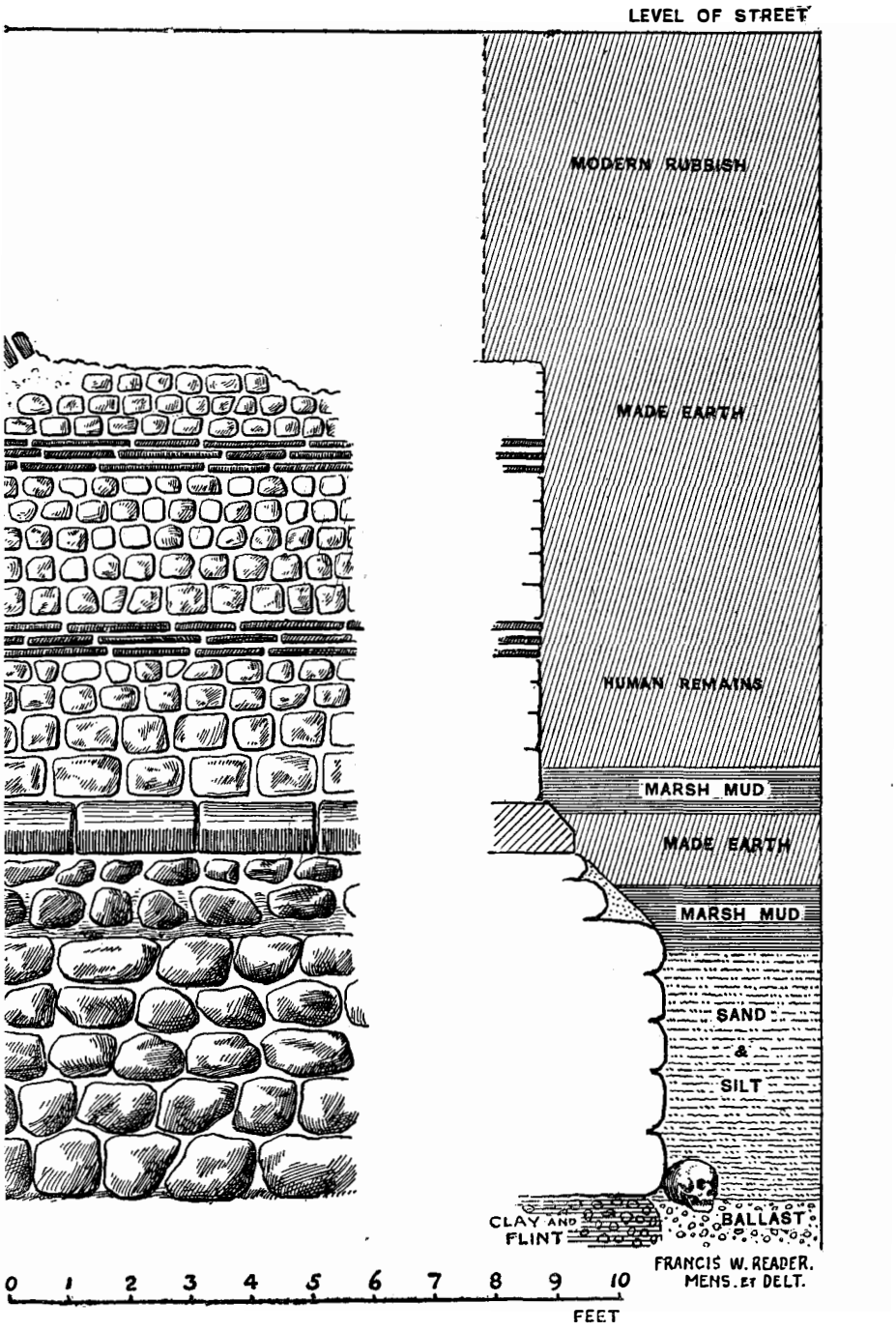
The exposure of the wall aroused the keen interest of the Society of Antiquaries, who applied to the Post Office for permission to deepen an excavation in order to ascertain how the wall had been constructed by the Romans across the stream, known later as the Walbrook, recorded as having flowed under the wall near the site of the operations. The requisite permission was obtained, and the Society representative who had the matter in hand reported *inter alia* that, in connection with the work, " . . . the Post Office officials from the first evinced a very sympathetic interest. This is worthy of record, as in former years authorities have been by no means favourable to inquiries of the kind we (the Society of Antiquaries) had undertaken."

To the Society I am indebted for an electrotype of **2**, showing an elevation of the wall and a section of the shaft sunk near Circus Place and opposite Throgmorton Avenue.

Briefly, the wall consists of layers of ragstones of varying sizes, the first and second and the second and third layers being separated by bonding courses of tiles of red clay. The third and fourth layers are separated by a red sandstone plinth, which in turn rests on a few courses of rough rubble ragstone, with a final footing of clay and flint.

Interesting relics came to light, *e.g.* fragments of mediæval and Roman pottery, and several skulls and other bones. At the bottom, resting in the sand overlying the ballast, were found two skulls, the one shown in **2** being in almost perfect condition.

(*To be continued.*)



2.—Section of Shaft cut through Old Roman Wall near Throgmorton Avenue, London.

TELEPHONE PROGRESS IN LONDON.

By G. F. PRESTON, M.I.E.E.
(*General Manager, Post Office London Telephone Service.*)

To furnish a comprehensive account of the development of the Post Office London Telephone Service in an article of reasonable length is not an easy matter, as this development may be viewed from so many different standpoints and the mass of material in the shape of figures, all seemingly too important to be omitted, and all calling for at least a few words of explanation, makes the task of selection very difficult. It has, however, been assumed that the readers of the JOURNAL will be principally interested to know the actual number of Exchange lines and stations which have been brought into use, and this article, therefore, deals with the development from this point of view only, leaving questions of traffic, rental, etc., to be dealt with at a later date.

The table on page 30 shows the total number of Exchanges open in the London area, together with the number of direct Exchange lines and stations * working at the 31st December each year from 1902 to 1907. It will be seen that during the six years which the service has been in operation the system has grown to a total of 34,100 Exchange circuits, and 46,355 extension stations. When it is remembered that at the time the Department's service commenced, on the 1st March, 1902, there were only 25,000 Exchange lines in the London area as the result of over twenty years' work, it will be seen that very great strides have been made. The National Telephone Company have added to their system at a rate only slightly slower than that of the Department, and they have now 53,928 direct lines working: this makes a total of 88,028 direct lines working in the Metropolitan area, so that during the last six years the number has increased three and a half times.

Much has recently been made of the objection of telephone users to the abolition of the flat or Unlimited Service rate. In this connection it is interesting to know that, of the total number of Exchange lines connected with the P.O. London system, no less than 30,245 are Message Rate circuits, only 3855 being Unlimited Service lines. It will thus be seen that, since the P.O. Metropolitan subscribers have had the choice between Unlimited Service and the Message Rate, 90 per cent. have elected for the latter, and it is, therefore, extremely difficult to believe that there is any such

* Some misapprehension exists as to the exact meaning of the term Exchange Station. It may be defined as any speaking point (main or extension instrument) at which facilities for communication over the Exchange system can be obtained.

widespread objection to the measured rate as its opponents have endeavoured to show.

From the table above referred to it will be seen that during the first year, 1902, seven Exchanges were opened, in 1903 two more were added, in 1904 a further two, in 1905 three, in 1906 one Exchange and two Exchange centres, and in 1907 three Exchanges and five Exchange centres, making a total of eighteen Exchanges and eight Exchange centres. The table also includes the lines working on the Treasury Exchange, and the direct lines rented to the trunk Exchange.

It will, perhaps, be of interest to give the average user of the Exchange lines connected to the principal Exchanges. The following figures are from records taken at dates approximate to the 31st December, 1907 :

Average Number of Calls per Line per Day.

Central	6·81.	Mayfair	4·5.
Western	4·0.	Hampstead	3·1.
Victoria	4·8.	Hornsey	4·0.

The smaller Exchanges range from 1·8 the lowest, to 2·9 the highest.

The average is based on the figures for the total demands made —not the total effective calls.

Trunk Exchange.—The trunk Exchange was transferred to the G.P.O. (South) on the 3rd February, 1904. The growth has been rapid, and there are now twice as many trunk circuits working, and nearly double the number of local call wires, junctions, and record circuits as existed at the time of the transfer. The number of calls dealt with daily has increased two and a half times.

The introduction of call wire working on trunk lines has been the most important change in practice, the carrying capacity of the trunk circuits having been very greatly increased thereby. There are now twenty telegraph and two telephone trunk call wires working. The results have been most satisfactory, the carrying power of the trunk lines affected having been increased from thirty minutes to forty-two minutes paid time per hour.

A change in the method of record working has also been carried out, whereby it has been possible to secure direct record working with all subscribers in the London area, with equal distribution of work between the various record operators. It is also possible with the new method to arrange for the "record" staff to be increased or decreased in direct proportion with the number of calls received.*

* Another improvement is the abolition of Trunk Transfer working and the provision of direct lines connecting each position with every other position in the Exchange.

Table showing Annual Increases of Lines and Stations P.O. London Telephone Service.

EXCHANGE.	Date of opening.	31st December.											
		1902		1903		1904		1905		1906		1907	
		Direct Lines.	Stations.	Direct Lines.	Stations.	Direct Lines.	Stations.	Direct Lines.	Stations.	Direct Lines.	Stations.	Direct Lines.	Stations.
Central	1/3/02	4,167	4,859	7,587	9,720	9,995	13,315	12,155	16,999	13,741	19,862	14,696	22,293
Putney	20/5/02	168	183	336	362	474	521	637	695	804	896	926	1,036
Kingston	20/5/02	175	187	288	316	403	446	517	580	668	752	783	902
Western	5/8/02	378	394	1,144	1,243	1,710	1,897	2,395	2,664	3,081	3,464	3,697	4,214
Wimbledon	6/8/02	109	117	215	238	308	348	424	471	564	631	667	747
Victoria	12/8/02	368	442	850	1,039	1,251	1,615	1,707	2,310	2,109	2,890	2,451	4,266
Richmond	7/11/02	94	112	245	283	358	419	524	602	605	693	695	799
Chiswick	3/6/03	...	...	178	180	360	393	500	553	630	708	709	807
Mayfair	20/10/03	...	...	725	794	1,520	1,787	2,359	2,924	3,006	3,892	3,548	4,707
Croydon	26/1/04	...	...	...	...	181	203	355	390	468	514	553	600
Hampstead	27/7/04	..	...	...	...	883	968	1,797	1,971	2,556	2,808	2,995	3,306
Epsom	29/5/05	...	...	...	...	...	...	63	66	112	116	145	153
Ealing	5/6/05	...	...	...	...	...	...	303	345	471	526	579	640
Sutton	9/6/05	...	...	...	...	...	...	65	69	225	234	345	362
Hounslow	1/7/06	...	...	...	...	...	...	...	...	73	87	101	120
Harrow	10/10/06	...	...	...	...	...	...	...	...	91	100	158	185
Wembley	18/10/06	...	...	...	...	...	...	...	...	23	29	41	62
Malden	11/2/07	...	...	...	..	...	...	...	...	...	...	25	27
Esher	13/2/07	...	...	...	...	..	..	...	...	...	...	62	65
Willesden	26/2/07	...	...	...	...	...	...	...	...	...	...	232	250
Finchley	28/3/07	...	..	...	...	...	...	...	...	...	...	22	23
Southall	11/9/07	...	...	...	...	...	...	...	...	...	...	7	9
Hornsey	7/11/07	...	...	...	...	...	...	...	...	...	...	287	306
Barnet	14/11/07	...	...	...	...	..	...	...	...	...	...	13	14
City	26/11/07	...	...	...	...	...	...	...	...	...	...	129	170
Treasury	...	...	...	105	126	113	142	118	155	120	157	136	170
Trunk	...	...	...	...	...	105	127	103	125	100	124	98	122
Total	...	5,459	6,294	11,673	14,301	17,661	22,181	24,022	30,919	29,447	38,483	34,100	46,355

COMMON BATTERY TELEPHONE TRANSMISSION SYSTEMS, AND SOME METHODS OF THEIR APPLICATION BY THE POST OFFICE.

By M. RAMSAY.

THE number of common battery circuit arrangements differing more or less from one another that have been devised is very large, but only three fundamentally different transmission systems have

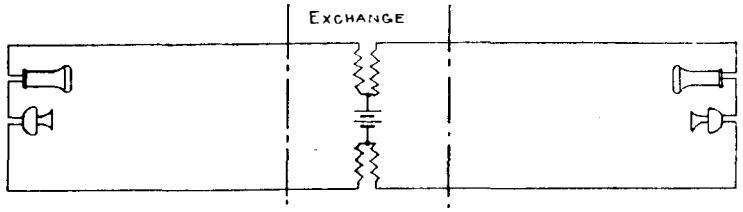


FIG 1 HAYES COMMON BATTERY SYSTEM

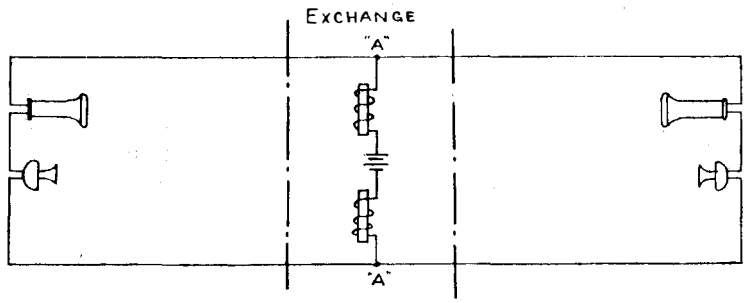


FIG 2. STONE COMMON BATTERY SYSTEM

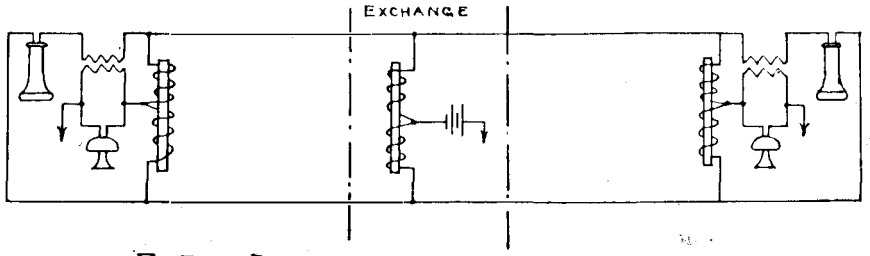


FIG 3 DEAN COMMON BATTERY SYSTEM

been proposed, and, so far as the writer is aware, only two of these are in operation.

In the year 1892, Hayes and Stone devised the systems shown in **1** and **2** respectively; the third, known as the Dean system, is shown in **3**. The essential feature of the Hayes system is the use of a repeating coil (a transformer, in this case possessing a trans-

formation factor of unity) with the common battery in the centre of its windings.

When two telephone circuits are connected together by such a combination, the voice currents are simply repeated inductively from one to the other by the transformer, that circuit whose transmitter is being spoken into acting as the primary for the time being, and the other, in whose receiver the speech is being reproduced, acting as the secondary of the system.

The characteristic of the Stone system is the interpolation of impeding coils between the common battery and the lines. When two circuits on this system are connected together, the variable currents produced in one of them by speaking into its transmitter, develops a correspondingly variable pressure between the points "A" and "B" (see **2**), and these two points being the terminals of the second circuit, a variable E.M.F. is impressed upon the latter, with the result that a correspondingly variable current passes through the second telephone.

In the Hayes and Stone systems current is fed to the transmitters round the loop, in which respect both differ from the Dean system, whose characteristic is the supply of the primary speaking current to the transmitters over the line wires in multiple, the earth being used as a return. Each transmitter in the case of the Dean system is placed in the earthed circuit in multiple with the primary winding of an induction coil, whose secondary is connected up, to operate in the loop circuit. When transmitting, current flows out from the exchange, and, dividing between the transmitter and the induction coil primary, passes to earth. Any variation of the resistance of the transmitter causes a variation of the current strength in the primary, and this varying current acting upon the secondary winding impresses a variable E.M.F. upon the line circuit.

It is obvious that the grade of transmission furnished by any system will depend upon the values of the various factors involved. In the Hayes circuit, for instance, the value of the E.M.F. impressed upon the receiving circuit will depend largely upon the battery voltage, upon the number of turns, resistance of the windings, and the conformation of the repeating coil, upon the resistance of the primary line circuit (its capacity may be ignored unless the circuit is comparatively long), and upon the range of variation of the transmitter resistance, as well as the arrangement and nature of the various parts making up the complete transmitting set.

4 indicates an application of the Hayes system. The diagram shows the typical cord circuit installed by the Western Electric Company in the Department's large common battery exchanges. The supply voltage is 22, but it may be 26 or more when the current is taken from the generators direct.

The repeating coil has four windings, two of which act as primary and two as secondary, and each of the four has 2150 turns and a resistance of 38 ohms. When this repeating coil is used with a battery of 22 volts and with telephones of the standard type supplied by the Western Electric Company, commercial speech is possible over a length of approximately forty miles of standard cable with 300 ohms line resistance in the transmitting circuit. A result about 5 per cent. better is obtained when the repeating coil is substituted by one of the 25 C. type, whose four windings have each 1000 turns and 23 ohms resistance. The first-mentioned coil is built round a straight core, while the 25 C. type is constructed round a core whose axis is a circle, and it is probably to this difference of conformation and the lower resistance that the advantage of the 25 C. type is due.

