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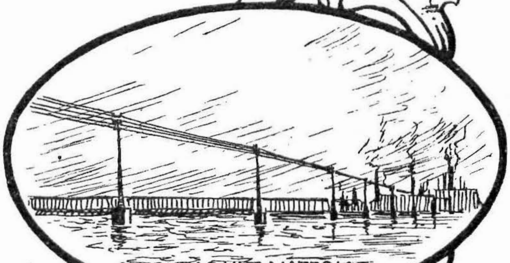


OVERHEAD LINE MATERIAL
EQUIPMENT

PRIMARY
CELLS

WIRELESS.

TELEPHONES

THE
Post Office Electrical Engineers' Journal

SUBMARINE CABLES OF THE WORLD.

In our last issue we published details of the submarine cables operated by the British Post Office. The list included the London-Halifax line, all the cables to the Continent of Europe, and also the Irish cables. In the present number we give the Great Northern Telegraph Company's cables from England to Iceland and to the northern European countries, their Baltic cables, and their lines from Vladivostock to China and Japan. The list embraces also the Pacific Cable Board's cables from Canada to Australia and New Zealand, which operate in conjunction with the London–Halifax cable and the Canadian land lines. This constitutes an "all-red" route to Australasia. We hope to be able to give later the Mediterranean routes to India and the Far East, and also details of the Atlantic cables.

TABLE II.—*Great Northern Telegraph Co.'s Cables.*

Name of circuit.	Cable sections.	Date laid.	Length in nautical miles	Cable res. in ohms.	Cable capacity in m.f.	Method of working.
						The method of working employed generally on these cables is Wheatstone automatic for transmitting with undulator reception. In the cases shown the Creed system of receiving on perforated slip and Creed printers is used.
Lerwick-Seydisfjord (Iceland)	Burwick-Sandegærde	1906	215	1388	70	
	Sandegærde-Budarøre	1906	319	2056	104	
Newcastle-Gothenburg . .	Newbiggin-Marstrand	1880	502	3284	155	
Newcastle-Petrograd I . .	Newbiggin-Marstrand	1890	520	3320	189	Creed apparatus (in Petrograd).
	Bromskärsvik-Sundholm	1911	107	683	39	
Newcastle-Petrograd II .	Newbiggin-Hirtshals Skagen-Marstrand	1873	460	2447	178	—
	Bromskärsvik-Sundholm	1869	97	516	37	—
Newcastle-Fredericia . .	Newbiggin-Søndervig	1868	346	2195	129	Creed apparatus.
Newcastle-Copenhagen .	Newbiggin-Søndervig	1913	349	1653	123	—
Fredericia-Paris I . . .	Fanø-Oye (Calais)	1873	389	2326	149	—
Fredericia-Paris II . .	Fanø-Oye (Calais)	1891	370	1439	135	—
Fredericia-Libau . . .	Liselund-Hvideodde Snogebæk-Libau	1868	308	3599	119	Creed apparatus (in Libau).
Fredericia-Petrograd . .	Rødvig-Libau	1907	320	1511	112	,, ,, (in Petrograd).
	Libau-Petrograd	1907	472	2231	165	
Stockholm-Petrograd . .	Bromskärsvik-Sundholm	1883	105	986	38	,, ,,
Stockholm-Helsingfors . .	Bromskärsvik-Varfsvik Djupvik-Sundholm	1876	88	677	31	,, ,,
Vladivostock-Nagasaki I .	Vladivostock-Shembon	1871	772	3791	358	—
Vladivostock-Nagasaki II .	Vladivostock-Shembon	1883	756	4944	259	—
Nagasaki-Shanghai I . .	Shembon-Gutzlaff Gutzlaff-Woosung	1871	490	2464	225	Creed apparatus (in Shanghai).
Nagasaki-Shanghai II . .	Shembon-Gutzlaff Gutzlaff-Woosung	1883	480	3095	166	,, ,, ,,
Shanghai-Amoy-Hong-Kong	Woosung-Gutzlaff Gutzlaff-Kulangsu Kulangsu-Deepwater bay	1871	953	4886	377	—
Shanghai-Chefoo . . .	Woosung-Chefoo	1900	516	4940	175	Creed apparatus (in Shanghai).
Chefoo-Pekin . . .	Cheefo-Taku	1901	220	1988	75	—

TABLE III.—*The Pacific Cable Board's Cables.*

Name of circuit.	Cable section.	Date laid.	Length in nautical miles.	Cable res. in ohms.	Cable capacity in mf.	Remarks.
Canada to Australia and New Zealand.	Bamfield Creek, Canada–Fanning Island	1902	3,458	6,874	1,397	Syphon recorder working with repeaters and Cox's magnifier.
	Fanning Island–Suva	1902	2,043	10,934	721	
	Suva–Norfolk Island	1902	982	8,965	319	
	Norfolk Island–Doubtless Bay, N.Z.	1902	519	4,738	172	
	Norfolk Island–Southport	1902	837	7,626	274	
	Sydney–Auckland	1912	1,251	8,363	414	
	Doubtless Bay–Auckland	1912	199	1,610	68	

A NEW WIRELESS CALLING DEVICE.

WIRELESS telegraphy and telephony have both suffered in the past for want of a simple and reliable calling arrangement which would drop an indicator or ring the familiar electric bell. There are many small isolated wireless stations where the traffic does not justify continuous attention by the operator, and a calling arrangement would considerably reduce the cost of running the station. There is also the small ship which carries wireless in connection with the regulations for the safety of life at sea, to enable her to receive distress messages when necessary, or, on the other hand, to initiate distress calls.

The coherer, one of the first forms of wireless receiver, was capable of ringing an electric bell, but it suffered from two drawbacks, viz. it required strong signals and was unstable. These disadvantages have caused it to drop out of use during the march of progress of wireless.

With the advent of the highly sensitive and stable thermionic valve, however, new possibilities have been opened, and weak wireless signals can now be amplified sufficiently to work a relay and ring a bell.

One of the difficulties of making a calling arrangement reliable is that atmospherics create impulses in the receiver which are very similar to signals, and while the human ear can as a rule distinguish between a signal and an atmospheric, a machine cannot do so. The result is that any calling signal which depends upon a combination of Morse dots and dashes is liable to have some of the spaces filled up with atmospherics, and the signal fails to register a call. For this reason, therefore, it was decided to adopt a long dash of 15 seconds duration as the calling signal, the termination of the dash causing the bell to ring. This system, as our readers are aware, has been found highly successful in connection with the calling of relay stations by the various forms of sounder silencer which have been in use in the Post Office for a number of years. With the long dash call any form of jamming or atmospherics merely assists the signal, instead of preventing it working the apparatus. They may prolong the time interval slightly, but that is of no importance. Another feature is that neither jamming nor atmospherics is of a sufficiently continuous or prolonged nature to imitate a long dash, and therefore they cannot give false calls.

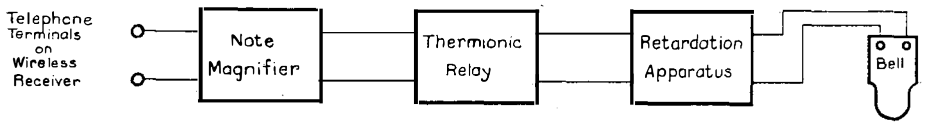


FIG. I.—GENERAL ARRANGEMENT OF APPARATUS.

The general arrangement of the apparatus for receiving the long dash and ringing the bell is shown in Fig. 1.

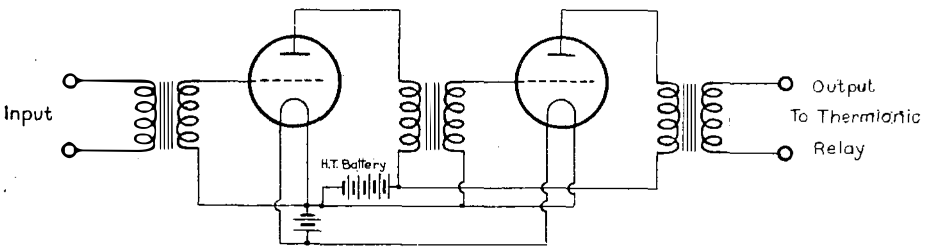


FIG. 2.—NOTE MAGNIFIER.

The chain of apparatus shown is intended to take the place of the operator's telephone receiver when he is absent and can be plugged into the telephone socket in the usual manner.

The first item, the note magnifier (see Fig. 2), may consist of one or two valves, depending upon the strength of signals received. It employs iron-cored transformers, and its function is merely to amplify up the low frequency pulses which would be normally heard in the telephone. Incoming signals are transformed on to the first grid, causing it to rise and fall in potential. These pulsations of potential cause corresponding magnified variations in the anode current, which are again transformed on to the second grid, giving it a still larger potential variation. This in turn causes a magnified copy of the variations to appear in the anode current of the second valve, which are transformed up to the grid of the thermionic relay. The result is that the thermionic relay receives a very much magnified copy of the original low frequency pulses which are the normal product of spark wireless transmission. The object of magnifying these pulses is to enable them to work the thermionic relay with certainty.

The next item in the chain of apparatus is the thermionic relay, which enables these low frequency and still comparatively weak pulses to actuate an ordinary Post Office "B" relay. Various forms of thermionic relay have been developed in the Post Office for use in connection with the calling system and also for high-speed wireless telegraphy, but the one described here is that invented by Capt. L. B. Turner, formerly of the Wireless Section, Engineer-in-Chief's Office. The diagram of Capt. Turner's relay is show in Fig. 3.

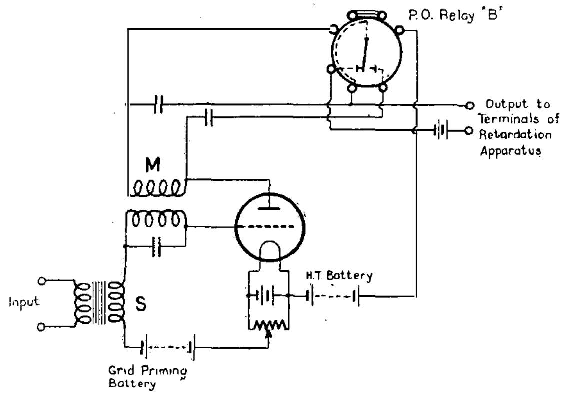


FIG. 3.—TURNER THERMIONIC TRIGGER RELAY.

The operation of this relay is as follows:

The incoming magnified signal is transformed by the last transformer *S* of the note magnifier so that alternations of potential are applied to the grid of the trigger valve. The grid circuit in this case is tuned to a high frequency, and the application of the low frequency pulse to this circuit sets it oscillating at the high frequency. These oscillations are reproduced in the anode circuit and transferred back to the grid oscillating circuit through the air-core transformer in such a direction as to assist the oscillations. If the coupling is made sufficiently close the valve is self-oscillatory, but for the purpose of this relay the coupling is weakened, and the grid potential adjusted, until the valve is just on the point of oscillation. This point is known as the trigger point, because a slight impulse, causing the grid potential to rise above the point, makes the valve self-oscillatory, and the oscillations will continue until they are quenched.

The quenching of the oscillations is effected by placing a Post Office relay in the anode circuit, so that when the mean anode current rises on account of the oscillations, the relay tongue moves over and short circuits the anode portion of the reacting coil *M*. In the diagram two condensers are shown in this short circuit path. From a wireless point of view these condensers perform the same function as a short circuit, as their impedance is very small compared with that of the coil *M*. The signal therefore causes the anode current to rise until it works the relay and quenches the oscillations. This process is repeated very rapidly, at least five quenches per Morse dot being normally employed.

Now the action of the tongue in leaving the spacing stop can be made to work further apparatus, which is shown in Fig. 4. It should be stated at this point that while a signal is on, the tongue chatters on the marking stop, and does not come back to the spacing stop until the end of the signal.

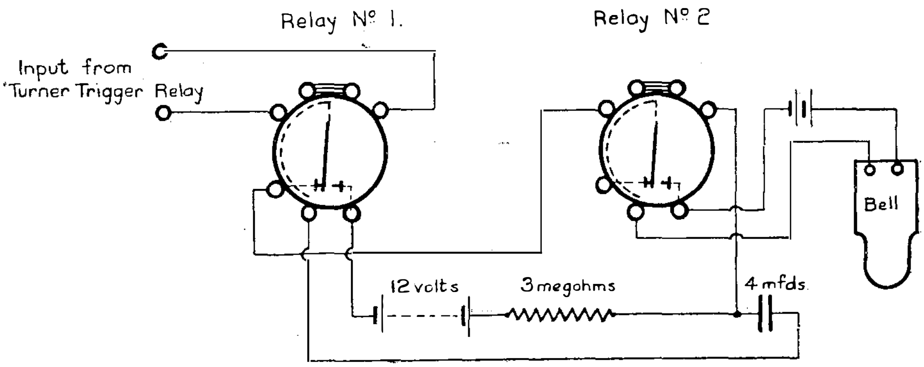


FIG. 4.—RETARDATION APPARATUS.

Relay No. 1 of the retardation apparatus is therefore moved over to marking when a signal arrives on the Turner relay. This charges a 4-microfarad condenser through a resistance of 3 megohms, which is a process requiring a considerable amount of time, measured in seconds. At the end of 15 seconds charging the condenser has acquired sufficient charge, so that when the tongue of relay No. 1 moves back to spacing on the conclusion of a call signal the condenser discharges and works relay No. 2, thus ringing the bell. If the time of charge of the condenser is less than 15 seconds it has not enough charge to work the second relay—that is, if the signal does not last 15 seconds the bell is not rung.

The complete apparatus was fitted on the cable-ship "Monarch" last summer, and was found to work very reliably. All the calls sent out by the coast stations were received, some of them through a very considerable amount of jamming and atmospherics. The range over which calls were received successfully was approximately 100 miles.

In order to give the apparatus a very severe test for working through jamming it was fitted to one of the aërials in the laboratory, which was tuned to 300-metre wave-length. Another aërial attached to the laboratory was tuned to 600 metres, and connected to a transmitter which gave 5 ampères in the aërial. On account of the proximity this induced a current of 500 milliampères in the 300-meter aërial, which was sufficient to get through the tuning circuits and work the relay. When sending in plain Morse the relay on the 300-meter circuit responded to the signals but did not ring the bell. While the Morse signals were still on, the 300-metre aërial was buzzer-excited by a long dash signal, which immediately rang the bell on the conclusion of the long dash.

One of the drawbacks of the system is that false calls are liable to be received if a station depresses its key—*e. g.* whilst tuning up. As a matter of fact the false calls from this or any other source during the six weeks' trial on the "Monarch" were remarkably few. It is possible to overcome the difficulty either by increasing the length of the dash, or by having more than one dash and a step-by-step integrating mechanism for ringing the bell after the arrival of a predetermined number of long dashes. In this case there should be a clockwork arrangement for restoring the set if the requisite number of dashes do not arrive. These precautions add to the complication and decrease the reliability, and it is not thought they are worth while.

THE TRANSPOSITION SYSTEM OF WIRING.

By CAPT. H. CARTER, A.R.C.Sc., B.Sc., A.M.I.E.E.

INTRODUCTORY.

DURING the present year the use of the familiar "twist system," which has hitherto been the standard method of construction on the telephone lines of the British Post Office, has been discontinued, and instructions have been issued that, within certain defined limits, new wires will be run straight, and that inductive interference from external sources, cross-talk between adjacent telephone circuits and telegraphic induction will be guarded against by the insertion of crosses in the telephone pairs at standard intervals. Probably a short survey of the reasons which led to this procedure will be of interest to the readers of this JOURNAL. At the same time the opportunity is taken to present the reasons underlying some of the decisions as to the manner in which the transposition system is to be applied, and a few notes as to the treatment of one or two special cases which are being encountered in practice.

Advantages of the Transposition System.

As a method of eliminating induction the twist system is quite efficient, but from a construction point of view it possesses a number of disadvantages over the transposition system. These are:

(1) Wiring and regulation is slower and more difficult.

(2) Maintenance is more difficult. It is much easier to check the regulation of a line on which the wires are straight.

(3) Leading in at terminal poles is more complicated and costly, due to the fact that the two wires forming a pair are not on the same arm, and a long lead is required to connect the two leading insulators.

(4) On subscribers' lines in sparsely populated areas in which there is no possibility of development it has in the past often been necessary to run long lines carrying two arms for one or two subscribers. When the transposition system is in use one arm will suffice in these cases.

It may be urged as regards (1) that the Department's men are so familiar with the twist system that the change to the transposition system will effect no saving. The point is, however, that straight-run wiring and regulation can be done more satisfactorily under all conditions than corresponding work on the twist system.

Requirements of a Transposition System.

Every telephone circuit on a pole line must be adequately protected, by the insertion of crosses, against induction from outside sources such as power circuits, and from other circuits, telegraph or telephone, carried on the same pole line. A very simple system could be evolved which would provide against power and telegraphic induction. All that is necessary is to determine what is the maximum length of circuit that can be run without crosses and yet cause no trouble, and then to insert crosses in all the telephone pairs at these intervals. The necessity for guarding against induction between telephone circuits on the same line, however, leads to the building up of a complicated system. It will be obvious that all circuits likely to interfere with each other must be crossed on a different system, so that although at certain points there will be a cross in more than one circuit, over a considerable length of line every circuit will have a number of crosses relative to every other circuit on the pole line.

The induction between telephone circuits is mainly electrostatic, and a figure which represents approximately the inductive effect between any two circuits can be calculated. It is found that between two circuits four arms apart this effect is so small as to be negligible over moderate distances, *i.e.* it is less than the inductive effect between a twisted circuit carried on the first and second arm of a pole and one parallel to it on the third and fourth arm of a pole. Since this gives little trouble with our existing lines, it is only necessary to provide crossing systems for each of the circuits on the first four arms of a line. The same systems may then be repeated on subsequent groups of four arms.

The inductive effects between various pairs may be arranged in order of magnitude, and then it only remains to arrange the systems chosen amongst the various pairs so as to give the largest number of relative crosses between the pairs which stand highest on the list.

