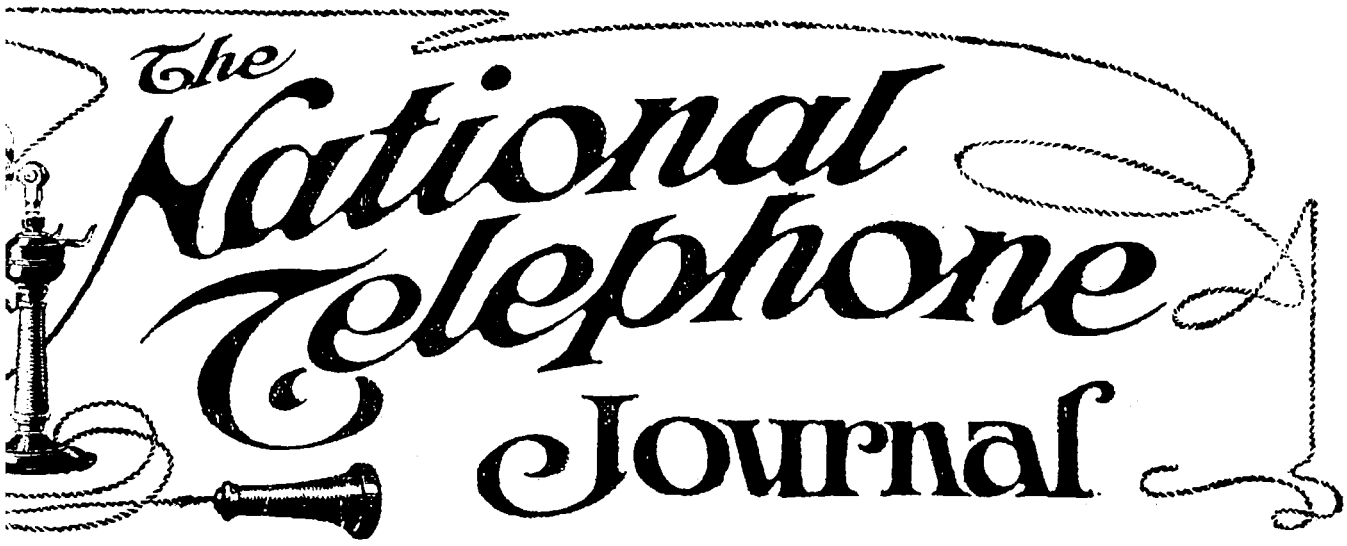

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CONTENTS.

THE
National Telephone Journal

VOL. VI. JULY, 1911. No. 64.

TELEPHONE MEN.

LXII.—DAVID BOWIE FULTON.

DAVID BOWIE FULTON is a Scotsman, having first seen the light at Kilmarnock, in Ayrshire. After receiving an education at the Grammar and Academy Schools in that town he entered the Telephone Company's service in November, 1889, as a Junior Clerk, whose duties in those days seem to have included assistance in the work of the switchboard.

In 1890 Mr. Fulton was appointed Instrument Inspector, and, as the district was a small one, part of his time was devoted to the keeping of the books. He continued at this work until his transfer to Cork as Second Clerk in July, 1897, and found the grounding he obtained in the Company's system of bookkeeping, from the work of keeping the postage and cash books up to that of making out all the returns, an extremely useful experience. During the same period he obtained a knowledge of the work of the Electrical Department.

In October, 1897, Mr. Fulton was promoted from Cork to Limerick as Local Manager, and, while he was in the latter town, exchanges were opened at Tralee, Galway, Castleconnell, Roxborough and Ennis.

In September, 1899, Mr. Fulton was transferred to Dublin as Engineer, and assisted in the reconstruction work then in progress there. A further transfer awaited him in August, 1902, when he was appointed Engineer at Belfast, and Local Manager the following year. While in this capacity he carried out extensions of the original underground scheme, and, on the electrification of the city tramways, dealt with a big reconstruction of the Company's plant. He also reconstructed the Londonderry system when an underground scheme was laid down and common battery board installed.

In March, 1906, he received further promotion, being appointed District Manager at Gloucester. The Company's business was extended considerably during his stay in this district, twelve new exchanges being opened and underground schemes completed at Hereford and Evesham. In February, 1909, Mr. Fulton was promoted to the staff of the Engineer-in-Chief, and after more than a year's work at Head Office was selected as one of the Divisional Officers on the Inventory staff. Resourceful and determined, with an excellent sense of proportion, Mr. Fulton in this latest task again demonstrates his ability to organise and carry out important work successfully.

Mr. Fulton has excelled in more than one branch of athletics, having played Association football for such well-known clubs as Queen's Park, Kilmarnock and Dublin Bohemians. He is the holder of a number of Scottish and Irish medals, has played in Inter-Provincial matches, and has been selected as reserve for International contests. He also plays bowls, and has won the Gloucestershire Club championship and other honours. As a Scotsman he is, of course, interested in golf, but does not at present find much time for that pastime.

LIST OF GRANTS TO LOCAL TELEPHONE SOCIETIES IN RESPECT OF THE 1910-11 SESSION.

	£	s.	d.
Dundee Telephone Society	4	10	6
Greenock Telephone Society	4	0	6
Paisley Telephone Society	4	6	6
Glasgow Telephone Society	4	6	0
Glasgow Operators' Telephone Society	5	0	0
Edinburgh Telephone Society	5	0	0
Newcastle Telephone Society	3	16	6
Sunderland and South Shields	3	14	0
Hull Telephone Society	3	16	6
Leeds Telephone Society	4	16	6
Bradford Telephone Society	2	5	0
Blackburn Telephone Society	3	6	0
Bolton Telephone Society	5	0	0
Oldham Telephone Society	1	0	0
Manchester Telephone Society	3	13	6
Liverpool and Birkenhead Telephone Society	4	9	0
Liverpool and Birkenhead Operators' Telephone Society	4	8	0
Douglas Telephone Society	4	10	6
Sheffield Telephone Society	4	1	0
Sheffield Operators' Telephone Society	4	7	6
Nottingham Telephone Society	4	4	0
Leicester Telephone Society	3	11	6
Birmingham Operators' Telephone Society	4	1	0
Wolverhampton Telephone Society	4	14	0
Coventry Telephone Society	4	14	0
Northampton Telephone Society	4	3	6
Brighton Telephone Society	3	3	0
Hastings Telephone Society	4	1	0
Dover Telephone Society	3	5	0
Tunbridge Wells Telephone Society	2	6	0
Luton Telephone Society	4	18	6
Southampton Operators' Telephone Society	3	16	0
Bournemouth Telephone Society	3	10	0
Weymouth Telephone Society	4	5	6
Portsmouth Telephone Society	4	1	0
Plymouth Telephone Society	4	10	0
Truro Telephone Society	5	0	0
Exeter Telephone Society	4	1	6
Torquay Telephone Society	4	8	0
Bristol Telephone Society	4	15	0
Bristol Operators' Telephone Society	5	0	0
Bath Telephone Society	5	0	0
Gloucester Telephone Society	4	17	6
Cheltenham Telephone Society	5	0	0
Cardiff Telephone Society	4	4	6
Cardiff Operators' Telephone Society	3	18	6
Swansea Telephone Society	4	13	0
Swansea Operators' Telephone Society	4	17	6
London Operators' Telephone Society	5	0	0
London Telephone Society	3	15	6
London Southern Telephone Society	3	11	6
London Western Telephone Society	3	7	0
London North-Eastern Telephone Society	3	6	0
Belfast Telephone Society	1	12	0
Dublin Telephone Society	3	8	0
Cork Telephone Society	4	7	0
Nottingham Factory Telephone Society	5	0	0

AWARDS FOR SUGGESTIONS AND INVENTIONS.

	£	s.	d.
H. Woodland, Bristol, overtime payments	2	2	0
W. Bailey, London, improved wiring clamp	2	2	0
H. Hall and J. Hateley, London, aerial rings	2	2	0
J. Johnson, London, method of testing subscribers' earth connections	2	2	0
P. J. Mantle, London, fitting of green opals on supervisory lamps	2	2	0
G. F. Staite, Manchester, alteration to ticket clips	2	2	0
J. H. Stewart, London, automatic counter for register testing	2	2	0
J. Hawney, Liverpool, alteration to Form No. 1,489	2	2	0

INVENTORY OF PLANT.

THE following additions have been made to previous lists :—

TRAVELLING STAFF.

Riley, J.	Local Manager	Neath.
Tipping, P. N.	Jointer	Swansea.
Partington, J.	Instrument Inspector	Liverpool.
Boniface, G. E.	Faultfinder's Overseer	Metropolitan.
Beaumont, J. C.	Draughtsman	West Yorks.
Wigg, H. H.	Local Manager	Norwich.

Deletions—*Nil.*

THE TELEPHONE EXCHANGES OF LONDON.

BY G. H. BRYANT.

(*Continued from page* 54.)

The passing away of the testroom and the innovation of the apparatus room and other changes that have been made, can be followed from the next figure, No. 7, which sets forth in tabular form some features of the Company's Metropolitan exchanges. The exchanges are arranged in the order in which they were transferred to C.B. working as will be seen by the second column. From the third column it will be noticed that there are sixteen No. 1, three No. 9, one No. 10 and one Kellogg, making a total of 21; the difference between the four patterns we will consider later from skeleton diagrams of the principle of their working. The next two columns show that only three exchanges are provided with test boards, and the remainder with main frames. The design of the main frame has not been altered, but it will be seen from the three sub-headings under main frame that the outside cables terminate on the horizontal tabs at the earlier exchanges, and at the later on the arrestors, also that line fuses now form part of the main frame equipment. Where the outside cables terminate on the arrestors the switchboard cables are connected to the horizontal tabs and *vice versa*. At Brixton and Paddington, although line fuses are fitted, the outside cables terminate on the horizontal tabs, and therefore although the line fuse would sever a faulty circuit at the arrestor the main frame jumper would remain connected to the line. At subsequent exchanges the outside cables terminate on the line fuses, so that the switchboard equipment including the lightning arrestor is entirely disconnected by the blowing of the line fuse.

Intermediate distribution frames are fitted at all the exchanges excepting No. 9's, and the design has not been varied except in the addition of alignment straps and the disposing of the miscellaneous circuits nearest the floor line.

Six of the exchanges have, it will be seen, power rooms; the remainder accommodate their power plants in a room together with the HF, IDF, relay racks, coil racks and fuse panels, hence the name of apparatus room. This centralising of the apparatus tends to lessen the cost of maintenance, and no doubt decreases the first cost of the equipment.

Comparison of Circuits.—Fig. No. 8 shows the skeleton connections of the five line circuits in use at the Company's Metropolitan C.B. exchanges. Commencing with Fig. 8—A, which indicates the pioneer, it will be observed that the "A" line is connected through the contacts of the cut-off relay marked CO to the line relay marked LR and thence to earth; and that the "B" line is connected to a resistance lamp to the negative of the battery *via* the cut-off relay.

The next stage is shown in Fig. No. 8—B, and it differs from A inasmuch that the line relay is connected to the second cell of the battery instead of earth. The result is that an earth on the "A" line would cause the line relay to operate, due to the 4-volt battery, and a permanent glow at the switchboard results, notifying a fault.

Fig. No. 8—C indicates the latest circuit; you notice that the line relay has been transferred to the "B" line while the "A" line is direct to earth, and the "B" line lamp intended to indicate an earth "B" has been dispensed with. The resistance of the line relay on all No. 1 boards is 60 ohms, but in the case of No. 10 boards, see C, the resistance is 1,000 ohms and the relay has been considerably reduced in size.

No. 9 boards, see Fig. 8—D, are fitted are fitted with 500-ohm eyeball signals in lieu of line relays and lamps; and the break jacks serve the purpose of cut-off relays.

The Kellogg line circuit, see Fig. 8—E, is similar to A excepting that a resistance takes the place of the "B" line lamp, and that a two-point jack is used. The only Metropolitan exchange of its kind is Battersea. The five line circuits account for the Company's Metropolitan C.B. exchange lines in the following proportions:—

A	31·0 per cent.
B	50·0 „ „
C	13·0 „ „
D	2·5 „ „
E	3·5 „ „

SOME FEATURES OF THE METROPOLITAN CB EXCHANGE EQUIPMENTS

EXCHANGE	YEAR TRANSFERRED TO C.B.	PATTERN OF S.B.P.	SUBS' EQUIPPED FOR	TEST BOARD	MAIN FRAME: OUTSIDE CABLES TERMINATING	MAIN FRAME: LINE FUSES	INTER-DIST. FRAME	POWER ROOM	APPARATUS ROOM	SUB'S LINE CIRCUIT: LINE RELAY IN "A" LINE	SUB'S LINE CIRCUIT: "B" LINE LAMP	SUB'S LINE CIRCUIT: LINE RELAY IN "B" LINE	SUPERVISORY RELAY	REPEATERS: "A" POS'N	REPEATERS: "B" POS'N	"B" POS'N RINGING: MECHANICAL CLUTCH	"B" POS'N RINGING: MAGNETIC CLUTCH	"B" POS'N RINGING: KEYLESS	PARTY LINE WORKING	ANTI-SIDE-TONE INDUCTION COIL	STEEL CONNECTOR CORDS	ALARM FUSES	JACK SWITCHES CONNECTED FROM BACK OF S.B.P.	POWER PLANT: BATTERY	POWER PLANT: MOTOR GENERATING CURRENT SETS: BELTED	POWER PLANT: MOTOR GENERATING CURRENT SETS: DIRECT COUPLED	GAS ENGINE BELTED TO GENERATOR	RINGERS: POWER	RINGERS: BATTERY	RECORDING AMMETER
KENSINGTON	1901	No 1	4,100	✓	-	-	✓	✓	-	✓	-	✓	-	-	-	53 MFD 15	✓	-	-	✓	-	-	✓	-	-	-	-	-	2-22"	2	-	-	-	2	-
BATTERSEA	1902	Kellogg	2,000	※	✓	-	✓	✓	-	✓	-	100 Ω Rec. Coil	-	-	-	1000 Ω	-	-	-	KELLOGG		-	-	✓	-	-	-	✓	2-22" ×	-	2	-	1	1	-
HOLBORN	1904	No 1	5,520	✓	-	-	-	✓	✓	-	✓	-	✓	-	✓	-	-	✓	-	-	✓	-	-	✓	-	-	-	-	-	1-22"	-	2	-	-	2	✓
NORTH	1904	" 1	3,600	-	✓	-	-	✓	-	✓	-	✓	✓	-	✓	-	-	-	✓	-	-	✓	-	-	-	2	✓	-	✓	-	1-22"	-	2	-	1	1	✓
LONDON WALL	1905	" 1	9,520	✓	-	-	-	✓	✓	-	✓	-	✓	-	✓	-	-	✓	-	-	✓	-	-	✓	-	-	-	-	-	1-22"	-	1	1	-	2	-
STOKENHAM	1905	" 1	1760	-	✓	-	-	✓	-	✓	-	✓	✓	-	✓	-	-	-	✓	-	-	-	-	✓	-	2	✓	-	✓	-	1-22"	-	2	-	1	1	-
HOP	1906	" 1	4480	-	✓	-	-	✓	✓	-	✓	-	✓	-	✓	-	-	-	✓	-	✓	-	-	✓	-	2	✓	-	✓	-	1-22"	-	2	-	1	1	✓
EAST	1906	" 1	2,880	-	✓	-	-	✓	✓	-	✓	-	✓	-	✓	-	-	-	✓	-	-	-	-	✓	-	2	✓	-	✓	-	1-22"	-	1	1	1	1	-
BRIXTON	1906	" 1	1,500	-	✓	-	✓	✓	-	✓	-	✓	✓	-	✓	-	-	-	✓	-	-	-	-	✓	-	2	✓	-	✓	-	1-22"	-	2	-	1	1	-
PADDINGTON	1907	" 1	5,540	-	✓	-	✓	✓	-	✓	-	✓	✓	-	-	✓	-	-	✓	-	-	-	-	✓	-	-	✓	-	✓	-	1-22"	-	2	-	-	2	-
GERRARD	1907	" 1	9,520	-	-	✓	✓	✓	-	✓	-	✓	✓	-	-	✓	-	-	-	✓	-	-	-	✓	-	4	✓	-	✓	-	1-22"	-	2		1	1	-
HAMMERSMITH	1907	" 1	1,160	-	-	✓	✓	✓	-	✓	-	✓	✓	-	-	✓	-	-	-	✓	-	-	-	✓	-	4	✓	-	✓	-	1-22"	-	2	-	-	2	-
EAST HAM	1908	" 9	500	-	-	✓	✓	-	-	✓	-	-	-	-	Pre Bnd.	-	-	Pre Bnd. 1000 + 1000	-	-	-	-	✓	-	4	✓	✓	-	✓	1-32" ×	-	1	-	1	1	-
ENFIELD	1908	" 9	480	-	-	✓	✓	-	-	✓	-	-	-	-	Pre Bnd.	-	-	Pre Bnd. 1000 + 1000	-	-	-	-	✓	-	4	✓	✓	-	✓	1-32" ×	-	1	-	1	1	-
TOTTENHAM	1908	" 9	800	-	-	✓	✓	-	-	✓	-	-	-	-	Tot Bnd.	-	-	Pre Bnd. 1000 + 1000	-	-	-	-	✓	-	4	✓	✓	-	✓	1-32" ×	-	1	-	-	2	-
DALSTON	1909	" 1	2,020		-	✓	✓	✓	-	✓	-	-	-	✓	-	✓	-	-	-	✓	-	-	-	✓	-	-	✓	✓	✓	✓	1-22"	-	2	-	-	2	-
BROMLEY	1909	" 1	1,000	-	-	✓	✓	✓	-	✓	-	-	-	✓	-	✓	-	-	-	✓	-	-	-	✓	-	-	✓	-	✓	✓	1-22"	-	2	-	1	1	-
WALTHAMSTOW	1909	" 10	480	-	-	✓	✓	✓	-	✓	-	-	-	✓ (Lost)	-	✓	-	-	-	✓	-	-	-	✓	-	2	✓	-	✓	✓	1-22"	-	1	-	1	1	-
NEW CROSS	1909	" 1	1,500	-	-	✓	✓	✓	-	✓	-	-	-	✓	-	✓	-	-	-	✓	-	-	-	✓	-	-	✓	✓	✓	✓	1-22"	-	2	-	-	2	-
STREATHAM	1910	" 1	1,230	-	-	✓	✓	✓	-	✓	-	-	-	✓	-	✓	-	-	-	✓	-	-	-	✓	-	-	✓	✓	✓	✓	1-22"	-	2	-	-	2	-
LEE GREEN	1910	" 1	1,300		-	✓	✓	✓	-	✓	-	-	-	✓	-	✓	-	-	-	✓	-	-	-	✓	-	-	✓	-	✓	✓	1-22"	-	2	-	-	2	-

※ TEST JACKS ARE FITTED ON JUNCTION CIRCUITS AT BATTERSEA.