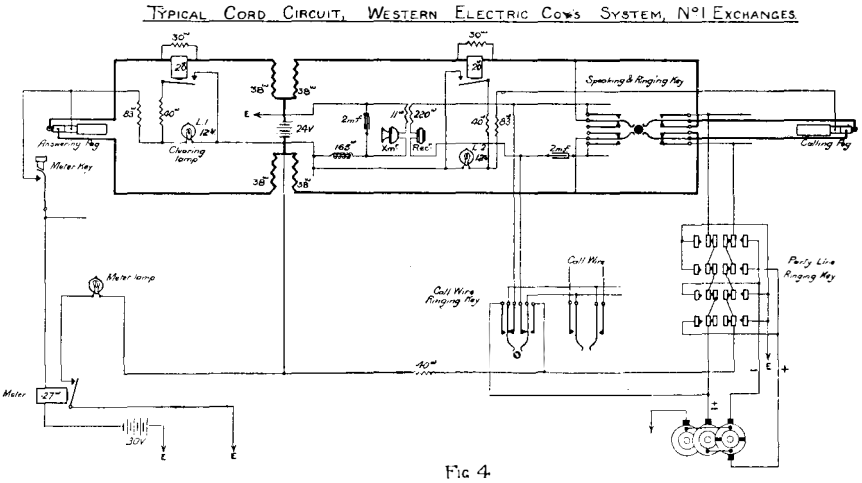


FIG 4

The effect of line resistance upon the transmission values is indicated by the curves shown in 5 and 6, which are reproduced here from the paper on " Telephone Transmission " read to the Institution by Mr. J. G. Hill.

The circuit shown in 7 is an application of the Stone system. This, and several other kindred circuits, are used by the Post Office on Branch Exchange Switchboards for communication between extensions. Their use is limited to this purpose because of a defect possessed by the system which renders its use objectionable in public exchanges. In the case of the Hayes circuit, just considered, the conditions for the supply of current to the transmitter on any circuit are constant, provided the voltage between the distributing bus bars does not vary. It is not so in the case of the Stone system, as the current supplied to a given transmitter is determined, not only by the battery voltage and the various resistances in the trans-

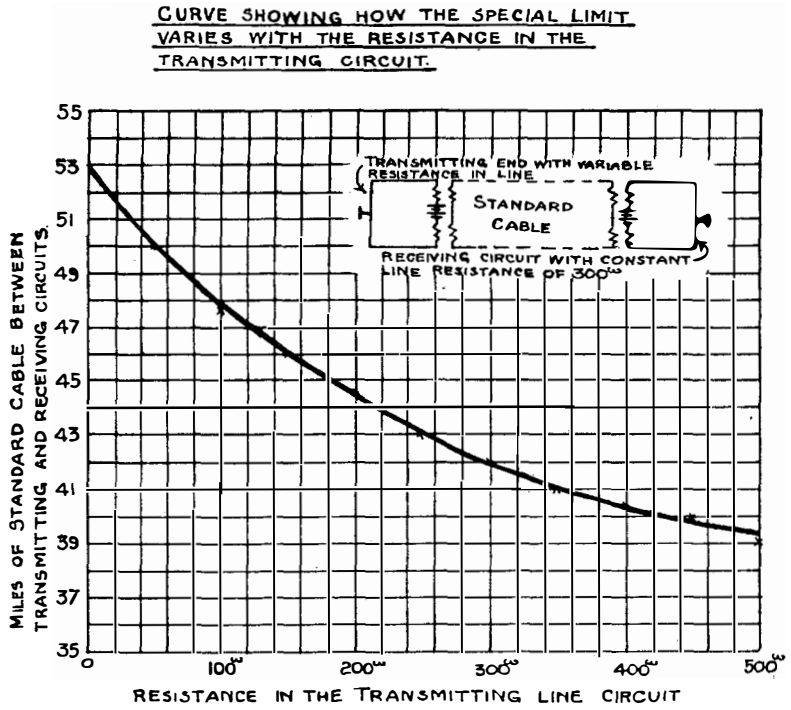

CURVE SHOWING HOW THE SPECIAL LIMIT VARIES WITH THE RESISTANCE IN THE TRANSMITTING CIRCUIT.
TRANSMITTING END WITH VARIABLE RESISTANCE IN LINE
STANDARD CABLE
RECEIVING CIRCUIT WITH CONSTANT LINE RESISTANCE OF 300Ω
MILES OF STANDARD CABLE BETWEEN TRANSMITTING AND RECEIVING CIRCUITS.
55
53
51
49
47
45
43
41
39
37
35
0
100Ω
200Ω
300Ω
400Ω
500Ω
RESISTANCE IN THE TRANSMITTING LINE CIRCUIT

FIG. 5.

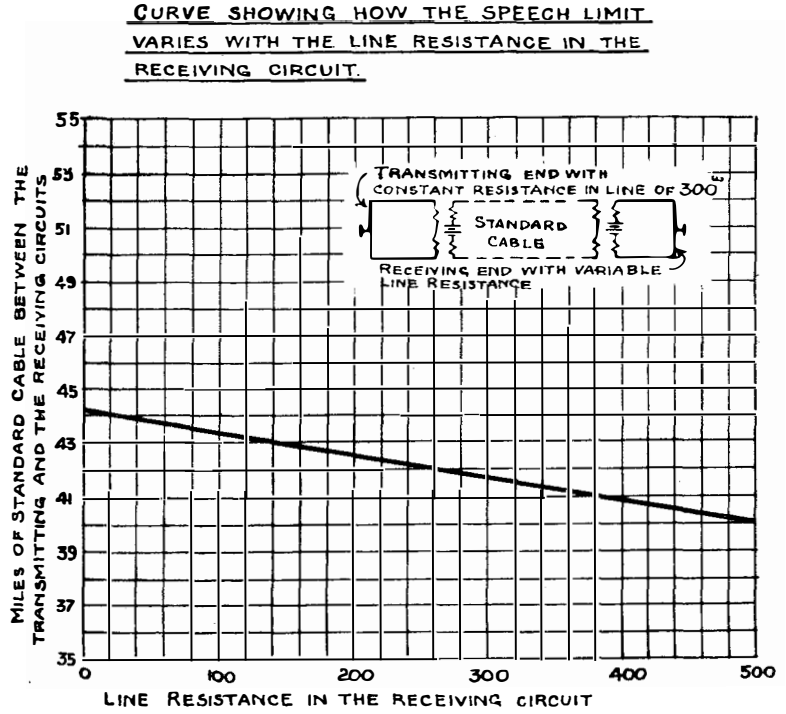
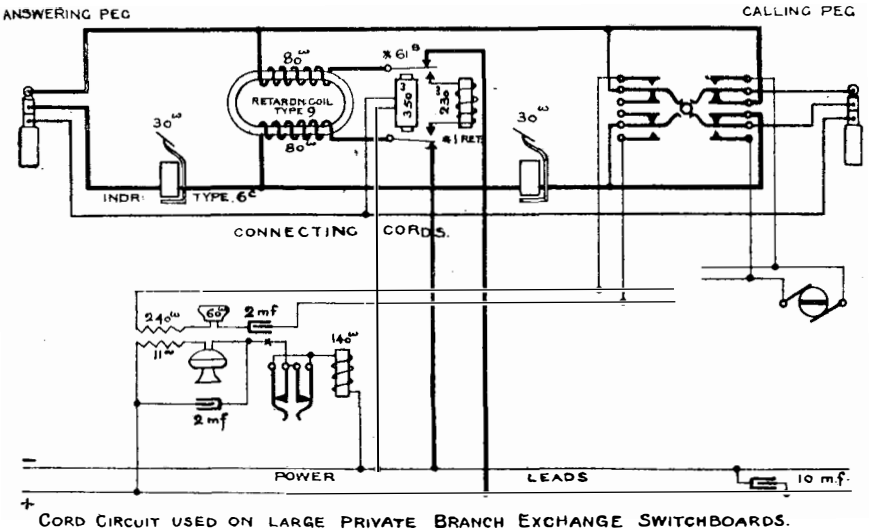

CURVE SHOWING HOW THE SPEECH LIMIT VARIES WITH THE LINE RESISTANCE IN THE RECEIVING CIRCUIT.
TRANSMITTING END WITH CONSTANT RESISTANCE IN LINE OF 300Ω
STANDARD CABLE
RECEIVING END WITH VARIABLE LINE RESISTANCE
MILES OF STANDARD CABLE BETWEEN THE TRANSMITTING AND THE RECEIVING CIRCUITS
55
53
51
49
47
45
43
41
39
37
35
0
100
200
300
400
500
LINE RESISTANCE IN THE RECEIVING CIRCUIT

FIG. 6.



CORD CIRCUIT USED ON LARGE PRIVATE BRANCH EXCHANGE SWITCHBOARDS.

FIG. 7

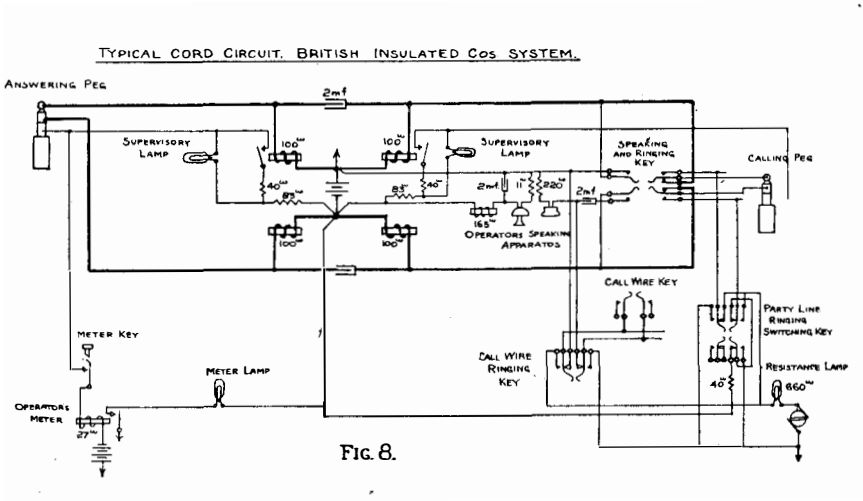


FIG. 8.

mitter's own line circuit, but also by the resistance of the other line to which it is temporarily connected. As a consequence of this variation of supply conditions, the Stone system in its pure form is not employed where the highest grade of transmission is required.

The defect is overcome by the employment of condensers and two sets of impeding coils, and circuits embodying such a method are indicated in **8**, **9**, and **10**.

In **8** is depicted the typical cord circuit of the British Insulated and Helsby Cables, Ltd., employed by the Post Office at Cardiff and elsewhere. Certain of its features, viz. the signalling, metering and operators' circuits, are substantially the same as those of the Western Electric Co.'s system. The supervisory relays act as the impeding coils between the battery and the tip or "A" side of the lines, while the retardation coils have a similar function between the battery and the "B" or ring side of the circuits.

The grade of transmission obtained with this combination is very similar to that furnished by the Western Electric Co.'s circuit.

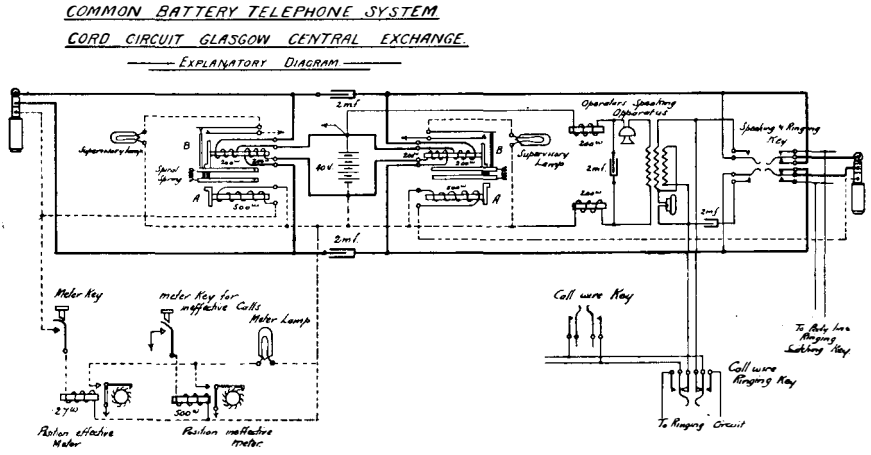


FIG. 9

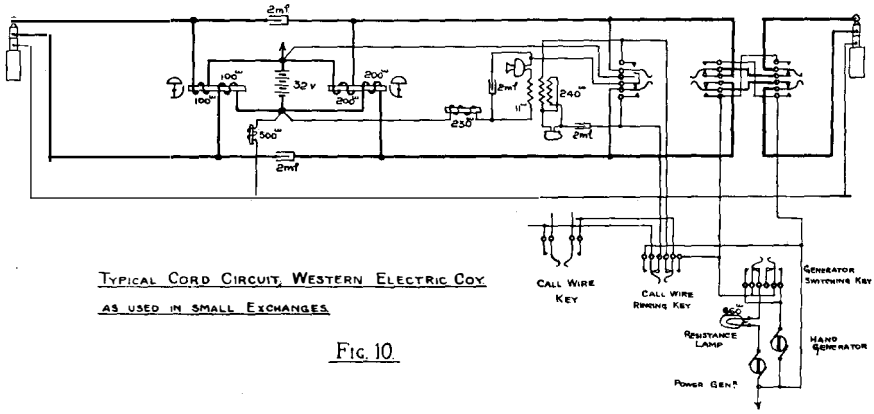
The variation of resistance in the transmitting circuit gives a curve somewhat flatter than the one shown in **5**. With low resistance in the transmitting circuit the Western Electric arrangement has the advantage, but with 200Ω and upwards in the line the two systems are equal. As regards reception, with low resistance in the receiving circuit the advantage is with the Helsby system, but, as in the case of transmission, with line resistances of 300 ohms and upwards, the systems are equal.

A circuit of a similar transmission type, but whose details differ considerably from those of the circuits already considered, is that shown in **9**. The features of this circuit, from a transmission standpoint, are the high voltage of the battery and the comparatively

high resistance in the impeding coils, which are actually the electro-magnets of the supervisory relays. On account of these high values, line resistance has a smaller effect upon the transmission when this circuit is used than is the case with either the Western Electric or Helsby circuits.

Better speaking is furnished by the Western Electric Co.'s arrangement from circuits of low resistance, but as the resistance increases the disparity disappears; at 300 ohms the circuits are equal, and beyond that value the General Electric Co.'s circuit is the better.

Apart from transmission the circuit is noteworthy, inasmuch as the signalling arrangement is peculiar to the Stromberg Carlson and General Electric Co.'s systems. The condition for the lighting of a supervisory lamp is that the electro-magnet "A" only of the



TYPICAL CORD CIRCUIT, WESTERN ELECTRIC CO.
AS USED IN SMALL EXCHANGES.

FIG. 10.

composite relay, marked A.B. on the diagram, shall be operated; when both A and B are energised the lamp circuit is open. This type of circuit is about to be installed by the General Electric Co. in the Department's new Central Exchange at Glasgow.

Another example of the same type of speaking circuit is furnished by **10**, which indicates the typical cord circuit which the Western Electric Co. instal in small common battery exchanges. Lamps are not used, and indicators with two windings are employed for the double purpose of speaking and signalling. The resistances in this case in each coil is 100 ohms, and the battery voltage is 32. The value of the transmission furnished by this combination is approximately of the same order as that provided by the circuits already described.

GLASGOW TRUNK EXCHANGE—NEW EQUIPMENT.

Necessity for Change and Extension.—Early in 1907 it was decided, in accordance with the general policy of obtaining immunity from fire in Post-office Telephone Exchanges, to put in hand the work of constructing a fire-resisting floor for the Trunk Exchange at the Glasgow Head Post Office, and, at the same time, to instal an exchange equipment with switch sections having iron frames, and fitted with the necessary apparatus for full junction and transfer multiples. The disposition of the present equipment, which includes forty-nine trunk switch sections, is shown on Plan No. 1.

Method of Procedure in Carrying out the Work.—In order to carry out the work with the least cost and inconvenience to traffic, the portion of the room used as Girl Learners' cloak room, Telegraph school, and writing room have been treated in the first instance, and the new plant has been installed, as shown by full lines on the "lay-out" Plan No. 2. The fire-proofing of the second portion of the room, now used as the trunk exchange, test room, etc., will be proceeded with as soon as the transfer is carried out and the present equipment recovered. The extension of the new switch will then proceed, as shown on the plan by dotted lines, as occasion requires. The switchroom has a high-pitched roof with lantern lights, but, in order to obtain accommodation for the new accumulators, power board, and time checks, a floor has been erected at a height of 12 feet over the portion allocated for the test room. The mezzanine floor thus provided is reached by a spiral staircase. There is also a doorway opening into the switchroom at a height of slightly over 12 feet to permit of the entry or removal of heavy or bulky articles.