The American Telegraph & Telephone Company have used a transposition system for some years which fulfils these conditions. That system has been adopted here. The maximum distance between crosses according to this arrangement is two miles, the minimum distance a quarter of a mile. Every circuit on the first four arms is completely balanced against every other circuit over sections of line eight miles in length. On very long lines it is arranged that every circuit on the second group of four arms is crossed once against every circuit on the first and third groups of four arms at intervals of sixteen miles.

The details of the system will be set out in the official instruction (T.I. XIII, Sect. IVD). The diagrams there shown will be for ten-way arms, a size of arm not in use by the Department. By omitting certain pairs the diagram is readily adapted to four-way, six-way and eight-way armed lines.

Points of Departure from American Practice.

In a few respects the American practice has not been followed.

To insert crosses the American Telegraph & Telephone Company use a special transposition insulator, which carries both wires of a circuit. This type of insulator is unlikely to give good service in the climate of the British Isles; consequently it was decided that crosses should be inserted by breaking each wire of a circuit by the interposition of a U-spindle, and bridging across between insulators at the corners of the square thus formed.

The A.T. & T. Co. further complicate their system by transposing pairs as distinct from wires, to overcome overhearing on phantom circuits. As phantom circuits on overhead lines are not viewed with favour in the Department, this extension of the system has not been introduced.

The A.T. & T. Co. uses different systems for trunk and subscribers' lines. In view of the fact that we are not likely to experience the same trouble from power circuits in this country, it was decided that one system should be used for all lines. The fact that subscribers' lines are short and will practically never complete the eight-mile section necessary to give complete balance is not likely to cause trouble. It will be remembered that lighting circuits on the same pole lines as telephone circuits are common in America.

APPLICATION OF THE TRANSPOSITION SYSTEM TO EXISTING LINES.

Naturally the superposition of a system of this kind on lines which were designed for an entirely different system has brought to light a considerable number of difficulties, and has necessitated considerable departure from the ideal system as it would be laid out when building a new line.

It was soon found that on heavy lines the situation was so complex, and so many departures from the standard were necessary, that it was preferable to complete the lines to their full capacity on the twist system. In the case of main lines, it has been laid down that additional wires on lines equipped with eight arms or less carrying trunk circuits will be run in accordance with the transposition system. Since subscribers' lines are short, this complexity does not occur, and instructions have been issued that all additional wires erected on these lines shall be run on the straight.

The determination of the position of transposition poles on an existing line is a matter in which a certain amount of difficulty may arise.

In doing this it is necessary to look ahead somewhat to the probable development of the line. It will often be found necessary to depart considerably from the ideal arrangement, the carrying out of which, in the case of a new line, would present no difficulties. For instance, there will be many cases of incomplete eight-mile sections, and it may be impossible to ensure that a new straight-run circuit occupies the same position on the pole line throughout an eight-mile section. It should be remembered that the system aims at crossing the route as a whole, according to a standard plan. Should the first new circuit, to be run on a line which will ultimately extend between two points, A and B, be only over a portion of the whole line, say between two intermediate points, C and D, crosses should be inserted between C and D as though the circuit were being run between A and B. This will fit in with the general scheme when circuits come to be run between A and B.

Due to the existence of frequent changes of pole diagram along an existing line, it may at first sight appear almost impossible to make any arrangement that will give a long continuous run of line from the transposition point of view—that is, there may be a temptation to make frequent S_0 poles, resulting in numerous incomplete sections. It should be remembered, however, that the transposition system is concerned with the new wires only, and it will be found quite often that from this point of view it is possible—perhaps with slight rearrangement—to secure long runs for new wires, although the line as regards existing wires changes character considerably.

Junction of Sections of Line Fitted with Arms of Different Capacities.

Such cases will be met with frequently, the most common case being the change from a four-way to an eight-way armed line. This change is frequently introduced to obtain adequate clearance at road or railway crossings without the use of excessively tall poles.

When twisted wires were in use, it was possible to make such a change without any special arrangements of the wires. This cannot be done with straight-run wires, as it is impossible to avoid contact between certain of the wires. To overcome the difficulty a transposition pole between the two sections of line must be used to allow the change of position of the wires to be made in two steps. The horizontal displacement of the wires is carried out in the first span and the vertical displacement in the second span, the wires being treated in groups of four, corresponding to the "square" on the twist system. If the eight-way armed sections is over half a mile in length, it will be transposed in accordance with the standard diagram for eight-way armed lines. Below this length the change of character of the line will be ignored for transposition purposes.

Labelling Transposition Poles.

To enable new circuits to be run on lines from time to time with the certainty that correct transpositions are inserted, transposition poles must be labelled clearly. It was first intended that a distinctive lead label should be used similar to the old wayleave label. The cost of such an item has, however, been found to be prohibitive, and arrangements are being made for a supply of letter nails.

OUTPUT OF RINGING MACHINES FOR AUTOMATIC TELEPHONE EXCHANGES.

By F. P. DUMJOHN, A.M.I.E.E.

Preliminary.—The output of the ringing machine for a new telephone equipment is generally specified at a steady value in current, which the machine must supply continuously. An overload of 25 per cent. for one hour is allowed.

The "normal demand" is not a steady value, but one which varies with fluctuations in the traffic. The normal demand has been taken in this study as the maximum number of simultaneous demands, which will probably not be exceeded more than once in 100 occasions; or, approximately, that 99 per cent. of the time the computed output of the machine will suffice, and for the remaining 1 per cent. it will be exceeded.

Such a basis should provide a very safe specification figure, since the occasions when the normal demand is exceeded would be of very short duration, the time being a matter of seconds. It provides also that the probability of an overload exceeding 25 per cent. is practically *nil.* The main part of the problem will be solved if we can determine the maximum number of simultaneous demands which are likely to be made on the machine during the heaviest period of the day—viz. the busy hour. A formula is given for the output of the ringer providing for such a maximum number of simultaneous demands at a full-load voltage of 75 and periodicity of $16\frac{2}{3}$ per second (or 1000 r.p.m.).

The formula given applies to automatic exchanges. The output required for a manual exchange is a matter for separate study. It should not exceed the predicted value for an automatic exchange having no distributed ringing; in fact it should be less, owing to the levelling up effect produced in manual operation of calls, and that the maximum number of demands is limited by the number of operators' positions.

Data.—The various items requiring evaluation are detailed below:

The values are given against each item, and the manner in which they have been determined is given in the appendix.

(*a*) The number of lines to be rung simultaneously during the busy hour (M), such that the probability of exceeding it shall not be more than 1 in 100. (This we will call the maximum "ringing density" (M.)

$M = k.A.$

where A = average ringing density

$$= \frac{L.C}{\text{No. of ringing sections}} \cdot d$$

k = ratio $\frac{\text{maximum ringing density } (M)}{\text{average ringing density } (A)}$ (read off curve in Fig. 1.)

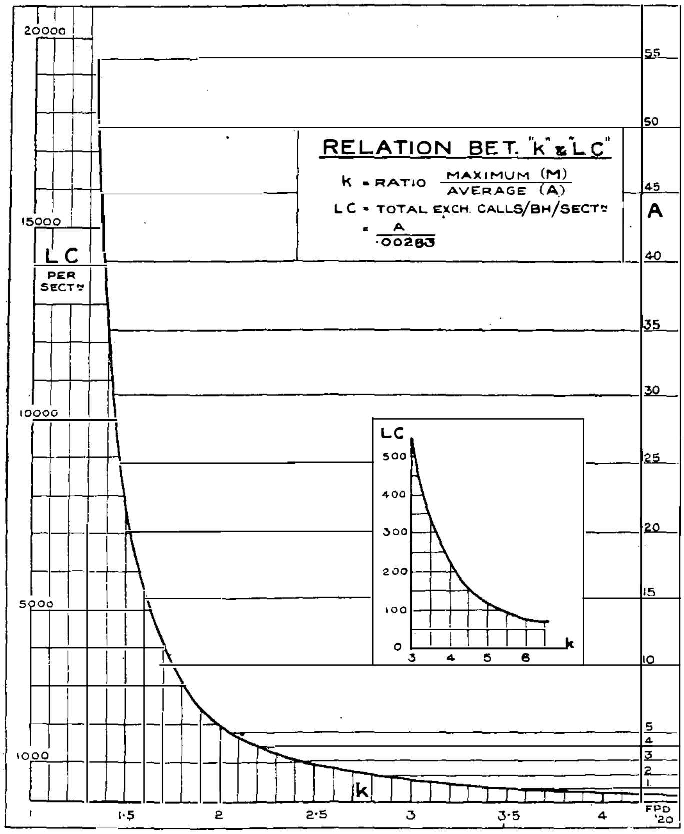


FIG. 1.

L = No. of working lines.

C = average originating calls per line per busy hour (assuming originating = incoming calls).

d = average duration of ringing period (in hours).

(*b*) The average duration of the ringing time per call (d) taken as 10·2 seconds $d = \frac{10{\cdot}2}{3600} = {\cdot}00283$ hours.

(*c*) The average current required to ring a subscriber's bell = 22·5 m.a., providing for—

(1) Standard exchange ringing circuit.
(2) An average length of subscribers' line. Res. $= 60^{\omega}$.
(3) Standard auto-telephone, having 1000^{ω} bell and 2 mfd. condenser.

(*d*) Miscellaneous exchange requirements, such as desks, testing, etc., taken as negligible.

(*e*) Distributed ringing resulting in a fraction of the total demand being drawn from the machine. This has been provided for in (*a*) above; if ringing is not distributed this factor must be omitted.

(*f*) Demands for private branch exchange ringing $(Rl) = 8{\cdot}25\,(k.n)$ m.a., where k is value determined in (*a*) above, n = number of P.B.X. ringing leads.

Output of Ringer.—The output is given by—

$$(a\ .\ c) + (d) + (f)—$$

$$i.e.\ \text{output of ringer} = (k\ .\ A\ .\ 22{\cdot}5) + (Rl)$$

$$= 22{\cdot}5 \times {\cdot}00283\left(k\ .\ \frac{L.C}{3}\right) + 8{\cdot}25\,(k.n)$$

$$= 0{\cdot}0637\left(k\ .\ \frac{L.C}{3}\right) + 8{\cdot}25\,(k.n) \qquad . \qquad . \quad (1)$$

when ringing is distributed to 3 sections.

Or, output of ringer $= 0{\cdot}0637\,(k.L.C) + 8{\cdot}25\,(k.n)$ . . (2)
when ringing is not distributed.

(*Note.*—"k" is the value from curve (Fig. 1) corresponding to the $L.C$ per section. If ringing is not distributed, it corresponds to the value of the total $L.C$—*i.e.* as one section.)

Examples.—(1) A 10,000-line exchange having 1·5 calls per line per busy hour; distributed ringing to 3 sections; 10 P.B.X. ringing leads.

Output of ringer $= {\cdot}0637\left(k.\frac{L.C}{3}\right) + 8{\cdot}25\,(k.n)$.

$L.C = 10{,}000 \times 1{\cdot}5 = 15{,}000$.

$\frac{L.C}{3} = 5000$. k for $L.C$ per section of $5000 = 1{\cdot}63$. (Read off curve in Fig. 1.)

$$\therefore \text{Output} = ({\cdot}0637 \times 1{\cdot}63 \times 5000) + (8{\cdot}25 \times 1{\cdot}63 \times 10)$$
$$= 520 + 135$$
$$= 655 \text{ m.a. at } 75 \text{ volts.}$$

(*Note.*—Probability of exceeding 25 per cent. overload is 1 in 5000.)

(2) A 1000-line exchange having 1 call per line per busy hour; no distributed ringing; 2 P.B.X. ringing leads.

Output of ringer $= 0{\cdot}0637\,(k\ .\ L.C) + 8{\cdot}25\,(k.n)$.

$L.C = 1000 \times 1 = 1000$

k for $L.C$ of $1000 = 2{\cdot}45$. (Read for curve Fig. 1.)

$$\therefore \text{Output} = (\cdot 0637 \times 2\cdot 45 \times 1000) + (8\cdot 25 \times 2\cdot 45 \times 2)$$
$$= 156\cdot 2 + 40\cdot 4$$
$$= 197 \text{ m.a. at } 75 \text{ volts.}$$

(*Note.*—Probability of exceeding 25 per cent. overload is 1 in 1000.)

If in example (1) we allow for no distributed ringing, the output would be 1412 m.a. This is much below the figure usually specified for a manual 10,000-line exchange. It provides for a fairly heavy calling rate.

Possibitity of Standard Sizes.—The formula given has a very liberal basis, and as the output of the largest machine is such a small figure, it would seem a practical proposition to standardise on two or three sizes. The economical advantage in first cost of three standard machines should be comparatively great.

The outputs required to cover various ranges of exchanges, allowing for no P.B.X. ringing leads, are shown below:

Total exchange calls per B.H. (originating).	Value of "k."		Output.	
	Distributed ringing to 3 sections.	Non-distributed ringing.	Distributed ringing to 3 sections.	Non-distributed ringing.
			m.a.	m.a.
10,000–15,000	1·63	1·36	520	1290
5,000–10,000	1·78	1·43	378	912
2,500– 5,000	2·1	1·63	222	520
1,000– 2,500	2·6	1·88	138	300
500– 1,000	3·5	2·45	75	156
500 and less	4·4	3·1	47	99

Suggested Ranges for each size of Ringer.—If we allow for 20 P.B.X. ringing leads as a maximum number on the largest exchange of 15,000 calls without distributed ringing, the output would be 1512 m.a., which gives the lower and upper limits of output as 47 m.a. and 1512 m.a. respectively.

By standardising three sizes of ringers we could fix the range of exchanges as under. (The ranges shown allow of approximately 10 to 15 P.B.X. ringing leads on the largest exchange of each range.)

Output at 75 volts and 1000 r.p.m.	Total originaing calls per busy hour.	
	Distributed ringing to 3 sections.	Non-distributed ringing.
1½ ampères	(Not required)	8000 calls and upwards.
1 ampère	5000 calls and upwards	2500–8000 calls.
½ "	Less than 5000	Less than 2,500.

For small exchanges it would be possible to standardise a smaller machine still—for instance, a 200 m.a. output would serve any exchange up to 1000 calls. If ringing to P.B.X.'s has to be provided, each case would need to be considered separately.

It should be noted that the above outputs apply to 1000 r.p.m. Very small machines frequently run at a higher speed, which would necessitate a larger output for the same size of exchange, the reason or this being the greater current required to ring bells at the higher periodicity.

APPENDIX.

(a) *Ringing Density.*—It is now generally accepted that telephone traffic originates and fluctuates according to the laws of probability, and that Poisson's Law can be applied to represent the fluctuations.*

That is, if P_m = probability of simultaneous calls (m).

a = Average number of calls per duration interval,

then—

$$P_m = \frac{1}{e^a} \cdot \frac{a^m}{m!} \qquad e^a = 1 + a + \frac{a^2}{2!} + \frac{a^3}{3!} + \quad . \quad . \quad .$$

the probability (Q) of exceeding any number (m) will be given by the sum of the (m + 1)th and subsequent terms of the expansion, *i. e.*,

$$Q_m = \frac{1}{e^a} \sum_{n = m + 1}^{n = \infty} \frac{a^n}{n!} .$$

This formula provides for a case when the possible number of calls in progress is not restricted. This is not precisely the case on the final selectors in an automatic exchange, where calls have been restricted between ranks of switches owing to the size of contact bank, and the maximum number of demands is equal to the total number of final selectors. The formula, however, will be sufficiently accurate to apply to the conditions when ringing demands are made; in fact, it will provide a margin of safety. It will therefore be used to determine the maximum ringing density, which is the value (m) above. Fig. 2 shows the relation between (a) and (m) when $Q_m = \cdot 01$.

(a) = average number of lines rung simultaneously, which is denoted as "A" and called the ringing density.

(m) = maximum number of lines rung simultaneously, denoted as "M," when the number is not exceeded more than once in 100 occasions.

Traffic statistics show that originating calls and incoming calls per line are practically equal, and as the originating calls are always known, we may apply them here.

* Grinsted, POST OFFICE ELECTRICAL ENGINEERS' JOURNAL, April, 1915, and October, 1918.