+ THE JUNCTION CIRCUITS ON O.P.O. POS'NS ARE SO ARRANGED THAT THE RINGING IS INOPERATIVE UNTIL "A" OPER'R TAKES UP LINE.

× REGISTER BATTERY NOT FITTED AT THESE EXCHANGES.

G.H.B. 1910

FIG 7

The basis of the "A" cord circuits is set out in Fig. No. 9. The circuit which is most prevalent is shown at the top, omitting the supervisory lamp. It is in use at sixteen of the 21 exchanges. The type of repeater and supervisory relay varies, but they can be considered from Fig. No. 7. At the last six exchanges the supervisory relay is fitted in the "B" line, and it is a question as to whether there is any advantage in this arrangement, for a low insulation on the "B" line would tend to prevent the supervisory relay releasing, and delay the clearing signal.

You observe that the No. 9 and Kellogg circuits are practically identical so far as the talking circuit is concerned; the two halves of the circuits are connected to the battery through impedances and together through condensers. Two batteries in the Kellogg circuit are not necessary; one would suffice. Possibly the steering clear of a patent accounts for the duplication.

It should be noted that the clearing signal on a No. 9 board is a negative one, for the eyeball signal it is operative while the subscriber is in circuit, and returns to a condition equal to that of a disengaged circuit when the subscriber hangs up.

I have shown the Kellogg supervisory lamp circuit in full because the circuits at Battersea Exchange are generally considered by those who have not come into close contact with them to be very complex, whereas they are simple, once the principle is grasped. It can be seen from the diagram that an earth on the "B" line would cause the lower relay of the side concerned to operate, and that as a result the supervisory lamp would glow; this is the condition set up when a cord is connected to a subscriber's line, for a 500-ohm relay is tapped off the "B" line of the jack, which, it is important to remember, is a two-point one, see Fig. 8, then when the circuit is completed A to B through a subscriber's instrument the upper relay would operate and disconnect the supervisory lamp until the subscriber hangs his receiver up. In a similar manner when connected to an outgoing junction the upper relay is controlled by the distant 12,000-ohm relay.

If A, B and C are compared with the A cord circuit fitted at the Post Office Glasgow Exchange, of which full details were given in a recent *Post Office Journal*, you will notice that, in addition to the talking circuit being identical to B and C, the Glasgow circuit embodies the cream of the three, inasmuch as it has the single relay of A, the compound impedance of B, and the disconnecting of the supervisory lamp circuit of C. The "B" position cord circuits in use at these exchanges all include a repeater (see Fig. 7), the lamp circuit and the arrangement of the relays controlling it vary but slightly. The automatic ringing device is the feature in which the circuits differ most.

Fig. 10 shows in skeleton form the ringing circuits of twenty of the 21 exchanges. The sketches are purely diagrammatic and do not depict the actual arrangement. A indicates the earlier, and is used at Kensington, London Wall and Holborn. You notice that the depression of the ringing key would be sustained owing to the catch or mechanical clutch; the outline in small dots denotes the ringing circuit which would connect the generator to the cord and thence to a subscriber's line *via* the long springs of the key, and, provided the subscriber's receiver is on the switch-

hook, sufficient current will not be passing through the releasing coil RC, and therefore the bell at the subscriber's will ring until the receiver is lifted from the hook, when the releasing coil will attract its armature, disconnect the mechanical clutch, and so automatically sever the ringing and complete the speaking circuit A tripping device is provided so that the operator can restore the key to normal after disconnecting from an uncompleted call.

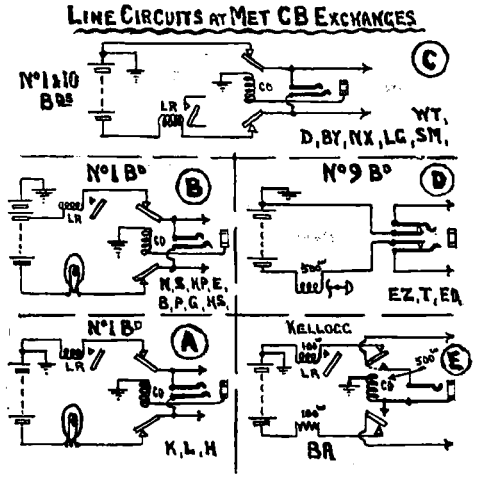

FIG. 8.

The releasing coil was originally in the earth side of the circuit, which enabled the subscriber's bell circuit on magneto instruments to be worked without a condenser: the circuit being: "A" line through bell to earth and "B" line dis., but this arrangement at the subscriber's did not long prevail and condensers were fitted. I have shown the generator connected direct to the release coil; actually there is a resistance lamp in between these points, one lamp per four or five circuits; also the return to earth

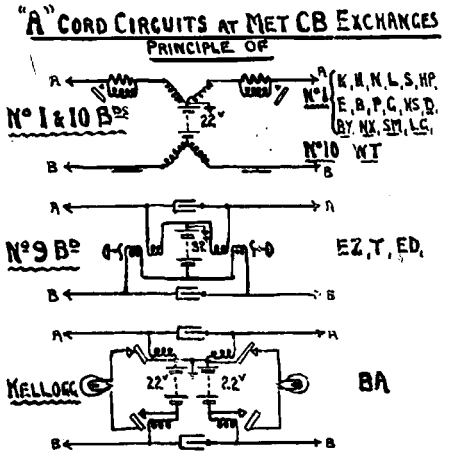

FIG. 9.

from the key is *via* the battery, and further the ringing interrupter is omitted. Neither of these points is material to the principle which it is my object to outline.

The possibility of party line development no doubt led to the designing of the key shown in B, for the reason that a single key per cord circuit of the type shown in A accounts for the available key space per cord circuit, while five keys per cord circuit of the type shown in B can be accommodated on the key shelf.

You observe in Fig. 10—B circuit, that the key is held down magnetically, the outline in large dots shows the retaining circuit, and on the key being depressed you notice that the two inner springs of the key—providing the plug is connected to a line—would complete the magnetic clutch circuit and so connect the ringing circuit—shown by small dots—to the plug and thence to line. The key is released by the tripping relay TR, which does

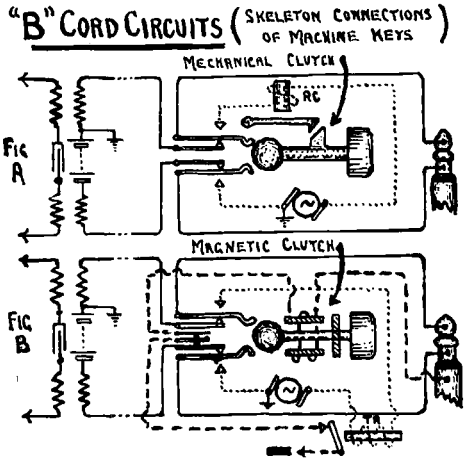

FIG. 10.

not actuate until the subscriber lifts his receiver from the hook. When the tripping relay does actuate you observe that the magnetic clutch circuit is broken and as a result the ringing key returns to normal and completes the speaking circuit. If a call is not completed the key releases when the operator removes the plug from the required subscriber's jack, because the retaining circuit is completed *via* the bush of the jack to earth through the cut-off relay. This type of key is used at seventeen of the Londo

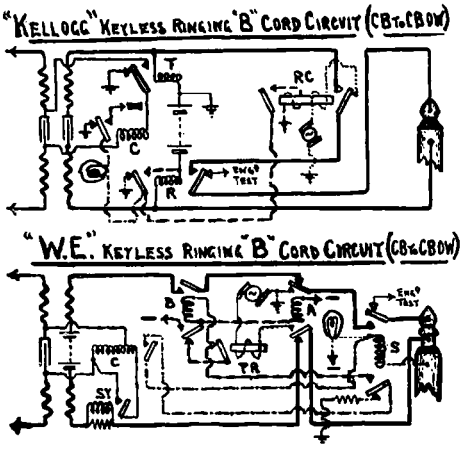

FIG. 11.

exchanges. At eight of these exchanges the circuit on O.W. junctions is so arranged, by means of an additional 40-ohm relay, that although the "B" operator depresses the key on allotting and connecting, the ringing does not pass out to line and so call the subscriber until the distant "A" operator takes up the junction.

It will be observed that each of these circuits entails the "B" position operator depressing the ringing or machine key as it is called, and therefore the ringing is not strictly automatic.

Extract from

The National Telephone Journal,

October, 1908.

ELECTRICAL ENGINEERING . . . in particular has contained quite a number of special articles on telephone subjects. But, in addition, we particularly desire to point out the necessity of telephone engineers, whatever they may for the moment specialise upon, keeping in touch with the developments and modes of thought in other branches of the industry, and one of the best ways of doing this is to read regularly some of the engineering periodicals. With the price of a first-class paper so low as **1d.** per week, there ought to be but few who are reckless enough to think they can afford to neglect this means of advancement, and we trust that there will be many readers of this paper among the Company's staff.

There are, however, three exchanges in the Metropolitan area which have purely automatic, that is keyless ringing circuits, Bartholomew House, a sub-exchange to London Wall, Woolwich, a differential system exchange—the only survivor in London—and Battersea, the Kellogg system exchange. The latter was the second C.B. exchange to be opened in London, and the "B" positions there are provided with a keyless ringing cord circuit, which means that the operators at those positions have not to attend to ringing keys. After becoming familiar with this system, when and for some time after the equipment was installed, I was struck by the many advantages of a keyless ringing cord circuit, and as a result endeavoured to find out why such circuits were not used more extensively; the chief obstacle I gathered was the party line possibility, and it would seem that to the realm of possibilities that obstacle is still confined, for party lines in London are conspicuous by their rarity.

Keyless ringing circuits on "B" positions are, however, now making their appearance in this country, and two-party line working is arranged for by utilising two numbers on the multiple (per party line) and reversing the jumper of one of them.

Fig. 11 shows the Battersea keyless ringing circuit, and also the circuit which is being fitted at some of the Company's provincial exchanges. The ringing portion of the circuits is shown in small and the retaining in large dots. The Kellogg circuit acts as follows: When the "B" position operator assigns a junction, the corresponding plug is inserted by her in the required subscriber's line providing it is disengaged, and, owing to the 500-ohm relay on the "B" of the subscriber's jack, relay R actuates, disconnecting the "A" of the plug from the engaged test circuit and connecting it to the generator *via* the back contact of the relay RC. The subscriber's bell circuit consists of the usual condenser and bell in series, and the ringing that passes through relay RC to the "A" line, back over the "B" line to earth through the cut-off and relays, is insufficient to actuate relay RC until the subscriber lifts his receiver, when relay RC operates and its armature locks, owing to the retaining circuit being completed by its own movement; for relay R was actuated by the insertion of the plug.

When relay RC has operated and so disconnected the ringing, relay T is in a position to respond to movements of the called subscriber's switch-hook, and by connecting relay C across the line towards the distant exchange, instead of to earth off the "B" line as it was previously, the distant "A" operator's supervisory relay is controlled.

Relay C is held up by the distant exchange's cord circuit battery, and completes the clearing lamp circuit (shown by the dotted line) on releasing; also if the "A" operator takes up an incorrect junction you notice that the clearing lamp would glow. When a connection is taken down you observe that RC would release owing to the retaining circuit being severed by relay R ($C = 100\omega$, $R = 100\omega$, $T = 100\omega$, $RC = 500\omega \times 500\omega$).

The Western Electric's keyless circuit operates thus: when the plug is inserted in the required subscriber's jack, relay S actuates, and provided that the distant "A" operator has taken the line, which means that relay C will have operated, there will be a path for current to flow through the 40ω relay A, back contact of 40ω relay B to armature of TR relay to its back contact, and thence, through contacts of relays S and C through the coil of relay S to bush of jack to earth, incidentally shunting the clearing lamp. The actuation of relay A connects the generator to line through the tripping relay marked TR, which will not operate until the subscriber lifts his receiver, but when he does so the relay B is momentarily un-short-circuited by the chattering of TR relay's armature; this results in the actuating and locking of relay B, which in turn short-circuits relay A and thereby causes it to release and so sever the ringing and complete the speaking circuit; after which the supervisory relay SY is free to throw the 27-ohm winding of relay C across the line, and so operate the distant "A" operator's supervisory relay ($C = 12{,}000\omega \times 27\omega$, $SY = 30\omega/7c\omega$, $A = 40\omega$, $B = 40\omega$, $TR = 200\omega$, $S = 83\frac{1}{3}\omega$). The clearing signal is given by the releasing of relay C, which unshunts the clearing lamp and also severs the retaining circuit of relay B. The guard lamp circuit can be easily traced by the large and small dotted lines. It should be noted that the subscriber is not called unless the "A" operator takes up the line, also that the ringing can be re-started by the "A" operator momentarily removing her plug from the junction. An additional 40ω-relay in lieu of the machine key is the difference between the apparatus in this circuit and that fitted at the recently opened Metropolitan exchanges.

The "WE" circuit is very ingenious, but it has, I consider, no special advantage over the Kellogg, and is, if anything, more complex.

As shown in the diagram, the Kellogg circuit does not provide for the ringing to be inoperative until the "A" operator takes up the line, but this could be arranged without additional apparatus by utilising the spare contacts of relay C for breaking the generator circuit.

We will now return to Fig. 7. The columns headed "Subscriber's line circuit," "Supervisory relay," "Repeaters," and "'B' position ringing" should be studied in conjunction with Figs. 8, 9, 10 and 11*a*.

The equipments arranged for party line working are shown in the next column; there are, I believe, only three or four party lines working in London so far as the Company is concerned. You observe that anti-side-tone induction coils are fitted at sixteen exchanges; Kensington, London Wall and Holborn have this pattern coil fitted on the positions which have been added since the original equipment was installed.

The Post Office do not use this type of coil, and arrive at an anti-side-tone result by connecting the third winding of a three-winding induction coil across the receiver. This arrangement was tried recently at Holborn and London Wall with success, and the question of its general adoption is, I believe, under consideration.

Steel conductor cords, it will be noticed, are not fitted at some of the recently opened exchanges.

Some details of the power plants can be observed from the last seven columns. Kensington is the only exchange where two batteries are provided for use alternately; in practice this is not satisfactory, and the batteries are worked in parallel; also at this exchange the charging generators are coupled to the motors by belt.

Only two gas-engine charging sets are fitted, one at London Wall and the other at East; in each case the running expenses are much lower than those of the motor sets. And I anticipate that in a few years' time it will be more economical to install well-designed direct-drive gas engines—of the vertical multi-cylinder type—instead of motors at large exchanges.

Three exchanges are provided with recording ammeters. I consider that a recording instrument is a useful adjunct to a power plant, and that a systematic handling of the battery can be more effectively made when such an instrument is fitted.

(*To be concluded.*)

PRESENTATION TO MR. W. A. VALENTINE, GLASGOW.