New Equipment, Trunk Switch Sections.—The new equipment consists of 30 three-panel trunk and junction switch sections having iron frames, fully fitted with lamp signals, transfer and junction multiples, and time check signalling apparatus, as described in the paper published by the Institution on "Post Office Trunk Exchange Signalling Arrangements." Plates 6 and 7, issued with that publication, show a front and rear view of the switch sections. The trunk circuit arrangements are also as described in the same publication, with some slight modification of the junction and record circuit arrangements to meet the local conditions.

Record and Local Switch Section.—The switch section marked Record and Local on the plan is of the same construction as the three-panel trunk and junction switch sections. The three panels are fitted with local subscribers, transfer, and record circuit apparatus, whilst the keyboard is fitted as follows:

No. 1 position for 20 record operators' cord equipments; ultimate equipments 32—and

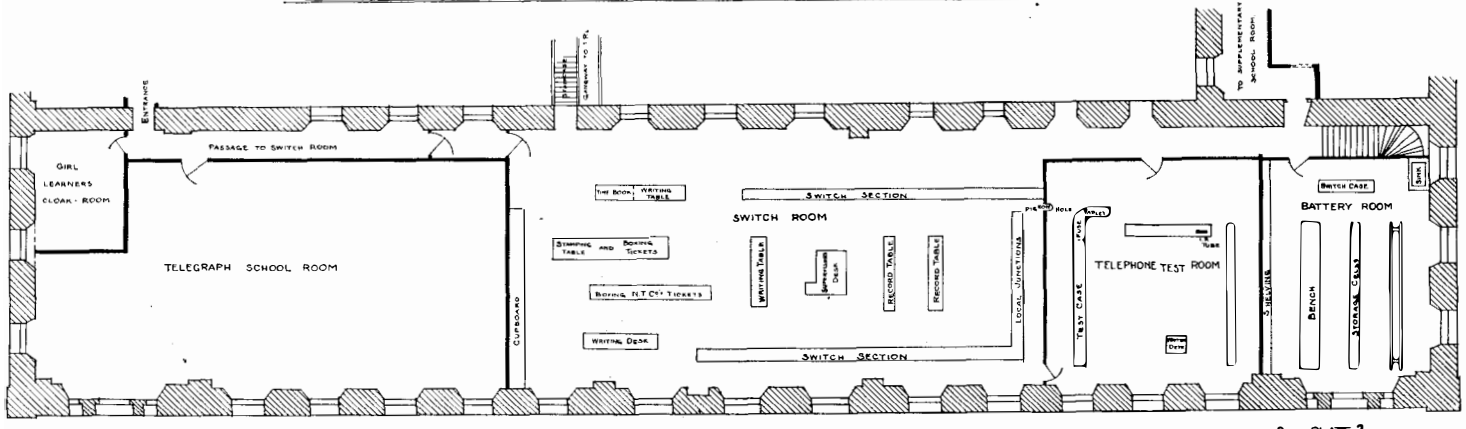
No. 2 position for 17 pairs of connecting cord equipment for local circuits. Trunk subscribers and official circuits are joined up to the local switch, the circuit arrangements being common battery signalling with lamp signals.

Record Table.—The record table is fitted at present for 20 record operators' speaking and signalling sets, with an ultimate equipment of 24. It is also fitted with a band carrier, travelling in both directions at the rate of

PLAN 1 PLATE 1

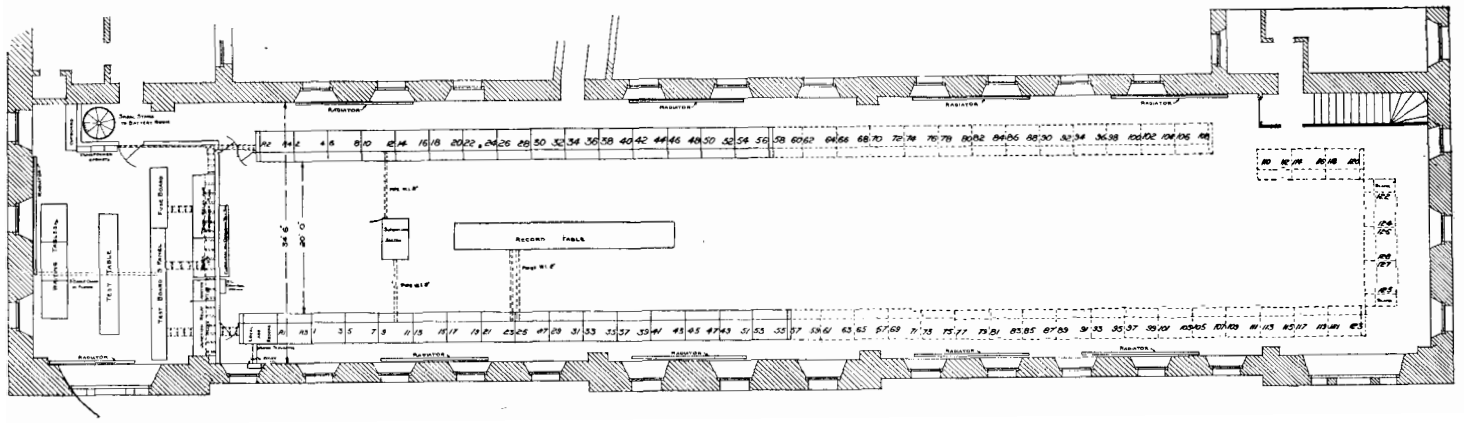
GLASGOW HEAD POST OFFICE

PLAN OF SCHOOL ROOM, SWITCH ROOM, TELEPHONE TEST, AND BATTERY ROOM.



PLAN 2 PLATE 2

PLAN OF SWITCH AND TEST ROOM.



approximately 100 feet per minute, which delivers the record tickets into boxes at either end of the table.

Supervisor's Switch Section.—A supervisor's switch section, affording the supervisor listening in facilities to each operator in the exchange, in addition to outward and inward signalling, has been provided.

Test Board.—As in all large trunk exchanges of recent date, trunk and junction circuits are brought from the main frame through a test board of the switchspring type, thence to the intermediate distributing frame. The test board is of mahogany with nine panels, having a capacity for 1800 trunk, junction, and miscellaneous circuits, and 720 switchsprings for reserve multiples, test circuits, and cross connections. Five panels have been fitted in the first instance.

Trunk and Junction Intermediate Distributing Frames, etc.—The trunk and junction intermediate distributing frames, relay and condenser racks, are of the usual type, and have a sufficient capacity to meet the ultimate requirements of the exchange.

Fuseboard.—The frame of the fuseboard is of iron, and 1196 alarm fuses of the well known bead alarm type are mounted on slate panels of the best quality. Lead cables are used exclusively between the fuseboard and the switch sections.

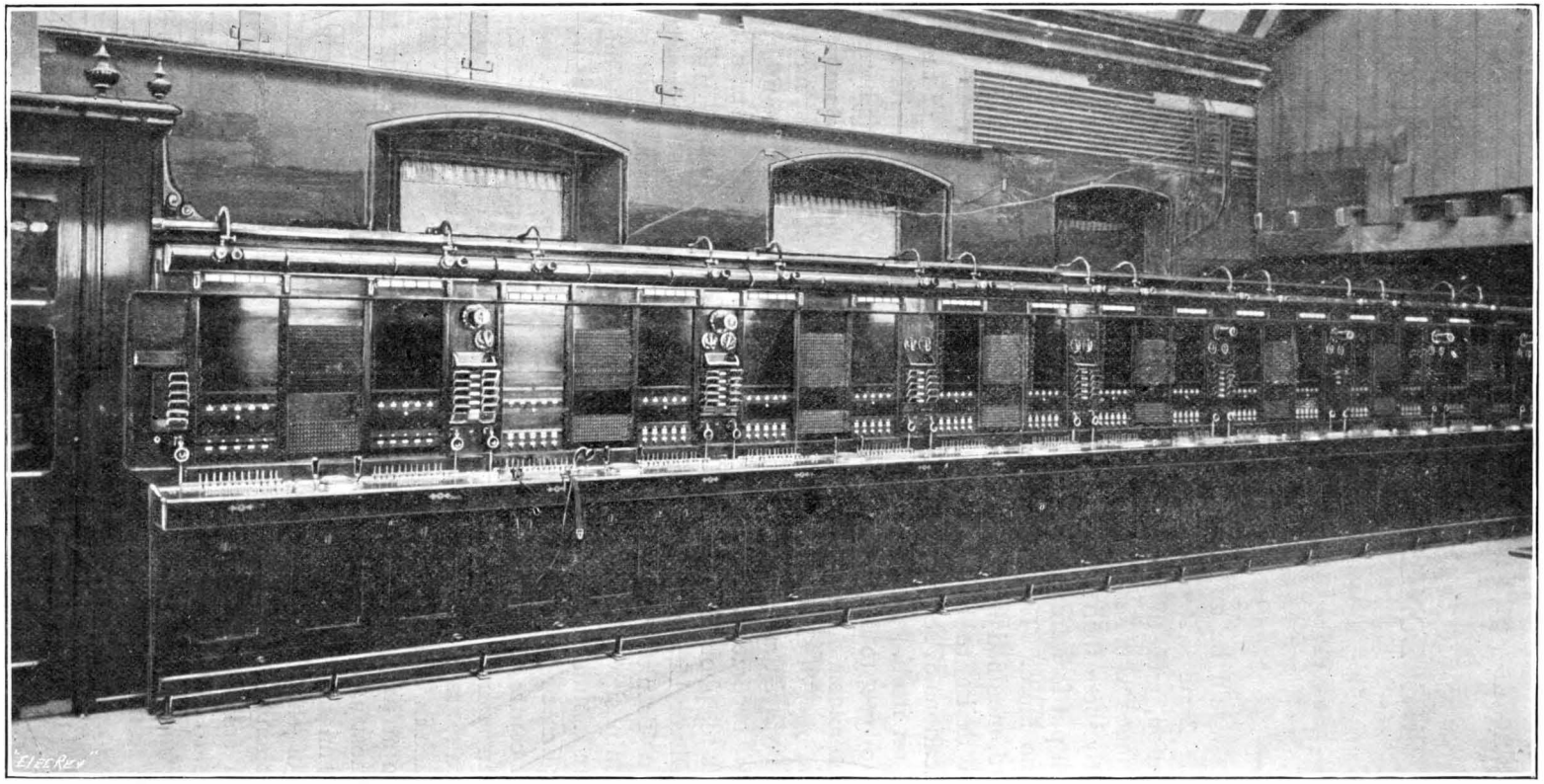
Transformer Cabinets.—Three transformer cabinets are provided, with a capacity of 96 transformers.

The existing test tablet and morning test apparatus will be utilised for the new equipment.

Accumulators and Power Switchboard.—The main accumulator equipment for supplying the lamp signalling and speaking current for the whole exchange consists of 4 secondary batteries of the Tudor type, each of 12 cells, fitted in glass boxes, each cell having a capacity of 720 ampere hours at the 9-hour rate. A subsidiary equipment of 4 secondary batteries of the K7 type, each of 6 cells, is provided for the P.C. signals. The batteries are charged from the Department's own supply through a separate power switchboard. The slate slabs supporting the switches and other apparatus are of dark slate of extra fine quality, oiled, enclosed in a rigid angle iron frame, and all the metal work is of the highest standard. The switching arrangements afford facilities for charging two sets of the Tudor cells in series, or leaving them temporarily spare, and at the same time the other two sets are left available for supplying the current to the Exchange. A reversing switch is provided for approximately equalising the discharge from each half of the battery. In addition, facilities are provided for charging two sets of the K7 cells (12 cells) in series, or leaving them temporarily spare, and at the same time the other two sets are joined up for supplying current at + 12 v. and − 12 v. respectively to the Exchange. A reversing switch is also provided in this case for equalising the discharges. The usual charging resistances, circuit breakers, and measuring instruments, in addition to 2 electrolytic meters, Reason type, each of 800 ampere hours capacity with 1/5 shunt, are mounted on the power board.

Plate 3 shows a portion of new switching equipment.

J. S. B.



3. Glasgow Trunk Exchange.—New Sections.

THE ZONES AND THE TRUNK-LINES.

By JOHN LEE
(*Assistant Traffic Manager*).

IT would be an impropriety to argue, in this place, in favour of the *Z*one system of working Trunk-lines. That system is in operation, and to bring battalions of logical military forward in its defence would seem to imply the existence of an enemy. Consequently there shall be nothing of direct polemic in this little paper. It will put forward a few main considerations of the *Z*one system, and no more. These considerations may possibly be affected and, indeed, modified by others of which I am unaware, but to which I could desire to keep an open mind. Telephony, like all other applications of science to the usage of man, has a knack of turning back on itself. Development has its circular movement—its reversion to type, to use the Darwinian phrase, and yesterday's heresy is the emboldened belief of to-day. In local telephony, for example, as the number of exchanges within an area increases, and must increase even further than we yet can realise, the deficiencies of the multiple system become plain to us. In a parallel way the development of Trunk telephony is antagonistic to a continuance of what I will call the Direct Line method. Quite naturally we think, at the outset, that a Trunk system should provide a line wherever there is a certain positive quantity of traffic between two points. That might ensure a multitude of satisfactory routes, but would it ensure a co-ordinated system as a whole? Would it provide that every trunk centre, be its traffic great or small, should have a route with a certain standardised efficiency to every other trunk centre? Until we can answer this question affirmatively we have not reached Nirvana in Trunk telephony.

In arriving at the Direct Line method as the solution we are led mostly by telegraph tradition. But the analogy is imperfect. Transmission at an intermediate point is, in Telegraphy, a duplication of the original transaction. But intermediate connection in Telephony, even though it take place on two switch sections, is a much smaller factor. Admittedly it is a factor of which we shall strive to rid the service, so long as we do not introduce other disturbing factors, such as inequalities of delay and the like. The *Z*one system, as will be seen presently, has its own remedy for much of the unfortunate loss of time in the "Through" transaction. Though in one hand it brings an apparent increase in the number of "Through" calls, it brings in its other bountiful hand a method of

dealing with a vast proportion of the "Through" traffic which raises it, in facility of treatment, to the level of simple direct traffic.

Glancing at a map of England (and Wales, of course) we see at once that so far from being a country wherein towns and cities are equally be-peppered, there are congeries of towns here and there, each town having close business intimacy with the other, and having a grouped but less close intimacy each group with another group. We may avoid the word "*Z*one" for the present, and consider a few groups, as the word "*Z*one" will come to have a somewhat technical meaning. Now the Trunk system has two characteristic demands to face. There is the demand for quasi-local connection of a particularly prompt kind within the group, materialised, so to speak, in threepenny calls for the most part; there is the demand for long-distance calls from every town in the group to every town in the other group. The first demand will represent very heavy traffic. The second demand will represent very light traffic, if we consider each town separately, and only heavy traffic, or considerable traffic, when we deal with the group as the unit. But in each group there is a predominant partner—Manchester for the South-East Lancashire group, Newcastle for North-East England, Cardiff for South Wales, by way of examples. And the long-distance traffic from the predominating partner will be broadly representative of the long-distance traffic from the smaller towns of the group, seeing that the commercial interests are mainly identical, and will differ in degree certainly, but not at all in kind. Hence we arrive at two conclusions. By making the group the unit we can handle (*a*) the special traffic within the group, (*b*) the great, because aggregated, traffic from group to group.

Now for two postulates, albeit that postulates are about as dangerous as prophecies. The call wire and other methods of working have brought home the fact that Trunk circuits can be worked more efficiently in considerable numbers than in ones and twos. (I exclude the continuous attention method, wonderfully successful though it has been, since, as regards the cost of staff and buildings and equipment, it could never be the national system.) Govern eight lines by a superimposed Telegraph call wire, and we get the best results. There is elasticity for the distribution of traffic, and to provide for occasional interruptions of lines; there are revenue results amounting to 50 per cent. better than can be obtained by ordinary working. The second postulate is that the intermediate connection of lines is more likely to be achieved without delay, without waste of lines, where there are groups of circuits available, for the mathematical probability of coincidental clearance is raised enormously.

If we come back from these postulates to our group notion we see the inner meaning of the *Z*one System. The group is the *Z*one.

It is a commercial rather than a geographical entity. The predominant partner is the *Z*one centre. The *Z*one centre will have sufficient traffic, with the aid of its co-operating towns, to render call wire working practicable on most of its long-distance routes. Each town in the *Z*one will have precisely the same delay to the long-distant centre, and the odiousness of unhappy comparison is obviated. The traffic from the small towns will be cultivated, and this is an important factor at the present moment, since manufacturers are showing signs of transferring their works to smaller towns. Nor will the traffic from the *Z*one centre suffer, since that town will have more lines and far more efficient working than would be the case if there were numerous lines to other *Z*ones from the subsidiary exchanges. Also the central administration is handling the traffic of the country in a scientific way, dealing with it in a series of large routes, rather than continually striving to equalise small routes for particularised traffic. But the striking truth of all is the paradox that by raising the efficiency of working the within-*Z*one lines, time is saved on the long-distance lines. A call from Warrington to London is worth one penny per minute on the Warrington-Liverpool lines, and eight times as much on the Liverpool-London lines. How important it is, therefore, to have the former lines so efficiently worked as to give an absolutely prompt connection, when such a connection is required, to the London-Liverpool line!