If L = total number of working lines,
C = average number of originating calls per line per B.H.,
d = average duration of ringing period per line (in hours),
then average number of lines rung simultaneously (a)

$= L.C.d = A.$

The maximum number of lines rung (M) for our stipulated value of Q_m (= ·01) varies with values of (A). A curve showing the relation between "k" and "A" is shown in Fig. 1,

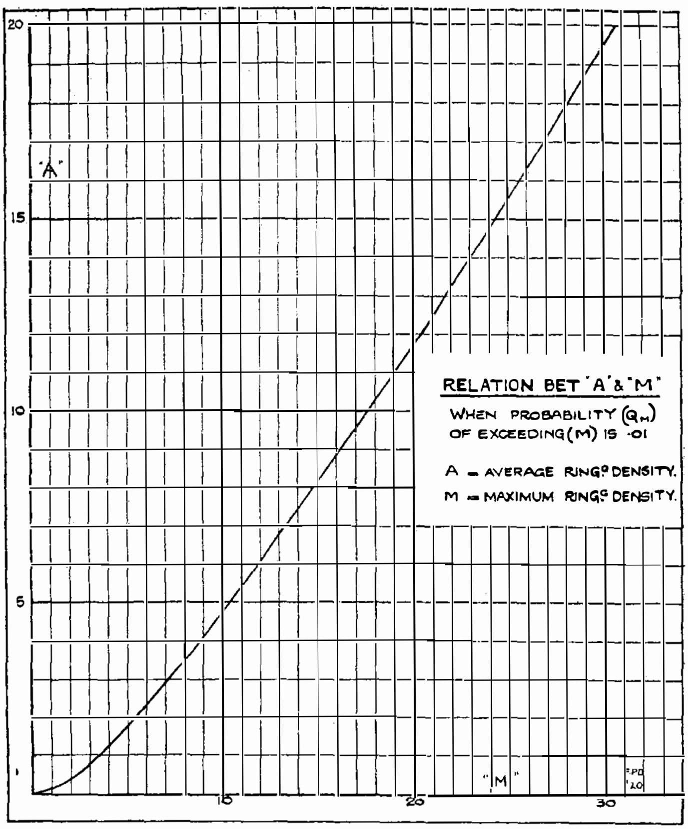


FIG. 2.

where k = ratio $\dfrac{\text{maximum } (M)}{\text{average } (A)}$,

hence $M = k.A$

$= k\ (L.C.d)$ = maximum ringing density for the whole exchange, *i.e.* for the case when non-distributed ringing is employed

when ringing is distributed (see Section (e))

$$M = k \left(\frac{L.C}{\text{number of ringing sections}} . d\right)$$

(b) *Average Duration of Ringing per Call* (d).—Traffic statistics given by Messrs. Laidlaw and Grinsted show* :

		For a local call (seconds).	For a junction call (seconds).
Average time in which called subscriber answers	=	26·6	38·8
Average time in which called subscriber is first rung	=	16·4	28·6
∴ Average time called subscriber takes to answer	=	10·2	10·2

In auto exchanges the subscriber is not rung continuously for 10·2 seconds, but only for 1 second in every 3 (see (e) below), but

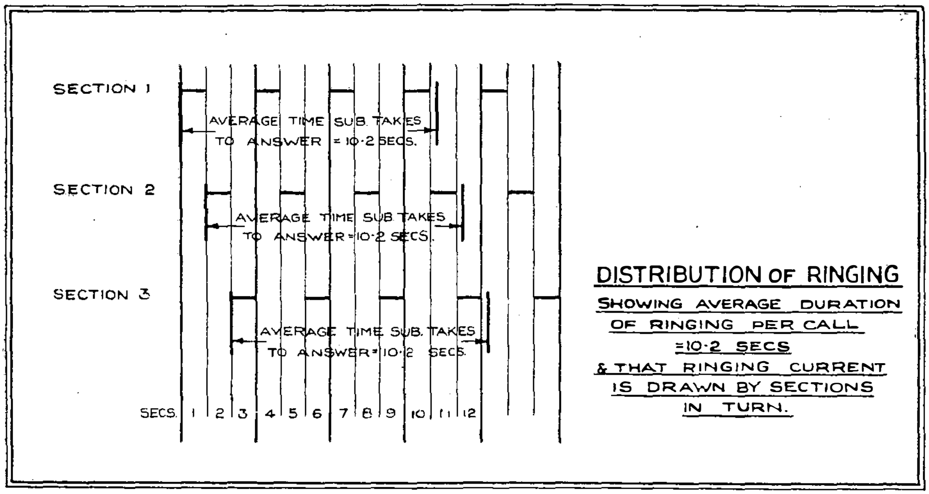


FIG. 3.

the average number of demands is dependent on the total ringing period, which is taken as 10·2 seconds.

The output will vary with the average time as observed for a particular system, but not in proportion, *e. g.* a 50 per cent. increase on 10·2 seconds does not increase the output as much as 50 per cent., because the value of " k " decreases with greater ringing densities.

The figure quoted by Messrs. Laidlaw and Grinsted is the average for a large number of exchanges in the United Kingdom.

(c) *Average Ringing Current per Call.*—Tests made under representative exchange conditions in Messrs. Siemens Brothers' laboratory give the average ringing current per call = 22·5 m.a. at 75 volts and $16\frac{2}{3}$ periodicity.

* "The Telephone Service of Large Cities," 'Journal of the Institution of Electrical Engineers,' pt. ii of Supplement to vol. lvii.

This value is the average of tests on twenty-four lines. Fig. 4 shows the circuit connections.

Tests show that the resistance of the subscriber's line does not affect the value of the current to a readable extent, but that the periodicity of the current is the deciding factor.

Curve (A) in Fig. 5 shows the variation of the current with the periodicity, and indicates the importance of keeping the speed within the specified limit.

Curve (B) in Fig. 5 is not of practical value. It represents the

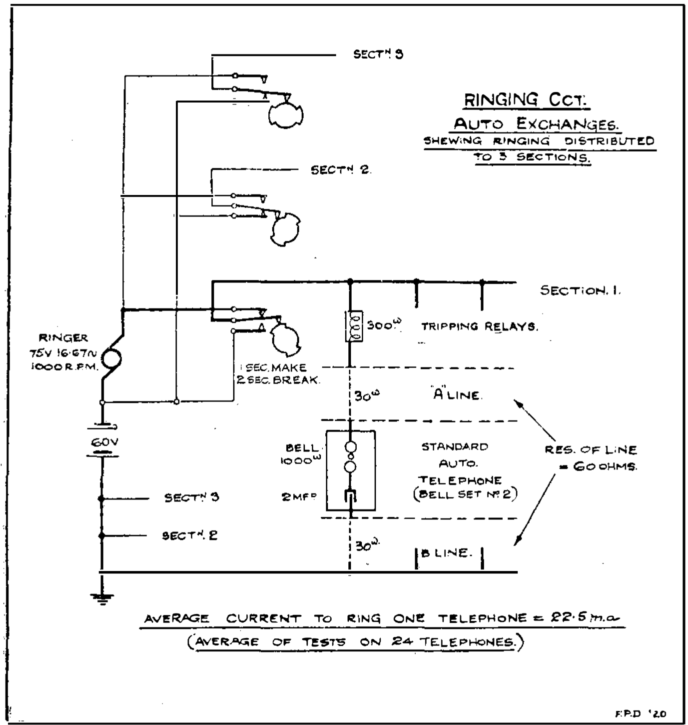


FIG. 4.

current variation with periodicity when the voltage is kept constant at 75—a condition not obtained in practice.

In the case of non-distributed ringing, current is drawn for 1 out of 3 seconds only. The same current per call is assumed as required for distributed ringing.

(d) *Miscellaneous Exchange Ringing*.—Ringing required for communication between desks is very small. The latest circuits for auto exchanges use battery signalling, but occasionally the standard ringing circuit is still fitted. The number of simultaneous demands if ten working positions exist would theoretically be a small figure, and if we allowed for two demands we should be on the safe side.

There will be other occasional demands, such as ringing on short circuited lines from a test desk, or ringing required in connection with maintenance and fault testing. Such demands would probably not be more than two simultaneous rings in a very large exchange.

These miscellaneous demands can be taken as provided for in the formula, for it must be remembered that the predicted output provides for the maximum exchange peaks, which will probably be exceeded only once in 100 occasions, and that the small demands

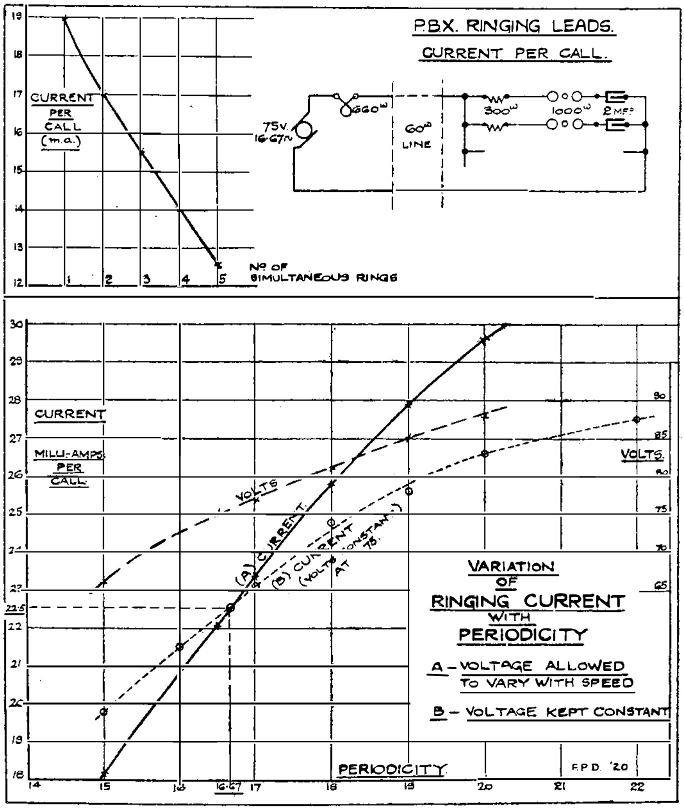


FIG. 5.

from miscellaneous sources will occur at any moment, not necessarily at the exchange peaks.

(e) *Distributed Ringing*.—The ringing of subscribers may be arranged on either of two schemes, viz.:

(1) No distribution: In this case the ringing of all subscribers occurs at the same second, followed by 2 seconds' silence.

(2) Distributed ringing: In this case the exchange is divided into three sections and the subscribers in each are rung in consecutive seconds as shown in Fig. 3.

When ringing is not distributed, the ringing current drawn must be based on the maximum simultaneous demands over the whole exchange. This is allowed for in (*a*) above, by determining the maximum number based on the total exchange calls.

In the case of distributed ringing, the current to be drawn is that required for the maximum demands in any one section. This is provided for in (*a*) by determining the maximum number in each section, assuming that calls occur on the average uniformly in each section, *i. e.* the value of A in the formula provides for calls $= \frac{L.C}{3}$.

(f) *Demands for P.B.X. Ringing: Number of Simultaneous Demands per Ringing Lead.*—The basis on which ringing leads are generally provided is not known. It would be within reasonable limits to assume that one lead would serve not more than a maximum number of five positions. (It is assumed that manual P.B.X.'s only are supplied with exchange ringing. For auto P.B.X.'s ringing would be provided locally and not drawn from the main exchange.)

We will allow for each ringing lead to draw current during the busy hour based on four working positions as the average maximum. Taking a P.B.X. operator's load as 120 calls per busy hour, and assuming that each call is to an extension, *i. e.* that calls to public exchange (requiring no ringing current) are not handled, each ringing lead must provide for 480 calls per busy hour.

The duration of ringing is dependent on the number and duration of rings which the operator makes; we can take this as equivalent to the total ringing intervals observed on public exchange calls as in (*b*) above, viz. four 1-second rings = 4 seconds per call.

The average ringing density $= 480 \times \frac{4}{3600} = 0{\cdot}533$.

The maximum ringing density allowing for exceeding it 1 in 100 $= 2{\cdot}2$, *i. e.* $= 3$.

Current per Call.—"Continuous" ringing is supplied for private branch exchanges. The standard arrangements provide for a 660^{ω} resistance lamp in each lead at the exchange and a 300^{ω} resistance in each position feed at the P.B.X. Curve in Fig. 5 shows the results of test, allowing for an average resistance in the ringing lead of 60^{ω}, and direct ringing to extensions over 0-ohm. lines.

The curve shows the current per call when 3 lines are rung simultaneously, as 15·5 m.a.

For "n" P.B.X. leads—

the average ringing density $= n \times 0{\cdot}533$,
the maximum ringing density $= k\,(n \times 0{\cdot}533)$,
$\therefore$ current drawn $= k\,(n \times 0{\cdot}533) \times 15{\cdot}5$ m.a.

The value of "k" will vary according to the number of ringing leads, but we can safely take it as the same value as determined for "k" in the formula (a) above.

∴ The current drawn over "n" P.B.X. leads = 8·25 ($k.n.$) m.a.

I have to express my indebtedness to Messrs. Siemens Bros. & Co., Ltd., for permission to publish results of their investigations.

RINGING MACHINES IN SMALL EXCHANGES.

By A. B. EASON.

[The writer had the privilege of seeing Mr. Dumjohn's article before completing this; it is complementary to his.]

THIS article discusses the probable maximum momentary load upon ringing machines, and gives particulars of the small standard ringing dynamotor of the A.T.M. Co. recently introduced. The symbols used are as follows:

A = number of A positions.
B = ,, B ,,
C = the incoming calls per busy hour per line.
e = effective rings, *i.e.* ratio of subscribers "called" to calls made, = 0·85. This value is chosen rather than 0·81 to allow for those calls which are ineffective because the subscriber does not reply.
f = a ratio (actual "A" board load) / (maximum possible "A" board load).
i = current used on the average to ring a subscriber's bell. This = 0·020 ampères; a bell will respond to a much smaller current—of about 0·005 ampères.
k = a ratio (maximum simultaneous calls/average simultaneous calls).
L = number of subscribers' lines.
P = the number of P.B.X. ringing leads.
q = proportion of the ringing load which is put on the ringing machine at one moment; when the ringing is divided between odd and even cords, $q = \frac{1}{2}$; when the exchange is divided into three groups, $q = \frac{1}{3}$.
R = maximum ringing load in a busy hour in ampères.
t = the "calling" time, *i.e.* the average period of time elapsing after the operator commences to ring a subscriber till the subscriber answers; the present standard time on manual boards is 13·7 seconds.
ϕt = the period of time ringing current is sent to line.

$\phi = \frac{1}{3}$ for British P.O. standard machine-ringing, 1-second ring, 2-seconds' interval; if ϕ were made $\frac{1}{4}$, with a 3-seconds' interval, the exchange could be divided into four groups for ringing purposes.

ϕ = approximately 0·50 for manual ringing.

Probable Ringing Loads.—There are two ways of estimating the maximum instantaneous load on the ringer. Firstly, determine maximum reasonable possible load that "A" and "B" and P.B.X. operators could put on the machine; secondly, determine the maximum probable load, when the number of busy-hour calls ($= LC$) is given. This is what Mr. Dumjohn has done.

Possible Load from Operators.—The load from operators includes three loads—viz. from "A," "B" and P.B.X. operators. The load thrown on the machine from each of these is dependent upon how the ringing current is sent out to the subscriber, which partly depends upon how much of the "calling" time is really ringing time and how much is idle time.

Consider first the "A" operators. Each operator can ring one subscriber; all the "A" operators can simultaneously be calling subscribers, and might physically be ringing them simultaneously, but such a condition is not likely to occur. Out of the "calling" time of 13·7 seconds it is unlikely that the operator will be ringing more than for half of it, or 6·8 seconds. Look at this in another way. To ring a subscriber takes i ampères. The number of "A" operàtors is taken as A and the P.B.X. operators $= P$, so that the instantaneous load would be $(A + P)i$ ampères if all the operators moved their ringing keys forward at the same moment; this does not appear to occur, so that the maximum load is somewhat less than the above quantity; let it be taken as $f(A + P)i$ ampères, where f is a fraction. We can read the maximum current on an ammeter placed in the lead to the *manual ringing* bus-bar, and at the same time find out the number of operators on duty and how many P.B.X. ringing loads are provided; the ammeter reading gives $f(A + P)i$. Thus we find values of f. When making tests in London exchanges the manual ringing load was sometimes very small, but the few readings that were obtained showed $f = 0·40$ to $0·60$.

Distribution of Ringing.—It may be mentioned that the ringing machine supplies current at from 75 to 95 volts A.C.; this is taken direct to a bus-bar for *manual ringing*, from which continuous A.C. ringing current is available. The supply is taken *viâ* a distributor to 2, 3 or more bus-bars for *machine ringing;* these latter bus-bars supply intermittent A.C. ringing current, viz. 1-second ring, 2-seconds' battery.

Load from "B" Operators.—"B" operators take on the average 8 seconds between receiving a call and plugging into the subscriber's line; the subscriber takes 13·7 seconds to reply. Therefore it is possible for two subscribers to be called simultaneously. If the subscribers take over 16 seconds to reply, or if the operator made connection in 6 seconds, it would be possible to have three subscribers called simultaneously. But such speeds are unusual and will not hold over the whole "B" board. We shall allow for a maximum of 2 rings per "B" position. The number of "B" positions $= B$. Thus we get "B" load $= 2\,Bqi$, where q is the factor introduced if the ringing current is split into groups, *i.e.* among odd and even cords, the real ringing being fed to these at different periods of time.

Total Load from Operators.—The total load, $R = f\,(A + P)i + 2\,Bqi$. Allowing that f may reach 0·60, $i = 0·020$ ampères, $q = \frac{1}{2}$ for "B" positions in the British P.O., then—

$R = 0·012\,(A + 1·66\,B + \text{P})$ ampères . . . . . (1)

For No. 10 C.B. exchanges, $A = 5$ to 12, $B = 1$ to 4, $P =$ *nil*, and R will vary between 0·080 and 0·225 ampères, using the above formula. For a particular case, viz. Stroud, $A = 8$, $B = 0$, then $R = 0·096$ ampères.

Determination of Maximum Load from Probability Theory.—We are given the number of busy-*hour* calls, LC, of which $e\,LC$ are effective. The calling period $=$ 13·7 seconds on the average; this $= t = 0·0038$ *hour*.

The average number of simultaneous calls $= e\,LC\,t$. The maximum number of simultaneous calls $= k\,e\,LC\,t$, where k is the multiplication factor to allow for the variations in the rate at which the calls are received during the hour. Mr. Dumjohn's Fig. 1 shows values of k. The maximum load on the machine is $k\,(e\,LC\,t)\,i$, assuming that all the subscribers are rung at once. If the exchange ringing is divided into various groups the factor q may come in, and we get—

$R = k\,(e\,LC\,t)\,q\,i$ . . . . (2)

One is liable to fall into mistakes in discussing this question, so consider the following example: The Gerrard junction load—where there is no divided ringing—is about 10,000 incoming calls per busy hour. On the average 38 subscribers are being rung, taking 0·76 ampères for 1 second. Then there is no load for 2 seconds. The equivalent average load on the machine is 0·0253 ampères extended over the whole hour. If we divide the ringing into odd and even cords, the load is 0·38 ampères for the first and second seconds, and is *nil* for the third second; the average load is 0·253 ampères as before. If the exchange were divided into three groups the load would be 0·253 ampères during the first, second and third second of each 3 seconds. These figures must be multiplied by k to allow for the chance variations. With *machine ringing* and no division into groups, $q = 1$, and the fact that $\phi = \frac{1}{3}$ is useless for reducing the maximum load; the whole junction load comes on the machine at once. With *manual ringing* the exchange is undivided, but the operators produce a divided load: $q = 1$ as far as the mechanism goes, but since the operators move their keys at chance moments, and do not all ring the subscribers for 1 second and release their keys for 2 seconds, a division of the load occurs and q becomes 0·40 to 0·60. A test made at Gerrard on the ringing load gave the following results: The incoming busy-hour calls = 10,000; k from Dumjohn's Fig. **1** = 1·7; $q = 1$, as the ringing is undivided; i = 0·020 ampères.