IN the Contract Department office on Friday, June 9, after business hours, Mr. W. A. Valentine, the District Manager, was presented by the staff with a very handsome solid silver coffee service to mark the completion by him of 25 years' telephone service. Mr. Valentine was accompanied by Mrs. Valentine, and there was a large and representative attendance of the Glasgow staff. The presentation was made in happy vein by Mr. F. Douglas Watson, Superintendent for Scotland. There was a well-worn saying current amongst Englishmen, he said, to the effect that when a Scotsman took up a position in England he never returned to his native land. Mr. Valentine, however, was a living falsification of that statement, as going from the North of Scotland to Manchester he returned from the latter city to Glasgow in 1898. Mr. Watson referred to the strenuous thirteen years' service given to the Company, to its complete satisfaction, by Mr. Valentine in Glasgow, during which period the system had been practically reconstructed twice over, the business had grown amazingly, and the lively and historical fight with the Glasgow Corporation had taken place. He complimented Mr. Valentine on the completion of 25 years' telephone service, and on his own behalf as well as on behalf of the members of the Glasgow staff he welcomed Mrs. Valentine amongst them on that occasion. In handing over the gift Mr. Watson expressed the hope that Mr. and Mrs. Valentine would be long spared to use it.

Mr. Valentine, on behalf of Mrs. Valentine and himself, eloquently thanked the staff for the gift and Mr. Watson for his kind words in presenting it. He gave an interesting *résumé* of his telephone "life," and dealing with his past thirteen years' service in Glasgow said that he had been indeed fortunate during the whole of that period in having under him a staff upon whom he could always absolutely rely; if that had not been so the Company could not have occupied the creditable position in Glasgow which it did to-day.

On the motion of Mr. J. R. Brown, Contract Manager, a hearty vote of thanks was accorded Mr. Douglas Watson for so adequately voicing the sentiments of the staff on that occasion.

TELEPHONE WOMEN.

XCIV.—ADA GERTRUDE BUCKWELL.

MISS BUCKWELL, the Clerk-in-Charge of Battersea, entered the service as an Operator at Westminster on June 21, 1895. This exchange then consisted of something less than 300 subscribers. A new switchboard was fitted in February of the following year, and this brought into use the head-gear operating sets. Just at first they were not regarded very favourably by the girls; since then, however, their opinion has altered, and Miss Buckwell feels certain that every girl would admit that the present instrument eclipses in comfort and quickness the old style. In January, 1903, Miss Buckwell was promoted to Gerrard Exchange as a Supervisor, and continued in that capacity until January, 1907, when she was placed in charge of sub-Gerrard, a temporary additional exchange which it was necessary to open until the new building was completed and the original exchange transferred to the central battery system on one floor. In November, 1907, Miss Buckwell was again at Westminster, amid old scenes and familiar faces, this time with the promotion to Clerk-in-Charge. At this period the exchange had been much enlarged, having some 1,500 subscribers. After two years at Westminster, Miss Buckwell was promoted to her present position at Battersea, where she found and appreciated a more up-to-date equipment. She is strongly of the opinion that improved equipment is not the only or even chief means of rendering good service, and feels, if the staff is trained to take a personal interest in the exchange and to work in this spirit, the best results must follow. This, Miss Buckwell has, without doubt, endeavoured to engender in her staff individually, exercising, at the same time, kindness and firmness in her rule. She is an enthusiastic member of the committee of the London Telephone Operators' Society, and also of its papers sub-committee. Owning to no particular hobby, she spends most of her spare time in reading and music.

ADA GERTRUDE BUCKWELL.

XCV.—MINNIE FRANCES BUTLER.

THE Clerk-in-Charge of Kensington entered the service of the United Telephone Company in June, 1883, when there were only thirteen exchanges in London, accommodating at most 6,000 subscribers. Her first experience was at Cornhill, and on presenting herself to the clerk-in-charge she was given the usual list of exchanges, showing the numbers allotted to each. When she had mastered these she was told a few details of the work and set to operate. Supervision was then unknown, operators were left entirely to their own resources, and if anything out of the ordinary routine occurred they had to decide for themselves how best to deal with the matter.

MINNIE FRANCES BUTLER.

Miss Butler is singular in her experiences of the various exchanges. From Cornhill she went to Coleman Street; back to Cornhill; from thence to Avenue (then in East India Avenue), and next to Queen Victoria Street. She was at the latter exchange at the time of the transfer to the first multiple board. Subsequently she was employed at Hop, Clapham, Battersea, Hop again, and Avenue. In 1896 she was promoted to be a Supervisor at Gerrard Exchange, where, however, Miss Butler states she did more clerical work than supervision. In 1898 she was made Clerk-in-Charge at London Wall, at the time of the change-over from boy operators. It is interesting to learn that there were then only about 200 subscribers, especially when one remembers the present London Wall Exchange, which has roughly 8,600 direct lines. The subscribers at this exchange increased rapidly, and a new exchange was built, fitted with central battery equipment, and opened in March, 1902. In the following July this was completely burnt out, the conflagration commencing about eight o'clock, just before the day operators went off duty, and in twenty minutes only the bare walls were standing. Fortunately no lives were lost and no one was injured in any way, the staff behaving with admirable coolness and courage. Temporary

boards were rapidly fitted in the offices next door and all subscribers' lines were re-connected in a very short time.

Miss Butler continued her peregrinations even as Clerk-in-Charge, and has served in that capacity at Westminster, Holborn, London Wall, Bank and North, being transferred to her present position at Kensington in July, 1910. As one of the senior clerks-in-charge with greatest length of service Miss Butler is able to appreciate to the full all that has been done in recent years to improve the comforts and conditions of work for the operating staff. It is safe to say that in each of the many exchanges in which she has worked Miss Butler's buoyant disposition and even temper have gained her the sincere affection of her staff, and her chiefs have always appreciated her keenness and enthusiasm, which have marked her work throughout her long service as a "Telephone Woman."

THE NATIONAL TELEPHONE COMPANY IN COUNTRY DISTRICTS.

BY W. H. GUNSTON.

So much has been heard of late of the introduction of what, for want of a better name, are known as "farmers' telephones," and so much has appeared in the Press regarding the extension of the benefits of telephone service to rural places that an impression is apt to be created that the National Telephone Company and its parent companies (the true pioneers of telephony in these islands) have played little or no part in that good work. This is very far from being the case. The Company—a commercial corporation, and bound therefore by the rules of the game to obtain a return on its capital—naturally commenced its operations in the large centres of population, but, having attended to their needs, it proceeded rapidly to extend its system over the whole country to all places where there was the least prospect of obtaining a moderate profit in so doing.

The difficulties of supplying country towns and rural villages with telephone service stand in need of some explanation. It is, of course, not the rurality or the size of a town which is most likely to make it a late-comer in the telephone network. It is rather its remoteness from and inaccessibility to the busier and more crowded areas. A place may be delightfully rural and sequestered, but if it is within seven or eight miles of some great city with which two or three wealthy inhabitants require communication it is likely to obtain a telephone exchange while the service is still something of a novelty. The wealthy resident, however, is by no means an indispensable factor in the early rural exchange. Many small towns of no commercial importance possessed telephone exchanges in the 'Eighties. Dalston and Wigton (two small places respectively about five and twelve miles from Carlisle—itself no huge centre of population) will serve as instances.

On the other hand, places not on the route between London and the Midlands, Lancashire, Yorkshire and the West, although old towns such as Spalding, Sleaford, Horncastle, Melton Mowbray, Ely, Oundle, Aylesbury, Maldon, Thetford, Horsham, Romsey, Wallingford, Calne, Malmesbury, Sherborne, Wimborne, Wareham, Shaftesbury, St. Ives, Bodmin, Wells, Glastonbury, Ross, Leominster, Droitwich, Wenlock, Ludlow, Richmond (Yorks), Malton, Northallerton and many others have had to wait until the last decade for the service.

It is now exactly ten years ago that the Post Office began to open exchanges in rural areas. Thitherto their activities had been almost entirely confined to the South Wales and Tyne and Tees districts. It will therefore be of interest to see what the Company had already done in the direction of supplying the service to the less lucrative districts of the country, that is to say, to the more isolated and the non-manufacturing towns. Considerations of size and population do not come into the question so much as geographical position and economic conditions in the towns which I shall instance.

Before the end of the last century the Company had opened in the South of England exchanges at St. Albans, Hertford, Hitchin Wycombe, Marlow, Guildford, Godalming, Farnham—all places, it will be observed, twenty miles or more from London or from any other large town. I leave out of account the popular watering places of Kent and Sussex. In the large semi-circular belt which lies between London and Southampton, Bristol, Northampton, Leicester and Norwich, an extensive tract in which perhaps in the last century the only towns of 30,000 souls were Reading and Oxford—and in which consequently no town, even though of some importance in itself, forms part of a populous area—the Company was by the year 1899 working exchanges at such places as Chelmsford, Manningtree, Saffron Walden, Huntingdon, Market Harborough, Banbury, Witney, Salisbury, Wilton, Devizes, Trowbridge, Winchester and Chippenham. None of these places boasted 20,000 inhabitants, and it must further be borne in mind that when the Company opened at Oxford in the Eighties and at Bedford in 1896, these places had only about 40,000 and 30,000 inhabitants respectively, and were quite self-contained, having no town of importance nearer than twenty miles distant.

Going further afield, the Company had by the year 1899 supplied the service to Wisbech (Cambs), Boston, Stamford, Louth (Lincoln), Retford, Newark (Notts), Bakewell, Buxton (Derby), Rugby, Kenilworth, Stratford-on-Avon (Warwick), Oswestry (Salop), Hereford, Chepstow, Taunton, Yeovil, Truro and Penzance. In the far North such places as Hexham, Alnwick, Berwick-on-Tweed (Northumberland), Cockermouth, Wigton, Penrith (Cumberland), Kendal (Westmorland), Grange-over-Sands, Carnforth (Lancs) and Ripon, Settle and Knaresborough (Yorks) were all working before the closing years of the last century. These are all country towns properly so called, and do not, of course, purport to constitute anything like a complete list. They are rather places of a certain geographical importance but small population, and the selection of them is designed to show that the Company did not neglect towns situated outside the great industrial areas and the large and popular pleasure resorts. It may be submitted that country towns are not identical with rural districts, but in reply it can be pointed out that to serve the country town is the first and natural step towards serving the small village, that in fact around many of the country towns selected on my list, village exchanges have been opened up, so many indeed that it would be tedious and uprofitable to enumerate them. My paper on the "Development of the Telephone in the English Counties" (JOURNAL, October, 1907, *et. seq.*) gives them in detail. Another point is that it was more meritorious to extend the telephone to such towns as Peterborough—a particularly isolated city of only 30,000 inhabitants—in 1887 than it would be to open exchanges at Latchington-with-Snoreham or Frisby-on-the-Wreake in the present year of Grace. It must be remembered that the "telephone habit" is now widespread, that the pioneer work of years is bearing fruit, that the farmer, the small tradesman, and the country resident feel the necessity of the service no less than the merchant and the townsman. Many country towns (in areas now abandoned by the Company under the Telegraph Act, 1899) in which the Post Office has now a flourishing exchange were vigorously canvassed by the Company in the 'Nineties for sufficient support to warrant the opening of an exchange, but in vain. Ten years' education of the public easily supplies the required explanation. It is not the resuscitation of unwieldy party line rates that will effect the telephonic development of rural England; it is rather that the harvest is ripe and only awaits the capital which can set an army of reapers to work in it.

An interesting illustration of the progress of the telephone under the Company's ægis in country places would be found in a list of towns which received the telephone service before that of the railway. Our railway system is so well established and has been so widely developed for upwards of 50 years that we not unnaturally find few towns or villages of any sort of importance without a railway station. Yet there are quite a considerable number of such villages which boast a telephone exchange, as the following tentative and incomplete list will show. It may find employment for the curious and exact to amplify it by extending it to Scotland and Ireland, or to correct it in a few cases by deleting the names of villages which possess a station near at hand but bearing another

name. The exchanges given are all in England and Wales and are those of the Company only:—

Berks
Burghfield
Hurley
Sonning
Bucks
Iver
Cambs
Trumpington
Cheshire
Christleton
Stockton Heath
Upton
Cornwall
Torpoint
Stenalees
Portleven
Denbigh
Tyn y Groes
Derby
Baslow
Dorset
Preston
Durham
Hurworth
Middleton-one-Row
Flint
Halkyn
Glamorgan
Three Crosses
Sketty
Glo'ster
Saul
Hardwicke
Bream
Westbury-on-Trym
Amberley
Wotton-under-Edge
Frenchay
Hants
Odiham
Hartley Wintney
Horndean
Hambledon
Bassett
Rownhams
Longham
Southbourne
Stubbington
Titchfield
Niton (Isle of W.)
Bonchurch „
Herts
Markyate
Bushey Heath
Hereford
Burghill
Bartestree
Kent
Pembury
Hadlow
Boughton
Lamberhurst
Langton
Fordcombe
Kennington
Riverhead
Willesborough
Easry
Lancs
Newby Bridge
Leicester
Anstey
Oadby
Lincoln
Laceby
Immingham
Northants
Wollaston
Rothwell
Norfolk
Catton
Somerset
Chew Magna
Beckington
N. Petherton
Stafford
Sedgley
Eccleshall
Barton-under-Needwood
Suffolk
Woolverstone
Sussex
Hurstmonceux
Westmorland
Grasmere
Sedgwick
Wilts
Hilperton
Wroughton
Worcester
Cropthorne
Kempsey
Yorks
Whixley
Rothwell
Dringhouses
Poston Spa
Dinnington

Some of these places are suburban in character, but the majority of them are genuine country villages, in many cases three or four miles from a railway station. They are striking evidence of the activity of the Company in rural districts.

AUTOMATIC TELEPHONES.

(*Paper read by* Mr. W. AITKEN *before the Institution of Electrical Engineers.*)

THE following report of this paper is reprinted from *The Times*:—

In this country, the author observed, development had been connected almost entirely with manually operated switchboards, though from time to time automatic features had been introduced to simplify the operating, and thereby to expedite the speed of connection. These automatic features had been principally adopted on the incoming junction switchboards which controlled the work between different exchanges in the same area, where it was essential that the operating should be of the very best. He mentioned that the British Insulated and Helsby Cables, Limited, had lately introduced small switchboards of his design, in which the connections were controlled by a rotary multi-contact electro-magnetic switch, so that when a connexion was made manually it was held electrically and automatically disconnected, and all apparatus was restored to the normal condition when the subscriber replaced the telephone receiver after a conversation. At present, on small switchboards, clearing signals were given to the attendant when the telephone was replaced; but with these new switchboards the lines were automatically disconnected and all apparatus restored to the normal condition by the replacing of the telephone. This would make the work from the private branch exchange to the central exchange much more positive, and would prevent delays from occurring at the central exchange on account of slow operating at the private branch exchange. Primarily these boards were designed for small exchanges where there was no regular attendant, say, up to 20 or 30 lines.

AUTOMATIC EXCHANGES.

Most of the leading telephone manufacturers were now busy developing automatic systems, but, practically, there was only one system in common everyday use—that of the Automatic Electric Company, of Chicago. It was claimed by that company that there were 300,000 telephones working on their system, San Francisco, Oaklands, Los Angeles, Columbus, Grand Rapids, and Chicago being among their largest installations. San Francisco and Los Angeles were both laid out on a basis of 100,000 lines. The former had already four exchanges with three at Oaklands, across the bay, most of them of 10,000-line capacity. Los Angeles had six main and four branch exchanges equipped for 25,700 lines. These exchanges were on the common battery system. The Chicago system, just being brought into use, was said to be suitable for 1,000,000 lines.

In a cosmopolitan city the advantage seemed to be with the automatic apparatus as regards operating by the public. The opinion that the subscriber could not be trusted to operate the switch correctly, and that he should not do more than lift and replace the receiver, all operating being done by a trained staff, was, he thought, now held only by a few enthusiasts. The subscriber's instrument might be of any of the well-known patterns fitted with a dial switch. The switch had finger holes near the circumference into one of which a finger was placed and the dial revolved until the finger came against a stop. In the three-wire system this dial as it revolved intermittently earthed one or other of the wires, and thus completed a circuit from a central battery which caused electro-magnetic mechanism to perform certain functions step by step. In the later system these functions were performed by the dial simply intermittently opening the circuit which had been completed by lifting the receiver.

An important feature of the automatic system, of which the mechanism was fully described in the paper, was that it was not essential to concentrate a great number of lines in any one building. The system would work as efficiently if 10,000 lines were in one building as in ten exchanges of 1,000 lines each. The apparatus, with the exception of, probably, the power plant, would be exactly similar, but the street cable plant would be very different. It would thus be seen how efficiently the automatic system met the varied needs of a great city, where a residential district of a few years ago with few telephones became a busy business centre requiring many telephones, like Finsbury Circus; or when a slum, such as the district between Holborn and the Strand, gave place to a great thoroughfare like the Kingsway, and thus upset all calculations of capacity in underground mains and necessitated the re-opening of streets. In the automatic system a district station of suitable capacity would be opened in such localities, and the necessary local lines concentrated on these. The existing cables of small capacity to the large exchange would be utilised as junction wires. A small town with an ultimate capacity of 12,000 to 15,000 lines might be efficiently served by a central of 10,000 lines and several district exchanges varying from 100 to 600 or 800 lines. In existing manual systems somewhat similar automatic district stations might be used with advantage as valuable adjuncts to avoid expensive underground cable work, or the provision of new manual plant, or expensive additions to existing plant of limited capacity.