So forcibly has this fact driven itself home that it has placed the question of *Z*one-centre-control in the foreground. Theoretically, calls are controlled, *i. e.* they are timed on and off, at the originating point. But where a chain of circuits is involved this may mean—and frequently has meant—that some of the lines have been held for a period far longer than that for which payment has been received, which is, of course, for the completed connection. It is manifest that the circuit of which the greatest care is to be taken is the longest, and that in the bulk of cases this will be the circuit from the *Z*one centre to another *Z*one centre. Hence the operator, who will most economically control the call, is the operator who is responsible for this line, and for this reason the control of what may be called "*Z*one-outward" traffic is to be transferred to her. Various trials have been made, and they agree in proving that on every "Through" call which is transferred to *Z*one-centre-control system, something between one and a half and two minutes' revenue time is saved. I might aggregate this into its proper total of thousands of pounds, but the mathematical-minded reader will love to do it for himself.

It is probable that as time goes on the apparent loss on the less expensive, the within-*Z*one, lines will be reduced, for greater expertness in handling *Z*one traffic will produce its effect. The saving of revenue time on the long-distance circuits, however, far outweighs

whatever loss takes place on the shorter lines. Indeed, if we might venture on the unprofitable hazards of the prophet, we might expect a development of the Zone system, which would have special within-Zone lines for the purpose. Some would say they might be multiplied on the long-distance sections, and worked after the fashion of junctions. Personally, I am inclined to think the development will be in another direction. The abolition of the area which will come to pass with the unification of the system of the country, will bring us, with the co-operation of the measured service system and its junction charges, to regard the Exchange (or the grouped Exchanges) as the unit, differing only in charge according to the distance which separates them. In their relation to the Zone centre the several Exchanges in the predominant town will not differ in essence from the Exchanges in the towns in the Zone. The wheels of progress seem to be revolving in the direction of unifying within-Zone work with junction work, with the possible result of rendering unnecessary so many Trunk Exchanges as there are at present. Moreover, the necessity for prompt service within the Zones will bring the necessity for a more prompt record system into the foreground of discussion. Some of my engineering friends will hit upon a record system for within-Zone traffic by which the subscribers can be connected at once from the circuit on which he makes his original demand. I hope that I may have some lowly share in helping such a venture.

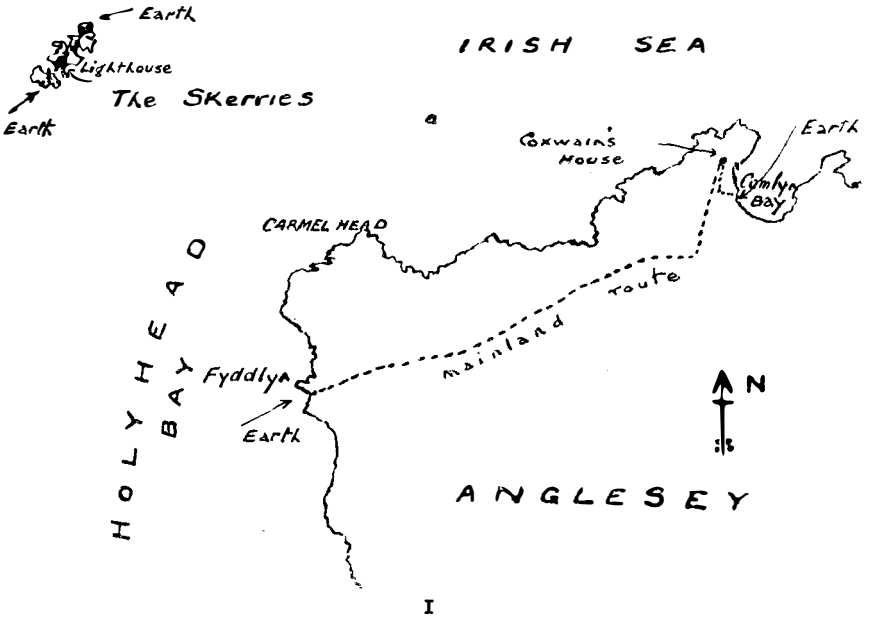
But I must protest. This paper looks uncommonly like what it declared that it would not be, a defence of the Zone system. It is not such a defence, for now it must indicate limitations. Such a doctrine, slavishly adhered to, might be disastrous. Within the Zone every effort is made to connect traffic away from the Zone centre. Subsidiary centres are given cross connections wherever the traffic can be said to justify them. Moreover, there is something to be said in respect to the difficulty of leading lines into the centre of our vast cities. It is an expensive arrangement. An engineering friend told me the other day that he would believe in the Zone system if Zone centres were always villages with not more than a thousand inhabitants. There is much truth in the contention which lies behind his genial cynicism. But it is a modifying truth, I think, rather than an absolute truth. After all, the big centres, with their wealth of traffic, are there. Civilisation will have it so, and all the demand it makes upon each of us who strives, according to his lights, to think out the problems which follow from the fact is that we should grin and bear it. For assuredly we cannot alter it.

[I am indebted to my friend and colleague, Mr. J. Stuart Jones, for kindly perusing this paper, and for an expression of his general accord with the views expressed in it.]

THE SKERRIES WIRELESS TELEPHONE.

By J. S. Elston.

Immediately north of Holyhead Bay, and about one and three quarter miles from the wild and rugged coast of North Anglesey, lie the "Skerries," a group of three rocky islets at high water, and an almost continuous rocky island at low water. On the centre island stands the Skerries Lighthouse, well known to mariners navigating vessels in the Irish Sea, and more especially to those sailors who seek to guide their ships to the great seaport of Liverpool. No doubt officers of ships passing the Skerries have wondered what reason there



could be in stretching over the length of the Skerries a telegraph wire whose ends lost themselves in the sea. If they knew that such wire was part of a wireless telephone arrangement, passengers on passing vessels would probably benefit by the active imaginations of the "old salts," and possibly we should read of further marvellous advances in "wireless," which occasionally transform our morning papers into small but inexpensive editions of fiction on the lines of Jules Verne's novels.

The sea between the Skerries and the mainland is exceedingly turbulent even on calm days, and it can be left to one's imagination what a sight must be possible in a storm to those on look-out duty in the lighthouse. It is obvious thus that no shore-end of a cable could be manufactured at a reasonable cost to withstand the constant

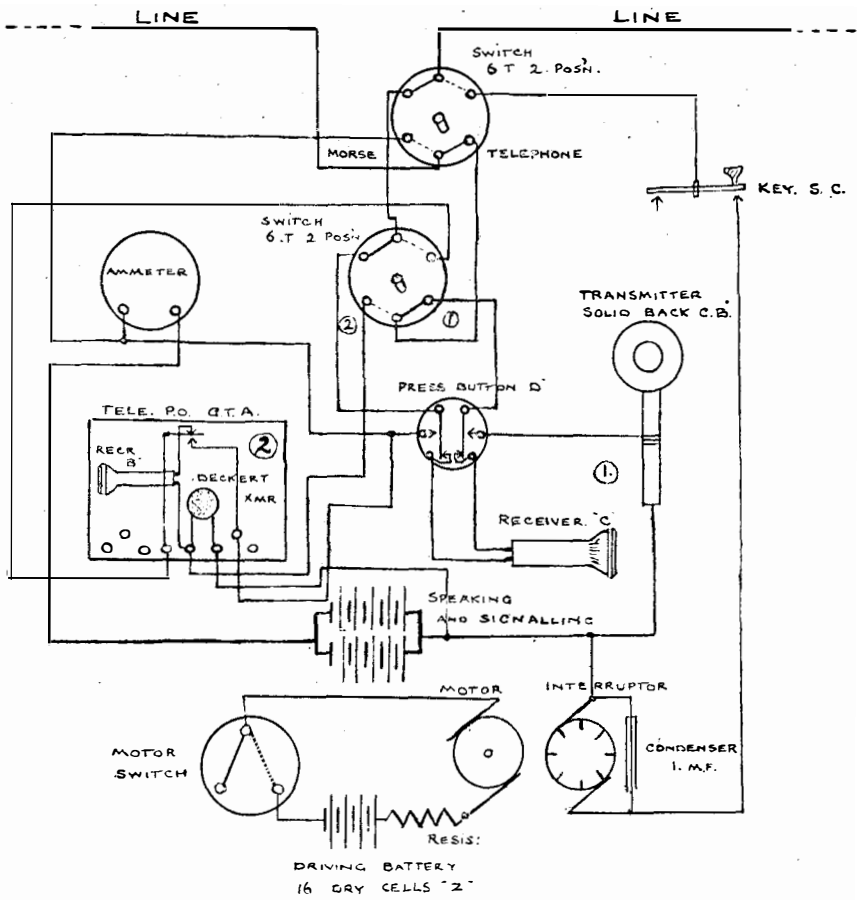
wear on rock, and, further, the expenses of laying and maintenance would be high. It was therefore suggested by the Post Office engineers about 1899, during Sir William Preece's term of office, that the arrangement I propose to outline should be given a trial, and this was done.

The system consists of two insulated parallel conductors of unequal lengths, earthed at the ends, the adjacent ends being separated by sea; one conductor is erected on the Skerries, the other conductor is erected between Cemlyn Bay and Fyddlyn on the mainland. The route of the lines is shown by a tracing from the 1 in. Ordnance Map (1). The conductor on the Skerries is a 600 lb. copper wire erected on 24–26 ft. well-stayed poles, and is insulated by P.O. standard insulators. The line passes from an "earth" made in the sea at the S.W. end of the island, for a distance of about 300 yards, to the lighthouse, where it is led to the apparatus, and from thence to the "earth" made in the sea at the N.E. end of the island, a distance of about 500 yards; the total length of the circuit is about 800 yards. The mainland conductor consists of a 400 lb. copper wire, insulated by P.O. standard insulators, and erected on 22–30 ft. poles. The "earth" at the S.W. end of the line is made in the sea at Fyddlyn, and the line is some three miles long before it is taken to the apparatus installed in the coxswain's house at Cemlyn. The wire then doubles back on itself for about 300 yards and finally is "earthed" at Cemlyn Bay.

It will be seen from the diagram (2) that with the switch at "telephone," a receiver "C" is in series with the line and that no calling apparatus is provided. No satisfactory calling arrangement has, as yet, been devised for these circuits. In 1902 Sir O. Lodge suggested an arrangement, but on trial it was found that earth currents actuated the device almost continuously. Recent measurements of earth currents present on the mainland show that at low water the earth currents reach as high a value as 30 m.a., while at high water they are as low as 1 m.a. The readings were never steady, and fluctuated from 15–30 m.a. and again from 1–7 m.a., intermediate values of 1–30 m.a. being registered at different stages of the tide. The failure to establish a system of calling is, of course, a great drawback, rendering the service useless from a commercial point of view. At present attention is given at both stations at prearranged times. The first speaking trial is usually made at 9 a.m., and attendance is given each complete hour, viz. 10 a.m., 11 a.m., noon, and so on, to 6 p.m.

Passing to the electrical actions when the Skerries "speak," the press button "D" is depressed; the speaking battery, of twenty-four cells in two parallel rows, completes its circuit through the transmitter, lines, and "earths." The circuit on the mainland is completed

by the telephone receiver "C," lines, and "earths." In whatever manner energy is transmitted from the Skerries circuit to the mainland circuit—and I am inclined to suggest sea-conduction as the manner of transmission—it is transmitted, and faint speech is received at Cemlyn and *vice versâ*. The volume of speech varies very considerably; to put it roughly as a guess, it may be likened to five



SPEAKING AND SIGNALLING BATTERY.—20 + 20 "Z" cells—*Cemlyn*.
12 + 12 "Z" cells—*Skerries*.

To speak depress Press Button "D" or Button on Tele. P.●.

2

miles beyond the standard cable limit. It is curious that with a measured earth current of the varying values stated there is an absence of noise; the usual trouble, if any, is faint speech. At times, however, through some unknown cause, considerable noise is present; the lines may be in good order and the "earths" intact and nothing can be traced likely to cause the disturbance. It is due

possibly to some atmospheric effect. At times, also, it is found that the reserve circuit with a Deckert transmitter gives better results than the prime circuit with a solid back C.B. transmitter.

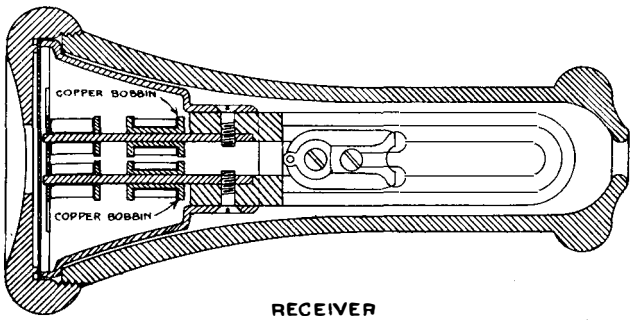
There is also a wireless telegraph arrangement for use when the telephone circuit is too noisy or otherwise faulty, provided the trouble is not on the line circuits. The arrangement consists of a motor on whose armature is fitted an interruptor, which makes and breaks the circuit of the speaking battery. The motor is driven by sixteen "*Z*" dry cells. The interruptor and S. C. Key replace the telephone transmitter only, the remainder of the arrangements holding good for the reception of the message, which is translated from the Morse code.

The original installation remained until 1903, when Mr. J. E. Taylor, of the Engineer-in-Chief's office, acting under Sir J. Gavey, C.B., re-arranged the apparatus to the present connections and introduced the solid back transmitters, thereby increasing the volume of speech very considerably. The circuits are maintained by the Post Office for the Board of Trade. Conversations are carried on daily and interruptions are infrequent. The principal troubles are battery maintenance and washing away of "earths." It is interesting to note that at first earth-plates were tried on the Skerries, but the heaviest boulders placed on the plates were moved away as though they were pebbles by the tremendous seas which sweep the rocks during even a moderate gale. Next, stranded copper wire was led through eye-bolts driven into plugs which were inserted into holes drilled in the rock. Gradually electrolytic action weakened the iron eye-bolt and the "earth" was swept away. The last method adopted has stood since 1902. It consists of a steel rope formed of six cables of four 200 lb. stranded steel wires, the cables being bound into a rope by 200 lb. iron wire. This rope was let into a groove chiselled in the rock to the low-water mark, and was kept in position by threading it through eye-bolts, which were driven into plugs fixed as already described. The joint between the steel cable and the stranded copper earth lead was made above high-water mark.

A NEW COMMON BATTERY TELEPHONE.

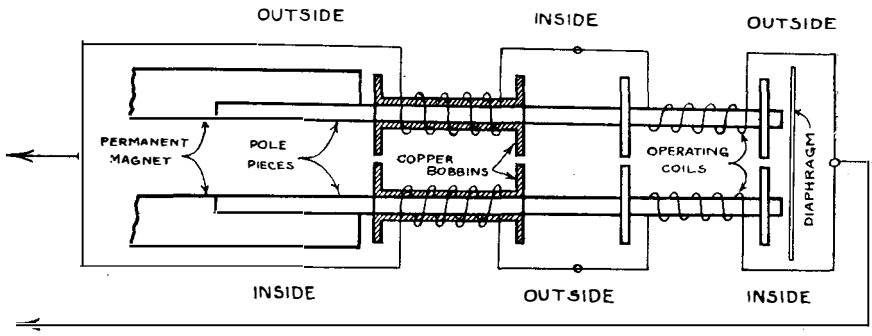
In the manufacturers' column of the *American Telephone Journal*, dated 18th December, 1907, Mr. C. D. Enochs describes a new common battery telephone which, so far as concerns transmission and reception of speech, consists merely of a transmitter and a receiver in series.

The method of eliminating any ill effects due to the direct current from the common battery circulating through the receiver coils is a novel one. From the accompanying figures 1 and 2 it will be seen that the soft iron pole pieces of the permanent magnet are longer than usual, and that upon each are fixed two separate coils, joined up so that the magnetic effect of the direct current in one is in opposition to that of the direct current in the other. As



RECEIVER

1



CIRCUIT OF RECEIVER

2

the coils on each pole are in series the current strengths will be equal, and it is claimed that the magnetic effect of the direct current in one coil is counterbalanced by that of the direct current in the other. In order, however, that this may not be the case with the high frequency telephone currents, the coil which is furthest away from the diaphragm is wound upon a copper bobbin. The currents induced in this copper bobbin will, of course, be in magnetic opposition to the currents producing them. With rapidly varying currents, therefore, the magnetic balance is upset and the coil nearest to the diaphragm will become operative. J. W. T.

INSTITUTION NOTES.

UNDER this heading there will appear, in future issues of the JOURNAL, a *resumé* of the proceedings of each of the Centres during the quarter prior to publication; and it is hoped that by this means the local Committees will be enabled to secure new ideas with regard to the subjects of papers, the arrangement of visits to manufacturers' works, etc., and in other ways to benefit by the interchange of information as to the progress which is being made with the educational work of the Institution.