R = (1·7) (10,000) (0·0038) (0·020) (1·0) = 1·30 ampères . (3)

The ammeter reading during the busy hour each time the junction load came on jumped up to amounts varying between 0·80 and 1·5 ampères; the "A" board load was included, but it was not large.

Comparison of Method 1 *and Method* 2.—We can relate the busy-hour load LC to the number of "A" and "B" positions, and thus get a formula similar to the previous one (Equation (1)), but it is not worth doing so here. Consider, however, a particular case, viz. Stroud, which is a typical No. 10 Exchange. We have, $LC = 1200$, $e = 0{\cdot}85$, $k = 2{\cdot}6$, $i = 0{\cdot}020$, $q = 1{\cdot}0$ as far as the mechanism goes, but as it is all manual ringing we shall take $q = 0{\cdot}60$.

$R = \quad k \quad e \; LC \quad t \quad q \quad i$

= (2·6) (0·85) (1200) (0·0038) (0·60) (0·020) = 0·120 ampères.

This is a little over $\frac{1}{10}$ ampère; by Equation (1) R = 0·096 ampères. The Department's three standard ringing machines give outputs of 1, 2, 4 ampères; it is obvious, therefore, that there is a place for ringing machines of smaller outputs. This has been met by the use of dynamotors Nos. 3 and 4, for whose introduction the A.T.M. Co. should have the credit.

A.T.M. Ringing Machine.—Full references are given here for the use of Post Office men who may be dealing with the dynamotors. The A.T.M. Co. use a small dynamotor on their P.A.X. and P.A.B.X. boards; the Department borrowed one of these (MSR type), driven from a 48-volt battery, and tested it artificially and in actual service at Weybridge; it proved satisfactory. Quotations were obtained from certain firms for such a ringer to run from either 22 volts or 40 volts and to give the standard interruptions. An order was placed with the A.T.M. Co., and the samples supplied to this order were tested during the summer of 1920. The Siemens type of small ringer—output 0·60 ampères—was also tested; it was too big for the purpose, but may be suitable if at a later date an intermediate size of ringing machine is adopted as standard. Fig. **1** shows the A.T.M. MSR 46-volt ringer. (The 22-volt ringer is MSS type, the 40-volt ringer is MST type.) The official titles of the machines and their relative choke-coils are:

Dynamotor No. 3 (for 22 volts), coil retardation 19 A
,, ,, 4 (,, 40 ,,) ,, ,, 20 A.

Mechanical details are in *Dwg EL* 1428, wiring to jacks in *PR* 211. The overall dimensions are 11 in. long, 5½ in. broad, 4½ in. high. The machine is fixed to the front of the slate panels of the power board by four bolts. The leads from the machine are taken to 3-ampère tumbler-switches and a telephone type-key (No. 198), instead of to the heavy copper 9-pole knife-switches, as is usual for 1-ampère machines. No starter is required. The high-speed interrupter is seen at the end of the main shaft; the low-speed interruptions are made by cams acting on spring contacts; this is a much cheaper and lighter arrangement than the drum interrupters.

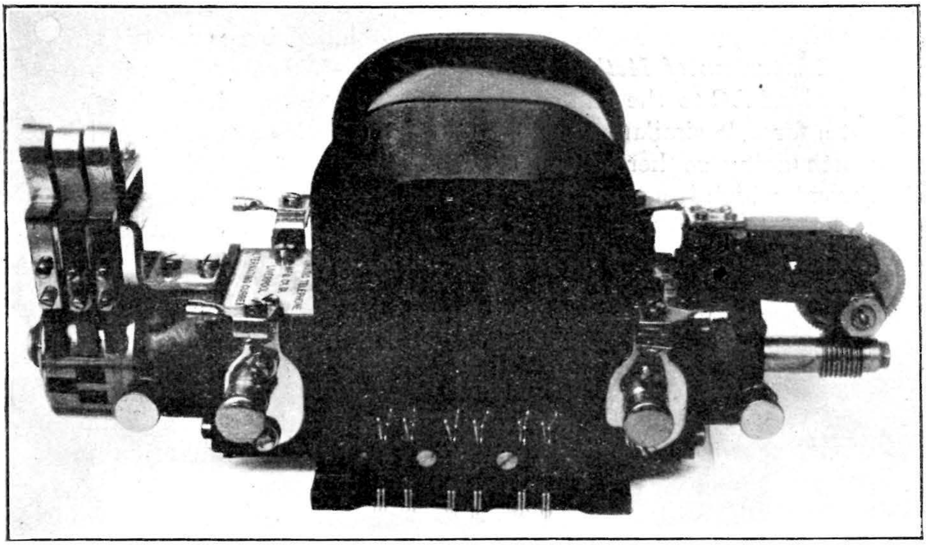


FIG. 1.—THE A.T.M. CO.'S MSR 46-VOLT RINGER.

The inputs and outputs, etc., are as follows :

Dynamotor No. 3 (22-volt) ; Non-inductive Load.

Input (ampères).	Output (volts).	Ampères.	Watts.	Efficiency.	r.p.m.
1·26	102	*nil*	*nil*	*nil*	1330
1·39	96	·024	2·3	7·5	—
1·73	79	·098	7·79	20·5	1200

Inductive Load with Bell Sets.

Input (ampères).	No. of bells.	Outpu (volts).	Ampères.	Speed.
1·43	1	96	·039	—
1·58	2	91	·073	1220
2·05	8	71	·190	1030
2·52	20	50	·290	(rings satisfactory)

Dynamotor No. 4; Inductive Load with Bells.

0·70	1	89	·0359	—
0·78	2	85	·070	1200
1·05	8	60·5	·200	1060
1·37	20	53	·320	(rings satisfactory)

Non-inductive load tests were similar to those for the 22-volt machine. To run the machine from batteries for 24 hours will take about 33 ampère-hours at 22 volts, and 18 ampère-hours at 40 volts. The efficiencies include the losses in the choke coil, which is used to prevent the machine causing a noise on the telephone circuits.

Reduction in Exchange Costs.—The costs of No. 10 C.B. exchanges of small size were reduced by about £300 to £500 each owing to the use of these ringers, as the size of various portions of the plant could be reduced. (See the schedule herewith for a general comparison.)

	For 1-amp. ringer.	For dynamotor.
Office of Works costs	Erected on brick piers (30 cub. ft. brick)	Erected on power board.
Power board apparatus	2 starting switches 2–12 amp. D.P. tumbler switches; 1–9 pole 20-amp. D.P. knife-switch	No starter. 2–3 amp. S.P. tumbler - switches. Key 198; 2–3 amp. switches.
Switchboard	1 panel for ringing apparatus	Small space on generator panel.
Battery: allowance for running ringer if electric supply fails	120 amp.-hr.	33 amp.-hr.
Generator: allowance for charging above	20 amp.	5·2 amp.
Motor, switch-gear, cables: allowance for above	0·8 kw.	0·16 kw.
Output for running a ringer	200 watts from supply	30 watts from battery.
Units for 365 days, 24 hours each	—	262 kw.-hr.
Units from supply company	1750	420.

The other aspects of this ringing question which might be dealt with later are: (*a*) tests upon actual loads on ringers; (*b*) comparison of ringing vibrators, pole-changers, etc.; (*c*) circuits for and types of tones, interrupters, etc.

THE FIRE AT BRIGHTON (KEMP TOWN) EXCHANGE.

ALTHOUGH the number of telephone exchanges in the United Kingdom exceeds 3000, the destruction of even a portion of the equipment by fire and the consequent cessation of the service is so rare an occurrence that a brief description of that which took place at the Kemp Town Exchange, Brighton, on March 17th last, and which caused an entire stoppage of communications, may be of interest to readers of the JOURNAL.

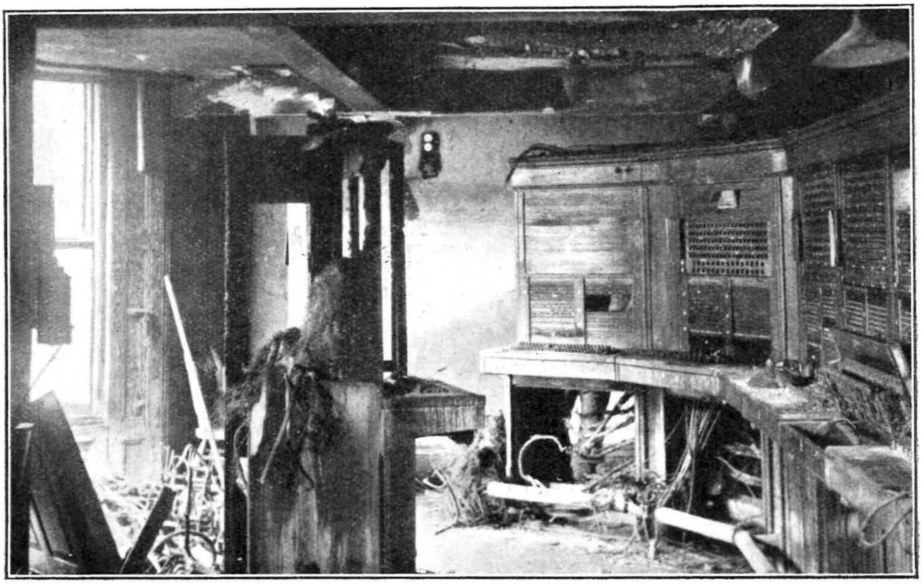
The Exchange, which is located in a building the ground floor of which is in use as a corn-chandler's shop, was installed by the Western Electric Company, Limited, for the National Company in 1907, and consisted of C.B. No. 9 equipment, made up of two "B" and seven "A" positions, having a maximum capacity of 960 subscribers' circuits. The cables between the switchroom on the first floor and the test and battery rooms on the second floor were supported in a cable-turning section adjacent to the first "B" position.

At the time of the fire 520 subscribers, 27 in-coming, 26 outgoing and 6 both-way junction circuits were working, 3 "A" positions being spare.

Shortly after taking duty at 8 a.m. the operator became aware of the presence of smoke in the switchroom, and thinking it arose from another part of the premises and was due to cooking operations, closed the door. As this proved ineffective as a remedy, a more detailed search was undertaken and revealed the fact that the offending smoke proceeded from the first "B" position. The alarm was given to the engineering officer engaged in the test and battery rooms, who, on arrival in the switch-room, found a red glow at the back of the first junction section, which was visible from the face of the switchboard through the centre of the multiple jack field. The immediate attempts made to extinguish the fire by the application of sand were unsuccessful, because, coincident with the removal of the shutter at the rear, the burning mass burst into flames, which, fanned by the draught created by an open window through which they were projected into the street, cut off access to the chemical fire extincteurs.

Two fire brigades arrived on the scene—after commendable and persistent efforts to summon them had been made by both the operator and the engineering officer, with somewhat uncertain results owing to the failure of the power supply due to the "blowing" of the main fuse in the 32-volts battery lead—and the outbreak was subdued by the application of water, and a "spray" consisting of bicarbonate of soda, sulphuric acid and water.

The building was not seriously damaged; one of the front windows was burnt out and a large portion of the ceiling of the switchroom fell. The cable-turning and the two junction sections were practically gutted, as indicated in the photograph, which, in addition to giving a front view of a portion of the damaged suite of sections, shows a back view of the first junction section. Section 3,



FIRE AT KEMP TOWN EXCHANGE. THE DAMAGED SECTIONS.

viz. the first subscribers' position, suffered considerably; No. 4 was but slightly affected by fire; the remaining five sections were damaged by smoke, water and chemicals only.

The fire evidently spread from the first "B" position to the others *viâ* the holes in the wooden sides of the sections. The lead-covered cables between the M.D.F. on the second floor and the switchboard carried *viâ* the cable-turning section were damaged by fire and water, but the asbestos cables and M.D.F. were affected by water only.

It is perhaps superfluous to say that no time was lost in making arrangements for the early restoration of the service; all doctors' and other particularly important subscribers' services were temporarily connected to Brighton C.B. Exchange by means of the junction cable with minimum delay.

Day and night staffs were organised, and the work of removing the damaged sections and *débris*, cleaning, drying and testing that part of the equipment—viz. six subscribers' boards, which had not been destroyed—was pressed forward. As a point of interest it may be mentioned that a petrol motor desiccator was used successfully in drying out part of the plant; insulation tests taken subsequently with a 500-volts megger showed in the case of the multiple 50 megohms and the cords 1 megohm.

The new switchboard cables arrived by passenger train at 11 p.m. on the same day. An entirely new iron cable-run between the M.D.F. and the switchboards was erected and the 42-wire cables placed in position, formed and tagged, and at about 11 p.m. on the 20th 100 subscribers' circuits, 5 outgoing, 5 incoming junctions and 1 order wire had been restored.

The preliminary work having been completed, the restoration proceeded continuously with increased rapidity, about 150 circuits being dealt with daily, and the whole of the 560 subscribers and all junction services had been restored at about 11.30 p.m. on the 23rd —a very creditable performance on the part of the day and night staffs concerned.

The junction service was reconstituted by converting the dummy section, at the end of the suite remote from the seat of the fire, into a jack-ended junction position, a specially designed circuit to suit the local conditions and providing automatic calls and clears but without through supervision being introduced.

The chemical spray used by the fire brigade had been projected at random, and it was feared the effects of this might be felt in an impaired service due to faults caused by the corrosive action of the chemicals, but no such difficulties have matured, and it is proposed to retain the renovated sections in the scheme of permanent restoration.

The cause of the outbreak is wrapped in mystery. Although very exhaustive inquiry was instituted, every atom of evidence weighed, the parts of the plant which remained carefully examined, every subscriber's premises visited, with the object of detecting possible contact with electric lighting or power systems, and the fault records examined for possible contacts between falling overhead telephone wires and tramway trolley-wires, it has not been possible to discover the source or origin. The switchboard was idle at the time, the usual morning speaking and signalling tests of junctions having been completed; no faults had been reported on the morning in question; the last fault dealt with was on the 15th, and no workmen had been recently engaged upon the junction positions, neither had any recurring or persistent fault, nor anything likely to cause the outbreak, been observed.

C. T. CRISP.

TELEGRAPH AND TELEPHONE PLANT IN THE UNITED KINGDOM.

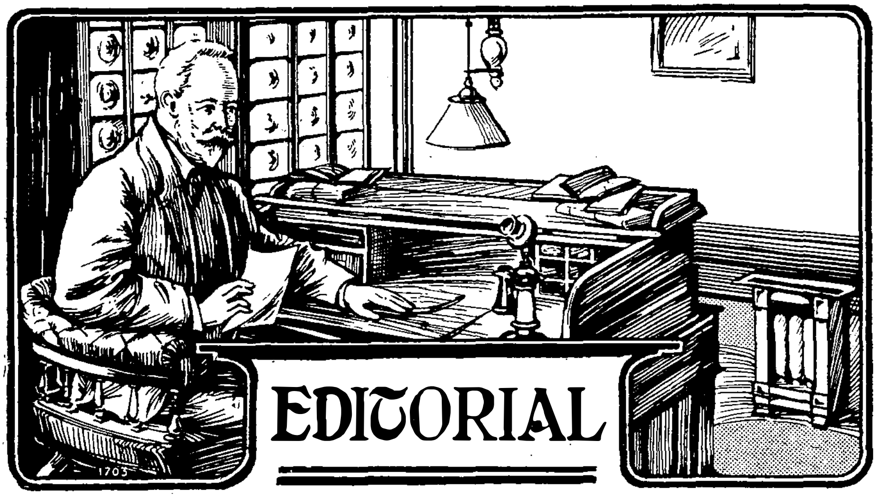
TELEPHONE STATIONS AND SINGLE-WIRE MILEAGES AS AT 30TH SEPTEMBER, 1920.

Telephone Stations. (a)	Overhead Wires: Mileages.				Engineering District.	Underground Wires: Mileages.				*Submarine Wires.
	Telegraph.	Trunk.	Exchange.	Spare.		Telegraph.	Trunk.	Exchange.	Spare.	(Land Miles.)
310,804	1,419	2,906	57,541	56	London	16,884	16,510	1,053,277	16,172	
45,990	6,308	15,709	43,158	2,071	S.E.	2,406	6,956	140,152	16,949	
38,985	8,493	18,086	36,186	1,355	S.W.	12,358	1,483	67,334	1,460	Telegraph: (b) 14,876
31,414	15,911	26,506	32,899	4,203	E.	8,164	13,367	34,323	16,610	
54,506	16,036	38,100	40,472	2,764	N. Mid.	6,952	12,869	89,765	15,134	
41,772	11,178	23,943	45,194	4,948	S. Mid.	6,214	7,078	93,638	13,991	
34,359	7,919	23,095	37,020	3,251	S. Wales	4,573	8,936	58,232	13,334	Trunk: 1,575
49,829	12,412	20,201	32,928	5,568	N. Wales	11,617	16,231	89,838	10,113	
92,890	4,607	16,215	44,830	3,520	S. Lancs.	9,420	30,052	222,413	31,011	
45,818	8,704	23,227	35,825	2,872	N.E.	4,127	11,707	100,827	16,921	Exchange: 2,440
44,332	6,762	26,636	37,943	2,091	N.W.	9,233	12,204	85,728	15,423	
30,265	4,078	13,391	22,779	2,229	N.	3,114	4,270	46,641	6,573	
31,656	26,072	10,002	25,544	656	Ireland	834	100	50,208	453	Spare: 328
41,348	11,669	16,318	27,918	2,485	Scot. E.	1,419	4,763	72,738	3,297	
61,942	10,933	20,274	40,873	443	Scot. W.	11,139	7,650	150,796	15,100	
955,910	152,501	294,609	561,110	38,512	Total.	108,454	154,176	2,355,910	192,541	19,219
937,734	152,657	292,568	557,355	38,942	Corresponding Figures 30th June, 1920.	107,793	151,992	2,297,949	183,786	19,852

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

(b) Includes Atlantic Cable, 3985 land miles.