In some countries objection had been raised to the automatic system because it would do away with one form of employment which was very suitable for women; in new countries where women were scarce the automatic appealed as a way out of a great difficulty.

EFFICIENCY AND COST.

The manual system was now as near perfection from an operating point of view as it could be brought, and increased efficiency could be obtained only by refinements due to more expert

operators and thorough supervision. The principle of working was that the subscriber should only remove the receiver, state his requirements, and replace the receiver on the switch-hook, all operating beyond being performed by experts. This sounded simple, but it depended, first, on the articulation of the speaker, who might be from any county or any country, and secondly, on the ear and understanding of the operator to interpret the words before giving effect to them. Again, in a city like London, about 75 per cent. of the calls were over junction lines, which meant that the first operator had to repeat the number required to a second operator. In the automatic system the responsibility for getting any number, no matter how large, was entirely on the caller. If a blunder was made, the caller had only himself to blame. Practically he was asked to spell out his number, and yet some experts said he was not to be trusted to do this. It was also claimed that the subscribers on an automatic system answered more quickly, as there was no operator to blame. Unquestionably for rapidity of service the automatic had the advantage. As quickly as a caller could spell out his number, so quickly was the connexion built up, for any number on the system, and the clearing was instantaneous. The time taken to send in a clearing signal on the manual was the time taken on the automatic to disconnect. The secrecy of the conversations would also appeal to many.

The capital cost for the actual exchange equipment in small exchanges was much more with automatic than with manual, but with increase in size the costs approached each other until at about 10,000 lines they were equal. This was for single exchange equipment, but when the telephoning of a great city was considered the results might be very different. The subject, however, was a very complex one, and would require very careful study of a particular area to determine exact costs. It might be noted, however, that whereas the manual system increased with an ever-increasing ratio owing to the increase of junction lines with their complicated circuits, huge multiples, and attendant operators, the cost of the automatic system increased much more uniformly. The apparatus increased on the percentage basis, and the junction lines were actually fewer, as they carried a greater number of busy-hour calls owing to the rapidity of the service. Owing to the tendency on the manual systems for junction lines to increase abnormally, as great a number of lines as possible were accommodated in one exchange, and therefore the average length of the subscribers' lines was increased. On the automatic system, however, as the working from beginning to end was junction working, there was not the same necessity for large exchanges, and the apparatus could be broken up and distributed in groups of moderate size as best suited the economical lay-out of an underground cable system, with the result that the average length of the subscribers' lines would be much less.

The manual system was seen at its worst when sub-division took place. Owing to the cost of line equipment it was not economical practice to concentrate all lines on one large central exchange, even when this could cope with the requirements of a town. It was usually advisable, therefore, to have district exchanges. It was difficult to deal with the saving effected in conduits and cable for lines; but generally it must be conceded that as the service remained always at 100 per cent. efficiency, no matter how the units were distributed, there must be a great saving owing to the possible reduction of the average length of the subscribers' lines, the reduced number of junction lines owing to their greater carrying capacity under automatic conditions, and to the greater flexibility due to the feasibility of opening an automatic exchange owing to the growing telephonic density of a district, whereas a manual exchange could be opened only at the cost of reducing the efficiency and increasing the operating cost of the whole area.

The cost of buildings was very much less on an automatic system, as the equipment was much more compact—no kitchen, rest room, and other conveniences for operators were necessary. The furnishings, decorations, electric light fittings, were simpler.

With regard to maintenance, all operators' expenses were saved except such as were required for trunk service, information desks, and the like. Against this, of course, had to be placed the cost of electricians or mechanics. One good man was usually provided for every thousand lines. Many of the sub-exchanges had no regular attendant, all lines being tested from the nearest main office, and charging of accumulators being effected over wires from the main exchange, only periodical visits were paid to see that all was in order.

The author concluded the paper by expressing his conviction that there was a great future before automatic telephony.

DISCUSSION.

Mr. J. E. Kingsbury said Mr. Aitken's belief that nothing else than the full automatic system could be other than transitory might be right, but there was no material put forward, based upon accomplished facts, to permit of a judgment yet. Mr. Aitken believed that the subscriber could be relied upon to a very considerable extent, and here again he might be right, but it was all a matter of experience and statistics which were at present lacking, and it was unwise and unsound engineering practice to assume that something which had not been sufficiently demonstrated might be relied upon.

Mr. F. Gill said that no discussion of circuits or apparatus would enable a conclusion to be arrived at. It was essential to take a large area and study throughout the conditions which would be found if manual switch gear were installed and the same if automatic gear were used. No decision could be arrived at by generalisation. He referred to Mr. Carty's contribution to the discussion at the International Conference in September last in Paris (N. T. JOURNAL, November and December, 1910). Among other detailed points, he indicated some of the functions of the private branch exchange operator which could not be filled by automatic apparatus. He stated that 22½ calls per junction per busy hour, a figure taken by the author, would be unsafe for English practice, and he criticised the statement of one man per 1,000 lines for maintenance of automatic exchange equipment.

Mr. A. W. Whalley said he had studied five different systems in the United States, and they had filled him with astonishment and admiration at the results accomplished. In his opinion it was now time for the business man and the man in the street to be consulted.

Mr. R. Scruby thought that telephone engineers in England and also the public would one day have cause to thank the inventors, engineers and financiers of the Automatic Electric Company of the United States for having shown them that entirely automatic telephone systems were feasible and economical. About eight years ago in Los Angeles there was the finest independent manual exchange in the United States, but only a year or two after that date all extensions were on the automatic system, and now one of the largest automatic exchanges in the world existed there. At Dayton, Ohio, where there was a manual exchange and a 10,000-line automatic exchange, the public were very much in favour of the automatic exchange. The question of first cost was really a manufacturing problem. Only one firm had up to now been making the apparatus, and the repetition orders were not put through the factory in anything like the same quantities as in some of the manual telephone works.

Mr. M. S. Conner thought the automatic system was a successful one for giving a telephone service; the subscribers liked it. The service was quick, and he believed that they were reduced to considering the question from a financial point of view. The cost of maintenance of the automatic system was greater than for the manual system. He thought it hardly right to say that the cost of maintaining subscribers' instruments might be anything from $1 to $10 with the manual system, but only 2 cents with the automatic. He had seen a good many comparative figures, but had never seen any verified by audited balance sheets. It was very evident to him that up to the present no automatic or machine-operated system had been devised that could give a reliable telephone service at the same cost that a corresponding service could be given by a modern manual equipment. The question of depreciation also had a bearing on the matter. There might be some hope for the automatic system if a large proportion of the parts required to make up the mechanism could be done away with, thereby reducing the maintenance cost.

Mr. Aitken, in reply, said he had no idea of doing away with the operator in private branch exchanges. The Automatic Electric Company recommended full automatic for the main exchanges and for the private branch exchanges, but to meet local conditions in warehouses, etc., where automatic working was not convenient, they always had a manual operator. On the question of maintenance, he pointed out that there were very few wearing parts in the automatic system, and the wipers were the only parts which had to be renewed at all frequently.

SOME RECENT ADVANCES IN TRANSMISSION EFFICIENCY OF LONG DISTANCE CIRCUITS.*

BY B. GHERARDI, *Engineer of Plant, American Telephone and Telegraph Co.*

IN June, 1900, Professor Pupin took out his patents for loading. Since that time practical applications of loading on a very extensive scale have been made in the plants of the American Telephone and Telegraph Company and the Associate Companies, and most gratifying results in improved transmission and economy in first cost of construction have resulted from the applications of

* Reproduced from the *Telephone Review*, New York, May, 1911.

Professor Pupin's invention. At first the work done dealt with the loading of ordinary open wire lines and standard cables and with the perfection of the apparatus required to accomplish these results. Later, attention was directed to the more complex problem of loading phantom circuits, the loading of our high-grade No. 8 circuits and the design of special cables so constructed that phantom circuit working was possible in connection with loaded cable conductors. As a result of the work which has been done along these lines during the last two years some very remarkable improvements in the transmission efficiency of long lines and cables have been made. The New York-Denver circuit which is now in operation and the Boston-Washington cable which is in process of manufacture have been made economic possibilities by these advances. While it cannot be said that these results could not have been obtained with our knowledge of the art as it was two years ago, it may safely be stated without fear of contradiction that the cost of such work, as it would have had to have been done with our knowledge of two years ago, would have been so great as to have been commercially prohibitive. Someone once defined an engineer as "a man who could do with one dollar what anyone could do with two." This definition, while not complete, is certainly good as far as it goes, and is, I think, well illustrated by the developments which I am going to tell you about this evening.

THE NEW YORK-DENVER CIRCUIT.

The New York-Denver circuit has a length of a little over 2,000 miles, that is, it is more than twice as long as the New York-Chicago circuits, which are about 950 miles long, and is a little less than twice as long as the New York-St. Louis circuits, which are about 1,050 miles long. Until the completion of the developments which have made the New York-Denver circuit possible, the New York-Chicago and New York-St. Louis circuits represented practically the limits of long distance transmission. Now service from New York to Denver can be given which is as good as, or even better than, the service given a year or two ago from New York to St. Louis or Chicago, and this without using any heavier wire than was formerly employed. All our old circuits from New York to Chicago and St. Louis were No. 8 B.W.G. wire, weighing 435 lbs. to the mile. No heavier wire is used to get the New York-Denver service.

One of the aims of our President, Mr. Vail, is to give universal service. The first step in the direction of giving such service is

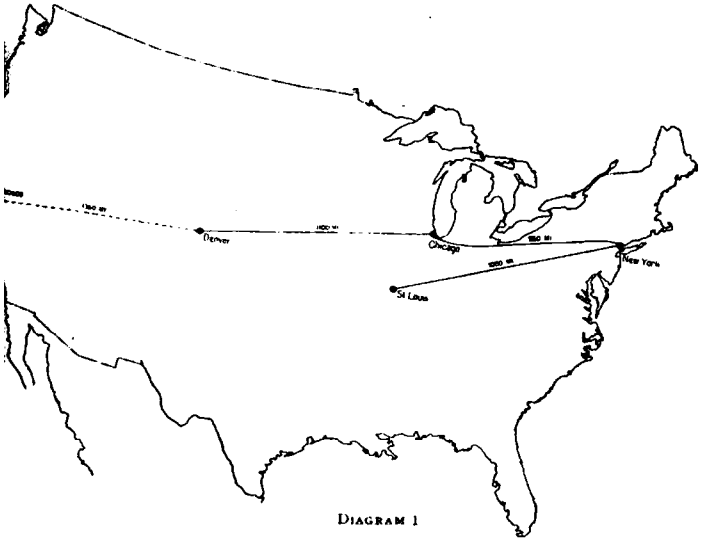

DIAGRAM 1

obviously to be able to give transcontinental service—that is, a talk from New York to San Francisco. Diagram 1 will show how much of a step in this direction has been made since Mr. Vail's wish on this matter was stated about two years ago. This diagram shows what we could do two years ago, what we can do now, and how much remains to be done to get to San Francisco. It was a long step from Chicago to Denver. One more step a little longer will take us to San Francisco.

Two years ago we did not know how to successfully load No. 8 circuits, how to commercially phantom No. 8 circuits, or how to combine phantoming and loading. Since that time we have found out how to do all of these things, and it is as a result of these developments that the Denver circuit is a reality to-day.

Before explaining how each one of these results was accomplished, and the part which each result contributed to the achievement of talking from New York to Denver, I will describe the

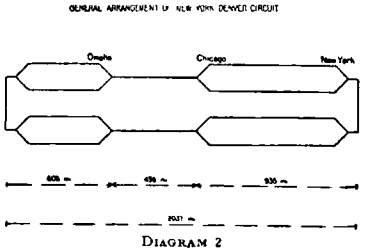

DIAGRAM 2

circuit. Diagram 2 shows in a general way the New York-Denver circuit. From New York to Morrell Park (the test station just outside of Chicago) there are two loaded No. 8 circuits. These are phantomed, thus creating a third circuit, and this phantom is also loaded. From Morrell Park to Omaha there is a loaded No. 8 circuit. No loaded phantom has as yet been provided here because the pole line did not carry two No. 8 circuits so located with relation to each other that they could be phantomed. Arrangements are being made to move a No. 8 circuit on this line to pins adjacent to the present loaded No. 8 circuit, and as soon as this is done a phantom will be created from the two circuits, and this phantom will also be loaded, thus giving between Chicago and Omaha the same arrangement as now already exists between New York and Chicago. From Omaha to Denver there are two No. 8 circuits which have been phantomed, thus creating a third circuit, and the two physical circuits and the phantomed circuit are all loaded, thus giving from Omaha to Denver the same general circuit equipment as now exists between New York and Morrell Park.

The circuit from New York to Denver, utilising the phantoms where they exist and including the reflection losses due to the present irregular arrangement, is equivalent in transmission efficiency to about 30 miles of standard cable. The circuit if connected throughout on a non-phantomed physical circuit over the same route is equivalent to about 32 miles of standard cable. When the final arrangement is completed between Chicago and Omaha our present estimate is that a New York-Denver connection on the phantom will be equivalent to between 28 and 29 miles of standard cable. If the circuit were made up throughout of unloaded No. 8's it would be equivalent to 69 miles of standard cable. A No. 8 unloaded circuit from New York to Chicago by the shortest route is equivalent to about 34 miles of standard cable from testboard to testboard. It will thus be seen that the new circuits to Denver are better than our old circuits were to Chicago. Not only are they better, but they are cheaper, because with the art as it was two years ago with four No. 8 wires we could get two circuits; now with four No. 8 wires and some coils and insulators we get three circuits of more than double the transmission efficiency. It is interesting to consider what results these cheaper circuits will accomplish when used in connection with the Chicago business. The No. 8 unloaded circuit to Chicago has a transmission efficiency of 34 miles. By the use of telephone relays or repeaters this can be cut down to about 22 or 24 miles. The efficiency of the No. 8 loaded circuits from New York to Chicago is equivalent to about seventeen miles of standard cable. The efficiency of the loaded phantom is equivalent to about fifteen miles of standard cable. As soon as certain additional circuits *via* Pittsburg are loaded and phantomed we shall start using the high-grade circuits for New York-Chicago business.

As I have already stated, there are embodied in the New

York-Denver circuit three advances recently made in the art, namely:

Loading No. 8 circuits.
Phantoming No. 8 circuits, and
Combining loading and phantoming on the same circuits.

LOADING NO. 8 CIRCUITS.

The problem of loading No. 8 circuits was primarily a problem in connection with the insulation of the line wires. A No. 8 circuit can be loaded with the same coils used on No. 12 circuits, and these coils would be spaced in the same manner, that is, at eight-mile intervals. It has been a fact known to us ever since we started to

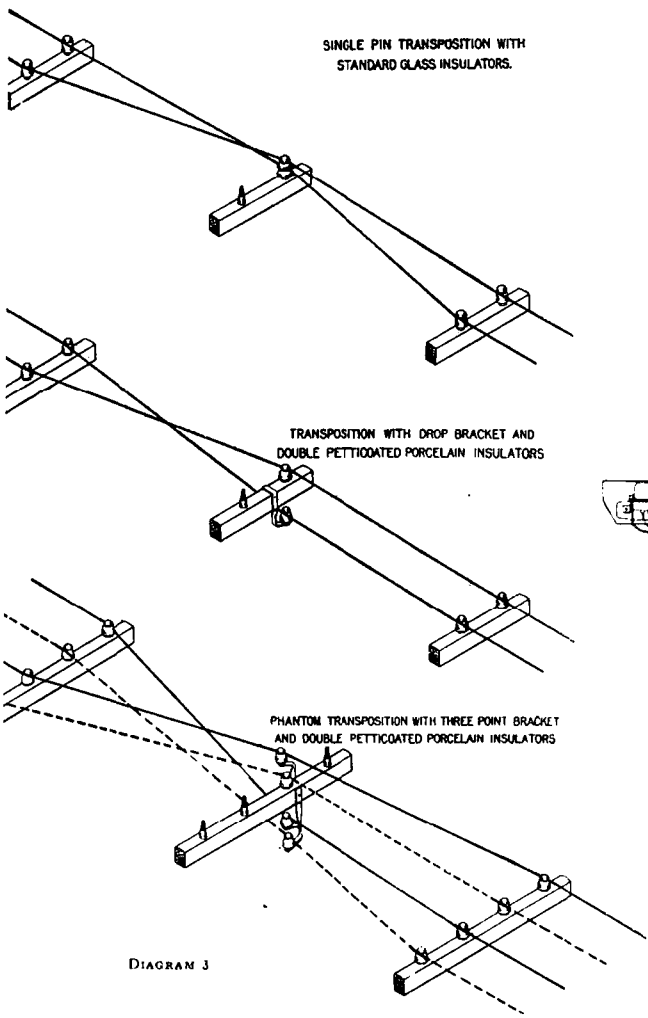

DIAGRAM 3

do commercial loading that low insulation on a loaded circuit has a much greater effect in impairing the efficiency of such a circuit than the same insulation has on an unloaded circuit. It has also been known that the effect of low insulation on the No. 8 circuits was much more serious than on the No. 12 circuits.