Another regular feature of this section will be the publication of such particulars of matters which have occupied, or are still engaging, the attention of the Council, as may with advantage be brought under notice in this manner.

Other items of general interest with regard to the organisation of the Institution, the modification of rules, the increase in the number and distribution of members, etc., will also appear, so that the individual member may be placed in a position to exercise that keen interest in everything affecting the Institution which is so essential if its aims are to be fully realised.

PROCEEDINGS OF THE COUNCIL.

A meeting of the Council was held at Nottingham on February 5th and 6th, 1908, the Chairman, Mr. J. W. Woods, presiding.

The following items of general interest to members have been extracted from the volume of business transacted.

District Reference Libraries.—Important additions have been made to the District Reference Libraries during the past quarter, with the object of increasing the utility of this department of the work of the Institution. The question of accommodation of the District Reference Libraries was also dealt with. The housing of the books in certain Centres was not considered satisfactory from the point of view of accessibility, and, to permit of the unrestricted use of books, it was arranged to provide accommodation in each case in the *General* Office of the Superintending Engineer.

Assistance to Centres in the Preparation of Programmes.—Reports from some Centres having indicated that difficulty had been experienced in completing the programmes for the current Session, the matter was taken up by the Council with a view to the supply of lecturers in response to any definite requests for assistance. Advantage has been taken of this arrangement by the Committee of one Centre up to the present. In this connection it is worthy of

note that a useful leaflet has been issued to members, giving a list of suitable subjects upon which papers might be contributed.

Membership.—Some interesting facts were brought out in connection with the present membership of the Institution. From a comparison made between the membership roll and the number of officers of the different grades eligible for membership, it transpired that nearly 75 per cent. of the Staff had joined the Institution, and that the membership list was on the increase. A leaflet, setting forth the advantages of the Institution, has been issued for circulation amongst non-members, and it is hoped that this leaflet, aided by the friendly co-operation of members, will result in an augmented membership.

Election of Honorary Members.—The Council unanimously elected the following gentlemen as Honorary Members of the Institution, viz.—

Sir John Gavey, C.B. (First President of the Institution).

Mr. A. W. Heaviside, I.S.O. (formerly Superintending Engineer of the Northern District of England).

Constitution of Council.—The question of representation on the Council is at present receiving special consideration with a view to determining whether the existing system best meets all requirements.

Representation at Meetings of the Council.—In accordance with the provisions for modifying the Rules of the Institution, the Council have arranged, so far as is practicable, that no section of the membership shall be unrepresented at two successive meetings.

Audit of Accounts.—It is proposed to amend the Rules so as to provide for a professional audit of the Institution accounts.

Institution Medals.—The awards for 1906–7 are:

Senior Silver Medal: Mr. J. E. Taylor, for paper on "Electric Wave Propagation."

Senior Bronze Medal: Mr. J. G. Hill, for paper on "Telephone Transmission."

Junior Medals: Mr. A. O. Gibbon, for paper on "The Construction of Underground Telegraphs in the Provinces;" Mr. J. S. Brown, for paper on "Trunk Telephone System Signalling Arrangements."

The decision as to the award of the Silver Medal in the case of the two last-named papers has been referred to the President in accordance with the Rules

DISTRIBUTION OF MEMBERS.

Metropolitan Centre:		
Engineer-in-Chief's Office (including Testing Branches and London Electric Light Staffs)	151	
Metropolitan Central District	66	
,, North ,,	38	
,, South ,,	64	
Southern (England) ,,	34	—353
Eastern Centre		33
North Midland Centre		35
South Midland ,,		43
North-Eastern ,,		43
Northern ,,		38
North-Western ,,		35
North Wales ,,		53
South Wales ,,		44
East Scotland ,,		21
West Scotland ,,		26
Irish ,,		34
	Total	758

LOCAL CENTRE NOTES.

METROPOLITAN CENTRE.

THE Metropolitan Centre has again completed a full session of six meetings, at each of which a gathering of 150 to 250 assembled. The programme was as follows:—

October.—"The Education of an Engineer." Major O'Meara.
"The Construction of Lead-covered Cables." Mr. R. W. Callender.

November.—"The Complete Co-ordination of Inter-urban Telegraphs and Telephones." Mr. D. H. Kennedy.

December.—"Open-line Construction." Mr. J. H. M. Wakefield.

January.—"The Management of a Metropolitan Post Office Engineer's Section." Mr. J. P. Price.

February.—"Unit Maintenance Cost." Mr. A. L. De Lattre.

March.—"The Education and Training of an Engineer." Sir John Gavey.

The long arm of coincidence is strongly manifested in the fact that the session was opened and closed by the present and past Engineers-in-Chief respectively, and that in both instances the addresses dealt with the various processes necessary for the mental equipment of the ideal Engineer. Mr. Price's paper was intended to show what the ideal Engineer would do with his Section, and was an interesting contribution which evoked considerable discussion. Mr. Kennedy's appeal, for fuller inquiry into the possibilities of "superposed" working on a grand scale, met with severe but unconvincing opposition, while Mr. Wakefield supported his case against dogmatism in Technical Instructions by a large number of lantern slides. Mr. De Lattre's excellent exposition of the original Unit Maintenance Cost System was only disappointing from the point of view of the possibilities suggested had there been a consideration of the subject itself rather than its history.

METROPOLITAN CENTRE.

The presence of two Engineers-in-Chief (past and present respectively) on one platform attracted a large and representative attendance at the Metropolitan Centre meeting on Monday, March 9th. Under the presidency of Major O'Meara, Sir John Gavey delivered an address on the subject which has recently received much attention both in England and in America, viz. "The Education and Training of an Engineer." The address was an eloquent plea for the broadening of the basis of general knowledge necessary for success in the Engineering profession, and suggested methods of training with that end in view. The discussion which followed was animated and vigorous, and was ably opened by Mr. A. W. Heaviside. Summed up in a sentence, all the speakers argued against any proposals involving undue extension of the period of academic education; characterising it as costly and unproductive as compared with the methods which produced so many successful engineers during the last century. In replying, Sir John Gavey energetically repudiated the idea of making an expensive University Training compulsory, but, while freely testifying to the capabilities and qualifications of the present staff, he recommended to the notice of the younger members and intending entrants into the Telegraph Engineering Department the general character of the training and equipment indispensable for real success in the profession. Major O'Meara, in an able and interesting speech, made reference to the courses and subjects of training for engineers adopted in various Foreign Administrations, and offered to contribute an article on the matter to the JOURNAL, in order that he might treat it more fully than in the limited time available at the meeting.

EASTERN CENTRE.

The first meeting of the Session was held in the afternoon of the 28th January. There was a very large attendance and the great interest shown throughout the proceedings was of considerable gratification to the Committee.

The meeting was opened by the President, Mr. J. Jenkin, who, in the course of an inaugural address, full of sound advice, reviewed the past work of the Centre and referred to the great possibilities of the future. He then called upon Mr. A. W. Martin for his promised lecture on "The Unit Maintenance Cost." Some of the members had expressed a fear that the possibilities of such a subject would be extremely limited, but any such thoughts were quickly dispelled. Mr. Martin first treated the question in a general way, dealing with the principles on which the system is based and then in turn explained its immense value to the engineers, the superintending engineers, and to headquarters. He next illustrated by means of graphs how easy it enables lengths, sections and districts, etc., to be compared and suggested how, with its help, the necessary representations to headquarters when additional linemen are required could be prepared in a very simple manner. Many other points were treated in a most lucid and instructive way, which lack of space prevents us from mentioning in detail, and we must content ourselves by saying that Mr. Martin caused his audience to regard the "Unit Maintenance Cost" in a very different light from what they had previously done.

A keen discussion followed the lecture, and, in replying to the questions raised, Mr. Martin still more forcibly demonstrated the all-round value of the system.

The meeting terminated with a very hearty vote of thanks to Mr. Martin.

SOUTH MIDLAND CENTRE.

It has not been found possible to arrange for any meetings up to the present. The Council have, however, been able to arrange for Mr. De Lattre to give an address on "Maintenance," and Mr. Plummer on "The Application of Inductances to Underground Cables," and it is anticipated that these lectures will prove of extreme value.

NORTH-EAST CENTRE.

The membership in this centre is 84·3 per cent. of eligible members, but we are hoping for an increase next year.

Five successful meetings have, so far, been held, the papers being attentively listened to, and keen discussions following.

In comparison with last year's meetings the most noticeable feature has been the readiness and interest with which members entered into the discussions. The Institution is doing good work from an educational point of view by affording facilities for an exchange of thought and experiences.

NORTH-WEST CENTRE.

The 1907–8 Session has, up to the time of going to press, been a very busy one, and promises to continue so. Six meetings are on the programme, four of which have been held.

The Chairman, Mr. J. W. Groves, opened the Session in October with an inaugural address, the papers read at the other three meetings being—

November, 1907.—"Lightning Conductors." Mr. W. B. Smith.

December, 1907.—"Induction." Mr. F. N. Harrop.

January, 1908.—"The North Underground." Mr. H. E. Martin.

NORTH WALES DISTRICT.

One of the most successful meetings of the North Wales Centre of the Institution was held on 19th February. The ordinary meeting was preceded by a demonstration by Mr. A. W. Martin (of the Headquarters Staff) of the tests that are now being carried out with "loaded" cable circuits between Manchester and Liverpool. Mr. Martin had made arrangements for listening tests to be made by those present between loaded and unloaded cables and this greatly increased the interest manifested on all sides. The marked superiority of the "loaded" over the "unloaded" circuit was a matter of general comment.

At the subsequent ordinary meeting a paper was read by Mr. Elston on "Primary Batteries." The discussion which afterwards followed was no less interesting than the paper.

From the time Mr. Martin commenced till Mr. Elston finished there was not a moment that was without interest, and we are deeply indebted to these two gentlemen for affording us such an enjoyable meeting.

SOUTH WALES CENTRE.

The fourth ordinary meeting of the South Wales Centre for the 1907–8 Session was held at Cardiff on the 18th February, 1908, when papers were read by Messrs. J. F. McMullen and T. Devereux, Sub-Engineers, Cardiff, entitled "Common Battery System, Telephone 'Trunk' and 'Local' Arrangements."

The lecturers dealt with the subject in a most lucid manner, and it was evident from the high character of the papers read that they had gone to a great deal of trouble in compiling such excellent and instructive information. An interesting set of lantern slides were shown to illustrate the lectures, which were greatly appreciated by the large number of members present.

IRELAND CENTRE.

The Institution in Ireland passed through many vissicitudes during the first year of its existence. Two of the Superintending Engineers, who would naturally have taken parental interest in it, went into retirement at the time of its birth, and a third followed their example a few months later. In addition, the Institute commenced with three Centres in Ireland, corresponding with the number of Districts existing at the time. Subsequently the number of Districts and Centres was reduced to two, and finally, when both the Superintending Engineers for Ireland came to be located in Dublin, it was decided that one Centre of the Institution would suffice. Happily, however, notwith-

standing the untoward experiences of infancy, the Irish Centre is now doing extremely useful work.

Mr. Moir is the chairman for the current year, and his enthusiasm has been well backed up by the vigour of the Committee and the general interest of the members. During the present session papers have been read on "Linemen's Loads," by Mr. Golding; "The Training of a Lineman," by Mr. Evans; and "The Telephoning of Small Towns," by Mr. Patterson. All these practical subjects have been ably dealt with and fully discussed.

The attendance at the last meeting numbered twenty-five, which, considering the distances some of the officers had to travel, is very satisfactory.

NORTHERN CENTRE.

The winter session has been very successful, four more papers being promised than could be given during the session.

The following papers were given—

November.—Mr. Tremain. Opening Address on "Telephone Trunk-Lines."

December 3rd.—Mr. Raper. "Stores."

,, 18th.—Mr. Kitchen. "Repeaters," with lantern slides.

February 10th.—Mr. Shadforth. "Expense Accounting."

On March 9th Mr. Bellwood will read a paper on "Trunk Signalling," with lantern illustrations.

LIBRARY NOTES.

A RECENT visit to one of the first Technical Libraries of the country revealed an almost priceless collection of volumes, well-bound, well-housed, well-dusted, well-arranged, but alas! rarely, if ever, read. The Librarian keenly emphasised the intrinsic value of his charge, quoting with evident assent Roger Ascham's dictum that "reading teaches more in one year than experience in twenty," yet apparently failing to see that the accumulation of well-chosen but unopened books is the least profitable of all experiences.

The Council of our Institution has strenuously tried to avoid this. They work with a two-fold ambition. First, to ultimately possess the best library of technical literature, so far as it covers the subjects of our professional work, of any in existence. Second, that no vexatious regulations hinder its fullest use.

Pursuing this ambition the scientific and technical catalogues are examined by the Library Committee, all promising books obtained on approval, examined, and, if of value, accepted. But though the net is spread thus widely, experience shows that useful works occasionally slip past unnoticed. Suggestions from members for new books are therefore gladly welcomed.

The selection is not confined to English works. American, French and German text-books of out-standing merit have recently been added, the foreign additions, of course, being of works of which no English translation exists. During the past twelve months 100 volumes have been added, including works presented by Sir Oliver Lodge, Dr. Glazebrook (National Physical Laboratory), W. Duddell, Esq., U.S.A. Government Census Office, the Royal Society, the Institution of Electrical Engineers, and others. The total number of volumes now in the library, exclusive of the district reference libraries, is 700, representing 575 separate works.

The range of subjects represented has recently been considerably widened, and now includes text-books on accounting, brick-work, building construction, draughtsman's work, forging and smith-work, lantern-work, management of works, microscopy, paper manufacture, pattern making, roads and pavements, turbines, water softening, etc.

The Committee's chief function, then, viz. to furnish the "tools of our craft,"—for, to the professional man a collection of good technical books is as needful as a kit of tools to a carpenter,—is being steadily performed.

But there is another and equally important function to perform. Arrangements must be made whereby each member can use the library with the greatest convenience and to the best purpose. In this respect the Committee's provision is, if not unique, certainly

exceptional, and deserves a wider publicity. Works in great demand are duplicated—in one instance to the extent of twenty-five copies. Books are despatched, as far as possible, on the day of receipt of requisition, and to the member's private address if desired. No troublesome time-limit is imposed : books may be retained until required by another member. Finally, a detailed and descriptive catalogue is being prepared which will briefly indicate the scope and general contents of each work, and thereby place the technical treasure-house of the Institution completely at the disposal of the most distant of its members.

J. M. CRAWFORD.

SOCIAL.

EASTERN CENTRE.

FOLLOWING the meeting of the I.P.O.E.E., at Cambridge on the 28th January, a dinner was held at the Castel Hotel. The chair was taken by the Superintending Engineer, Mr. J. Jenkin, the Vice-Chairmen being Mr. E. H. Shaughnessy, Assistant Superintending Engineer, and Mr. C. P. Walby, Chief Clerk. Close upon sixty sat down, and a thoroughly enjoyable evening was spent, the proceedings throughout being of the most pleasant and harmonious character.

The outstanding incident of the evening was a presentation to Mr. A. W. Martin (who was about to leave the District to take up the appointment of 1st Class Staff Officer), of an enlarged photograph of the Headquarter Staff on behalf of those officers, and of a silver tea service which had been subscribed for by members of all classes throughout the District.

Later in the evening Mr. G. Y. Fryer, of the Clerical Staff, was presented with a handsome overmantel as an expression of the good wishes of his colleagues on the occasion of his recent marriage.

There is a widely expressed desire that a dinner shall be held annually, and it is to be sincerely hoped that this will be found to be possible.

NORTH-WESTERN CENTRE.

A very successful Staff Dinner and Concert were held on the 16th November, at which there were forty-six present, including representatives from the North Wales and the Metropolitan Central Districts.

At the conclusion of the January meeting of the Institution a "hot-pot" supper was partaken of by a good muster of the Staff, and afterwards a smoking concert was held.

METROPOLITAN SOUTH DISTRICT.

The above District held their annual Conversazione on February 29th last. The gathering, which takes the form of a Concert and Dance at the District Headquarters, was, if anything, more successful even than its predecessors. Two large rooms in the office were converted into concert and dance rooms respectively, their tasteful appearance being eloquent testimony to the energy and resourcefulness of the Organising Committee and their assistants. The chair was occupied by the Superintending Engineer, and among the guests were : Major O'Meara, Mr. C. T. Fleetwood, Mr. J. W. Woods, Mr. W. Noble, Mr. R. McIlroy, and Mr. T. E. P. Stretche, whilst Mr. A. J. Stubbs and Captain Roberts sent expressions of regret at their absence. A strong musical programme was discussed in conjunction with dainty refreshments. Mesdames Cloydon, Edwards, and Reid, and Messrs. Ivison and Gamgee delighted the company with tuneful songs, whilst the humorous section of the programme was well sustained by Messrs. J. Hillier, F. Hudson, and A. Chantrill. The excellent recitations by Mr. J. J. French and violin solos by Mr. A. H. Morse were well appreciated, whilst Mr. F. Froud at the piano was all that could be desired. The proceedings terminated with three rousing cheers for the chairman, and a hearty vote of thanks to the committee—Messrs. F. W. Heath, T. A. Claydon, A. W. Field, and L. D. Pither—who are to be warmly congratulated on the success attending their efforts.