* The Submarine figures now supplied embody recent amendments due to the adjustment of "War Plant" and represent the position as at March 31st, 1920. These figures can only be supplied annually.



EDITORIAL NOTES AND COMMENTS.

THE sittings of the Parliamentary Telephone Rates Committee have given rise in certain quarters to a renewal of the attacks on the Post Office Telephone Administration. Elsewhere in this issue we publish a long and complete reply to the critics, which should be read by our own people as carefully as we hope it will be read by the general public. We need not inquire too closely into the origin of these sporadic outbursts; they are probably due to what we may call a combination of political motives *cum* personal interests, which do not operate always for the common good. We are now told that the Engineering Department is not to blame for the sorry condition into which the service has fallen. The engineers of the Post Office are a fine body of men, underpaid it is true—our critics have not to find the salaries of course—but their efficiency is thwarted and the fine edge of their zeal blunted by the deadening influence of their environment. The administration is to blame for the policy adopted some twenty years ago—a policy that handicapped the Telephone Company in its laudable ambition to provide an efficient national service, that stultified the extension and development of new plant and systems, and did all it could to discourage the telephone habit in the world of business.

But is all this in accordance with facts? The attitude of the State towards the telephone business was one determined by Parliament in open debate. The members of the House of Commons in those days were individualists almost to a man; they were not biassed in favour of the socialisation of industry, but they considered that the necessity for quick and reliable communications was of such vital importance to the community that the provision and maintenance should not be left in the hands of a private company. The interests and capital of the Company were safeguarded at the end of the lease by the tramway terms of purchase. There was nothing to prevent the Company extending and developing its business. As a matter of fact it did, in paying directions. North, East, Dalston, Wall, Hop, Gerrard and many provincial C.B. exchanges are standing examples of very fine work carried out by the Company on the most up-to-date principles of the time. Under the driving force of an engineer-in-chief like Mr. Frank Gill it was not possible for the Company to stand still. Nor was the Post Office marking time all these years. The trunk system was practically rebuilt and enormously extended; the underground cabling of London was undertaken on a vast scale and successfully carried through on new lines, which had to be evolved by the staff as the work proceeded; thousands of small exchanges were opened in remote country districts which the Company had studiously avoided; the Thames Valley and outlying suburbs were supplied with telephone facilities denied them before. At the beginning of the year of grace 1912 the combined staffs embarked on enterprises that would have revolutionised the telephone service in ten years had the tragedy of Serajevo not let loose the tremendous forces of death and destruction. Now we are told that Post Office methods have delayed and hampered progress, that State management is a failure, and that the control should be handed over to private individuals, who know and could handle the business far better.

Let us examine for a moment the position to-day in the industrial world, and see what is happening in that arena to which our friends would lead us. It is not a pleasing prospect. Carlyle opened his 'Past and Present' with a sentence that could be aptly applied to the situation to-day: "The condition of England, on which many pamphlets are now in course of publication, and many thoughts unpublished are going on in every reflective head, is justly regarded as one of the most ominous, and withal one of the strangest, ever seen in this world." Since the armistice industry has been rocking on its foundations. Five years of world-war swallowed up the accumulated wealth of a generation, and we have lived by taking in one another's washing. Even with the high wages, which had to be paid in the circumstances, the workers are claiming that they are no better off than before the war. Demobilised men find "Blighty" is not all their dreams in the trenches had painted it. Strikes in every industry of note, railwaymen, moulders, miners and electrical trades have taken and are taking place. Fear of unemployment in the near future fosters the "ca'canny" policy; men whose piece-rates were cut down in pre-war days when production increased scoff at the appeal to produce more. The clothing and bootmaking industries working at war pressure have produced more goods than the poverty-stricken world can buy; warehouses are full of stocks which cannot be cleared, even at prices much less than the cost of production. Shipbuilding is slowing down; the big engineering firms are combining with the steel manufacturers and amalgamating among themselves to avoid competition, to prevent duplication of plant and to save intermediate profit-taking, and yet they cannot deliver the goods, neither in quantity nor in time. Money was never so tight, and unemployment is increasing. Some authorities go so far as to say that the opening of trade with Soviet Russia is the only hope of Western Europe.

To such a pass has the country come. It is into this welter of conflicting interests and post-war scramble that our friends on the Northcliffe Press would throw the only engineering industry in the country that has kept its head. The 'Electrical Review,' in its issue of November 20th, in discussing the salaries of the electrical power engineers, said that a man earning £200 in 1914 should have £500 to-day. The poorest paid man in the Post Office Engineering Department receives a war bonus of only 140 per cent. on his pre-war wages; the salaried man's bonus averages out at less than 70 per cent. of his 1914 pay. But the staff is loyal; in no branch of the men's societies has the question of a strike ever been raised. They appreciate the fact that the results of their labour do not go to swell the dividends of an unknown and new-rich shareholder, that their livelihood is sure, even although it may not lead to wealth and the power to exploit the labour of others in the end. The Department has many failings, but we claim it is doing the work better than any individual or any combination of super-business men could do. The figures we quote on p. 291 show that the telephone stations have increased by 4·2 per cent. in the last six months in spite of delay in delivery of material from outside sources. The work of development is proceeding as quickly as the plant can be delivered; the education and training of the younger men of the rank and file is being taken up with an enthusiasm unprecedented; the research branches of the service are expanding and are about to commence a new era at Dollis Hill. The deficiencies of the service to-day are due mainly to causes outside the scope of the Department. The man who tries to win capital, political, party or real, from the deplorable aftermath of war by searching for motes and blowing them into the eyes of the people when he should be assisting to clear away the broken beams that choke the paths is rendering a disservice to the State and to his fellows. It is well, however, that the broad sanity of the British public remains unaffected. "The dog barks, but the caravan passes on!"

CORRESPONDENCE.

THE TRAFFIC CAPACITY OF AUTOMATIC SWITCHES.

The Editor, THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

DEAR SIR,—Monsieur Milon, of the French Telephone Administration, has written to me regarding my article in last month's journal, and enclosed a copy of 'Annales des Postes Télégraphes et Téléphones' for December, 1916, which contains an article by himself on the same subject. He points out that the formula given on p. 472 of the 'Annales' is the same as that on p. 221 of the Journal, for the probability of "*r*" switches being engaged when the total number of switches is unlimited. Monsieur Milon's work was prepared for the Technical Congress which was to have been held at Berne in 1914, but on account of the war its publication was delayed until 1916.

I am sorry that I was unaware of this article at the time my own was prepared, and I have pleasure in taking this opportunity of bringing to the notice of your readers a valuable contribution to the literature on the subject.

I am, Sir,

Your obedient servant,

November 12th, 1920. G. F. O'DELL.

HEADQUARTERS NOTES.

EXCHANGE DEVELOPMENTS.

THE following orders have been placed for new exchanges:

Exchange.	Type.	Number of lines.
Cambuslang	(No. 10)	400
Canterbury	(„ 10)	540
Dewsbury	(„ 1)	1300
Dunlop P.B.X.	(Auto)	800
Falkirk	(No. 10)	440
Giffnock	(„ 10)	460
Leamington	(„ 10)	820

Orders have been placed for extending the equipment at the following exchanges:

Exchange.	Type.	Number of lines.
Avenue (second extension)	(No. 1)	40 and 171 incoming junctions.
Bristol	(„ 1)	80 and rearrangement.

Exchange.	Type.	Number of lines.
Gerrard (conversion)	(No. 1)	Conversion.
Hop	(„ 1)	8 "B" positions.
Langside	(„ 1)	580
Londonderry	(„ 9)	220
Nottingham	(„ 1)	780
Streatham	(„ 1)	820
Sunderland	(„ 1)	200

Presentation of Album to Sir William Noble.

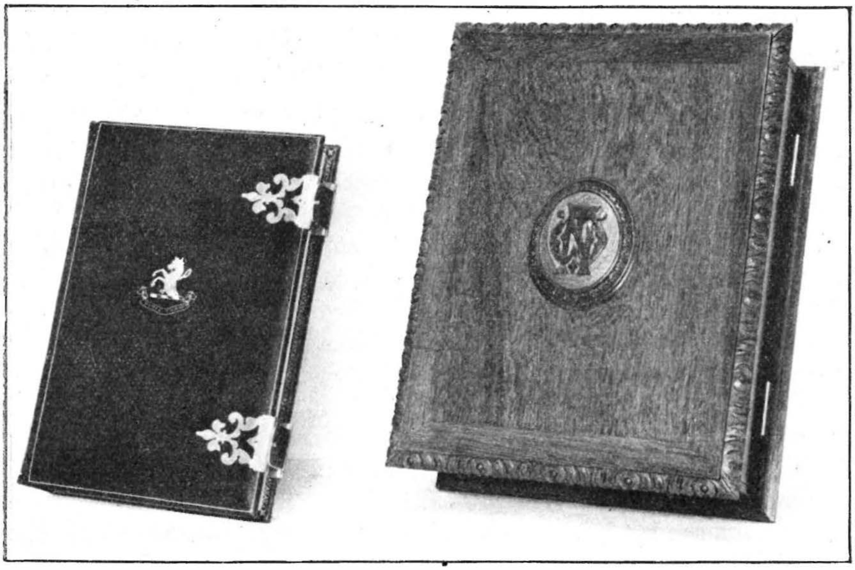
A large gathering assembled in the Deputation Room, G.P.O. North, on the evening of November 16th, to witness the presentation of an autograph album and case and a gold-mounted walking-stick to Sir William Noble to mark the occasion of his knighthood. The album is bound in royal blue morocco, silk-lined, and contains some fifty pages. The first page bears an illuminated address of congratulation, and the succeeding leaves are inscribed with the signatures of about 1200 members of the staff distributed all over the country. The case is of polished teak, elaborately carved, with the monogram "W. N." in relief in the centre.

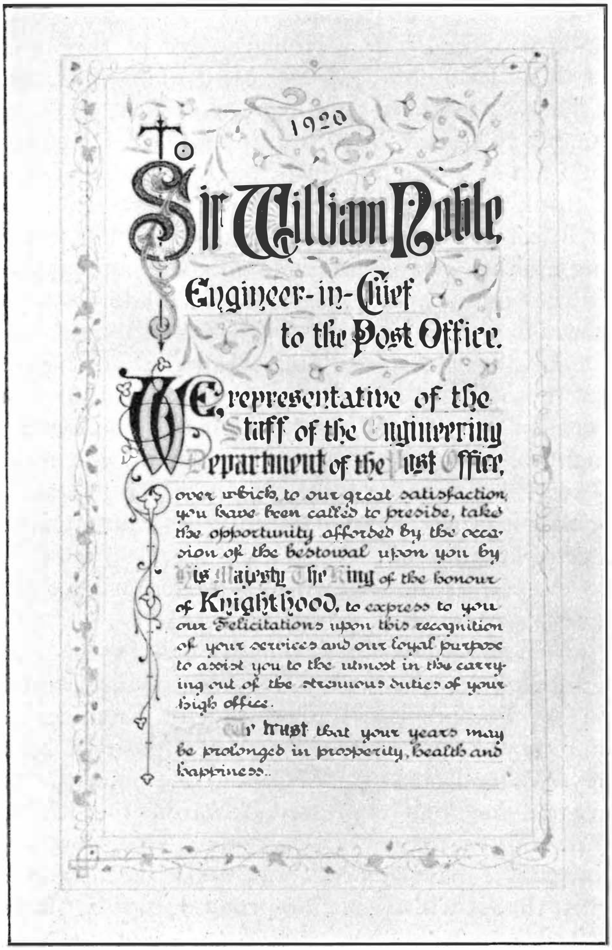
The presentation was made by Mr. A. J. Stubbs, who said:

"It is necessary to open with an apology from Messrs. Moir, Mountain and Renshaw, two of whom regret that Superintending Engineers' Committee business prevents them being present on this occasion.

"I feel that we shall think of this gathering as markedly symbolic. I must say that when the idea was first mooted I didn't think much of it. I thought that it was a suggestion that a few friends of Noble's, who had already very earnestly and lovingly expressed their congratulations, should do so in a more formal way. It seemed to me something like 'painting the lily,' but as the idea has developed, as we have the fruition of it here this evening, it is something of an entirely different order. It is really the acclaim of their Chief by a united Engineering Department. Another point that occurred to me at the time was that after all, to be the one Engineer-in-Chief of the British Post Office was a far more important honour and dignity than the dignity of sharing in knighthood with hundreds of more or less distinguished individuals.

"But the symbolic character of this again makes its appeal. It is true that the mountain is not increased in height by the possession of a snowcap; but that dignity marks the height to which it has attained in piercing the snow-line. In the same way the accolade of the King emphasises to us and signifies to the world the attainment of the high dignity of the Engineer-in-Chiefship by Sir William





1920

To Sir William Noble
Engineer-in-Chief
to the Post Office.

We, representative of the Staff of the Engineering Department of the Post Office, over which, to our great satisfaction, you have been called to preside, take the opportunity afforded by the occasion of the bestowal upon you by His Majesty The King of the honour of Knighthood, to express to you our Felicitations upon this recognition of your services and our loyal purpose to assist you to the utmost in the carrying out of the strenuous duties of your high office.

We trust that your years may be prolonged in prosperity, health and happiness.

ABOVE: ALBUM AND CASE. BELOW: ADDRESS ON FIRST PAGE OF ALBUM.

Noble. We may feel sure that even Sir William Noble's talents would not have secured this honour if he had remained Assistant Engineer-in-Chief. According to present practice, the Assistant Engineer-in-Chief lives in an arid zone, below the dazzling splendour of the snow-line, but above the grassy uplands and the fruitful valleys where men see the fruits of their labour.

"We supposed that there would be just a few signatures—probably most of the Superintending Engineers would sign besides the staff at Headquarters. As a matter of fact, in this volume we have the signatures not only of every S.E. and A.S.E. (Staff and Superintending), we have the signature of every chief Clerk and of over 1100 other officers of the Department. In times past we have sometimes felt more honour for the office of Engineer-in-Chief than respect for the holder. To-day there is no such divided allegiance. To-day this gathering is a symbol of the whole Engineering Department, which honours our friend because he is our chief and honours our Chief because he is our friend.

"In asking you, Sir William Noble, to accept this offering from your staff, I think I cannot do better than quote the expression of our goodwill as written here (quotes from album)."

Sir WILLIAM NOBLE: "Mr. Stubbs and Gentlemen,—It is very seldom that I am at a loss for words, but this is one of the occasions on which I think the less said the better. First of all, I would like to say that I feel greatly, indeed, the honour which you have done me in giving me this symbol of your goodwill and appreciation of my services such as they have been. I don't know whether you all know, but when you get the honour of knighthood all that you receive is a single sheet of notepaper—perhaps some of you will know one of these days—a single sheet of notepaper from the Prime Minister, consisting of three or four lines. You get no outward symbol, and therefore I appreciate this gift all the more, because I shall always have this beautiful album before me, and I shall be able to say that it is the opinion of my staff, that it is a certainty that I *did* get a knighthood.

"There is one quotation which I very often use, and it is this:

"'There is a tide in the affairs of men,
Which, taken at the flood, leads on to fortune.'

"Now if fortune means money, then few civil servants attain it; but I must say I appreciate the position of Engineer-in-Chief far more than I should appreciate any outside position earning much more money. When I occupy my present position, with your goodwill and your good feelings expressed towards me, then I doubly appreciate it.

"I know that I have a loyal staff and a keen staff, and I can only say this, that it will please me profoundly if at the end of my service none of you gentlemen will see any reason for altering any of the words in this address. Any success that I may achieve in my position—however long or however short its duration—as I said on a recent occasion, a large measure of that success will be due to the loyal and able staff I have around me.

"Gentlemen, I will not detain you longer, but will express my most hearty thanks for the great honour you have done me in asking me to accept this beautiful gift."

The company at this stage spontaneously sang—"For he's a jolly good fellow."

Mr. STUBBS: "Gentlemen, somebody reminds me that I did not offer Sir William this big stick. Apparently he does need it, but I think we may assume that we really have no special interest in it!"

Sir WILLIAM NOBLE: "I thank you, Gentlemen, and I shall have very great pleasure in using the stick on Hampstead Heath or on my native heath. I do not think I shall require it in pursuing my official duties!"

Sir William entertained the company to tea, which was very daintily served by the Manager and staff of the G.P.O. North Refreshment Club.

GALLANTRY AT SEA.

The Postmaster-General is glad to announce an act of conspicuous bravery on the part of Mr. J. H. Flavel, Chief Officer of the Post Office Cable Ship "Alert." While the "Alert" was engaged last February in recovering cable, it was found that a mine had become entangled with the cable and had been brought up to the bows of the ship. In preference to delegating to any of his men a task of considerable danger, Mr. Flavel had himself lowered over the bows in a boatswain's chair, and after examining the mine released it by cutting the wires, which had become caught in the cable. By his prompt action Mr. Flavel averted what might have been a serious disaster.

His Majesty the King has been pleased to award Mr. Flavel the Silver Medal for Gallantry in Saving Life at Sea.—*P.O. Circular*, October 26th, 1920.

DISTRICT NOTES.

LONDON DISTRICT.

Telephone Lines and Stations.—During the thirteen weeks ended September 28th, 1920, 3994 exchange lines, 4886 internal extensions and 536 external extensions were provided. In the same period

1145 exchange lines, 2179 internal extensions and 490 external extensions were recovered, making nett increases of 2849 exchange lines, 2707 internal extensions and 46 external extensions.

TELEPHONE LINES AND STATIONS.

For the year 1920 the net increase in exchange lines amounted to 14,500, being equal to 10·20 per cent. increase upon the existing figures. This is a record result, particularly satisfactory in view of the difficulty which has been experienced in obtaining stores and equipment. It is nearly twice as good as the figures reached in the pre-war years 1912–1913, and considerably better than the 1919 figures, in which the percentage increase was 8·32.