When we first began to unload our open wire circuits about ten years ago it was found that the No. 12 gauge circuits which had been loaded gave satisfactory results in dry weather. In wet weather the results were not so good, due to the lower insulation at such times, but these results were good enough. In the case of No. 8 circuits, however, it was found that when they were loaded the effect of low insulation was so serious in wet weather that at such times the circuit was no better that if it was unloaded—sometimes even worse. A system of loaded No. 8 circuits could not, therefore, be considered satisfactory, as it would be a system which part of the time would be better than if not loaded and part of the time worse.

It having been established that a substantial improvement would have to be made in the insulation of No. 8 circuits in order that they might be successfully loaded, and reasonably uniform results obtained from the loading, a study of line insulation conditions was made to determine what steps would be necessary in order to improve the line insulation. Aside from the general insulator leakage, two particularly weak points were found in the insulation of open wire circuits. One of these was at transposition points. Diagram 3 shows the arrangement of the wires on a standard single pin transposition. I will be seen that with this arrangement there is a very direct leakage path from one wire to the other during wet weather. The part of the insulator surface protected by the petticoat is the only part that is of much value during wet weather. Actual measurements showed that the leakage on lines equipped with standard single pin type transposition insulators was 20 per cent. greater during wet weather than on lines where the two wires were never allowed to be on the same pin. Of course the old standard transposition which employed two insulators, both of the transposition type, and in which the wires were tied to both of them, was just twice as bad as the single pin transposition already discussed. The method of overcoming this difficulty was to transpose the wires without bringing them on to the same insulator. This is accomplished in the manner shown in the second part of Diagram 3, that is, to employ the phantom transposition bracket for transposing a physical circuit. The same problem, of course, arises when phantoms are involved and having used the phantom bracket for

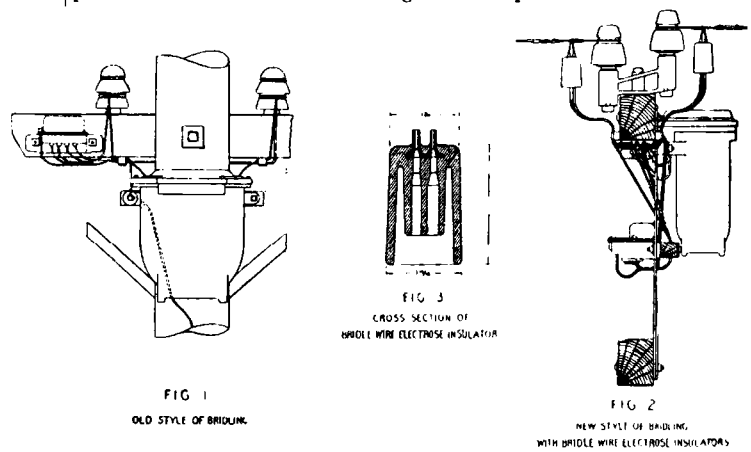

FIG 1
OLD STYLE OF BRIDLING

FIG 3
CROSS SECTION OF BRIDLE WIRE ELECTROSE INSULATOR

FIG 2
NEW STYLE OF BRIDLING WITH BRIDLE WIRE ELECTROSE INSULATORS

DIAGRAM 4

the transportation of physical circuits, something else is required when phantoms are involved. This arrangement is also shown in the diagram. By the means described above the transposition as a factor in producing low insulation is eliminated and the transposition points are made just as good as any other point in the line.

Another point at which it was found that there was considerable leakage was where, for the purpose of inserting loading coils, connecting with a test station, or for any other reason, the wires were bridled. These places were particularly bad during wet weather, especially after the bridle wire had been in service for a short time and had weathered. The path of this leakage is shown in Part 1 of Diagram 4. The braid on the bridle wire soon becomes weathered and when wet is a fair conductor. Leakage takes place easily over the wet surface at the end of the rubber insulation and thence to the wet braid. This difficulty was overcome by a very neat device known as a bridle wire insulator. Part 2 of the diagram shows a picture of such a bridle wire insulator, and Part 3 shows a cross section of it. The two wires shown in connection with this bridle wire insulator extend—one to the loading coil and the other to the lightning arrester. The adoption of this arrangement has completely eliminated low insulation at bridling points.

(To be concluded.)

The National Telephone Journal.

"BY THE STAFF FOR THE STAFF."

Published Monthly at
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VOL. VI.] JULY, 1911. [No. 64.

THE POSTMASTER-GENERAL AND THE STAFF.

THE Postmaster-General in his speech to the staff at the annual dinner made two statements which were listened to with unbounded satisfaction. The first was as regards the position of the staff on their transfer to the Crown, when he stated explicitly that all who contributed to the pension fund would be able to assign their share in that fund to the Postmaster-General when the fund is wound up, and be allowed to count all the years they had spent in the service of the Company and during which they had contributed to the fund as though they were years spent in the service of the State for pension and superannuation purposes. This was received with especial pleasure as it seemed to deal satisfactorily with the cases of the Legal and Contract Department staffs, about which much doubt had been felt. The other statement which evoked loud applause was one to the effect that promotion in the Post Office would not be determined by mere dead routine rules of seniority in which merit would not be taken into account, and that the telephone would in a large measure be kept apart from other Post Office work, with the allowance of a large measure of discretion to local officers.

In the recent debate which took place in the House of Commons on the Telephone Transfer (Consolidated Fund), Mr. HERBERT SAMUEL reiterated these statements and confirmed these promises, but with an important qualification as regards the first, which will inflict an undoubted hardship on a section of the staff. Anyone who has read a full report of Mr. SAMUEL'S speech cannot fail to discern therein his desire to act fairly to the staff, and to meet as far as possible the undoubted difficulties and nice points of the situation. Referring to Lord STANLEY'S promise to take over all employés of the Company who received less than £700 a year and had more than two years' service, the Postmaster-General said: "I propose to redeem that promise, but to extend it further, and not only to take over those who have more than two years' service, but to take over the whole staff, no matter what their length of service may have been," and as regards seniority he said "in no case will the years of service to the Company be left out of account with regard to seniority, and the present officers of the Company will have the full benefit to which their years of service entitle them."

Dividing the Company's staff into two classes, the pensionable and non-pensionable staff, the Postmaster-General informed the House that "*almost* the whole of the pensionable officers of the Company would be transferred to established posts in the Post Office, and therefore pensionable posts," and that a very large number of the other class would fall within the class of established Civil servants. "In fact," he said, "fully four times as many of the Company's servants will be placed on the establishment of the Civil Service as have hitherto been in the pensionable class while with the Company."

Of the Company's pensionable staff, however, there remain a certain number who, according to Mr. SAMUEL, "cannot be established without disturbing arrangements which are uniform throughout the Civil Service," and he instanced the Solicitor's Department. These he proposes to compensate by giving them an allowance in addition to their salary equivalent to their pension rights. But it may be pointed out that such an allowance would by no means compensate a man for the various disadvantages attaching to the personal service of an individual as distinguished from the established service of the State. We believe it is the fact that the Solicitor to the Post Office, his assistant and principal clerk are on the established service. This would seem to dispose of any difficulty in the establishment of corresponding men in the Company's service. As regards the clerical members of that department there should be no insuperable difficulty in finding them posts on the establishment in other departments.

As regards the second point mentioned at the annual dinner, Mr. SAMUEL said:

> "Certainly the system will not be thrown into the routine of the Post Office Department. We are on guard against over-centralisation. The responsible officers in the districts will be given a large measure of local control, and we mean to use to the full the experience and capacity of the Company's staff in connection with work in which they are experts. The Company's managers will be kept at telephone work, and they will be given a very large measure of discretion in their own sphere."

This, again, we are sure will be hailed with satisfaction by the staff.

The attitude of the House of Commons towards the claims of the staff was appreciative, and Mr. JOYNSON-HICKS, who seems to have a remarkably clear grasp of the difficulties of the staff's position, spoke strongly in their behalf and pressed for the inclusion in the forthcoming Bill of the various assurances which have from time to time been given. With the obvious willingness on the part of the Postmaster-General to meet the staff at all points, and with the general desire of the House to see that they are fairly treated, we hope and believe that a satisfactory solution of the establishment question will be found.

HIC ET UBIQUE.

IN a series of "Active Service Impressions" appearing in a weekly paper called the *Regiment*, Mr. J. F. Trustam, who has been a clerk and collector in the Company's London service since 1903, figures in the following exciting experience of a scout during a reconnaissance at Laings Nek:—

Having a white horse I made a splendid target, and I had not gone far before my horse came to the ground with a crash. I thought he was dead, but he scrambled to his feet again, and I jumped into the saddle.

Owing to this delay the Boers had come within 50 yards of me and called on me to put my hands up. But I made a dash for it, instilled with the idea that while there was life there was hope.

I was about 300 yards past Umbana Kopje, and had my corps well in sight when down came my horse again—this time on top of me. I was pinned to the ground with the horse lying, utterly exhausted, across my legs!

TO THE RESCUE.—The Boers were afraid to come from the cover afforded them by the kopje, as they would have come within range of our guns, so they lay taking pot-shots at me. How long I lay there I could not say, for the minutes seemed hours.

The bullets were cutting the sand into my face when I heard the sound of galloping horses. It was Capt. Denny and Troopers Maise and Trustam pluckily come to my assistance!

They pulled the horse off me, and I was soon in the saddle, out of range, none the worse for my adventure except for a bullet through my bandolier, one through my trousers, a black eye, and a few bruises.

ACCORDING to the *Standard* direct telephonic communication has now been opened between Paris and Vienna by a line passing through Frankfort and Munich. The ordinary tariff is eight francs a call.

ACCORDING to the *Zeitschrift für Schwachstromtechnik* the Swiss Bundesrat has agreed, with certain reservations, to the following alterations of tariff:—

Systems with less than 300 subscribers, 60 francs (£2 8*s*.).

Systems with over 300 subscribers, 70 francs (£2 16*s*.).

There is no flat rate in Switzerland, and we assume that the charge per call of 5 centimes (½*d*.) is unaltered. The old rates were 100 francs (£4) for the first year, 70 francs (£2 16*s*.) for the second year, and 40 francs (£1 12*s*.) for the third and succeeding years of subscription. There is little doubt that the Swiss Government could not make the service pay at the latter figure, even at the low rate of calling per day in vogue in Switzerland as a consequence of a universal message rate.

Major Hooper Military Plymouth when I was there

MR. G. HOOPER, District Manager, Plymouth, who holds the commission of captain in the Devon Fortress Royal Engineers and commands the electric light companies of that corps at Plymouth, took up a detachment to the Coronation ceremonies. They were encamped in "B" Camp, Kensington Gardens. They assisted in lining the streets on June 22 on Constitution Hill, and on June 23 Hyde Park Corner.

He had C. B S. Board ~~Constructed~~ when I went there

THE NATIONAL TELEPHONE COMPANY *v.* HIS MAJESTY'S POSTMASTER-GENERAL.

IN our last issue we gave a verbatim copy of the judgment of Mr. A. T. Lawrence upon certain preliminary questions arising out of the notices of objection which the Postmaster-General has given to the Company in which he claims to exclude from the scope of the purchase by him of the Company's plant certain plant, land and buildings which he considers will be unsuitable for the actual requirements of the telephonic service of the Post Office on Dec. 31, 1911. That judgment, it will be remembered, was in favour of the Company to the extent that it was held that the Postmaster-General was not entitled to object to buy the Company's plant because he will on the day mentioned be in possession of other suitable plant sufficient for the requirements of his service. The Court also held that certain of the notices were void by reason of indefiniteness. Against this decision the Posmaster-General has appealed, and the appeal came on for hearing in the Court of Appeal before the Master of the Rolls (Sir H. H. Cozens-Hardy), Lord Justice Farwell and Lord Justice Kennedy on June 14, and was continued on June 15, 16, 19 and 20. For the Postmaster-General it was contended that the interpretation placed by the Railway and Canal Commission upon the expression "unsuitable for the actual requirements" was wrong, and that the notices of objection held by the Commission to be void were in fact good and sufficient notices. The Company disputed these contentions and claimed that the notices held by the Railway and Canal Commission to be void were in fact void.

The same counsel appear as in the Court below—viz., the Attorney-General (Sir Rufus Isaacs, K.C.), the Solicitor-General (Sir John Simon, K.C.) and Mr. Branson for the Postmaster-General, and Sir Alfred Cripps, K.C., Mr. Danckwerts, K.C., Mr. Forbes Lankester, K.C., Mr. Morten, K.C., and Mr. H. H. Gaine for the Company.

REVIEW.

The Propagation of Electric Currents in Telephonic and Telegraphic Conductors. By J. A. Fleming. (316 *pp. Price* 8*s*. 6*d. net. Constable & Company, Limited, London.*)—In this text book the telephone engineer has for the first time a comprehensive explanation and description of that part of his subject generally termed "transmission."

Dr. Fleming has embodied in his book, which is based on two series of special lectures, all the information on transmission which has up to the present only been available by reference to the technical press and to such publications as the *Philosophical Magazine, American Philosophical Societies' Transactions, Harvard Engineering Magazine,* and similar sources inaccessible to the majority of telephone engineers.

Dr. Kennelly's methods of dealing with the calculations involved in transmission by the use of hyperbolic trigonometry are adopted by Dr. Fleming, and the simplicity of these methods when compared with the mathematics as used by Oliver Heaviside is well seen by a comparison of the latter's works with chapters in Dr. Fleming's book dealing with the same subjects. We are glad to see that most of the symbols used by the National Telephone Company for some years have been standardised by their inclusion in Dr. Fleming's book.

A considerable portion of the book is devoted to methods of measurements practically all the apparatus at present available for the measurement of telephonic current, potential, power, capacity. Resistance, etc., is described in detail.

The book teems with useful data and in this connection we are glad to see that Dr. Fleming has given many of the results obtained in the Company's Investigation Laboratory.

One chapter of considerable interest deals with loaded cables in practice, and here we have summarised most of the information so far published on this important subject. The great progress however which is continually being made in loading is resulting in the amassing of such valuable data that in all probability, before long, a book dealing entirely with this subject will become a necessity. Be that as it may, the subject of transmission which as we are all now aware is one of great and progressive importance, is fittingly dealt with in this book and no telephone engineer who would wish to be fully equipped can afford to be without it.

The following is a summary of the table of contents:—

Chapter 1.—Mathematical introduction, including the calculus of complex quantities, hyperbolic trigonometry, Dr. Kennelly's tables of hyperbolic functions.

Chapter 2.—The propagation of electro-magnetic waves along wires, including general and mathematical theory.

Chapter 3.—The propagation of simple periodic electric currents in telephone cable, including the cases of both lines of infinite and finite length.

Chapter 4.—Telephony and telephonic cables, including general principles. The analysis of complex waves. Distortionless lines. Various methods of improving the transmission, including a description of Pupin's methods.

Chapter 5.—Propagation of currents in submarine cables. This chapter deals more particularly with telegraphic signals.

Chapter 6.—The transmission of high frequency and very low frequency currents along wires.

Chapter 7.—Electrical measurements and determination of the constants of cables, including formulæ for the predetermination of the capacity and inductance of telephone lines. Practical methods of measuring line constants, etc.

Chapter 8.—Cable calculations and comparison of theory with experiment, including tables of valuable data.

Chapter 9.—Loaded cables in practice, including description of loading coils and their application. Data for various overhead lines and land and submarine cables.