CHESS CLUB NOTES.

THE chief event of the season, so far as the Engineering Department Chess Club is concerned, was the visit of Dr. Lasker to the Club's headquarters in Cheapside on the 13th March. It was at first thought that the whole of the champion's time, during his stay in England, was filled up, but at the last moment Dr. Lasker was able to offer the date in question. Dr. Lasker gave a short lecture on chess, and then a simultaneous display on twenty boards. Ten of the players were drawn from the G.P.O. North Club, who co-operated in this matter with the Engineering Department Club.

The first round of the Club tournament is rapidly drawing to a close. The following have qualified for the final round:—Class A, Section 1, Mr. De Lattre. Class B, Mr. Mitton. In the remaining sections the competition has not yet been completed.

The following is the score against the Paymaster-General's Office in the Civil Service League match, played on the 11th February, 1908, at Cheapside:—

Board.	Engineering Dept.		Paymaster-Gen. Office.	
1	A. L. De Lattre	0	J. Mahood	1
2	W. D. Frewin	1	C. E. Doubleday	0
3	R. A. Wells	0	R. C. Taylor	1
4	C. W. Cornwell	0	W. Smith	1
5	R. Smerdon	0	E. A. Eagar	1
6	W. L. Harrison	0	W. H. Maunder	1
7	S. Bartholomew	1	J. B. Denny	0
8	E. H. M. Slattery	1	F. W. Parker	0
9	W. H. Stephenson	1	L. J. Baker	0
10	W. Patey	1	R. H. Sandes	0
11	T. B. Braund	0	A. M. Johnson	1
12	J. W. Kimber	0	J. S. McIntyre	1
		5		7

The result was in doubt till the last, when adjudication on three unfinished games gave the victory to the Paymaster-General's Office.

VISITS TO MANUFACTURERS' WORKS, ETC.

METROPOLITAN CENTRE.

ONE interesting feature of the past session was a series of "visits," which included the Central and Trunk Exchanges, the Testing Branch and the Electric Lighting and other plant at the G.P.O. East, G.P.O. West, Mount Pleasant, and the Savings Bank. An average of over fifty members participated in the visits, all of which, save one, took place on the nights of Centre meetings. The movement is the outcome of several requests that the Committee should arrange for official visits to large manufacturing works and other establishments connected with the various branches of electrical activity and the success of an experimental programme confined to Post Office buildings and installations is a certain indication of the support that awaits a more ambitious scheme.

NORTH WALES CENTRE.

The Local Committee were invited by the Liverpool Chamber of Commerce to attend on Monday, the 24th February, a lecture by Marconi on "Wireless Telegraphy." As was to be expected the lecturer dealt with the commercial rather than the scientific side of the subject, and his address was confined to the rise and progress of his discoveries and their future prospects and utility.

NORTH-WESTERN CENTRE.

Two very successful and instructive visits to manufacturers' works have been organised during the present session, viz., to Messrs. The British Westinghouse Co.'s Works, Trafford Park, Manchester, and Messrs. The Chloride Electrical Storage Co.'s Works, near Manchester.

Before the first number of our JOURNAL appears, a visit will also have been paid to Messrs. F. Smith and Co.'s Wire Drawing Works, Salford, which will, without doubt, prove equally as interesting and instructive as the preceding visits.

NORTH MIDLAND CENTRE.

On the 10th February, about 70 members of the Nottingham Guild of Mechanical and Electrical Engineers visited the head office at Nottingham, at the invitation of Mr. T. J. West, a vice-president of that Guild. They were conducted through the various departments by Mr. West and some members of his staff, and it was evident they thoroughly appreciated the knowledge obtained of the inner working of a large post office.

COLONIAL AND FOREIGN NOTES.

Contributions are invited from readers abroad.

CORRESPONDENCE.

To the Editors of THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

MULTIPLICITY OF INSTRUCTIONS.

IN these days when one's interests are so varied it is impossible to carry in mind detailed knowledge of each and every subject. One's aim is, therefore, to classify information, and to index it—in the mind and in written records—so that precise details can be obtained at any time for immediate application. Perhaps it would be of general interest to consider the application of this everyday practice in the Engineering Department.

The work of the Engineering Department comprises, but is not limited to, telegraph, telephone, and electric light and power work. Apart from the Post Office each of these branches of electrical work stands by itself: it is specialised; there are telephone, telegraph, and power engineers—indeed, there are indoor and outdoor engineers of all three classes. But the Postmaster-General's interests are so vast, and so great is their variety, that the Post Office engineering officer must be all these, and he may at any time be called upon to deal with questions arising out of any branch of electrical work in its most complex form. Moreover, he must have a thorough knowledge of the Telegraph Acts, over and above his acquaintance with the regulations under which other undertakers work, he must have a clear understanding of the complex relations between the Department and the staff, and last, but far from least, he must have a sound knowledge of the Department's complicated system of accounting. And each of these subjects becomes more intricate every day, and the Department's methods are constantly being changed. It follows that an enormous number of instructions must be issued, and, in the interests of a heavily loaded and painstaking staff, these instructions should be issued in such a form that information on any point can be easily and quickly obtained.

But at the present time there are Regulations, Monthly Circulars, Technical Instructions, E Circulars, E in C Memos, and others; many are out of date, and others have been issued, with all due deference be it said, without reference to existing instructions. It is not exaggerating to say that at the present time not one knows definitely which of the circulars issued during the past ten years are in force.

It should not be a difficult matter, in these days of card indexes, patent files, and other office records, to devise a scheme by which complete instructions on any one subject could be easily found, and I am sure it would be of interest to readers of the JOURNAL if any who have interested themselves in the subject would discuss the matter through the medium of the Correspondence Column.—Yours faithfully, PERPLEXED.

To the Editors of THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

ENGINEERING ACCOUNTS.

The recent remarks of the Engineer-in-Chief to the Institute of Post Office Electrical Engineers, as well as those contained in the speeches of the Postmaster-General and the Secretary at the annual dinner of the Engineering Department, and in the Secretary's further speech at the Royal Engineers' annual gathering have raised hopes that the Department is realising the severe strain which the progressive elaboration of the accounting system has thrown upon the staff throughout the country. All these high authorities referred somewhat apologetically to the matter, and dwelt upon the importance of the accounting side of an Engineer's duties.

While these signs of the times are gratefully noted, I think we may fairly ask our chiefs to believe that the necessity for good and accurate accounting is a point which Engineers have never failed to realise or thought of calling in question. The present feeling of resentment associated with this subject in the minds of so many Engineers is not due to indifference or want of appreciation, but rather to the fact that they have all along been in a better position than the higher authorities to realise the futility of much of the laborious and microscopic accounting work which has been thrust upon them and their workmen, as well as to realise the serious deleterious effect upon their engineering work which the absorption of so much of their scanty time in this unremunerative way has caused. On the question of appropriation, for example, we are all fully alive to the fact that, while we have been forced to subdivide running charges of all kinds into minute fractions of a penny, there are numerous large items of expenditure which have necessarily to be appropriated in bulk at headquarters, and which entirely nullify these attempts at mathematical exactitude of subdivision. In brief, I need only mention the large sums represented by headquarters salaries, freight of stores, interest on value of stores in depôts, and discrepancies between the fixed "rate-book" values used in accounting, and the fluctuating market value of materials.

We rejoice to think that there is at last a prospect that wiser counsels will prevail, and that a system better adapted to the needs and conditions of the service may be introduced.

"ENGINEER."

To the Editors of THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

THE ART OF GETTING THINGS DONE.

The comparison between civil servants and the fountains in Trafalgar Square, which play between the hours of 10 and 4, is notorious. No doubt it is repudiated by all civil servants, but it is a gross travesty of the facts when applied to the Engineering Department of the Post Office, which claims that it can carry out work as well as any organisation performing similar work. At the same time the vast organisation of the Post Office, and the consequent complexity of its arrangements, create a considerable amount of *inertia* which can only be transformed into kinetic energy if every member of the staff strives to do his work, not only well, but expeditiously.

"Lose this day loitering—'twill be the same story
To-morrow—and the next more dilatory;
Then indecision brings its own delays,
And days are lost lamenting o'er lost days.
Are you in earnest? Seize this very minute—
What you can do, or dream you can, begin it,
Boldness has genius, power, and magic in it,
Only engage, and then the mind grows heated—
Begin it, and the work will be completed."—*Goethe.*

It is obvious, however, that, if work is to be expeditiously performed, each and all must be ever on the watch to simplify the procedure. There is a natural tendency in the officer who is engaged on detail work to go into greater detail—to ask innumerable questions; and he exhibits remarkable persistence. In an organisation like the Post Office much of the complex character of the work is inevitable, but many of its intricacies have their origin in this development of method in officers immersed in detail work.

Much can be done to simplify matters, however, and the solution of the question does not lie only in great administrative changes, but in numerous small modifications which it is within the province of individual officers to make or suggest. It is a difficult task; but a high standard of excellence can only be attained by adopting a high ideal and working earnestly and steadily towards it. The non-essentials must be cut away, new ideas must be welcomed and considered, and there must be no standing upon ceremony with colleagues whose aim, like ours, is the welfare of the Department.

The cordial co-operation of an Engineering staff, imbued with this spirit, can only result in a standard of work which cannot be excelled, and a frank and full recognition of its efforts must follow.

SIMPLICITAS.

STAFF CHANGES.

NOTE.—It should be clearly understood that these lists are unofficial; but every effort is made to render them accurate and complete.

BRITISH POST OFFICE.*
ENGINEERING DEPARTMENT.

PROMOTIONS.

Name.	Appointment.	District.	Previous Service.
Medlyn, W. J.	Asst. Suptg. Engr.	N.W.	Tel., Cardiff; Jun. Clk.; Relay Clk.; Engr., 2nd Cl.; Engr., 1st Cl.; Staff Engr, 2nd Cl.
Harriss, E.	Engr., 1st Cl.	N.Wa.	Tel., C.T.O.; Sub. Engr.; Engr., 2nd Cl.
Nimmo, R.	Engr., 1st Cl.	N.W.	Tel. C.T.O.; Sub. Engr.; Engr., 2nd Cl.
Hutchons, E. R.	3rd Navg. Offr.	Monarch	4th Navigating Offr., Monarch.

RETIREMENT.

Smart, W. S.	Engr., 1st Cl.	N.	E.T. Co.; Tel., Hull; Insp.; Engr., 1st Cl.

TRANSFERS.

Name.	Rank.	District. From	District. To
Downing, G. H.	Ch. Clk.	N.W.	Met. C.
Moon, W.	Engr., 1st Cl.	Met. C.	Met. N.
Lack, E.	Engr., 1st Cl.	Met. S.	Met. C.
Wilson, R.	Engr., 2nd Cl.	Met. S.	Met. C.
Fewtrell, J. W.	Engr., 2nd Cl.	Met. S.	Met. C.
McCloskey, A. E.	Sub-Engr.	Met. C.	E. in CO.
Aspinall, H. O.	Sub-Engr.	Met. S.	Met. C.
Evans, T.	Sub-Engr.	Met. S.	Met. C.
Hill, G. A. D.	Sub-Engr.	Met. S.	Met. C.
Davies, E. I. S.	Sub-Engr.	Met. S.	Met. C.
Hartnell, C. H. B.	Sub-Engr.	Met. S.	Met. C.
Gamgee, A.	Clk., 3rd Cl.	Met. S.	Met. C.

ABBREVIATIONS.

Asst., Assistant; C.C. & T., Counter Clerk and Telegraphist; Ch., Chief; Cl., Class; Clk., Clerk; Cont., Controller; Div., Division; Engr., Engineer; Exr., Examiner; Gr., Grade; Hd., Head; Hr., Higher; Insp., Inspector; Jr., Junior; Lr., Lower; Offr., Officer; Over., Overseer; P., Postal; Pn., Postman; Prin., Principal; Prob., Probationary; Prov., Provinces; Sec., Secretary; Sen., Senior; S.C. & T., Sorting Clerk and Telegraphist; Sr., Sorter; Stg., Sorting; Sta., Stationary; Supply., Supplementary; Sur., Surveyor; Super., Superintendent or Supervisor; Tech., Technical; Tel., Telegraphist; Temp., Temporary; Wtg., Writing.

Dist., District; E., East; I., Ireland; Met., Metropolitan; M., Midland; N., North; Scot., Scotland; S., South; Wa., Wales; W., West.

* It is hoped to include similar information from Colonial Administrations in future issues.

DESIGNS COMPETITION.

THE Designs Competition which was advertised in the preliminary announcement of the JOURNAL evoked a bewildering display of artistic talent, and the Selection Committee had a very difficult task to perform. We hope our readers will agree that they have chosen a design which is at once suitable and striking, and which, while exceedingly artistic, performs exceptionally well the utilitarian function of indicating what is contained within the covers. It is somewhat remarkable that Mr. O. P. Moller, who submitted the winning design, also succeeded in carrying off a similar prize in the competition held last year for a design for the Institution Medal.

Designs were submitted by the undermentioned gentlemen, and in view of the high character of the designs submitted by the four gentlemen who have been commended, the Board of Editors have forwarded to them additional (consolation) prizes of 10s. 6d. each.

RESULT OF COMPETITION.

O. P. Moller, London, Prize, three guineas.

C. P. Armstrong, Newcastle-on-Tyne.
W. J. James, London.
J. Mawson, Sheffield (2).
E. W. Pettit, London.
} *Commended.*

F. Bate, Birmingham.
A. L. Blackstaffe (2), London.
B. C. Bouquet, London.
F. H. J. Bunt (2), London.
O. Dawson, London.
R. H. Ellis, Newcastle-on-Tyne.
W. E. Gibbard, Cambridge.
H. Gusterson, London.
H. J. Loney, London.
W. V. Ryder, Lincoln.
W. Simpson, Barrow-in-Furness.
A. F. Shaw, London.
A. C. Smith (2), London.
W. E. Trist, Brighton.

Reproductions of the designs submitted by Messrs. Armstrong, James, Mawson, and Pettit, are shown upon page 63.

J. MAWSON.	C. P. ARMSTRONG.
W. J. JAMES.	E. W. PETTIT.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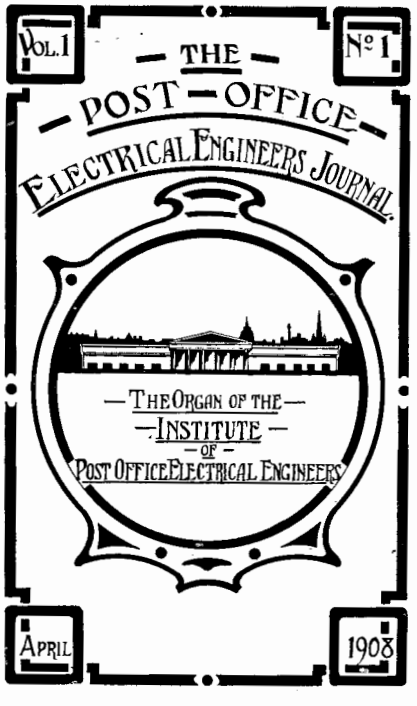
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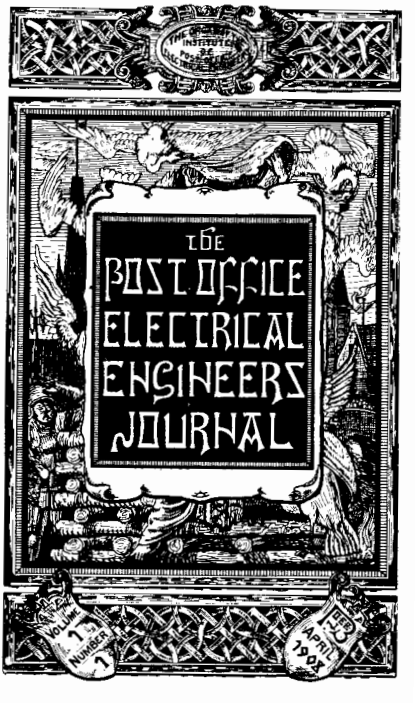
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THE AWARDS COMMITTEE.

THE scheme of awards for suggestions which has for some time been in operation in the Post Office Factories is now, by the direction of the Postmaster-General, extended to apply to all officers of the Department other than those on clerical and supervisory classes. Considerable advantage has been taken of this concession.

Suggestions tending to greater economy in production or increased efficiency, new designs of tools, improvement of existing tools, new designs or improvements in machines and apparatus, alterations in methods of manufacture, saving of waste materials, means of utilisation of cheaper forms of materials, prevention of accidents, etc., may be submitted to the Committee.

The scheme is not confined to the Telegraph Service, but applies to the whole of the Post Office.

Some 600 suggestions were dealt with up to the end of last year; of this number 101 have been adopted or have led to some improvement in practice.

Awards ranging from 5s. to £10 have been made in 196 cases, representing some £185.

A summary of the most important items may be of interest.