Unfortunately the provision of exchange equipment has not kept pace with this rate of development, the actual additions being 7460 lines = 3·57 per cent. increase. The provision made for next year's work will enable this leeway to be overtaken to a large extent.

INTERNAL CONSTRUCTION.

In the October issue it was stated that there was scarcely an exchange in the London Engineering District where some work was not either in hand or contemplated. The position is still the same, with the exception that the number of outstanding works has a tendency to increase, owing principally to the slow delivery of stores.

Contract works at Avenue, Victoria, Hornsey and Harrow exchanges are approaching completion.

Considerable progress has been made with the relief exchanges. It is hoped to complete the first Mayfair relief exchange (Langham) in the early spring.

A good start has been made on the permanent Clerkenwell Exchange. When it is opened the present temporary exchanges will be linked up with the Bishopsgate area, and give much-needed relief to that neighbourhood.

A start has been made on the new Toll Exchange in Norwich Street, Fetter Lane.

Building operations are in hand in connection with the following new or extended buildings: Monument (Tower), Holborn, Stratford, Tottenham and Barnet.

P.B.X's.—It was anticipated that most of the work to be done after the war in connection with multiple type P.B.X's would be in the nature of recoveries. Many war installations have been recovered and replaced by peace-time installations, but there has also been a big demand for multiple boards for commercial houses. At the time of writing nineteen cases are being dealt with.

W.E. Co.'s Panel Automatic Exchange (Blackfriars).—Although it may be some nine months from date before the panel equipment is delivered and its installation begun, yet there is quite a lot of preparatory work to be done by the District, such as providing new leading-in facilities.

Considerable structural alterations are involved to provide for a rearrangement of staff accommodation and to clear space for the new equipment.

External Construction.

During the three months ended October 31st, 1920, the telephone exchange wire mileage increased by 34,676 miles underground and decreased by 180 miles open-wire and 800 miles aërial cable, making a net increase for the period of 33,696 miles.

The telephone trunk wire mileage for the same quarter increased by 70 miles underground, the open being unchanged. Increases of 134 miles underground and 12 miles open were effected in wire in use for public telegraphs for the same period.

At the same date the pole-line mileage was 2847 and pipe-line 3740 miles, being increases on the previous quarter of 34 and 39 miles respectively.

An increase of 123 miles in the length of underground cable brought the total to 7505 miles.

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

Telegraphs	17,553 miles.
Telephone exchange . . .	1,127,878 ,,
Telephone trunks . . .	18,656 ,,
Spare wires	16,085 ,,

SOUTH MIDLAND DISTRICT.

Retirement of John McLorinan Robb, O.B.E.

"Unique and remarkable" were the terms in which the local press described the social gathering which was held at Reading on November 10th to bid farewell to the late "Chief" of the South Midland District. It certainly was, and certain it is that none of the Committee who organised the arrangements ever expected such an overwhelming response to the general invitation which was issued. Suffice it to say that one of the largest halls in the town was crammed, and the "departure from estimate" was such that had all the applications from those wishing to attend from all parts of the district been accepted a similar hall would have been similarly crammed. This fact alone is eloquent indeed of the phenomenal regard in which Mr. Robb was held by all grades of the staff he so ably administered.

Major G. H. Comport, M.C., R.E., presided over this memorable gathering, and in his opening speech with well-chosen words voiced the feeling of the entire company when he referred to the "lovable qualities" of Mr. Robb—"qualities which every man discovered who had the slightest acquaintance with him."

"The Major" was supported by Mr. H. C. McCormack and Mr. W. P. Hooban, who spoke on behalf of the clerical and outdoor staffs respectively. Speaking from different points of view, they struck the same chord in recognising the ever-unruffled courtesy of Mr. Robb, his appreciation of work well done and his generosity on less happier occasions.

Sir William Noble then presented to Mr. Robb on behalf of the South Midland District a cheque and an album containing the signatures of every man in the district. To Mrs. Robb he handed a gold watch and chain. Sir William also presented to Mr. Robb on behalf of the Superintending and Staff Engineers—many of whom were present—a camera and photographic outfit. The Engineer-in-Chief briefly outlined Mr. Robb's career in the service, and spoke in eulogistic terms of the splendid results of his (Mr. Robb's) administration, stating that this success "was largely due to personality, combined with common sense and sound judgment."

Mr. Robb, in rising to respond, was greeted vociferously and with musical honours. He was evidently affected by the sincerity and warmth of the welcome, and feelingly acknowledged in modest fashion the gifts which had been presented and the tributes paid to him. In delightfully reminiscent mood he spoke of his early days in the service and his subsequent career—years brimful of pleasant memories and associations.

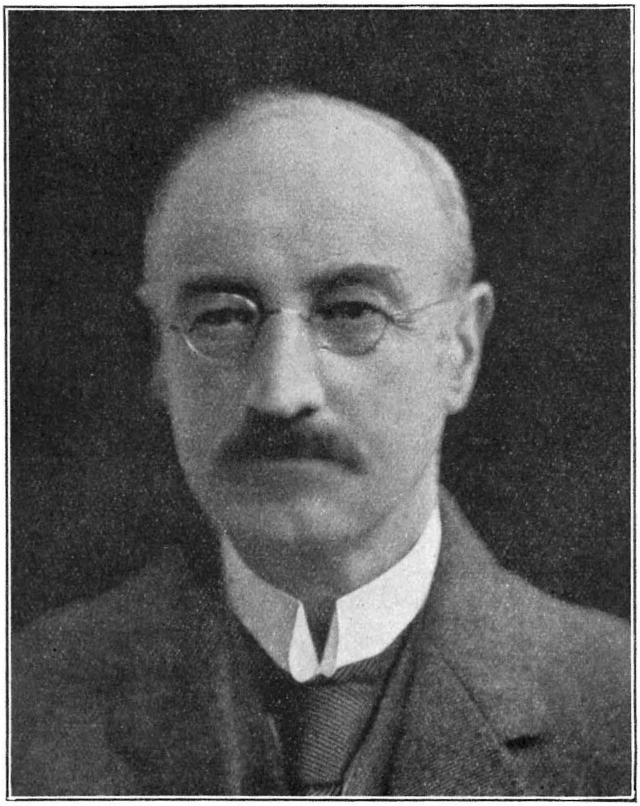
Mr. J. H. Thow, who arranged the excellent musical programme, is to be congratulated. A performance more successful than that rendered by the professional artistes from the Chapel Royal, Windsor, would be difficult to imagine. It was, indeed, perfect down to the slightest detail, and there was never a flagging instant.

Altogether it was a remarkable evening, and the most stirring event, we have no hesitation in saying, in the annals of the South Midland District.

It will be difficult for us to reconcile the loss occasioned by our late Chief's departure, but though his presence is lacking, his memory and personality remain with us. The united wish of the whole of the South Midland District staff, of every rank and grade, is that both he and Mrs. Robb may long be spared—in fulness of health—to enjoy a happy and peaceful retirement. *Vale!*

. . . . .

John McLorinan Robb was born on October 17th, 1859. He entered the Post Office Telegraph Department as a Telegraphist on November 16th, 1874, and remained there until December, 1882, when he was transferred to the Engineering Department as Junior Clerk in the Superintending Engineer's Office, Belfast, on the formation of the North Ireland District. In 1887 he was appointed Relief Inspector for Ireland, with headquarters at Belfast; in 1889 allotted a permanent section at Belfast; in 1897 promoted Engineer,



JOHN McLORINAN ROBB, O.B.E.

Class I; in 1902 made Assistant Superintending Engineer; in 1907 headquarters changed to Dublin on the re-arrangement of the Irish Districts. This was the first change in Mr. Robb's headquarters in a period of twenty-five years in the Engineering Department. He had been asked in 1897 to accept a transfer to London, but had not seen his way to do so. He remained in Dublin only a few months, as in September, 1907, he was appointed to the Telegraph Section of the Engineer-in-Chief's Office as Staff Engineer, Class 1, and after a period of a year and a half he was further promoted as Superintending Engineer at Newcastle-on-Tyne, where he remained until October, 1912, when he took charge of the newly-formed South Midland District.

He now retires at the age of sixty-one, after a service of forty-six years.

NORTHERN DISTRICT.

A Long Drop.

The accompanying photographs, which are printed with the courteous permission of the *Newcastle Illustrated Chronicle*, show the

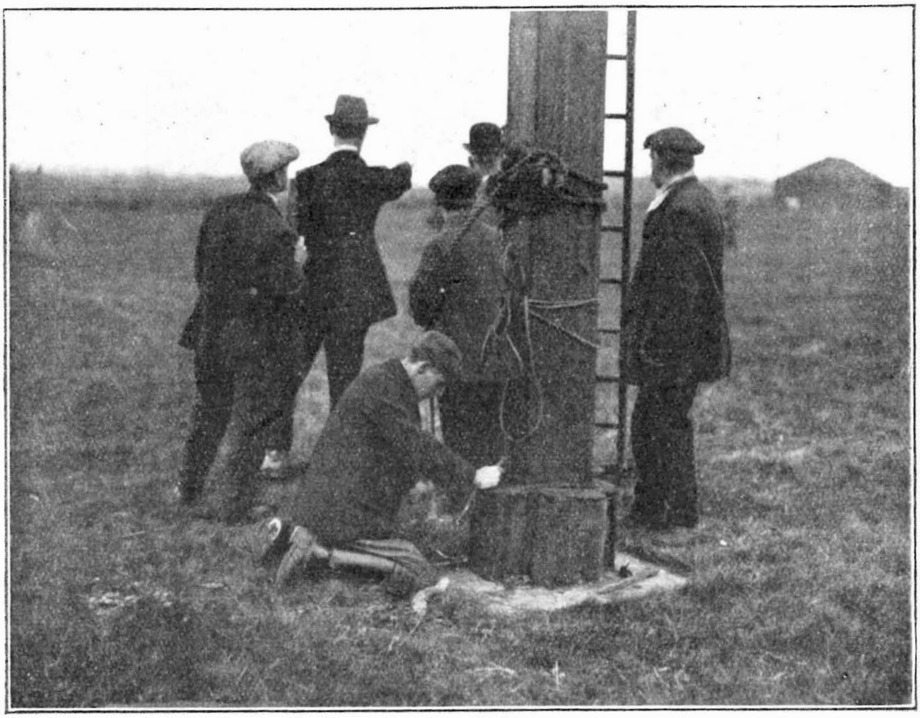


Fig. I.—Showing Butt of Mast.

striking of the four masts of a recently dismantled wireless station on the north-east coast.

The masts, which were 120 feet long, were of the box type, and were built up of boards 16 feet long by 1 inch thick. The boards in the bottom sections of 50 feet were 10 inches wide, and those in the remaining portions of the masts were 8 inches wide. They were nailed together at their edges, and at intervals of 8 feet blocks 6 inches long were inserted into the lumen of the masts, two opposing boards being jointed at each block.

Each mast was stayed in four directions, the sets of stays being attached to the four faces of the masts. Each set of stays (five in number) was attached to one heavy stay anchor. The masts having been in existence for six years, it was considered that the expense of lowering them was not justified, and it was therefore decided to allow them to fall.

Photograph No. 1 shows the stepping of the butt of one of the masts. The mast itself stood on a cement block, and was held on three sides by pieces of timber set about 3 feet into the cement.

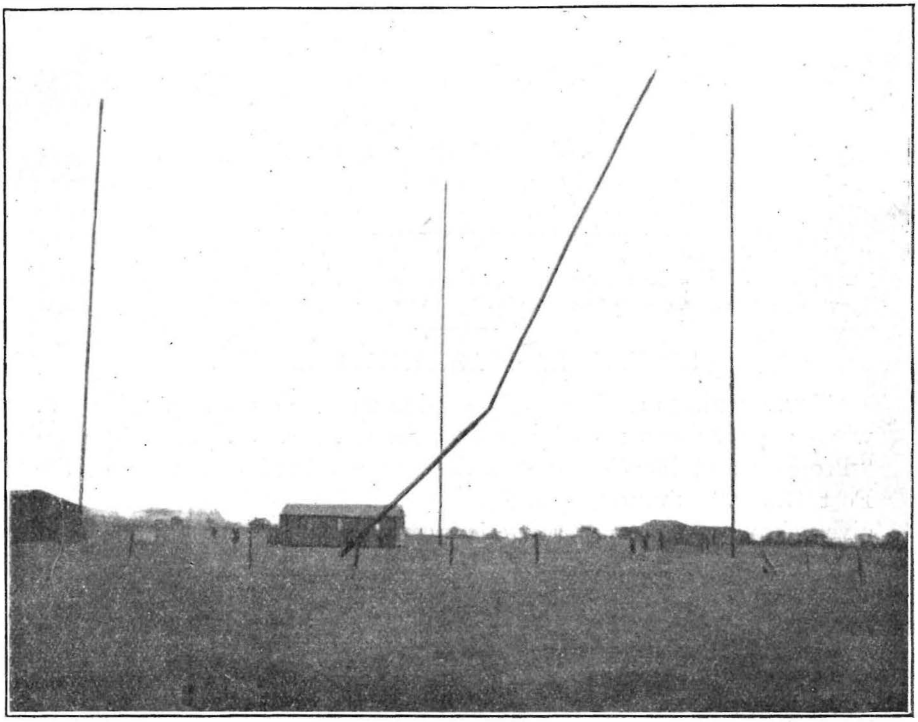


FIG. 2.—THE FIRST MAST FALLING.

On the fourth side the butt was held by an iron strap, which was secured to two of the wood blocks by means of long coach screws. This strap was removed and the stays on the opposite side cut away.

The mast was then pulled over towards the side where the strap had been by means of a guy-rope running through a snatch-block attached to crowbars, which were driven into the ground some distance away along the line of fall of the mast. The rope was a long one, and the men detailed to pull the mast over were therefore stationed well away from the danger area. As a preliminary and before any stays were cut the snatch-blocks and ropes were fitted to all the masts. The actual time occupied from the cutting of the first stay to the fall of the last mast was exactly eight minutes.

The first mast to fall (that shown in photo. No. 2) buckled in the centre, but the remaining three fell quite straight. It is worthy of note that the lateral sets of stays held the masts in perfect alignment while they were falling, and that the tension on these stays was very little less after the masts reached the ground than in the upright position.

The procedure of dropping the masts was fully justified, as an examination showed that the timber had become very "short," and at the point where the first mast buckled there were signs of incipient rot.

Surprisingly little damage was done to the timber in falling. The extreme top of each mast was splintered on two sides for a length of about 12 feet, but except for a few scattered cracks the remainder was practically undamaged. C. WHILLIS.

LOCAL CENTRE NOTES.

SOUTH LANCASHIRE CENTRE.

THE opening meeting of the session was held on November 1st, when a paper was read by the Chairman, Mr. W. J. Medlyn, on "Progress and Development in the Engineering Department of the Post Office." Some very interesting and instructive statistics were given showing the progress made by the Department in its efforts to meet the deficiency of telephone plant left as a legacy of the war. It was mentioned that the progress had been made in the face of difficulties due to shortage of stores and suitable labour, and the results achieved encourage the hope that in the near future the public of this country will enjoy a telegraph and telephone service which will be second to none.

The meeting was well attended, and on the invitation of the Chairman an interesting discussion followed.

The second meeting of the Session was held on November 29th, when Mr. A. B. Hart, of the Headquarters Staff, gave an address on "Telephone Repeaters." After reviewing briefly the earlier attempts to produce a satisfactory telephone repeater and explaining the reasons for the failure of all mechanical devices to become commercially successful, the lecturer passed on to the consideration of the thermionic valve. The evolution of the thermionic valve was traced, the theory of electronic discharge was dealt with briefly, and the principles of the modern telephone repeater were explained in a concise and interesting manner.

The lecturer then proceeded to give some particulars of the probable trunk telephone system of the future, together with data indicating the magnitude of some of the projected large repeater stations in this country. The lecture concluded with a short description of high-frequency telephony, and some allusions to the possibilities that were opened up by this further development of telephone science.

There was a large attendance, and the lecture was highly appreciated by all who had the opportunity of listening to it. The audience felt some regret that time did not permit of the lecturer proceeding further.

A DAY'S WORK OF A POST OFFICE ENGINEER.

At the outset it should be stated that temperamentally I am an optimist with a sense of humour, and one who does not think the Department is out to bleed me white and to leave my bones to bleach in the sun—that outlook is too gruesome.

Had I such an outlook each morning on arriving at the office I should expect to meet the executioner on the stairs, and should fancy that each of the presses which stand sentinel around my room concealed a ghost ready to pounce upon me at any moment.

No, there is no one on the stairs to meet me, unless it is my boy messenger being chased by the junior clerk, nor do the presses contain any ghosts left there the night before.

I get rid of all papers bearing any ghostly appearance, but some of my colleagues foolishly place these papers in the presses overnight, go home and think about them; and although, when the papers were put in the presses, they were only goblins sent out from the Superintending Engineer's Office just to keep things moving, in the morning they have grown, whilst on the second morning . . . one is afraid to shed light on them.

No, I prefer to deal with goblins in the goblin stage, before they assume dimensions they were never intended to assume. I don't let them grow up, and really in that stage they are more interesting; there is a certain frequent humour flickering about them.

The morning papers have always a peculiar interest—a freshness about them that I enjoy; like the meeting of old friends, and the hour spent amongst them is one of the most enjoyable of the day. With each official endorsement appears a portrait of the writer, his style, his peculiarities, all complete, and after a little practice you acquire the art of balancing the several writers—an art which is a very useful accomplishment to an engineer away from headquarters.

There is Jones of the Superintending Engineer's office, for instance. Now everyone knows that Jones has a talkative liver, and when you read an endorsement from him, at first glance you are irritated and think it "bad form," and then—well, it's Jones, and you pass the paper out. Then there's that Brown chap, who takes his official life very seriously and the Regulations is his bible, and well he knows it; and suspicious Wilson or Smith, whose endorsements always have a bite in them; but Smith is really no worse than a snapping toy terrier—he simply wants to be noticed. Walker is clearly a balanced man, and any report he writes receives careful consideration; and so on, right through the gallery. Yes, men on paper are very interesting.