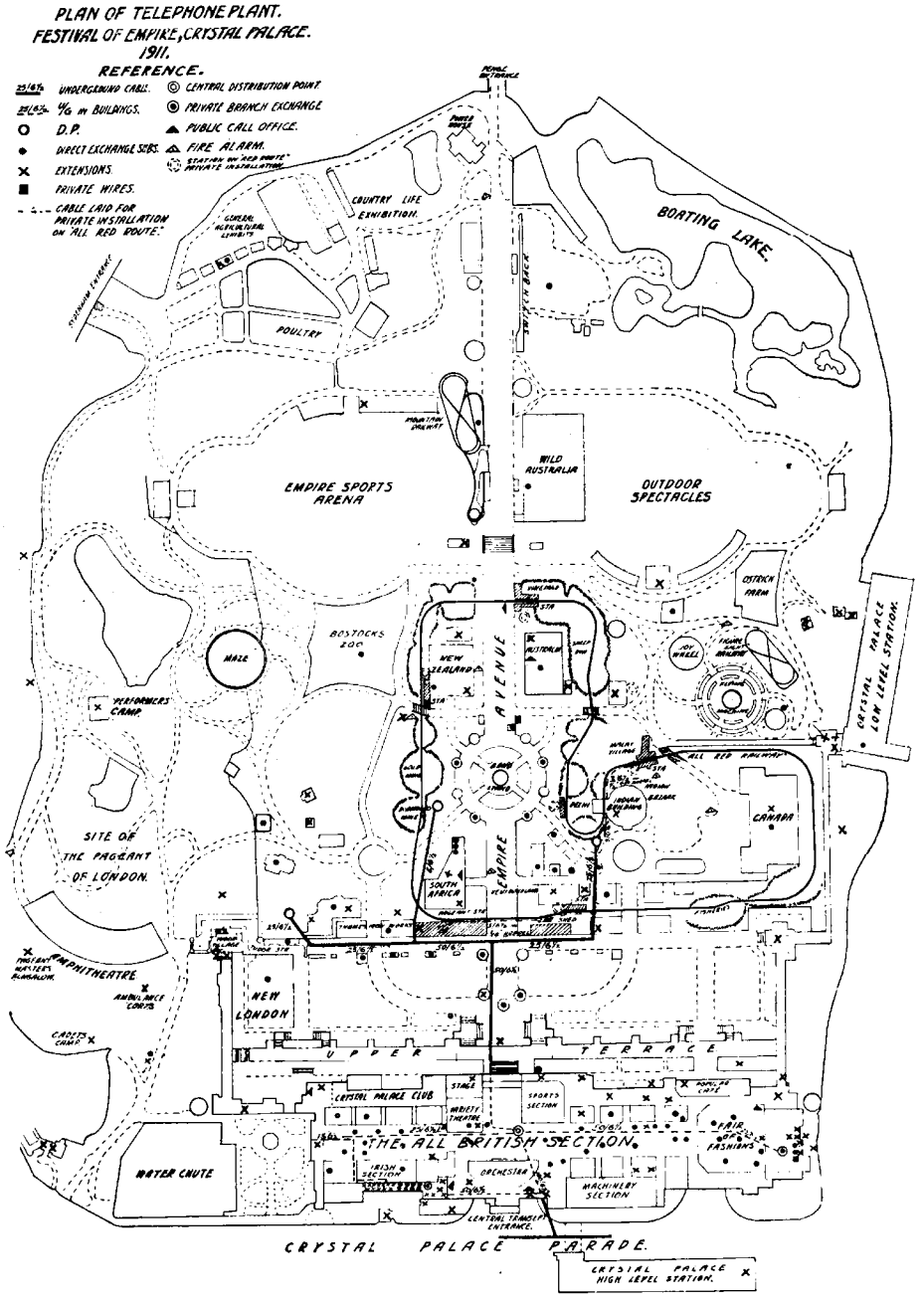
B. S. C.

TELEPHONES AT THE CRYSTAL PALACE.

BY F. G. C. BALDWIN, *Acting Metropolitan Engineer, London.*

IT is probable that many readers of the JOURNAL may have an opportunity of paying a visit to the Festival of Empire which is being held this summer at the Crystal Palace, and it is thought that some particulars regarding the telephone equipment which has recently been installed there by the National Telephone Company may be of some interest.

At the outset a difficulty was presented by the very limited information obtainable regarding the probable telephone requirements, more particularly of possible exhibitors. Orders were first received from the Festival of Empire authorities and from Messrs. Lyons, the refreshment caterers, for private branch exchanges with extensions both in the Palace itself and scattered throughout the grounds. As it was necessary that these should be installed without delay, and also that the requisite provision should at the same time be made for the lines of exhibitors likely to require telephones, a careful study of the probable requirements was quickly made and plant installed accordingly.



Overhead wiring was generally prohibited, being only permitted in certain restricted portions of the grounds, and distribution mainly by cable was therefore arranged.

The accompanying plan of the Palace and grounds gives a good

idea of the general arrangement of the exhibition, and also fairly full particulars of the equipment. The cable plant and distributing points are shown, and the general scheme of distribution can be readily followed.

Owing to the lack of definite information as to the telephone requirements of the exhibition, it was desirable that the cable system installed should be as flexible as possible, and should allow of alterations in circuit distribution being made as occasion arose. For this purpose a "distributing centre" was arranged with a

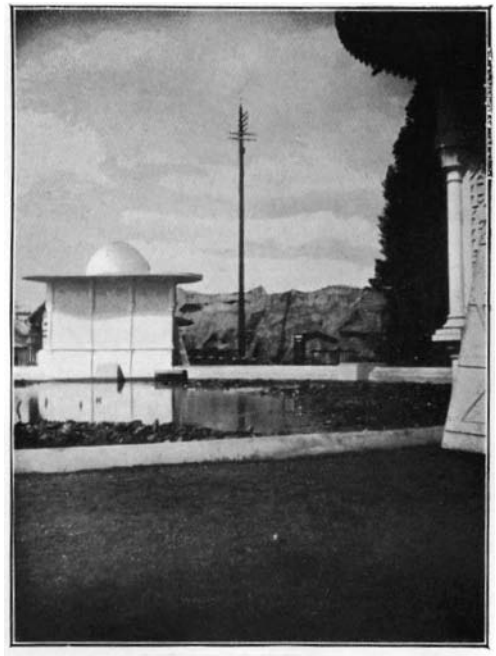


FIG. 1.—DISTRIBUTING POLE NEAR INDIAN BUILDING.

special joint at which the circuits from the exchange and those in the distributing cables were concentrated, and could be interchanged with as little delay and expense as possible. This joint is situated beneath the floor approximately in the centre of the Palace, and its position is marked on the accompanying plan. The utility of the method adopted has already been amply demonstrated.

The casual visitor as he walks along the floor of the Crystal Palace has little or no conception of what lies beneath him. Underneath, and covering the extent of almost the whole of the building, is a space some 10 or 12 feet in depth which bristles with the timbers supporting the floor, and in which pipes, cables and wires of all descriptions are located.

The Company's branch and distributing cables have been run in this subway, cleated to the timbers and terminated at suitable points by means of W.E. 14-type cable terminals. From these distributing points service leaders of V.I.R. wire are run to the subscribers' stations as required.

In the grounds external to the Palace the lead-covered cables are contained in gas barrel laid underground. Some of the telephones are connected therefrom directly underground by 1-pair lead-covered service cables, and three distributing poles have been erected from which lines are distributed aerially. Fig. 1 shows one of these distributing poles situated near the Indian building.

The attachment of open wires to the exhibition buildings, many of which appear to be of the most substantial construction—the fabric, however, being merely a structure of wood or steel framework—has in most cases been effected by means of tubular brackets. Where water services are not available copper earth plates have been sunk for earth connections.

The "All Red" Electric Railway, the route of which is shown on the plan, seems likely to be a very popular and interesting feature of the exhibition. By its means it is claimed that a 25,000-mile journey may be taken for the modest sum of sixpence, and this in a few minutes' time. The Company have installed railway telephones along the route for inter-communication between the various stations.

The system consists of a central switchboard situated at the central station of the railway with metallic circuit lines connecting to each of the other stations. The lines are of lead-covered cable laid in gas barrel along the sleepers, with some branches of aerial wire.

Special precautions have been taken to guard against fire, and the Company have installed a special alarm line to the order of the May Oatway Company. This line encircles a portion of the exhibition and links up nine different fire alarm call points with the central fire station of the exhibition. These are for use by the public and exhibitors, and on an alarm being given it is registered in an ingenious manner at the central station, the particular point at which the alarm is given being indicated by a special code.

There are also five sub-fire stations, but these have no special alarms.

At the central fire station there is a double cylinder steamer, a steam fire engine, hose cart and necessary appliances. The staff consists of one superintendent, four inspectors, and 25 firemen, and not less than two men are on duty constantly.

Forty-eight post hydrants, each with branch pipe and 100 feet of hose have been fitted up at different points in the grounds.

Seven public call offices, situated at various suitable points, have been installed in addition to the five already existing, and

FIG. 2.—CALL OFFICE IN PORCH OF "AUSTRALIA."

results to date indicate that they will undoubtedly prove thoroughly successful. On the opening day, when the Palace and grounds were densely crowded, it was interesting to note the constant stream of telephone users visiting the call boxes. A photograph of one of the call boxes is reproduced herewith (Fig. 2).

The growing popularity of the telephone is well demonstrated in the use to which the service is being put at this Imperial Exhibition, and the particulars given below regarding the circuits now in use there, are, it is thought, not without their significance.

	Telephones existing prior to Exhibition.	Telephones now fitted and working.
Direct exchange lines... ...	7	97
Public call boxes	5	12
Extension lines	11	108
Private lines	1	18

The Crystal Palace is in the Sydenham district, and all the exchanges' lines are connected to the Sydenham Exchange.

The installation of the lines was carried out under the supervision of Messrs. E. W. Newton, Divisional Engineer; W. J. Morrel, Local Engineer, and L. Worthy, Assistant Engineer.

A few details regarding the electrical equipment of the exhibition may be of interest, and are therefore appended.

At the central power house there are three generators, giving respectively 1,670, 1,500 and 1,200 amperes at 440 volts, by Messrs. The Lancashire Dynamo Company, The General Electric Company and Bruce Peebles. These are each direct-driven by vertical gas engines by the National Gas Engine Company.

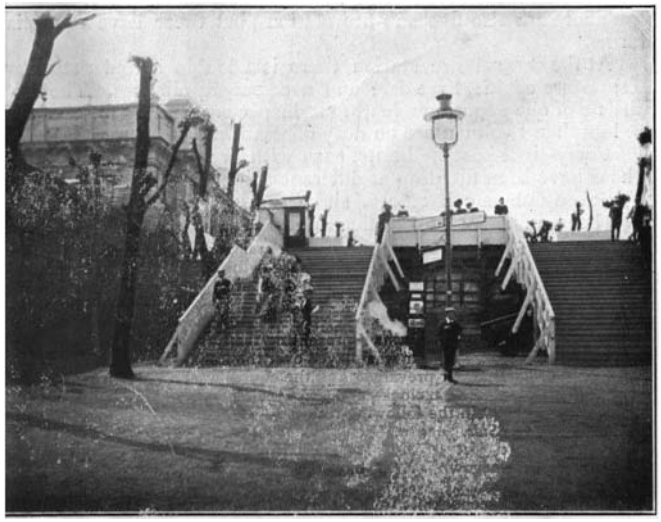


FIG. 3.—CALL OFFICE ON STEPS OF AUSTRALIAN STATION ON THE "ALL RED" ROUTE.

This power station supplies current for working the "All Red" Electric Railway, and for power and lighting to the exhibitors and grounds.

The Canadian power house supples electrical energy for lighting and working the refrigerating plant in the Canadian Pavilion. There are two generating sets, one a four-cylinder low-speed Diesel engine by Messrs. Thorneycroft, coupled direct to an 85-kilowatt generator supplied by the General Electric Company; the other a high-speed Diesel engine by Messrs. Carels Bros., Limited, of Ghent, coupled direct to a 185-kilowatt generator. Both are 225-volt generators.

The water for operating the fountains and waterfalls is pumped electrically.

There are eighteen naval searchlights for use in connection with the Pageant.

The grounds are lighted chiefly by electricity, but also by ordinary and high pressure gas.

PRESENTATION TO MR. MAGNALL.

MR. MAGNALL, Engineer, Manchester, was presented on June 3 with a travelling trunk and dressing case previous to his departure for Turkey to take up an important position in connection with the new telephone system. Mr. Rowland, Assistant Engineer, who made the presentation, paid a tribute to Mr. Magnall's popularity and his fame as a telephone engineer, and also wished him *bon voyage* and every success in his new sphere.

Mr. Magnall, in replying, thanked all for the useful and handsome presents. He would not say good-bye but *au revoir*, as he hoped to be back amongst the Manchester staff before the transfer.

MR. F. W. ROBERTS.

MR. F. W. ROBERTS, Local Manager at Brighton, recently resigned his position with the Company to take up the post of Engineer-in-Chief of United River Plate Company in Buenos Aires. Mr. Roberts entered the service as far back as 1886, and in January, 1895, was appointed Chief Clerk at Norwich. Since then he has been successively Local Manager at Southend (December,

1897), at Cambridge (December, 1898), Tunbridge Wells (December, 1900) and Brighton (July, 1903). Mr. Roberts was appointed to the Inventory staff in September last. Mr. Roberts was very popular in Brighton, doing good work in connection with the Staff Transfer Association and with the local benevolent society. We wish him every success in his new sphere.

NEW TELEPHONE PATENT APPLICATIONS.

THIS list is specially compiled for THE NATIONAL TELEPHONE JOURNAL by Messrs. Rayner & Co., registered patent agents, of 37, Chancery Lane, London, from whom all information relating to patents, designs, trade marks, etc., can be obtained gratuitously.

11,777. Emilio Zeppieri. Device for transmitting at distance the sounds of speaking machines. May 16.
11,950. William Innes Baxendale. Shield or protector for telephone receivers. May 18.
12,117. Siemens Bros. & Co., Ltd. Semi-automatic telephone exchange systems. May 19.
12,135. Shanker Abaji Bhisey. Automatic telephone instrument. May 19.
12,142. Bernard Parlagi. Disinfectant apparatus to be used especially for telephones. May 19.
12,175. Charles Hustwick Ellison and Charles Mark Jacobs. Telephone signalling systems. May 20.
12,200. George Sexton Bennett. Telephone mouthpieces. May 20.
12,278. Benjamin Harold Halstead. Wall telephone or the like message-recording device. May 22.
12,546. Josef Lindenthaler. Protective cap for telephones. May 24.
12,576. Soc. Des. Etablissements Gaumont. Phonic relays. May 24.
12,730. Harry Grindell Matthews. Telephone instruments. May 26.
12,898. Addis Jerome Dunton. Signalling devices for telephone systems. May 29.
12,907. Charles Henry Pritchard. Telephonic relays. May 29.
13,100. Gustave Schnieder. Devices for the recording and reproduction of telephone communications. May 31.
13,601. Henry Edward Robson Roose and William Templeton Finlay. Intercommunication telephone systems with secrecy. June 7.
13,641. Louis Steinberger. Telephone mouthpieces. June 7.
13,885. Augustus Rosenberg. Means for supporting a telephone receiver or similar instrument in contact with the ear. June 10.
13,887. Edward Alfred Graham. Telephone exchange switchboards and arrangements. June 10.

LONDON NOTES.

THE report of the last whist drive for the season arrived too late for mention in last month's JOURNAL. The South-West district has the honour of being "in at the finish" and making it a successful one. All departments united in the arrangements; there was an attendance of 120, and the prizes were distributed by Miss Deane, Clerk-in-Charge, Kingston. A dance followed.

WITH a view to sampling in advance the fraternisation which is expected after 1911, some of the senior officers in the Metropolitan Traffic Departments of the Post Office and the Company dined together at the Villa-Villa Restaurant on June 7. All the Company's Exchange Managers, with one exception, were present; also Messrs. Deane and Benham, Assistant Traffic Managers; Messrs. Dive, Larkins, Pink, Trayfoot and Webb represented the Department's traffic office, and Mr. White, the "Central" Exchange Manager, officiated as chairman. The arrangements of the tables enabled the men of the two services to be alternated in position, and so facilitated the friendly intercourse which was the object of the gathering. A programme of songs and toasts was gone through, and thoroughly enjoyed. The traffic men now know each other a great deal better than before, and this can only tend to good.

ENCOURAGED by the appearance of the first summer weather in three years, the Dalston operating staff have inaugurated a Ladies' Swimming Club. Club practice, and other natatory diversions and pastimes, will be indulged in every Thursday at the Hackney Baths from 7 p.m. Miss L. Williams, Dalston Exchange, is secretary, and she would be pleased to hear from any operators at other exchanges who may desire to join.

IT is rather a tempting of providence to arrange for a garden party in this country, but on the "never venture, never win" principle, the staff in the South-West district have taken their courage in both hands, and fixed one to be held at "The Firs," Clarence Road, Clapham Park, on Saturday, July 15. The proceedings will commence at 3.30 p.m. Interesting competitions will be held, and there will also be a dance and concert on the lawn. Should wet weather intervene a concert and whist drive will be held in the house. The South-West committee is to be congratulated on its enterprise, which ought to be rewarded by a large muster from all parts of London.

THE first meeting of the new committee of the London Telephone Society was held on the 15th of last month, when the election of officers for sub-committees took place. The results were as follows:—

Papers Committee.—Messrs. L. Harvey Lowe, W. H. France, G. F. Greenham and F. G. Baldwin.

Library Committee.—Messrs. D. Stuart, P. T. Wood, Harvey A. Smith and F. M. Ward.

Finance Committee.—Messrs. L. Harvey Lowe, W. Glenny, G. Goldsmith and Miss Reekie.

Organisation Committee.—Messrs. G. F. Greenham, S. H. Thompson, T. Beck, G. Hay, A. Wright, G. Nicholls, W. Glenny, A. Faulkner, F. G. Baldwin and Harvey A. Smith.

The organisation committee met on June 9 and discussed, amongst other things, the appointment of agents and the selection of a new place in which to hold the society's meetings. It is intended to revert to the old hour (seven o'clock) next session for starting the meetings, and in order to cater for those who cease work at five o'clock, it is proposed to organise a series of demonstrations somewhat on the following lines:—Supposing, for example, the subject chosen for the first night is sub-station equipment—then between five and seven, samples of sub-station apparatus will be on show, and an expert would be present to explain the applications of the various samples and answer questions concerning them. It is thought that such demonstrations will be of considerable interest to the members and have a high educative value. The papers committee are meeting shortly and hope to be able to arrange a strong programme. It may be possible to arrange for one evening to be set aside for a paper from a Post Office engineer, and another evening for a debate on some subject of general interest. The committee will be glad to receive suggestions from members on any points that they consider should receive consideration in connection with next winter's programme. The possibility of holding a *conversazione* at the commencement of the session is also being considered.