Case No.	Name.	Subject.	Award.
4	D. J. Ross, Holloway	Coin Collecting Box—improvement for ensuring correct registering.	£3
8	E. H. Hebden, do.	Trunk Time Check.	£2
9	W. Coleman, do.	Switch, 6-terminal, 2-position, to act also as 7-terminal, 2-position.	£2
21	W. N. Harradine, do.	Tool for painting labels.	£5
22	G. H. Willmot, do.	Fibre Cases for Detectors.	£2
29	C. S. Bull, S.W.D. Office	Improvement in working Telephone Switch Boards.	£3
94	G. T. Willmot, General Factory	Cable Grip, improved method of construction.	£2
97	F. W. Newman, Basingstoke	A. B. C. Communicators, improvement in collecting spring.	£2
106	M. W. S. Tetmeky, Holloway	Press Tool.	£5
115	Do. do.	Improvement in Press Tools.	£10
148	S. A. Colles, do.	Headgear Receivers and Sounders, improvement in ball-socket fitting.	£2
166	W. N. Harradine, do.	Tool for use with Engraving Machine.	£2 10s.
262	C. N. Singleton, H. Wilson, Reigate	Cycle Carrier Guard (Postal).	£2
317	Wm. Clarke, S.C. & T., Exeter	Concentrator Switch, improvement of Plug and Socket on Plug Keys.	£2
334	M. W. S. Tetmeky, Holloway	Design for Press Tool.	£2
358	H. G. S. Durrand, do.	Trunk Time Check.	£3
366	T. Russell, Sorter, I.D.	String Holder (London Postal Service).	£2
458	A. E. Petty, Mechanic, Met. Central	Murray Creed apparatus, improved spring for operating clutch on Printer.	£2
542	H. Piles, General Factory	Jointers' Stoves, Auto-byepass.	£2
646	C. J. Evans, Met. Cen. Dist.	Curved linings for Cable Distribution Heads.	£4

The 196 cases receiving awards were contributed by:—

The Factories	129
Engineering Department . .	33
Postal and Telegraph Services . .	32
Controller of Stores . . .	2
	196

It will thus be noted that, despite the fact that only the minor staff of the Engineering Department may submit suggestions to the Committee, a constant stream of suggestions for the improvement of apparatus and methods is being received at Headquarters from all districts. It would be difficult to find a parallel in a commercial undertaking, and the facts tend to show how great is the amount of zeal displayed by the staff.

INTERNATIONAL TELEGRAPHY!

A LAY FROM THE CABLE ROOM.

When "A and Z" becomes the wail,
'Tis London answers why;
Because no Hughes' machine *can* fail
Beneath a foreign sky! . . .

"Blanks," says the Teuton overseas;
"I'm running out," says he.
"Now, no blank nonsense, if you please—
But just attend to me!"

With "blanks" and "ints," with "ints" and blanks"
We lose the shining hour;
And little meed of fruits or thanks
Repays our wasted power!

Sometimes each instrument we take
Seems burdened with a curse;
For every signal that we make
"Comes better bad than worse!"*

Till e'en the gummer owns his pain . . . . .
But lo!—a change of cheer!—
We call our foreign friend in vain.
"He goes to get much beer!"*

And when at length is drained the flask
Wherewith that sinner sinned,
"What is your weather, sir?" we ask.
"Few rain and any wind!"*

Oh, shades of David Hughes, the great,
And Kelvin, famed afar,
How restful is thy last estate—
No cables where ye are!

ED. E. BAUGH.

LOWESTOFT RELAY OFFICE.

* Words literally used over the wires.

"HOWLERS, TECHNOLOGICAL."

By EXAMINER.

I PROPOSE in this and in some subsequent issues of the JOURNAL to give a few "Howlers" taken from actual examination papers set in Telegraphy and Telephony. Except where only quotations are made, the answers are given in full, the language and punctuation of the candidate being used.

Whilst the Howlers may afford some amusement to readers generally, they may serve a useful purpose by showing to those readers who are teachers how it is that some students fail to obtain certificates.

Question: Describe the ordinary method of laying underground telegraphs.

Answer: The wire is drawn through a hole in the ground and at certain distances there is an opening so that the wire can be seen all the more easily.

Question: What is meant by the "specific resistance" and "specific electrostatic capacity" of an insulating substance, and how can they be measured?

Answer: The specific resistance is a constant abstract comparative quantity and does not vary as or inversely as sectional area, mass, etc., etc.

Specific electrostatic capacity is the capacity of, as it were, sucking up the electrification due to a current, so to speak, of electricity.

I do not know how they can be exactly measured, but I should think that perhaps if a current were made to tend as it were, to pass through them and a galvanometer put in circuit, the amount of leakage from the insulator to earth could be calculated mathematically.

(Here followed a rather elaborate sketch of a galvanometer with a battery and a coil of wire in circuit.)

Question: Describe any form of dry battery, and illustrate the same by a sectional sketch.

Answer: A dry cell is a moist cell without any *liquid*. It is always a modification of the Leclanche, and the *z*inc plate is in all cases the containing vessel, so to speak. The exciting *fluid* is jellied, being generally a mixture of ammoniated chloride, gelatine, plaster of Paris, flour, and indeed anything that tends to keep moist without making a mess. The whole is pitched over the top.

A still more dry (!) answer was given by another candidate, who stated that: "A magneto generator may be said to be a 'dry' battery, and consists of several horse-shoe magnets placed parallel." This

was followed by a rather elaborate sketch of a generator, and the candidate ended his attempts to answer questions by informing "Mr. Examiner" that he had no time to finish.

Question: Describe the various methods of providing against damage to apparatus by lightning, and state which is the best.

Answer: The only reliable method is to cover the whole apparatus with a conducting metal and connect all to earth.

(An exactly similar answer was given by another candidate from the same town. It is evidently inadvisable for teachers to indulge in extreme language.)

Another answer to the same question was as follows: "The best way is having an instrument which has a patent for lightning at each end of its circuit in the same room."

Question: What are the relative advantages of single and double current Morse working?

Answer: D. C. working is better. It is one of the grandest inventions in telegraphy that has ever been made. In fact it is through this invention that others on the same lines has been invented with this working instrument.

Question: What should be the breaking stress of a wire 250 mils. diameter, in order that this may be equivalent to a breaking stress of 30 tons per square inch?

Answer: The Breaking Stress = 30 tons per square inch

$\therefore$,, ,, ,, = $7\frac{1}{2}$ per inch

or one inch Breaking Stress is $7\frac{1}{2}$ tons,

$\therefore$ on $250 \times 8 \times 40 \times 5\frac{1}{2} \times 3 \times 12 \times 7\frac{1}{2}$

$$= \frac{250 \times 8 \times 40 \times 11 \times 3 \times 12 \times 15}{2 \times 2}$$

= 118,800,000 tons.

Elaborate but mixed and rough calculations covered a page and a half of foolscap, and this being the last question attempted by the candidate, he finished with—

"Respectfully submitted as the best work of your humble servant

John P—."

POST OFFICE ENGINEERING DEPARTMENT, LONDON.

Fifth Annual Dinner.

The above dinner was held at the Grand Hotel, Trafalgar Square, on Tuesday, February 18th, Major O'Meara, C.M.G., R.E., Engineer-in-Chief, presiding.

The guests of the evening included the Right Hon. Sydney Buxton, M.P. (Postmaster-General), Mr. Babington Smith, C.B., C.S.I. (Secretary), Mr. A. F. King, Mr. H. S. Carey, Mr. A. M. J. Ogilvie, Sir John Gavey, C.B., Sir John Cameron Lamb, C.B., C.M.G., Hon. R. D. Denman, Lieut.-Colonel Price, C.M.G., Dr. Glazebrook, Dr. Walmesley, Mr. G. Morgan, Mr. A. E. Eames, Mr. J. Kingsbury, Mr. H. Hirst, Mr. J. W. Willmot, etc., etc.

After the Royal Toasts had been duly honoured,

Mr. Sydney Buxton, in proposing the toast of "The Engineering Department," said:

The toast which has been given to my charge is "The Engineering Department." It is also the toast which I think I had the honour of proposing last year, and I can only say that it has given me very great pleasure, as the momentary head of this great public department, to be able to accept the kind invitation conveyed to me to be present here this evening, because I think that these functions have great merits in the fact that they bring together all those who are working for the public interest in such a great department as the Engineering Department of the Post Office. Now, since we met last year, I think we have experienced a loss, inasmuch as we have lost Sir John Gavey, but I am glad that he is going to remain and retain a continued interest in the Engineering Department of the Post Office, because, like Sir William Preece when he retired, we have retained Sir John Gavey, I need hardly say at an enormous fee (laughter), to keep a watching brief over various matters which may occur in the future (applause), one of which—perhaps the most serious of which—will be the tussle which we shall have with the National Telephone Company in 1911.

Now, I am afraid that I have to confess, as head of the Post Office, and therefore head of the Engineering Department, I am afraid that I have to confess that of late we have put rather an extra strain on our Engineering Department. I wish to recognise to the full the zeal which has actuated the members of this department in carrying out the duties allotted to them, in some cases under severe strain and severe pressure. It is our desire—we have already plans for alleviating that strain—it is our desire to alleviate it still more in the future. As you know, the work of the Telegraph Department

has grown rapidly, and as you know, principally as members of the Post Office Service, revisions are not of the most rapid description (laughter), and the work always grows quicker than it can be carried out. Still, I do appreciate that in London, and still more in the provinces, there has been a certain amount, and in some cases a considerable amount of over-pressure, which we hope to be able in future to largely alleviate. (Hear, hear.)

You in the Engineering Department have two difficulties in the way of carrying out your duties to your country: one is the question of wayleaves, and the other is the question of money. (Hear, hear.)

On the question of wayleaves, I am endeavouring—not, so far, with great success—to pass a Bill through the House of Commons, which will give us greater powers of dealing with the obstruction of individuals who so often obstruct our telephone and telegraph lines. (Applause.) I confess I think it is a monstrous thing that a capricious individual—because in these cases it is nearly always a capricious individual, not a man who has the public interest at heart—that a capricious individual is able to obstruct our progress, and, to use a term familiar in the Post Office in other directions, to "blackmail" us if he allows us wayleaves at all. I am glad to think that, apart from an Act of Parliament dealing with these gentlemen, we have been more successful than usual of late in dealing with obstructive and capricious local authorities. I wish Sir Robert Hunter was here this evening, because I would venture in the various actions he has brought during the last two years, I would venture to compare him to Wellington, who never lost a gun. (Applause.) Sir Robert Hunter has brought many actions in the past two years against local authorities, and I do not think he has lost a single one of them. He has also made them pay the cost of the actions. These are the obstructions of the local authorities with whom you gentlemen have to deal. There is, as I said, another body also with whom we have to deal, and that is the Treasury. Some people think that the Postmaster-General, in this matter, has considerable power and authority, but the Treasury is far and away above the Postmaster-General. It reminds me a little of the picture in 'Punch' in the old days, one of Du Maurier's, I think, in which a bishop's page-boy, having committed some delinquency, the bishop is chastising him and is utilising the occasion for a little moral sermon, and he says to the page-boy: "Who is it whose eye is ever upon us, and before Whom even I am but a crushed worm?" And the page-boy says: "The missus, my Lord." (Laughter.) I am afraid that the Treasury is our "Missus" in this regard. However, in spite of the restraining eye of the "Missus," I am glad to think you are able to make considerable strides in the direction of the extension of the telegraphs and telephone lines and wires. (Applause.) I doubt if it is appreciated

outside, the enormous extent of the work carried on by the Engineering Department of the Post Office, because I find that in the last twelve months no less than 123,000 miles of telegraph or telephone wires were laid in this small island of England, and that, of course, includes Scotland. (Laughter.) That, I think, shows the great work that you are undertaking. (Applause.) Of course, most of that is telephone work.

There is one further matter on which I should like to congratulate Major O'Meara, whose presence in the Chair this evening we all much appreciate, and that is the great success which, I understand, is following the Institution of Post Office Electrical Engineers under the auspices of the Engineering Department. That, I think, is a really great step, and it is already founded on a very sound basis. And it seems, as far as one can judge, that it will be of very great advantage to the Engineering Department as a whole. (Applause.) The number of members is already great, and Foreign and Colonial members are now asking to join. One thing about it is that, like so many Post Office Associations of that description, while it is assisted to a certain extent from headquarters, it is entirely self-managed and practically self-supporting, and is run by those who are really interested in the matter. (Applause.) That is the only way in which an institute of that sort is likely to be a success.

I have to give you "The Engineering Department." I take it that nine tenths of you belong to the Engineering Department, and therefore, when I give you that toast you must not receive it with cheers, as that would only be a sort of self-praise. (Laughter.) I see one or two of us who are not members—like the Secretary, Mr. King, and others—and to them I give the toast with the greatest possible pleasure and gratification. I give to them the toast of the "Engineering Department." As far as we are concerned we will drink it with all the honours, because we feel that the Engineering Department of the Post Office is not only a great credit to the Post Office, but also to the nation at large. (Loud applause.)

Major O'MEARA, responding to the toast of "Engineering Department," said:

Mr. Buxton and Gentlemen: We had hoped to have had Sir William Preece with us this evening. Unfortunately this morning I received a letter from him in which he says: "I am very sorry to say I cannot come to the Dinner to-morrow night. I am just recovering from a very bad chill, and my doctor forbids my going out this week." On behalf of the Engineering Department I have to thank you, Mr. Sydney Buxton, for the very kindly manner in which you have proposed the toast of the evening. I feel sure that my colleagues very much appreciate the very kind words in which you have proposed this toast, words which afford us very much

encouragement, coming as they do from the great Chief of a very great Department. We also appreciate, sir, the fact that, with all the calls on your time, you have paid us a very great compliment by being with us this evening. (Applause.)

These annual gatherings have offered opportunities for reviewing the work done by the Department. Last year our gathering was something more than a family party. Prominent people connected with our profession seized the opportunity and made it an occasion to do honour to a retiring chief, whom we are very glad to see with us to-night. (Applause.) I am sure that the announcement that the Postmaster-General has been pleased to make, that Sir John Gavey is still going to have an active interest in our work, and is going to place his very large and varied experience at our disposal, has given you all very great pleasure. (Hear, hear, and applause.) When last we met as a family party last year we were not able to discuss our domestic affairs. The phenomenal growth which has been referred to at these meetings has been continued. What has been referred to as the great transfer is still the great problem which has to be tackled by us. Our appetite has been slightly whetted since our last annual dinner, for we have already swallowed up the municipal undertakings in Glasgow and Brighton. The Postmaster-General has told us of his dealings with the Treasury. And I think it only shows that he has got some of the qualities of my own countrymen—persuasive eloquence. For he has succeeded in getting funds, and he has been able to do a great deal, not only in the matter of telephonic development, but also in providing for the extension of the underground schemes in which we have been so interested during the last few years. A great deal has been done in Scotland, the North of England, and in the West in order to provide the necessary security during storms in regard to our telegraphs. In the period which has passed, of course, we have had also to carry out the trial and examination of many new inventions. The course of progress of our service and the protection of the public purse depends very largely on the care and thoroughness with which this duty is carried out, and also upon the correctness of the conclusions which are drawn from the practical trials which take place. I think that those who know something of the inner working of our Department are quite prepared to acknowledge that it is due to the successful manner in which our engineers have carried out these duties, coupled with their own inventive genius, that the British Telegraph Service to-day is acknowledged throughout the world to occupy the premier position. (Applause.) In matters telephonic our cousins across the millpond are supposed to take the lead. Well, gentlemen, we all acknowledge that we owe a great deal to our cousins, but we also feel that our engineers have not been content to be simply followers. They

themselves have in matters telephonic also exerted their ingenuity, and there are many devices in use to-day in this country which have been devised by our own engineers, which certainly do very much to improve the telephonic communication and at the same time cheapen the cost of the service. When I enter one of our large telephone exchanges or even one of our repeater stations, I often picture the different stages in which I have seen ideas which finally have produced the mechanism which our colleagues in the operating department are employing to so regularly and smoothly deal with the traffic. On these occasions I am reminded of Owen Meredith's lines :

> "Not a truth has to art or to science been given,
> But brows have ached for it, and souls toiled and striven."

It is on these occasions that the truth of these lines, as applying to the work of our own engineers, come sharply home to me.