After the morning papers I am visited by my two assistants—one dealing with maintenance and one dealing with works. I see them both together, and adopt this unusual course, because—

(1) It gives both men an insight into each other's work and the work of the section as a whole—watertight compartments are unhealthy. (2) It removes suspicion. (3) It prevents misunderstandings. (4) It gives both men a feeling that they are important units of the organisation.

If either man has a difficulty we three discuss it, and although at first they were reluctant to state their difficulties, they now openly state their cases, have them thrashed out, and we decide on a solution. They are not above learning from each other's experience, and there is no feeling of jealousy. Personally I look upon these two as men in training for executive posts, and amongst other things impress upon them the following rules:

(1) Be the "director" of the section.

(2) Don't give any decision until you have carefully weighed the matter. Don't jump at conclusions, as you may have have to change your decision. That is bad policy and a sign of weakness.

(3) Let all the staff appreciate your "directing." This cannot be done by giving instructions like a sergeant-major in the Army. You should appear as a teacher to the staff—and all efficient teachers are respected by their pupils.

Perhaps I take these meetings the most seriously of all my duties, and I do so as I am convinced that it is time well spent. Not only does it give that peace of mind necessary to all men, but it benefits the Department, as two men efficiently trained, full of self-confidence, will eventually be capable of taking charge of any section.

The remainder of the day I spend in visiting works in progress, talking with foremen, learning their difficulties, appreciating their good work, and generally giving them confidence in themselves and in the system under which they are working; visiting the linemen, offices, or any spot in the section where there appears to be a weak link.

Now and again I examine all the diaries for one day with a view to "sensing" the "tone" of the men. I find that examination a good means of tracing any weak spot in the section. I then concentrate on that spot, not in the spirit of fault-finding, but in the spirit of helping, of construction, and spend some time there until satisfied that the weakness has been removed.

With a large staff there must be men who require to be tactfully strengthened, and some of the most pleasing incidents in my official life have been those where the man has found his feet, and awkwardly expressed his sincere appreciation of the "first aid" rendered.

An engineer must appreciate the difficulties, the worries and anxieties, the hopes, the ambitions of the man who has not had a good education. It is wise also to keep your eye on the men's viewpoint. The change of scenery is refreshing to the mind.

The psychology of the workman is an interesting study. Many times it is difficult to ascertain what is the motive behind many of the actions of the men, what is "at the back of their heads," but when you have studied them and know their weaknesses, their strength, their peculiarities, you will find them very easy to direct and they will be loyal to you.

The following are a few mottoes in my office:

(1) There are no GHOSTS.

(2) You cannot "direct" a load and "carry" it at the same time. You have "carriers" supplied for your use.

(3) The men in your charge are dependent upon *you* for their training.

(4) Don't wobble—it's undignified.

(5) Don't be stiff—it's too funny.

(6) Be natural.

(7) You cannot be just to the Department if you are unjust to your staff.

"X."

THE TELEPHONE SERVICE.

(The following reply to the criticisms of the Special Correspondent of the Times *appeared in that journal on November 8th, 9th, 13th and 15th.)*

YOUR special correspondent has recently placed before the readers of the *Times* a series of articles dealing with "The Telephone Problem." He contrasts the telephone situation as it is in this country to-day with that in America; he has endeavoured to show that the Post Office has failed in its capacity of telephone authority, and that the remedy is either to reorganise the Post Office or to constitute an entirely new telephone authority.

We are probably all agreed that the primary duties of a telephone administration are to furnish to its subscribers as good a service as can be obtained at reasonable cost, and to connect up would-be subscribers without unreasonable delay. The quality of the service furnished is good when the calls are answered quickly, connections made quickly and accurately, and the instruments and lines are provided and maintained in a condition suitable for the good transmission of speech.

We are told that in America the service furnished is far superior to that which has to content the British subscriber. How is it really the case that the average telephone user in New York at the present time is better served than the Londoner? It is doubtful. The telephones, the exchange equipment, the line plants are similar. Probably all the equipment in New York was supplied by the Western Electric Company. Much of that in London was supplied by the same firm, though only a negligible fraction of it was manufactured in America, and it is all of an equal standard.

It would be just as easy to collect expressions of opinion against the efficiency of the telephone service in America as it is in England. For example, 'The Electrician,' a technical journal which has always been interested in telephony, says in its last issue :

"An examination of both the lay and technical American press shows us that even the much-vaunted Bell system has its weak points, while a statement recently made by a prominent American visiting this country was that telephone communication in New York was beneath contempt."

But there is really no need to deal with questions of telephone efficiency by wild assertions or counter assertions. It is usual for telephone administrations to employ service inspection staffs. Those inspectors observe and make records of the progress of calls through their various stages. The subscribers' lines on which observations are made are changed from day to day, and in the course of a month or a year great numbers of lines and greater numbers of calls come under review. From the records made, the quality of the service furnished can be determined. The speed, the accuracy, the discrepancies of the operating and the shortcomings of the subscribers are shown. Such observations were made in the past by the National Telephone Company, and they are made at the present day by the Post Office and by the various American organisations. A means, therefore, exists for determining whether the Post Office gives a better or a worse service than that furnished by the National Telephone Company. The Post Office has always courted investigation of its system and data, and, if the other administrations concerned would disclose the contents of their observation records, it would be possible to determine also how the American and British services compare.

For example, it can be shown how the average speed of answer (by the operators) varied in London during the years 1906 to 1919, that is, during the last six years of the National Telephone Company's existence and the first eight years of complete Post Office control. During the first half of 1906 the average speed of answer was 9½ seconds. From that date until the first half of 1908 the time fell till it was just over 5 seconds. It stood at about 5·2 seconds from the middle of 1908 onwards for two years, then gradually increased till it was just over 6 seconds at the end of 1911. Post Office control commenced on January 1st, 1912. After that date the "speed of answer" time commenced again to decrease. In the first half of 1913 it was down to the minimum time attained during the Company's control, and it continued to fall till it reached the figure of 4 seconds in the second half of 1915. During the first four years of undivided Post Office control there was thus a continuous improvement in the quality of the service given in London. At the end of that period the service was undoubtedly good. That it would have continued at that standard or would have still further improved is undoubted. But the war intervened, and the whole of the national effort had to be directed to the object of beating the enemy. Projected schemes for the extension and improvement of the service had to be dropped. Men and materials could not be spared for the erection of buildings. Trenches had to be dug in Flanders instead of in the streets and highways of Britain. All the poles, all the wire, all the cable that could be procured or manufactured were required for the use of our armies, and all the factories that previously had manufactured telephone plant had to be reorganised to produce munitions. More than 13,000 young men were released by the Engineering Department for military service, and the remainder, in addition to carrying on the telephone and telegraph service as best they could, equipped and connected up the war camps, aerodromes, observation posts, gun and searchlight stations, etc., with telephone facilities, and organised the production and supply of signalling material for the armies in the field. The general public has little idea of the vast volume of work of this kind carried on by the Post Office for the armies, or of the great number of new designs of electrical apparatus produced by its expert officials to meet the developing conditions of modern warfare. Not to be outdone by the male staff, over 5000 trained women operators left the service in the latter years of the war to take up work which appeared to them to be more directly connected with the great national aim. New operators or learners could not be obtained in anything like sufficient numbers, and the result was that the quality of the service deteriorated. The average time of answer lengthened from 4 seconds at the end of 1915 till it reached 8 seconds at the time of the armistice. At the end of the war, and when the immense revival of business immediately took effect, the Post Office operating staff was inevitably very much under strength as regards numbers and largely inexperienced. The latter was the more serious point. On top of that difficulty the traffic has continued to increase, so that a relatively inexperienced staff has had far more calls to attend to. During the first half of 1919 the average time of answer reached a maximum of $10\frac{1}{5}$ seconds. Thereafter the strenuous efforts of the Post Office to meet the situation began to bear fruit. An improvement of the service set in, and at the present time the average time of answer by the operator is 7·4 seconds.

The effect of the war upon the telephone service was not peculiar to this country. The same results in greater or lesser degree must have been experienced in every country that took part in it. America did not escape, although her total effort in the war was very much less than ours. There certainly has been a telephone agitation in New York, as the Press of that city has testified in no uncertain terms. The New York traffic observation figures have not been published, and a direct comparison between them and the London figures cannot be made, but in this connection a statement made by a witness at an inquiry held by the Public Service Commission of New York for the purpose of ascertaining the reason for inadequate service is interesting. The statement as reported in the issue dated December 13th, 1919, of the *New York Herald*, reads: "Miss J. T. Mooney, of the Bowling Green Exchange, said that from 14 to 30 per cent. of the calls in her exchange now take more than ten seconds to answer, while the average call on the others is from seven to eight seconds, which used to be made in from three to three and a half seconds. She said that there are now from 30 to 42 per cent. re-calls, while formerly there were only from 15 to 20 per cent."

The above statement does not indicate precisely the average time of answer, but quite clearly it was something greater than 8 seconds at the Bowling Green Exchange in December last. One is not anxious to make capital out of the difficulties of one's friend—especially a friend with whom personal relations have been so close and so pleasant as they have always been between the Post Office staff and the great American companies—but when the friend's performance is extolled while one's own performance, which is really no worse, is condemned, it is difficult to refrain from making some defence. At this point the defence can only be the statement of a well-founded belief that if the facts were forthcoming it would be found that the service in London during the last eighteen months is no worse than it has been in New York.

No responsibility for the character or magnitude of the effect of the war upon the telephone service can be attributed rightly to the nature of the administration. The dislocation would have been no less had the service been under the control of a private company, a group of business men or any other authority. Indeed, it might safely be argued that under a private company the deterioration would have been greater, since a Government Department could get material and equipment that a private company could not obtain.

Critics of the Post Office invariably paint the service of the late National Telephone Company in rosy hues, but many of your readers will be in a position to remember that things were far otherwise while that Company was actually in existence. They will recollect that it was mainly on account of the very hostile attitude of the public press towards the National Telephone Company that in 1899 Parliament was induced to grant telephone licences to municipalities, and to vest the Post Office with powers to establish a local exchange system in London. They will also remember that of the thirteen municipalities which applied for and obtained licences, only one (Hull) has been able to continue the business successfully up to the present day. All the others were glad, after a more or less prolonged trial, to sell out either to the National Telephone Company or to the Post Office.

It has been shown above that when the Post Office took over the management of the whole telephone service it was not only alive to its duty to furnish a good service, but that it acted. The statement that "the service immediately fell into a state of chaos, which lasted almost up to the time when the war arrived, to put all other troubles into the background," made by the *Times* special correspondent is not correct; the service at once commenced to improve, and continued consistently to do so till stopped by the war.

The Post Office was equally anxious to perform its duty of furnishing service to all and to any extent desired. It took over a plant in 1912 that had admittedly, and for perfectly obvious business reasons, been starved. Much of it had reached the end of its effective life and required not only extension but reconstruction. Canvassing had for some years been restricted to areas in which spare plant could be brought into use, with the result that spare plant was exhausted and the whole system was congested. It had become unstable and insufficient, and therefore inefficient, and only the most vigorous treatment could prevent it from becoming continuously more so.

Although handicapped by the diversion of a substantial portion of its export staff throughout the first year to work in connection with the valuation of the plant taken over, and the preparation of evidence to lay before the Railway and Canal Commission (which fixed the price to be paid), the Post Office at once put into operation a great scheme for extending the plant. Studies of probable future development were at once undertaken in hundreds of areas. This involved the consideration of every street and every large building, and calculation of the numbers of prospective subscribers for periods ten and twenty years ahead, in order to determine the proper location of exchanges and the lay-out of cabling systems. During 1912 a sum of £1,756,300 was spent on extension; during 1913 £2,838,200, and during 1914 £3,213,700, but this was only a beginning. Each year saw the vast arrears of work being overtaken at increasing speed. Then the war intervened. *What chance has the Post Office had since January, 1912?*

That this telephone system of this country has suffered from political vacillation cannot be denied, but the blame for this does not lie at the door of the Post Office or its staff. We have had a long-drawn-out series of private companies with terminable licences, and municipal licenses, mixed up with a partial Government system. Now that the whole has been placed in the hands of the Post Office it should, in common fairness, be permitted to show what can be done in this country by the continuity of development and control which has for many years been enjoyed by the great American companies.

"But after the Armistice the telephone chaos was as apparent as six or seven years ago, and it still continues," says the special correspondent, in reference to the British service. In an earlier article he had already written: "The war has temporarily banished ordinary times in all businesses, and the telephone service has been affected with the rest, but the very highly organised commercial branch of the American telephone system will certainly help the telephone to get over the post-war crisis without suffering too greatly in public esteem." He admits a post-war crisis in connection with the telephone in America, but that the British service has not completely recovered since the armistice, simply on account of Post Office ineptitude, is what the special correspondent wishes to lead the *Times* reader to conclude. It matters nothing that this country was in the war years before America, that she poured forth her manhood, her womanhood and her gold to a far greater extent than did America, that she stripped herself to the bone, and threw everything into the contest in order to win the war. While here in England the factory staffs and engineers and workmen were training for war and fighting, and dying, and the telephone factories were turning out munitions instead of telephones, there, in the United States, telephone plant was still being manufactured and installed under practically normal conditions.

It is quite evident that the writer of the articles is not a practical telephone man. He cannot have any knowledge of modern telephony, for if he did he would have some idea of the time necessary to provide exchanges and line plant, and he would know there has not been sufficient time since the end of the war for the service to recover. Many months are required for the design and erection of an exchange building. To design, manufacture and instal an exchange equipment also requires many months even under the normal pre-war conditions of supply. The manufacture and the laying of hundreds of miles of underground cable cannot be effected in a short time. As an illustration of the time involved, it may be stated that during 1918 the need for a new exchange equipment to replace an old plant in a large provincial town became so urgent that the Priorities Committee of the War Cabinet was approached, and agreed to the work being done, though the end of the war was not in sight. A contract was arranged in August, 1918, for the manufacture and installation of that equipment with the British branch of the largest telephone manufacturing concern in the world. The plant will not be completed until the end of this present month.

The difficulty and delay in providing the public with the telephone facilities it desires, consequent upon a five years' compulsory stoppage of development work, is part of the price which the nation has to pay for the war.

No administration could have done more than the Post Office has done since the armistice. There are a large number of exchange equipments, innumerable telephones and switchboards for subscribers, great quantities of poles, and wire and ducts and cables on order, *but the manufacturers cannot deliver the goods with sufficient speed*. In some cases the work cannot get into the shops because there are not enough engineers and draughtsmen expert in the requirements of telephone work, and to train new men needs time. The manufacture of munitions did not need telephone engineers, and as a consequence the trained staffs were dispersed when the manufacture of telephone plant ceased, and it has not been possible to get all of them together again. Need it be said there is no telephone equipment engineer out of employment in this country to-day?

The telephone industry, like most others, has had difficulty in obtaining its raw materials. It uses iron of various grades, partly for the purpose of making electro-magnets, partly for constructional purposes, and it has difficulty in getting its demands met. The world demand for fine magnet wire exceeds the supply. The same may be said of silk, which is used on wires as an insulating material. The shortage of silk is no doubt due to the extent to which it is used in ladies' clothing at the present time. There has been difficulty in obtaining the wool used as an insulating material in switchboard cables. All the wires used in underground cables are insulated from each other with paper of a special kind. There is a shortage of this material which is seriously reducing the present output of cables. One of the principal sources of supply of telephone poles—Russia—is not at present available, and there is a shortage of poles. Timber for poles has to be seasoned and creosoted before use, and the process requires time. Earthenware ducts similar to drain-pipes cannot be produced quickly enough to meet the demand: shortage of coal has checked their manufacture as well as having increased their cost enormously. Labour troubles affect the telephone industry in common with all others. The various coal shortages, gas shortages, transport difficulties, moulders' strike, etc., have all had an effect in slowing down output.

The Post Office is blamed for the limited extent to which the telephone has been taken up in this country. Let us examine this contention.

In comparing the relative developments of the telephone in the United States on the one hand and in the United Kingdom on the other, one naturally would like to know to what extent the field for development differs in the two countries. We may leave on one side the undoubted fact that this country possessed a far more rapid postal system and a much more highly developed and extended telegraph system than the United States, and that the need for telephones was therefore less pressing. Apart from this, would the ratio of telephone stations to population have been the same here as there if the attitude of the British Government towards telegraphs and telephones throughout their existence had been the same as that adopted in the United States? The answer is "No." Telephones may be divided broadly into two main clauses—business and residence. Let us consider the former. If at any time between the years 1890, say, and 1914, the possible telephone user in England had been subjected to the same blandishments and the same amount of pressure as the American sustained, would he have ordered as many telephone lines or as many stations per line? He would not. It was during those years that the cry, "Wake up England," rang out, and at whom was it launched if not at the British public as a whole? It was lagging behind the American; it was less up to date in its methods; it had a greater reluctance to scrap old tools and buy new ones; the necessity of employing the college man and the scientist in industry was less apparent on this side, and, among other things, the need for the equipment of factories, business premises and private residences with telephones was less effectively realised and admitted. And if a certain amount of national inertia has caused the well-to-do Briton to lag behind in the past in the desire to have the telephone, what of the employed class? It is well known that the standard of living in this country during the telephone period was lower than in America; that the remuneration of the employed class all the way from top to bottom was much lower relatively here than on the other side of the Atlantic; that the margin between the cost of the necessaries of life and income was much less than in America. The naked fact is, therefore, that excepting the few at the very top, the employed, whether they knew its advantages or not, whether they had or had not the desire for possession, could not afford to spend money on telephones.

Two conclusions may, therefore, be drawn concerning the relative fields for telephone development. The first is: the ratio of possible telephone users to total population at any moment during the telephone period was much less in this country than in the United States. The second conclusion is that the possible telephone subscriber in this country had a much greater reluctance to employ the telephone than had his American friend.