THE annual outing of the Metropolitan construction staff took place on May 27. The party, comprising close on 100 members, entrained at Waterloo and arrived at Chertsey without any casualties. An enjoyable afternoon was spent amongst beautiful surroundings. The chief item on the programme was the "tug of war," which the City won by two pulls to none. A number of races were run, but owing to the great heat of the day no records were broken. Many of the party found a quiet pull on the river more to their liking than the more violent sports. An excellent tea was served at the Cricketer's Hotel at five o'clock. After tea, a good portion of the time before the concert began was taken up by the photographers of the staff in arranging and snapping groups. The smoking concert, which was ably presided over by Mr. Greening, the chief of the Western district, was late in beginning, but nevertheless was a great success. The party arrived at Waterloo at 11 p.m., still without casualties.

GLASGOW NOTES.

THE Company's new C.B. exchange which has been built at Clydebank was opened on Saturday, June 3, the transfer of the Company's subscribers being then satisfactorily accomplished. Provision has been made for transferring the Post Office subscribers in the Clydebank district to the new exchange, and the P.O. lines will, it is expected, be taken over at an early date. The board is of a No. 10 pattern and has capacity for 420 subscribers. The arrangement for charging the accumulators in this exchange is by means of a mercury vapour arc rectifier and is one of the largest which has been fitted in any of the Company's exchanges.

ON Saturday afternoon, June 10, the members of the National Telephone Operators' Society and Club, along with friends, held a most enjoyable outing in the form of a picnic. The company of about 120, including the District Manager, journeyed to Row on the Gareloch, where games and sports were engaged in. Refreshments were served in the Row Hall on arrival and again before leaving. The weather was brilliant, and the time for departure arrived all too soon for most of the members of the company.

THE engineering and electrical staffs have been practically "snowed up" with work in consequence of the May term removals. This term has been an exceptionally busy one for us, the number of removals dealt with being far in excess of those for previous years.

THE Bell Golf Club May medal competition was held at Carntyne on Saturday, June 3, with the following result:—Mr. J. H. Murray, 104 − 21 = 83. The June competition was held over the same course on Wednesday, June 14, when Mr. A. S. Duncan, 100 − 26 = 74, was the winner. Other scores were Mr. J. F. Murray, 9 − 821 = 77, and Mr. D. B. Hebenton, 87 − 6 = 81.

WORK in connection with the new Douglas Exchange still proceeds apace. The building externally is complete, and the shops on the ground floor are now occupied. The completion of the equipment is being pushed forward in view of the anticipated transfer during the middle of July.

DOUGLAS Exchange operating staff held their annual cruise on Thursday, June 1, journeying by turbine steamer *Queen Alexandria* to Rothesay Bay. The company, which numbered about 135, left Glasgow by special train to Greenock, and on arrival at the steamer tea was served on board. The cruise was a most enjoyable one.

THE golf match between teams representing the East and West of Scotland which was inaugurated last year was played over the Lanark course on Saturday, May 20. Glorious weather prevailed, and the course was in perfect order. The teams arrived about two o'clock, and after being subjected to the camera commenced to play, with the following results:—

West Side.		*East Side.*	
W. Lowe, Greenock	1	R. Richardson, Dunfermline	0
W. A. Valentine, Glasgow	0	R. Allan, Edinburgh	1
J. MacHale, Hamilton	0	A. Robson, Edinburgh	1
A. Ramsay Lamb, Greenock	1	R. Inglis, Kirkcaldy	0
J. A. Swanson, Greenock	1	J. H. Allan, Edinburgh	0
W. Lang, Glasgow	1	J. Robertson, Edinburgh	0
R. Brough, Glasgow	1	R. C. Wilson, Edinburgh	0
W. Allan, Glasgow	1	A. F. Dunn, Edinburgh	0
T. B. Hebenton, Glasgow	0½	J. Brown, Edinburgh	0½
H. Thomson, Glasgow	0	C. McFarlane, Edinburgh	1
J. F. Murray, Glasgow	1	A. Lumsden, Edinburgh	0
A. C. Thomson, Glasgow	1	W. Chandler, Edinburgh	0
	8½		3½

After the match the players partook of high tea at the Clydesdale Hotel.

WE are looking forward with mingled feelings to the invasion of the Inventory staff, which is expected some time in the beginning of August. What with transfers to new exchanges, depleted staff, Inventory work and the further fact that this is supposed to be the holiday season, there is no danger of the staff suffering from ennui.

CORRESPONDENCE.

PROVINCIAL TELEPHONE TRAFFIC.

TO THE EDITOR OF THE NATIONAL TELEPHONE JOURNAL.

I NOTE Mr. Bristow's criticisms on my paper which appeared in the last issue, and shall be glad if you can grant space for this, but before replying in detail I would like to say that this was an extract from a paper read three year's ago and forwarded to Head Office about two years since, and while some of the remarks applied at that time, they may be a little out of place now; the chief points, however, still hold good.

With regard to the abuse of the observation system; I fail to see how Mr. Bristow makes his point on this, for I have shown clearly where the most has been made of the information obtained, and as no individual has been penalised I fail to see where any abuse has been made.

Speed of Answer.—This and disconnection are two of the most important points, and our attention to these two factors gives us the low rate of 12 per cent. of lost calls; 75 per cent. of lost calls are due to lines engaged, and any fraction of time saved here will reduce these. In March return I noticed Portsmouth had 8·8 per cent. lost calls and Swansea 29·3 per cent. It does not need a mathematician to see where the true economy in this case comes in. I main-

tain that with 29 per cent. of lost calls nearly one-third of the operating of that exchange is wasted. The fact that I have tried to create enthusiasm amongst the staff cannot be termed "abuse," except when viewed from a very narrow-minded standpoint. I would rather try to perform the astronomical feat mentioned than be content to sit with the hind wheels of my wagon in a ditch. By all means let us have something in view. We do not attain our object, but once renounce your aim and you will be on a par with a ship in a heavy sea with the steering gear broken down. Keep up a smart answer and disconnection and the other points necessary to a good service will follow naturally.

My remarks regarding the loads of exchanges apply to that period at which my paper was written.

Mr. Bristow's Remarks on Operators having Cords Ready.—I have had the opinion of many on this point and I am quite willing to follow the lead of an exchange of the size of Gerrard. I do not agree with Mr. Bristow's remarks *re* crossing. Give an operator a multiple repeating every seven panels (and an 11-inch panel at that) and engage all, or nine-tenths of her cords, and then see how many straight connections you have. I know there is a theory extant *re* "Cords in order commencing with No. 1." This theory would be "O.K." if all calls were of the same duration, but you will get crossing whatever happens, and the more extended your multiple the more matted will your cords become during the busy hour.

Re Observation Clerks.—I have had six different men holding this position since I have been in Portsmouth. I do not think they could all have been wrong; one man especially having been selected by Head Office to go to an important centre in the North to run the observation set there. This observation set at Portsmouth, up to two years ago, was controlled entirely by the district manager direct, and the utmost secrecy was exercised in allotting numbers for observation.

Portsmouth, June 13. S. J. PHARO, Traffic Manager.

MATHEMATICS AS AN AMUSEMENT.

BY E. T. PAYNE, *Chief Clerk, Newcastle-on-Tyne.*

(This paper, which has been considerably abridged, was written by Mr. Payne for the Newcastle Telephone Society with the view of interesting members of the non-technical staff in the subject. It has been necessary to omit many interesting problems and their solutions.)

IN selecting the above heading for this paper I was guided by actual experience of the fact that mathematics as a subject for study, perhaps even as a winter pastime, is much more interesting than many imagine.

When I first went in for it, it was with a view to being better able to understand a few electrical books and apparatus that I had on hand. Upon getting a little deeper into the subject, however, I found to my surprise that it altogether belied its reputation for dryness, and quite displaced for the time being my electrical arrangements. The two things are in any case closely related, and a fairly good knowledge of mathematics is necessary before electricity or any other branch of physical science can be satisfactorily tackled.

After having broken the back of this subject, one feels somewhat like a chess player who has studied "chess openings" until he has them more or less at his finger ends and is afterwards enthusiastic for chess converts.

The intention of this paper is to illustrate some advantages of a knowledge of mathematics, and also to show that, when once the preliminary stages are over, the study can almost be regarded as an interesting "hobby" rather than as a branch of "work." Incidentally, while my own experiences are fresh, I propose to give a few general hints, which may or may not be of use to others, and these I will deal with first.

To start with, anyone going in for the Company's classes would find it of distinct advantage to anticipate the subject, if possible, before actually taking up the classes at all. For instance, if any of you are not at present members, there are plenty of cheap books issued that would give such preliminary knowledge. Personally I obtained the Company's own books, "M" and "N" Courses, a year prior to entering the classes. These were got for reference rather than study, but undoubtedly helped to make the actual course taken subsequently more in the nature of pleasure than work. When knowing a bit of the subject beforehand one has a sense of freedom that is lacking when tied down to a certain book in a certain time (three weeks or otherwise).

These small booklets are also very handy for pocket, and therefore useful at odd times, such as in train on way in and out of town, etc. Personally I found that on my way to town, whether owing to motion of train or to time being a.m. rather than p.m., I was able to see through things previously considered difficult more easily than at other times. With some people, however, I believe the reverse applies, so I offer the tip for what it is worth.

Another thing I believe in as regards these or any other books is the advisability of reading them through again and again. From actual experience I found that even when one considers a thing well known, if the subject is read up once more, frequently some fresh fact arises that otherwise would be overlooked. In doing this the examples should, of course, be carefully followed.

One more point of assistance is the advantage to be gained on doubtful questions by a sort of mental argument with oneself, or by an attempt (mentally, of course) to explain to someone else what we don't quite understand ourselves. This is a habit fairly easily acquired, and it is wonderful how it helps actual knowledge. Writing this paper, for instance, has been of use to me in this connection.

The following articles not being in any way intended for actual instruction, are arranged alphabetically rather than in the natural order of subjects, this being more convenient for reference.

I have endeavoured to include as many main branches of mathematics as possible, and also—amusement being one of the objects of the paper—to deal with same from a lighter point of view than perhaps is usual in such a subject.

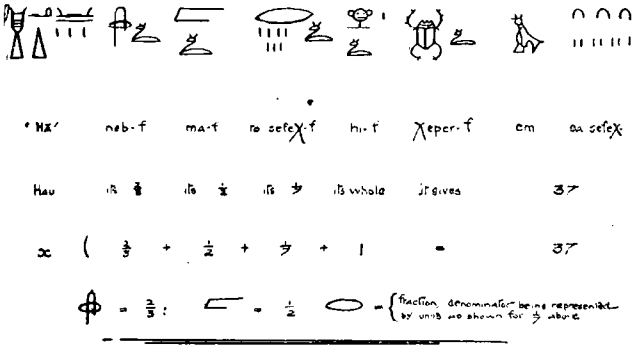


FIG. 1.

Algebra.—This, after the preliminary stages have been got over, is an interesting study, and in any case before mathematics, electricity, or almost any branch of science can be properly studied, a knowledge of algebra is essential.

It is fairly well known, I think, that with its assistance problems can be solved that are almost, and in some cases quite, impossible by arithmetic. It is said, in fact, that a French scientist by means of an algebraic equation proved, at any rate to his own satisfaction, that our souls are real demonstrable facts.

Algebra is known to have been in use when Rome was at the height of its power. It was also used in a very elementary sort of way in the time of the Egyptians, and I give, for your information, an actual specimen of an equation written about 1700 to 2000 B.C. by an Egyptian, Ahmes (Fig. 1).

When this branch of science first came into anything like common use, it was the custom for experts to challenge each other in much the same way as our present-day prize fighters and wrestlers do, and when a meeting took place the points were given to the man who solved most of the other's problems. This was at one time quite a fashionable amusement for mathematicians.

As regards modern times, most of the so-called puzzles, etc., that one meets with from day to day are based on some algebraic principle, the inventors relying on the fact that algebra is still unknown to the majority of people.

If we take up almost any book on algebra we find nearly identical problems but without the picturesque wording generally attached to puzzles, and as we advance in our study of the subject so we find that our ability to solve such problems increases.

Algebra has one almost human peculiarity, that is, if we ask it a question that has no satisfactory solution it will frequently give an answer that on examination is found to be absolutely correct,

provided we alter our problem a bit, so as to make an answer possible. Say the following question is given :—

"A man is 65 years old and his son 25 years at present date. After how many years will the man be three times as old as his son ?"

Working by algebra we get – 5 years, and on examining the question again we find that if the words "After how many years will" are altered to "How many years *back* was" five years is the correct answer, the minus sign in the solution giving the clue to where the problem was faulty.

Arithmetic.—Arithmetic is an important branch of mathematics, as will be seen from dictionary definition of latter, which is, "The service of magnitude and *number* including all their relations."

A good foundation in it is necessary before anyone can hope satisfactorily to take up any subject involving calculations, and this is evidently recognised by the Company in devoting seven out of ten "M" Course papers to arithmetic. Personally, I was much surprised on reading up this subject to find how little I knew compared to what I thought I did.

Perhaps arithmetic, not having the charm of novelty, at any rate in its name, does not appeal to one as an amusement. At the same time, when once the elementary stage is got over, it is very interesting, and if anyone doubts its possibilities, I would recommend them to have a glance at Murray's *Higher Arithmetic*, which is easily obtainable.

That the subject is interesting to many is obvious from the various so-called puzzles that are produced from time to time. These, as with problems in algebra, provide both amusement and instruction. Many of them are based on the rather peculiar fact that our brains do not so readily accept some facts as accurate as others. A similar remark applies to the eyes—hence various optical illusions.

The following examples of facts, not always accepted, may make my meaning clearer:—

(1) That it takes longer to row a certain distance up and down a stream than it does the same distance in still water.

(2) That more energy is necessary to run up and down a hill than to cover the same distance on a level surface.

(3) That it costs more to buy 30 articles at 3 a penny and 30 at 2 a penny than it does to buy 60 at 5 for 2*d*.

(4) That *multiplying* one fraction by another gives a result smaller than either fraction.

(5) That 4 square miles are not the same thing as 4 miles square (difference is 12 square miles).

(6) That a reduction, say, from 100 to 50 is not a *decrease* of 100 per cent., although an advance from 50 to 100 is an *increase* of 100 per cent.

That we don't naturally take to arithmetic is shown by the following old lines:—

"Multiplication is a vexation,
Division is quite as bad;
The golden rule is our stumbling stool,
And Practice drives us mad."

In this respect, however, it is fortunate that we were not in existence in time of ancient Rome. If the reason is not clear, an attempt to multiply, say, 723 × 364 in Roman notation only (DCCXXIII) × (CCCLXIV) will doubtless make it so.

While referring to multiplication, the following may be of interest (Fig. 2):—

The diagram at head is intended to show a method of obtaining product of two large numbers without writing down the usual intervening figures. This ruling is, of course, unnecessary in actual use, the multiplier and multiplicand being put down under each other in the usual way. The form shown applies to four figures multiplied by four figures, but the principle applies to any number of figures, whether higher or lower than this.

The order of the working is shown by the figures appearing in the *centre* of the various lines, and the number of actual operations necessary for each figure in the result, together with the actual figures to be multiplied, by the lines crossing each other at such centre.

Taking 6248 × 2414 for instance, the first operation is obviously 4 × 8 only, carrying 3, and the second as shown by the two dotted lines crossing each other (*e.g.*, 4 × 4 + carried 3 + 8 × 1 mentally), and so on to the end.

With a little practice, this method is accurate and rapid. It is given here, however, more as a matter that may interest than because it is of much importance. For the same reason I give ordinary full multiplication, showing the four lines of figures saved, and also one or two other variations in the way of contracted work on same figures.

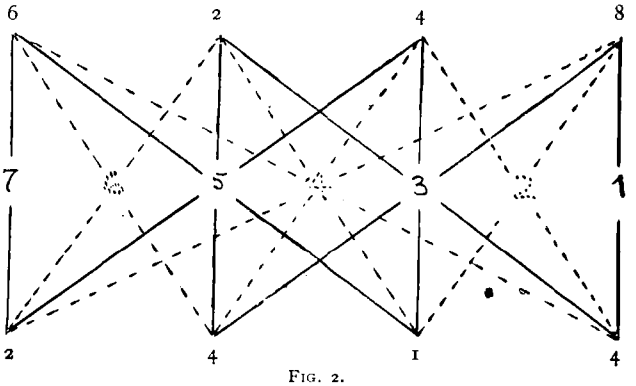


FIG. 2.

```
   6248
   2414
  -----
  15082672
```

```
   6248
   2414
  -----
  24992
   6248
  24992
  12496
  -----
  15082672
```

```
          6248                    6248
          2414                    4142
A =      24992          A =      12496
B =       6248          B =      24992
C = 6A =149952   C = 7A =       87472
         -----                   -----
         15082672                15082672
         =====                   =====

          2414                    2414
          6248                    8426
         -----                   -----
A =      19312          A =      14484
B = 3A = 57936          B =       4828
C = ¼B = 14484   C = 8A =      115872
         -----                   -----
         15082672                15082672
         =====                   =====
```

A curious fact as regards multiplication is that many people cannot see why if 3 ft. × 3 ft. = 9 sq. ft., 3*s*. × 3*s*. should not = 9*s*. This arises owing to words "concrete" and "abstract" not being fully understood. The latter was once defined as "something we can think of but not touch," a boy giving as an example a red-hot poker.