We all recognise that the Postmaster-General, as he has told us this evening, is desirous that our telephone undertakings shall be carried out on commercial lines. There are many of you present here to-night who I know have studied the commercial aspect of this question, and that you have studied this question with a certain amount of success I know is true. I am ready to say myself from what I see that your investigations are producing very valuable results. I can tell you this from the fewer demands that I have for additional maintenance staffs. Well, gentlemen, I fear that there are small grounds for anticipating in the coming year that our engineers will be less busy than in the present year. I do not think we shall have much time for meditative exercises. We still have, of course, a great deal of work to carry out in connection with telephone trunks and telephone exchanges. Heeltaps on the 31st March will amount to something over £850,000. We have to carry out the completion of the Western underground. I think by the end of the next financial year we ought to reach the cable landing places near Penzance. And the Postmaster-General has promised the good people in the North that he will proceed with the underground between Newcastle and Leeds. But we have received authority this year to do something more than that. The Postmaster-General has decided to link the old northern route and the new western route, and the first sod has been cut in a length of underground line from Bristol to Worcester. I do not think it requires me to be much of a prophet to suggest that some further work is likely to be authorised in that direction during the next year. The Postmaster-General has referred to wireless telegraphy. Of course, you all know that on the 1st July, if the British Government adheres to the International Radio-Telegraph Convention, new duties and responsi-

bilities will be thrown on the Post Office. As the Postmaster-General has told us, some share of these duties will certainly fall to the lot of our engineers. Now I come to a matter of personal moment to you all. During the past few months many changes have taken place. I am glad that some of them have distinctly improved your prospects. By the recent revisions and changes there has been an increase in the establishment, of higher appointments both on the engineering and clerical sides. I know there has been a rumour afloat for some time past that a great scheme of devolution is going to be carried out. I have no particular information on this point which is not open to the man in the street. I feel sure that none of you will shirk any additional responsibilities; in fact, I feel sure that you will welcome any additional responsibilities which may be placed upon you in connection with the devolution scheme, and that you will make any such scheme a very great success. We are not quite unprepared for some change of this kind, for in 1904 a reorganisation scheme was carried out which had devolution in view to a certain extent. I have been looking into the working of that scheme, and I may say that from most quarters I learn that people are satisfied with the scheme. It is a scheme which is likely to be a very successful one, and I think we can go one better. In 1904 we had first-class sections and second-class sections. My recent investigations, I think, show that we can get rid of some of the second-class sections, in fact—get rid of them all. I think we can afford to have only first-class sections. What that will mean to most of you I do not think I need say. I have expressed confidence in the successful issue of any devolution scheme, for I know how whole-heartedly the members of my own staff and those of the districts will apply themselves to any scheme which may be placed before them. I think there is plenty of evidence to show that there is quite sufficient *esprit de corps* to make any scheme a success. If any further evidence is necessary, I can only refer to the fact that at our first annual dinner Sir John Gavey offered us some valuable advice, pointing out that the demands of the future make it necessary that we should acquire the highest possible technical and scientific knowledge. The idea was taken up at once, and as a result we have to-day the Post Office Institute of Electrical Engineers, to which the Postmaster-General has referred. I think it must be very gratifying to all those who have taken such an interest in the birth and nursing of this Institute, to find that the educational work of this Institute, although it is only in its second session, is so widely recognised. I must say I should very much welcome the addition of honorary members to our ordinary membership, and I think we shall be doing an imperial work, for I think that the accession of

honorary members will be only the addition of another of those silken cords which bind our empire together. In connection with our Institute we are now going to have a journal. I think that the scope of the Institute is very clearly shown by the circular issued showing the many subjects under which those who will do so can contribute articles to help forward the success of this journal. In addition to the educational value, I have no hesitation in saying that the existence of the Institution plays a very important part in fostering feelings of good fellowship. The Postmaster-General has remarked that in a big service like ours there is a great deal of good comes from our meeting one another. I have for a long time felt that all those who have to work together should play together. Of course, in a big city such as this we are compelled to live widely scattered. We have to hurry up by an early train to get to our work, and then in the evening we dribble away as each one is released from his work. We cannot march away together like an army. We have not that opportunity of social intercourse which is provided in many other callings. This matter of playing together was brought home to me many years ago. I was with the Post Office at the time. I had to call on an old gentleman, one of the old school. He gave me what I asked for—a consent for poles, and then he gave me some advice. I may say I have always felt grateful for the advice given on that occasion. He told me he had a partner, and he said: "During the week I am afraid we jangle a bit; can't help it. But ever since my partner and I have been associated together we have made it a practice every week-end in our life to go away out of town together to wipe away the jangles, and begin with a clean slate on Monday morning." Well, I often feel that we ought to be able to do this too, but we are a very large family with many partners, and there are not many hotels that would accommodate us if we left our work in that way. Now, in connection with the Institute, I have a very strong hope that some day the Institute and these dinners will pave the way to the foundation of a club where we can meet together, and where not only officers stationed in the provinces may meet those doing duty in London, but where, also, officers may come who have retired from the service. I think that in this way feelings of brotherhood in our grand service will be strengthened, and I think it is only right that this should be so in the service which does so much to promote good understanding between individuals and nations. Well, gentlemen, I can only say we thank the Postmaster-General for the very kindly way in which he has proposed this toast and our friends for the very hearty manner in which they have received it.

Mr. NOBLE, in proposing the toast of "The Visitors," said:

We are pleased particularly to have with us the Postmaster-

General. We fully appreciate the inconvenience and sacrifice the Postmaster-General has made to spare an evening during the pressure of a Parliamentary Session, more particularly as we are aware there is an unprecedented amount of administrative work at the General Post Office.

We are very pleased to-night to have an ever-welcome guest in Sir John Cameron Lamb. (Applause.) Sir John was always known as the friend of the telegraphs, and I am sure that he will be pleased to know that since his retirement it has been abundantly proved that he left behind him two other very good friends of the telegraphs—Mr. King and Mr. Carey. Gentlemen, the telegraphs have a younger, robust, and rapidly-developing sister in the telephones, and here, again, the Department is fortunate in having at its head another able officer, Mr. Ogilvie, who is also with us this evening. (Applause.)

There is only one other name that I have to mention, and although I mention it last it is by no means the least. I refer to our Secretary, Mr. Babington Smith. (Applause.) I have left his name to the last because it has been our privilege each year to couple his name with the toast of the guests. Mr. Babington Smith's qualities and qualifications are too well known for me to mention them; indeed, it would be unbecoming of me to do so. They are known wherever the Postal Union extends. As an engineer, however, I may be allowed to say how proud we engineers were to hear of the high reputation he gained for himself at the International Wireless Convention.

Before sitting down I should like to say, although it is no part of my toast, that we are pleased with the suggestion of the Chairman that we might form a Club. We all feel that it is not sufficient to meet socially once a year, and the idea of a club is a good one. It has been suggested to me by a friend on my right that we might include the officers of the National Telephone Company, and I think this, too, is a good suggestion, as we might in this way get some useful information. (Laughter.) Gentlemen, in the name of the Engineering Department I ask you to be upstanding, and coupling with the toast the name of Mr. Babington Smith, drink to our guests.

Mr. BABINGTON SMITH, in reply to the toast of "The Visitors," said:

A serious responsibility always lies upon the person who has to return thanks on behalf of "The Visitors," in that he has to represent a large company of distinguished persons. I think I shall best discharge that responsibility if, on behalf of every one of them, I thank you very cordially for your kindness in inviting us to take part in your dinner this evening, for the terms in which this toast has been proposed, and for the hearty way in which it has been received. (Applause.) I should just like to add a few words of thanks on my own behalf to Mr. Noble for the very kind way in which

he spoke of myself. It is a very great pleasure for all of us to be here this evening, and to be able to take this occasion of welcoming your Chairman at the first dinner of the Engineering Department over which he has presided as Engineer-in-Chief. (Applause.)

Gentlemen, among your guests you have the producers of raw material for your work in the representatives of the factories and the stores. You have also representatives of the branches of the service that may be described as your consumers—branches which use the material that you provide—and looking at the Engineering Department as the indispensable link between these parts of the great machine of the Post Office, I think it is, perhaps, not too much to say that it is the most indispensable part of the machine. (Applause.)

I can imagine very easily someone saying that the Telegraph and Telephone service could go on very well without a Secretary. (Laughter.) I can even conceive somebody suggesting that the machine would continue to work—if I may be permitted to whisper such a heresy—without a Postmaster-General. (Laughter.) But it cannot get on without wires and instruments and without an Engineering Department to erect and maintain them. (Cheers.) I think, therefore, I am not far wrong in regarding your service as perhaps the most indispensable part of the whole Post Office machine, and as that indispensable part we naturally expect great things of you. (Hear, hear.) We are all endeavouring to carry on the great service of which we form part on efficient, economical, and commercial lines. To give one instance only, the Postmaster-General has mentioned the question of telephone rates which is engaging much of his attention at present. For the solution of that question, or of any other question of that nature, and I think I may say for all questions affecting the proper development and conduct of the service, one of the prime necessities is a full, precise, and accurate knowledge of the cost of each operation. (Hear, hear.)

Steps have been taken and are still being taken by the Engineer-in-Chief to provide machinery for arriving at fuller information on these points. I fully understand that the work thus thrown upon engineers may not be congenial, since their heart is naturally and properly in what they regard as their own proper work. Still, I feel sure that the Service realises that the accounting side has its great importance too, and that in that, as in all other respects, we can rely on the engineering service performing the functions that are entrusted to it with the same zeal and the same efficiency which it has always shown in the past. Gentlemen, I will only conclude by wishing success and prosperity to the Engineering Service, and success and prosperity to everyone of you individually, and may each one of you in due course rise to be Engineer-in-Chief. (Loud applause.)

Mr. H. R. KEMPE, who was received with loud and prolonged applause, in rising to propose the toast of "The Chairman," said:

I have very great pleasure in proposing the toast of our Chairman.

Major O'Meara has always taken the very greatest interest in matters, not only which concern the Department as a great State institution, but also in all matters which concern the interests of the staff under his command. The German philosopher Sulzer has stated that pliability without firmness is weakness, but firmness without pliability is foolishness, and, indeed, is stupid obstinacy. I feel that Major O'Meara has made that saying one of his guiding principles, for while he has always shown that firmness which is so necessary in order to control a large department, he has at the same time shown that tactful pliability without which the smooth and harmonious working of the department is quite impossible. (Applause.)

Major O'Meara on more than one occasion has expressed his desire that all members of the staff should, as far as possible, see eye to eye with him. If each individual member of the staff had such a personal knowledge of him as I have the pleasure of having, I feel sure they would do all they possibly could to further his wishes in that respect, and, further, that they would take him as an example of what a hard worker and one devoted to the Service should be. By continual and constant attention at all our meetings, whether it be a meeting in which Departmental matters alone are discussed, as, for example, the meeting of Superintending Engineers, or on a semi-official occasion, such as that of our Institution of Post Office Electrical Engineers, or of a social character such as, for example, our Chess Club, Major O'Meara has, except when he has been called away by official duty, never failed to attend, and in this respect I think we owe him our esteem and admiration.

Gentlemen, the toast is our Chairman.

Major O'MEARA, in replying to the toast of "The Chairman," said:

I have been very much touched by the kind words that our dear friend Kempe used in proposing the toast of myself. I feel, gentlemen, that it must have been my destiny to come to the Post Office. I can remember it was nearly twenty years ago when I first came to the Post Office. It may be interesting for you to know, perhaps, the conditions under which I came to the Post Office. I was a young subaltern then, stationed at Portsmouth. I was very much interested in military matters. I did not think of anything else at that time. I had gone away to Germany to go over the battlefields of Napoleon, and, apparently, whilst I was abroad my colonel wrote to me, asking whether I would like to go to the Post Office telegraphs. Well, I was travelling about, and that letter did

not reach me. I got back to my head-quarters, and I found waiting for me a communication from the Commandant at Sandhurst offering me the position of instructor at the Military College. At that time I was very anxious to go to the Staff College. My duties in some respects put me in a position similar to that in which you find yourselves. I had no time for study. I felt that, holding an instructorship, I should be learning something myself whilst teaching my pupils. I wrote to the Commandant saying I would call on him. Meantime I got a letter from my Colonel saying that he had sent me a communication to Germany, asking whether I would go to the Post Office telegraphs, and that he had received no reply from me. I did not know what to do; I found it difficult to choose between this instructorship and the Post Office telegraphs. Well, I knew there was an officer in the Command who knew something about the Post Office telegraphs, and I went to him and told him I did not know what to do. I had the offer of two appointments, which does not often happen to young men. I had been asked to go to Sandhurst and I had been asked to go to the Post Office. "Are you thinking of getting married?" he said. "If so, go to Sandhurst; if not, go to the Post Office." (Laughter.) I have often thanked my lucky stars that I was not thinking of getting married, and that I went into the Post Office. And I may say that in my career after I left the Post Office I have felt grateful for the experience I had had in the Post Office. That is the first occasion on which I came to the Post Office. On a later occasion, six years ago, I was in this country temporarily on leave. My leave was very much prolonged because I was asked to carry out some duties for the Government under which I was employed at that time, and that had a very fortunate result for me. Finally, the business I had to carry out was finished. I had gone into the Union Steamship Company's office and bought a ticket for South Africa. That was at one o'clock. At two o'clock my train was due to leave Waterloo Station. On my way there I came across the Consulting Engineer of the Post Office. He said: "What are you doing?" I replied: "I am going back to South Africa." He then said: "There is an appointment vacant at the Post Office which we want you to take. Haven't you heard about it?" I replied that I had not heard about the vacancy. Sir William Preece then requested me to postpone my journey, and see him again at four o'clock that day. I did so, and that is the reason why I am here to-night.

Gentlemen, I must say I have to thank you heartily for the very kind way in which you have supported me this evening. I do not think I need repeat how very much I have the interest of you all at heart, and I think you may rely on me to do the best for you all. (Applause.)

OBITUARY.

THERE died at 3, Southwood Avenue, Highgate, N., on Monday, February 17th, 1908, William Robson Smith, retired Post Office Electrical Engineer, at the age of 56 years. It is with great regret that we have to make the above announcement. Mr. Smith was born in Elgin, N.B. Early in life he started upon his travels as a journeyman watchmaker, in search of his fortune. He reached Newcastle-upon-Tyne in 1872, a modest young man with an apparently impassive countenance. He was given employment in the mechanician's shop of the Postal Telegraph Department. Having obtained a foothold he set to work to acquire electrical knowledge, and by sheer merit won the foreman's position in the workshop, which he reorganised.

As one of the pupils of Mr. A. W. Heaviside (then the lecturer to the City and Guilds Institute) he won the Silver Medal for Electricity, Magnetism, and Telegraphy. Eventually he became a lecturer himself under the City and Guilds Institute. Steam and pneumatics were then added to his studies.

In May, 1877, he and a colleague, always seeking knowledge, made, from a description in the 'English Mechanic,' perhaps the first telephone made in Great Britain. From that time forward, for many years, he became one, of two, of Mr. A. W. Heaviside's ablest assistants in pioneer practical telephony, firstly amongst switches and apparatus, and secondly as Engineer-in-Charge of the Newcastle exchange and the west section of the Newcastle district.

Later his ability carried him to London to become Engineer-in-Charge of the Central Telegraph Office, with its batteries, telegraphs, chronopher, engines, and pneumatic systems. Here his organising ability was shown to advantage, and also his mechanical skill. He redesigned the pneumatic valves, introduced an important improvement in the Pneumatic Tube Signaller, and carried out the rearrangement of the terminations of the main tubes in the Central Telegraph Office which brought them to their existing state. He also carried out the entire re-wiring of the Central Telegraph Office. This involved the removal of an enormous accumulation of gutta-percha-covered wire and its replacement by lead-covered cable. This difficult work was carried through entirely without interruption to the ordinary traffic.

Lastly, when the Post Office took up the telephone in earnest he was associated with that work in a very active manner, and became Assistant Superintending Engineer in the Central District, London.

His health failed in 1901, when he retired. Only his intimates knew and appreciated his merit as an engineer, a shy manner hiding an ability to design and to do things which were quite above the average.

A. W. H.

JOHN HENRY CORDEAUX.

We much regret to have to record the death, at the age of 66, of Mr. John Henry Cordeaux, late of the Postal Telegraph Department. Mr. Cordeaux, whose name is well known in connection with the "Screw Insulator," devised and patented by him, and which is almost universally used in the United Kingdom and also largely elsewhere, was born in 1841. In 1854 he entered the service of the Electric and International Telegraph Co., and was for a long period stationed at York. In 1870 he was appointed, on the transfer of the telegraphs of the United Kingdom to the State, as Inspector in the Engineering Department, at Birmingham, under the late Mr. E. Graves, in which capacity he devised the screw insulator. In 1878 he was transferred to the Engineer-in-Chief's Office, London, under Mr. W. H. Preece (now Sir W. H. Preece, K.C.B.). In 1883 he was promoted to the position of 1st Class Technical Officer, and subsequently, in 1898, became Acting Principal Technical Officer. In 1898, owing to ill health, Mr. Cordeaux retired from the Service, to the great regret of those with whom he had been so long associated. By Mr. Cordeaux's death another link of the very few remaining which connect the days of the old Telegraph Companies with the present State system, has gone. H. R. K.

The closeness of past friendship with Mr. Cordeaux makes me welcome an opportunity of paying a last tribute of love and respect to one whose kindliness of heart was always level with his business capacity. J. H. Cordeaux was, I believe, the "straightest" man I ever knew. This, in spite of the fact that he seemed to be almost entirely devoid of any religious instinct, which is *the* factor that keeps so many of us from being very wanting in this important virtue. Those who knew him at his prime remember him as constitutionally impetuous and impatient in his manner by sheer force of energy; and it was a revelation, when his painful illness had at last got the mastery of his body, to find him the most patient of invalids, the least exacting, and the most considerate.

The death of his wife left him the sole care of his two daughters, and he set himself to the task with a devotion that, while it secured an answering love and devotion from them, also increased the loving esteem in which he was held by those who were privileged to be counted among his friends.

Now that after years of suffering, heroically borne, he has passed away, rightly and right lovingly may we say for him, "*Requiescat in pace.*" A. J. S.

COMMUNICATIONS.

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