The use of the motor vehicle and the use of the telephone in the two countries are comparable. There is about one telephone to every ten persons in the United States, about one to fifty in the United Kingdom. Relatively, the telephones there and here on the basis of population are as 5 to 1. Now let us examine the motor vehicle situation. We are told in the *Times* of July 28th that there are now 7,500,000 automobiles in the United States—that is, about one to every fifteen persons. The number in this country is probably still considerably less than half a million—less than one to every eighty persons—so that the motor vehicles there and here are relatively as 5 to 1. Why is there this discrepancy in development? Wages, and consequently production costs, were until recently much lower here than in America. We had iron and coal, we had a good grip on the rubber production of the world, we were a highly industrialised and engineering nation. Petrol cost little more here than in America. This country is small and the bulk of the traffic is "short-haul"—ideal conditions surely for the motor vehicle. Then why has its development been so restricted? The reason given for the limited development of the telephone is the reason that applied, for some years before the war, to the restriction of the development of the motor vehicle. The employed class had not the money to buy cars, while the business man had not discovered the necessity for the motor vehicle in business. In this matter also we lagged behind America.

We have shown that the population of this country could not take up the telephone to the American ratio; that the people who could make use of the telephone would not do so to the American extent. For neither of those circumstances can the Post Office be held responsible. We have shown, also, that the construction and installation of plant requires considerable time; that the plant for future growth did not exist to a sufficient extent in the system taken over in 1912, that the Post Office made strenuouus efforts during the years 1912, 1913 and 1914 to place it on a proper basis, that its successful efforts in that direction were entirely upset by the war that the manufacturers are full up with Post Office orders, that they have difficulties in expanding their staffs and in getting materials, and that time is required for the work to be done.

Much play is made with the "scientific toy" statement made by a former Post Office official in the very early days of the telephone, which has been repeated *ad nauseam* by critics of the Post Office. Why not let us have the statement in its true perspective.

According to an article that appeared in the 'Telegraphic Journal' of September 1st, 1877, entitled "Electrical Science at the British Association," the late Sir William Henry Preece, then a member of the Post Office staff and probably the official referred to, made the following statement:

"It is evident that in Reis' telephone everything at the receiving end remained the same excepting the number of vibrations, and therefore the sounds emitted by it varied only in tone, and were therefore notes, and nothing more. The instrument remained a pretty philosophical toy and was of no practical value. . . .

"Gray also invented a method by which the intensity of the note as well as their tones could be transmitted, but it remained for Prof. Graham Bell, of Boston, who has been working at this question with the true spirit of a philosopher since 1872, to make the discovery by which tone intensity and quality of sounds can all be sent. He has rendered it possible to reproduce the human voice with all its modulations at distant points. . . .

"Bell's telephone is, however, in practical use in Boston, Providence and New York. There are several private lines that use it in Boston and several more are under construction. I tried two of them, and though we succeeded in conversing, the result was not so satisfactory as experiment led one to anticipate. The interference of working wires will seriously retard the employment of this apparatus, but there is no doubt that scientific inquiry and patient skill will rapidly eliminate all practical defects."

Did the author of these statements regard the telephone as a scientific toy, useless for commercial purposes? Obviously he did not. No doubt the work of Reis helped, but it was Bell's invention that gave birth to the transmission of speech over wires. Instead of decrying the instrument, here we find this prominent Post Office official expressing his belief in it to a body of scientists probably as soon after its birth as anyone in this country could have got into touch with it.

The Post Office is charged with failing to adopt improvements as they came along, with the lack of a real spirit of enterprise. Your special correspondent, however, carefully refrains from entering into details. He does not know what improvements have been or have not been adopted by the Post Office, and the general statement is made for acceptance without question by readers who cannot have information on the subject in their possession. Take exchange equipment. During the period that has elapsed since 1900 the common battery manual system has been the standard both here and in America. The Post Office adopted it when it commenced to instal a local telephone system in London, and it has used nothing else except where it has introduced exchanges of the full automatic type.

For many years inventors have been working at the development of various automatic systems until several have obtained a high degree of efficiency. A good standard of service can be furnished with either the common battery manual or the automatic system, and the question of which should be used is mainly an economic one. It is believed that the American Telephone and Telegraph Company has now come to the decision to adopt the automatic system largely in the future. But up to now that Company has not installed one automatic exchange in any part of the great "Bell" organisation. On the other hand, the Post Office saw at an early stage the possibilities of the automatic exchange, and has been installing such exchanges for years. Leeds, Portsmouth, Newport, Paisley, Grimsby, Stockport, Dudley, Darlington, Hereford, Blackburn, Epsom, are equipped with them. As a matter of fact, it would be difficult to name any telephone administration which has studied this subject more widely or more enterprisingly than the British Post Office. It has sent its expert officers abroad to every quarter where information and demonstration could be obtained. It alone has adopted the policy of equipping, *in actual service*, a series of comparatively large exchanges which constitute trial installations of *every* automatic system so far invented, which could be shown to be capable of meeting the essential conditions of large intercommunicating telephone areas. And the proportion of its subscribers who are already served by automatic systems is probably greater than that of any other large telephone administration in the world. The mechanical and electrical equipment necessary for mechanical switching is extremely complicated, and the larger the town the greater is the amount of equipment required to connect two subscribers together. It has been necessary to gain experience of the various systems before embarking on the heavy capital expenditure involved in the installation of any particular system in London and in the largest towns.

In the matter of line plant, readers of the *Times* must not assume that cables containing 1200 circuits in a 3-in. duct are used in America and are unknown here; that cables containing 600 and 800 circuits have been in use for many years in America and have not been used to a corresponding extent in this country, or that long-distance cables between cities 100 and 200 miles apart are peculiar to the United States. As a matter of fact this country has never lagged behind America in the manufacture and use of cables, and has often been, and probably is now, in front of her. It is certainly the case that some years ago the Post Office was using 200-pair telephone cables made in England, while America was unable to produce a satisfactory cable of more than fifty pairs. As regards long-distance telephone circuits, London already has underground communication with Birmingham, Liverpool, Brighton, Dover, Reading, Aldershot, Canterbury, Chatham, Aylesbury, Chelmsford, Colchester, Farnham, Gravesend, Guildford, Luton, St. Albans, Sevenoaks, Sheerness, Slough, Sittingbourne, Uxbridge, Walton, Watford, Woking and Weybridge. Liverpool has cable communication with Ormskirk, Prescot, Preston, St. Helens, Southport, Warrington and Wigan; Manchester with Ashton-under-Lyne, Bolton, Blackburn, Burnley, Bury, Halifax, Leeds, Liverpool, Oldham, Preston, Rochdale, Stockport, Wigan and Warrington. Glasgow is connected by cable with Edinburgh, Kilmarnock and Paisley; Birmingham with Chesterfield, Coventry, Derby, Dudley, Sheffield, Walsall, Wednesbury, Worcester and Wolverhampton. And so on. Schemes now in hand, when completed, will link up with cable nearly the whole of the important towns in the country south of the Forth and Clyde, but already this country has a much larger proportion of its long-distance lines in underground cables than any other country in the world. This long-distance cable communication was only rendered possible by (1) the introduction of "loading," *i.e.* the insertion of inductance coils at intervals in cables to correct the distorting effect of capacity, and (2) the use of the thermionic valve telephone repeater. Both of these inventions were taken up by the Post Office in the very earliest stages of knowledge of the subjects. They were made the subjects of close study and experiment, and were pursued systematically, with the result that the British telephone system will soon enjoy the full improvement in transmission efficiency and economy rendered possible by these discoveries. The Post Office has not been behind the American or any other administration in following them up, and taking advantage of them for the benefit of the telephone system of the country.

It may interest readers of the *Times* to know that in 1913, consequent upon the expressed desire of London business men for telephonic communication with Berlin and German towns, the Post Office engineers made an investigation and conducted experiments in co-operation with engineers of the German administration. The experiments were continued into 1914, and several of the telephone subscribers interested were given opportunities of talking to Berlin from their own instruments. A scheme for commercial communication was decided on, and the Germans requested the Post Office to undertake the design of the necessary submarine cable. The incidence of the war extinguished the scheme, but the scientific work commenced in that connection was carried on and used against the Germans.

Much of the trouble of the telephone user or the would-be telephone user is due, according to your special correspondent, to the fact that the Government did not take into its employment in 1912 some of the senior headquarters officers of the late National Telephone Company. Now, although it has, been shown that none of the trouble is due to the cause stated, let us try to get this point also into fair perspective. Out of a total staff of 19,000 there were twelve officials not transferred to the Post Office. These were the General Superintendent, the Secretary and Accountant, the Engineer-in-Chief, the Assistant Engineer-in-Chief, the Solicitor, the Assistant Solicitor, the Metropolitan Superintendent, and five provincial superintendents. Before 1912 the Post Office was running the telegraphs, the trunk telephone system of the country, local systems in London, Glasgow, a few other provincial towns, and in numerous villages which the National Telephone Company had not served as there was little or no profit to be made. It had therefore a fully organised headquarters establishment. It took over, however, from the Company all its district managers, all its traffic staff, all its engineering staff except the two men at the top, and all its commercial staff, with the few exceptions mentioned. Additional contract managers were appointed, and the district managers were relieved of engineering work, and thus left free to devote all their time to development and management. All the expert telephone men in the country other than those employed by the telephone manufacturers and one consulting engineer are now in the Post Office organisation.

"The way out" lies so obviously along the simple lines of hard work and continuous endeavour on the part of the telephone staff that it is hardly worth while to discuss it, but let us consider shortly the two following propositions:

(1) It would be absurd to dissociate the telephones from the telegraphs.

(2) The telephone service of the future must continue under some measure of State control.

It certainly would be absurd to revert to a condition which required two sets of ducts in a street or road where one would do, two lines of poles along a road where one would do, two sets of men at one point doing similar work. The advantage of combining the telegraphs and telephones in one system is well known to that organisation (The American Telephone and Telegraph Company) which is held up to us as the pattern to follow. Some years ago it absorbed the Western Union Telegraph Company, but although the combination of the two concerns would undoubtedly have led to great economies of working, the Supreme Court, or some other high Government authority, dissolved it as being contrary to the law or the Constitution of the United States.

With regard to (2), it is obviously uneconomical to have two telephone systems operating in the same territory. If there are two systems there will be more operating costs than necessary, more line-plant than necessary, and subscribers would frequently have two telephones where one should be enough. On the other hand, one system in a territory is a monopoly, and where there is monopoly there must be public control. During recent years in the United States the idea of only one telephone system in a territory has been growing, but so also has public control. All the telephone organisations operating in the United States are owned by the shareholders, but very few of these companies, if any, have it in their power to fix the rates which they will charge their subscribers. The State Public Service Commission does that. These Commissions have staffs of experts, and they compel the telephone companies to keep their books in a prescribed way so that the financial position of the companies and their running costs can be readily ascertained at any time.

Just one word more: the President and Vice-Presidents of the American Bell Telephone Companies are never amateurs; they are always telephone men, and no doubt the other directors of the Company are the same. Theodore Vail, who was head of the Association of Companies for many years, began his telephone career in 1878, when the first company was formed to exploit the invention of Prof. Bell, and his successor in the presidential chair has also served a strenuous telephone apprenticeship.

Any collection of business men gathered together in this country except from the Post Office, or from the telephone manufacturing concerns, would be amateurs at the telephone business. What success could they possibly attain unless they simply allowed their expert staff to run the service for them?

To quote again from the last issue of 'The Electrician': "The Post Office has great resources at its command, its engineers are second to none in technical ability, and improvements in telephone working, as we hope shortly to show, are going on satisfactorily."

All civil servants who reach the top in a democratic institution like the Post Office are men possessing brains and business capacity. Also the Post Office buys as well as sells; it is a big business concern, one of the biggest in the country. Why not recognise the facts: that the men at the head of the Post Office are big business men; that the staff is highly trained, expert, and willing; that the present telephone position is not due to Post Office organisation or administration; that time is necessary for recovery from the effects of the war; and that in the end the Post Office will produce as good a result in as short a time and at as little cost as any other possible organisation.

BOOK REVIEWS.

'Telegraphy.' By T. E. Herbert. (Pitman. 18s. net.)

The appearance of this (fourth) revised and enlarged edition of Mr. Herbert's book will be cordially received by the telegraph service and others interested therein. Those who remember the modest dimensions of the book on its first appearance, many years ago, and compare its ample proportions to-day with its thousand well-illustrated pages, will, we are sure, desire to congratulate the author on his achievement.

The new matter includes the vibroplex, the amplifying or thermionic valve, Gulstad relay, etc., whilst the section on secondary cells has been thoroughly recast and added to, and the Kleinschmidt perforator included in the body of the work.

For the would-be buyer's information we may state that the book is well planned, commencing with the simple and gradually progressing to the more complex. Starting with the main principles of electricity and magnetism, the nature and measurement of current, resistance and E.M.F. and the various forms of primary cell are amply treated, and the simpler systems of telegraphy, single needle, single current and polarised sounder are explained. Duplex, quadruplex, the Wheatstone automatic, Hughes, Baudot and Murray then follow, together with the Gell and Kleinschmidt perforators, Creed and Bille apparatus. Included with these larger systems are the Wheatstone A.B.C., Steljes' recorder, Rebesi type-writing telegraph, Siemens' automatic transmitter, Harrison printer, etc. These are followed by sections on central battery working, secondary cells, repeaters, test-boxes, protection from lightning and power circuits, testing of all sorts, and, lastly, by a very full section on construction. Many useful appendices and addenda complete the work.

It will be seen that the volume covers the whole field of the subject, and the work is really an encyclopædia, in miniature, of the subject. Both the student and the practical engineer will find in it a mine of information.

A Paper on Telephone Transmission from South Africa.

We have been favoured with a copy of the 'Transactions of the South African Institute of Electrical Engineers' for September, 1920 (Johannesburg, price 3*s*. 6*d*.). This number contains a paper covering 36 pages on the subject of "Modern Developments in Telephone Transmission," written by Mr. J. W. Keefe, and read before the Institute at Johannesburg on September 14th by Capt. McArthur.

The first part of the paper contains an account of the development of telephonic transmission in America and England, with details of the application of the theory to loaded lines and data respecting loading coils and loaded circuits. The author is well informed on the general literature of the subject in the countries named.

The second part of the paper deals with telephone relays, and gives a large amount of information based on American practice.

A mathematical proof of the usual transmission formulæ is given in an appendix, and transmission data of lines and apparatus are added. A useful bibliography concludes the paper.

J. G. H.

STAFF CHANGES.

POST OFFICE ENGINEERING DEPARTMENT.

PROMOTIONS.

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Taylor, J. E.	London	Asst. Suptg. Engr., London	Suptg. Engr., S. Mid. Dist. (*vice* J. McL. Robb, to retire)	1 : 1 : 21
Walmsley, T.	E. in C.O. (Wireless)	Inspector	Asst. Engr.	8 : 10 : 20
Ancell, W. J.	South Eastern	Chief Inspector	,,	,,
Dring, J.	South Wales	,,	,,	1 : 11 : 20
Hollinghurst, W.	E. in C.O. (Equipment)	Chief Inspector	Asst. Engr.	To be fixed later.
Smith, D.	Scot. E.	,,	,,	
Robertson, Capt. A. J.	E. in C.O. (Construction)	3rd Cl. Clerk	2nd Cl. Clerk	23 : 7 : 20
Robinson, W. D.	E. in C.O. (Designs)	,,	,,	7 : 8 : 20
Malkin, J. L.	E. in C.O. (Accounts)	,,	,,	28 : 9 : 20

RESIGNATIONS, ETC.

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Wootton, G. A. H.	E. in C.O. (Power)	Asst. Engr.	Met. Police (Power Engr.)	13 : 11 : 20

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Name.	District.	Rank.	Date.
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Moon, W.	North Western	Exec. Engineer	29 : 11 : 20

TRANSFER.

Name.	Rank.	Transferred.		Date.
		From	To	
Weaver, R. A.	Asst. Suptg. Engr.	S.-Eastern	London	(*Vice* J. E. Taylor, promoted) 1 : 1 : 21

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

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

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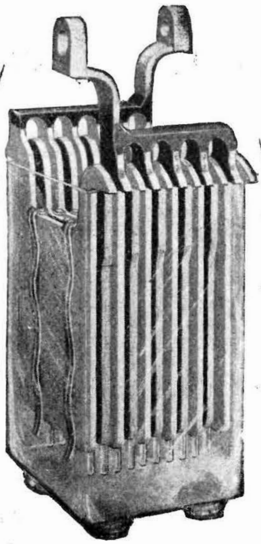

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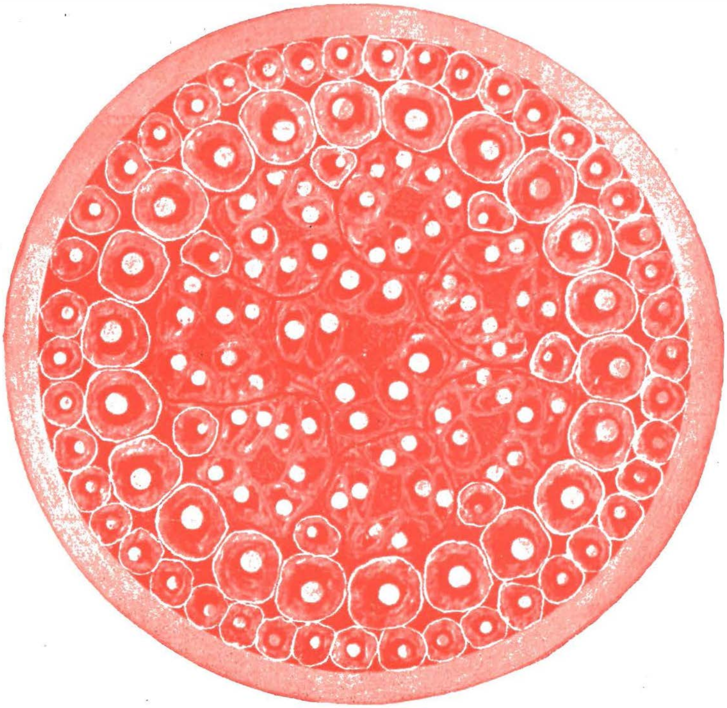

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