If shillings were square, and regarded as units of area, there would be no reason why, if we multiplied 3*s*. by 3*s*. we should not get 9 square shillings as a correct result, but the fallacy of multiplying money by money generally is evident if we multiply 3*s*. by 2*s*.

and then 10*d.* by 9*d.*; the first gives 6*s.* only, whereas the latter gives 7*s.* 6*d.*, which, as Euclid would put it, is absurd.

Arithmetic has also its humorous side in various anecdotes, catches, etc. Such problems, however, are a bit outside the limits of this paper; I will therefore leave arithmetic and pass on to subjects that may be a little more interesting to you.

Geometry.—This is not usually considered an attractive form of study, the reason perhaps being that rigid logic as represented by the various books of Euclid is remembered from one's schooldays

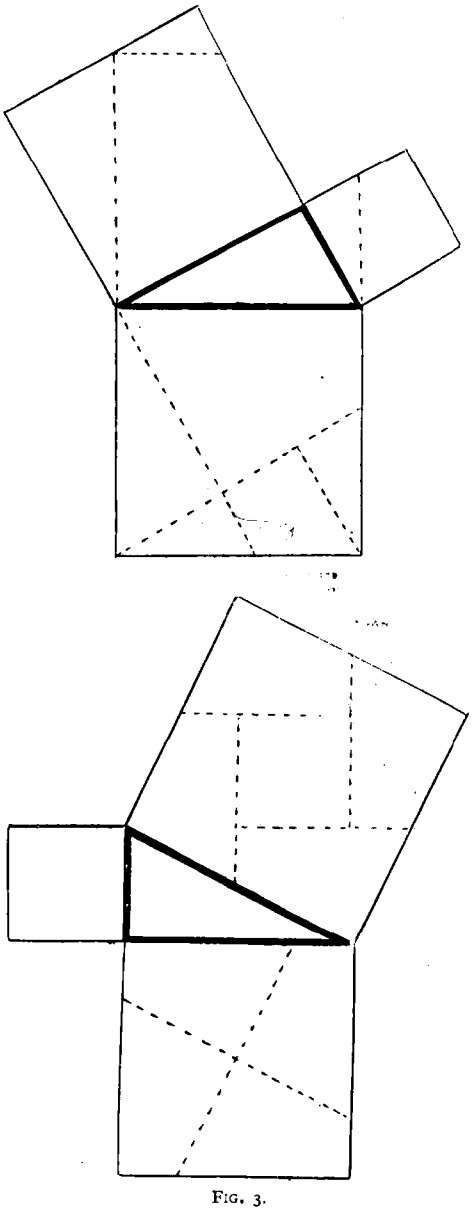


FIG. 3.

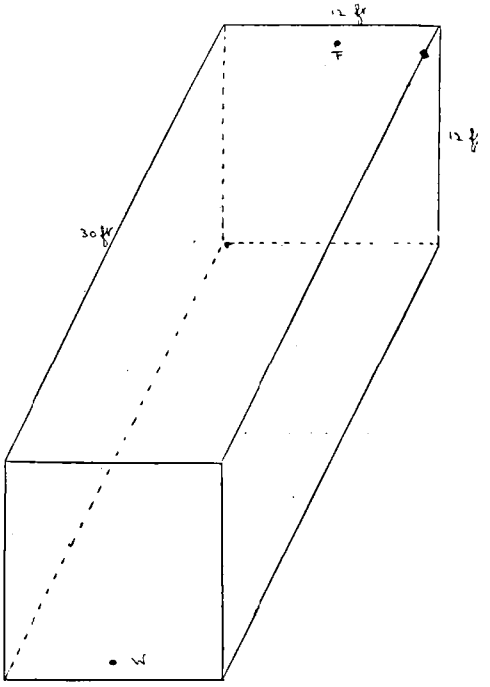
almost with horror. Discarding such experiences, however, geometry, which embraces Euclid, is by no means uninteresting.

Many are forced to learn Euclid at school on the principle, I think, that it trains the mind, but as it is practically never used in ordinary commercial affairs, on leaving school it is promptly forgotten, and might just as well have been left unlearnt, except, of course, in those cases where mathematics generally is a subject taken. As far as this Company's classes are concerned it is, except for occasional reference, almost ignored, both in the elementary and advanced mathematics. This is presumably on the principle that time spent on same might be more advantageously spent on other things, and this appears to be the case. As a book of reference Euclid is very useful, but is not like, say, algebra, essential in its entirety to mathematical knowledge, therefore anyone *starting* on mathematics might well leave it alone *pro tem.*

For above reasons I will not go into geometry in detail. There are, however, one or two interesting things connected with the subject that might not be out of place.

For instance, the following proposition of Euclid, Book 1, No. 47, is very important (especially in mensuration and trigonometry) and should be thoroughly understood by anyone going in for mathematics:—

"In a right-angled triangle the square described on the hypotenuse is equal to the sum of squares described on the other two sides."



F—1 foot from top of wall.
W—1 foot from bottom of wall.

FIG. 4.

As most of you know, the hypotenuse is the side facing the right angle. (A boy with rather hazy ideas once described it thus "a certain thing is given which means, let it be granted that such and such thing is equal to or unequal to something else.")

As the graphic proofs of this proposition may be of interest, I give two specimens (Fig. 3). By taking the large square or two smaller ones, in either diagram, and cutting as per dotted lines, we get sections which will be found to fit exactly the remaining space shown. These proofs will be found to apply to any style of right-angled triangle you can construct.

Geometry is also used for numerous square, cross or other dissection puzzles, and has provided amusement of the sort from very ancient times. Although it is not generally known, Euclid himself issued a set of such problems for the edification of his pupils. These were, however, eventually scattered or lost.

The following is an example of a really classical geometrical problem, although the fact, perhaps, is disguised by its everyday language:—

"In a room 30 ft. × 12 ft. × 12 ft. and on one of the small walls a fly is resting. Its position is on the middle of

Miss LILY M. FOX, Operator, Lowestoft, upon leaving the Company's service to be married, was presented with a tea service and fruit dishes by the Lowestoft and Great Yarmouth staffs as a token of their kindly regard and best wishes for her future happiness.

Mr. JOHN A. SWANSON, Chief Clerk, West of Scotland district, was presented by the staff on the occasion of his marriage with an inlaid chiming clock and inlaid mahogany tray with silver rail.

Miss GRACE MABEL BILLINGTON, School Teacher, Birmingham, resigned the Company's service on June 1 on account of her approaching marriage. She entered the Company's service in 1894, having passed through the service successfully as Operator, Supervisor and Monitor. She was appointed School Teacher in November, 1908, on the opening of the Midland Exchange. Miss Billington by her kindness and tact had endeared herself to every member of the operating staff and she will be greatly missed by many of her colleagues with whom she came in personal contact. The staffs throughout the district united in presenting her with a tea and coffee service, in addition to which she received many presents from various members of the staff, including one from the Provincial Superintendent. Before leaving Miss Billington entertained the Supervising staff to a high tea, and she left with the best wishes of the entire staff for her future happiness.

Miss MARY YULE, Private Branch Exchange Operator at the Clan Line offices, Glasgow, left on June 15 to be married. When leaving she was presented with a French timepiece, a purse of sovereigns, also various gifts from individual members of the staff. She was also the recipient of a honey jar and a few other presents from members of the Argyle Exchange staff.

On the occasion of her marriage Miss MARGARET BLACK, Argyle Exchange, Glasgow, who left the service on June 21, was presented by the staff of her exchange with dinner and tea knives and a case of teaspoons.

Mr. G. H. HATTON, Faultsman, Dover, on the occasion of his recent marriage, was presented with a sheepskin rug and a pair of carvers, subscribed for by the district and local office staff.

Miss LUCY SCOTT, Operator, Honley Exchange, Huddersfield area, has resigned to be married. She has seen seven year's service with the Company, and was greatly respected by all with whom she came in contact.

Miss ELIZABETH HARPER, Chief Operator, Shipley Exchange, Bradford, resigned her position on May 27 in order to be married, and was presented by her staff with a tea service. Miss Harper has had a fairly long service in the Company's employ, which she entered in January, 1896.

Miss MARY ELLEN FRANCIS, Operator, Docks Exchange, Swansea, who resigned the Company's service to be married, was presented, on leaving, with a silver kettle and stand by the Swansea Operating staff, as a mark of esteem.

Mr. W. A. TAYLOR, Senior Clerk, Bath, was presented by the Bath staff with a saddlebag easy chair, and by the Cheltenham staff with an upholstered wicker chair on the occasion of his recent marriage.

Miss BEATRICE CAINE, Operator, Sheffield, resigned on May 25, in view of her approaching marriage. That she had earned the goodwill of her late colleagues was shown by the handsome dinner cruet with which she was presented.

Miss BESSIE FORD, Operator, Exeter, left the Company's service on June 8 after seven and a half years' service. Mr. H. Reid, District Manager (on behalf of the Exeter staff), presented her with a silver-plated cake basket. In making the presentation, Mr. Reid stated Miss Ford had been an efficient operator, and the staff wished her health, happiness and prosperity in her new sphere.

The following members of the London Traffic staff left during the past month to be married, and were presented with gifts from their colleagues as follows:—

Miss HARRIETT HAYWARD, Operator, carvers and biscuit barrel

Miss MAUD CULHAM, Operator, tea service, tea cosies, table centre, ornaments, jam spoon, butter knife.

Miss ROSA STONE, Clerk, cutlery, salad bowl, fruit bowl, rose bowl, vase, doyleys, pickle jar, bread fork, two jam spoons, two sugar sifters, cushion covers, also kitchen utensils.

Miss MABEL SAMPSON, who also left during the month of June, was presented with an attaché bag.

Miss ROSIE SMITH, Operator, Bromley Exchange, on resigning to be married, was presented with an electro-plated coffee percolator and bread fork by the operating, engineering and maintenance staffs.

Miss MARGARET ADAMS, Operator (late Clerk), North Exchange, on resigning to be married, was presented by the staff with a brass spirit kettle.

OBITUARY.

It is with sincere regret that we record the death of Mr. T. A. CROWTHER, Chief Clerk Leeds district, which took place on May 30, after a prolonged illness. Mr. Crowther entered the company's service as office boy in 1888, and was appointed Chief Clerk in 1896. He leaves a widow and one child.

The funeral took place on June 1 at Lawnswood Cemetery, Leeds, and the Company were represented by the following:—Colonel J. C. Chambers, Provincial Superintendent; E. J. Gillett, Engineer; W. R. Senior, Contract Manager; T. Robinson, Provincial Superintendent's office; B. Robinson, Cost Clerk; J. E. Jenkins, Cashier; W. Grierson, Collector.

Floral tributes were sent by all grades of the staff, testifying to the respect in which Mr. Crowther was held.

We have to announce the death of Commissionaire SLATER, of Bradford, which took place on June 14 after a comparatively short illness. He was one of the attendants at the Hustlergate call office, and entered the Company's service in July, 1905. He had previously served in the 24th South Wales Borderers for 21 years, and had been through the campaigns of South Africa in 1879 and Egypt 1882 and 1884. The deceased was of a genial temperament, and his demise is regretted.

WE regret also to announce the death of Mr. ALBERT H. T. BRATTON, Storekeeper, Wolverhampton, on June 9. He was only married on the 4th and passed away suddenly while on his annual holiday. He was buried at the General Cemetery, Wolverhampton, and his funeral was attended by the District Manager, Mr. Archer Smith, and by Messrs. Kay, Lloyd, Shillito and Nock, as representing the different departments. Two handsome wreaths were subscribed for by the clerical, operating and contract and local office, electrical and construction staffs.

STAFF GATHERINGS AND SPORTS.

Hamilton.—A most successful and enjoyable picnic was held on June 10, when about 70 members of the Mid-Lanark staff and their friends drove by way of the beautiful fruit-growing district of Clydeside to Tillietudlem Castle. After an excellent tea had been partaken of in the Nethanbank Temperance Hotel, Crossford, the party proceeded to the castle, where various games were heartily engaged in, and a photograph of the party was taken. Mr. J. T. Whitelaw, District Manager, presented handsome prizes to the successful competitors, and some mock medals and sham prizes to the tug-of-war teams created much merriment. Altogether a delightful day was spent, the weather being excellent, and the drive through the picturesque district was much appreciated.

Norwich.—On May 27 an outing was arranged by the Norwich staff, augmented by a number of the "E" division, Inventory staff, working in the district at that time. The party travelled by train to Wroxham, and thence by motor launch to Horning "Swan," a tour being made on the Broads. Mr. Stevens (District Manager) presided at tea, and in a short speech welcomed the Inventory staff to the district, and wished them every success. Mr. Squire, on behalf of the Inventory staff, suitably responded. The return journey was commenced at 7 p.m., and Norwich reached in due course. Being favoured with ideal weather conditions, the trip proved a delightful one and was greatly enjoyed by all.

Sheffield.—The social club had an outing on June 17 to Cleethorpes. About 50 members took this opportunity to spend a splendid half-day by the sea. As was the case last year, this excursion turned out to be one of the most enjoyable outings of the season. The time was spent on the sands, and full advantage was taken of the numerous amusements to be found there.

The photographic club held its second ramble to Little Matlock on June 3. It is gratifying to note that the ramble (which was made under much more favourable climatic conditions than the first) was better attended and, needless to say, thoroughly enjoyed by all. Several good photographs were obtained by ambitious amateurs.

LOCAL TELEPHONE SOCIETIES.

Bradford.—There was a very good attendance at the annual general meeting of the above on May 30, when the report and balance sheet were presented. The secretary reported a balance in hand of £6 11s. 3½d., and it was decided that during the early summer an educative trip to the new City Exchange, Manchester, be organised.

The election of officers for the ensuing session resulted as follows:—Hon. president, Mr. J. C. Chambers; president, Mr. H. B. Sutcliffe; vice-presidents, Messrs. T. W. Jowett and C. Wood; committee, Messrs. J. Aked, F. Bastow, A. May, H. Poole and J. C. Walker; hon. secretary and treasurer, Mr. H. Shaw.

North Midland.—The last meeting of the session was held at Walsall, when three papers were read by Messrs. F. Adcock, E. Clissold and H. Kendrick on "P.O. Calling and Clearing," "Line Maintenance," and "Primary Battery." The papers were fully appreciated by those present, and at the end of each paper the usual discussion took place. The chair was occupied by Mr. Dalton, Local Manager of Walsall. The committee of the society have decided that the annual prize given by the District Manager for the best paper read by a member of the local staff should be awarded to Mr. W. Bentley for his paper on "Curve Plotting and the Slide Rule."

Southampton Operators.—At the meeting held on March 28 the subjects discussed were "Ticket Recording" and "Night Operating," the papers being given by Miss Harper, Bournemouth Clerk-in-Charge, and Mr. A. W. Wilson, Southampton Senior Night Operator. Miss Harper's paper covered many interesting points and suggestions and evoked an animated discussion. Mr. Wilson's paper effectively covered the duties of a night operator and was presented with a dry humour to an appreciative audience numbering 65 per cent. of the total membership, Mr. F. W. Richards, Chief Clerk, presiding.

The last meeting of the session was reserved for a paper by Mr. F. Quinn, Acting Local Manager, Southampton, the subject being "The Common Battery System." Mr. Quinn's paper gave evidence of careful preparation and, being supplemented by a series of lantern slides bearing on the subject, was thoroughly instructive. At the close of the meeting the chairman, Mr. Howe, District Manager, briefly reviewed the work of the session, paying a special tribute to Mr. S. O. Allen, Traffic Manager, to Miss B. Hoare, Clerk-in-Charge, and to the popular secretary, Miss Q. Smith, to whose joint efforts the success of the society was largely due. Mr. F. W. George, Contract Manager, endorsed the chairman's remarks on behalf of the visitors who had been accorded the privilege of attending the meetings, and the first session closed with a bright outlook for the next winter session, for which an ambitious programme has been arranged.

Hastings and Eastbourne.—A meeting was held at Eastbourne on May 25, when Mr. N. C. Bilton, of Eastbourne, gave a paper entitled "Ringing and Signals." Mr. P. A. J. Barker occupied the chair. The paper was a very interesting one, and at the end a general discussion took place on the points raised.

The Electrical Press, Ltd., has now published in volume form the admirable series of articles contributed by Mr. Herbert Laws Webb to "Electrical Industries" on "The Development of the Telephone in Europe." There is no other volume giving a clear and accurate survey of telephone progress in different countries. Upon that survey Mr. Laws Webb builds a strong case against the policy of State monopoly to which this country is for the time being committed. The volume is full of interesting information, lucidly stated in a most readable style. It bears a characteristic introduction by Mr. Harold Cox, who indicates the grave dangers of telephone retrogression under Post Office ownership. It is published at one shilling net, and may be ordered at any booksellers or from the publishers direct at 1/3 net, post free.

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