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L. A. BERTHON.

TELEPHONIC CIRCUIT AND APPARATUS.

No. 311,944. Patented Feb. 10, 1885.

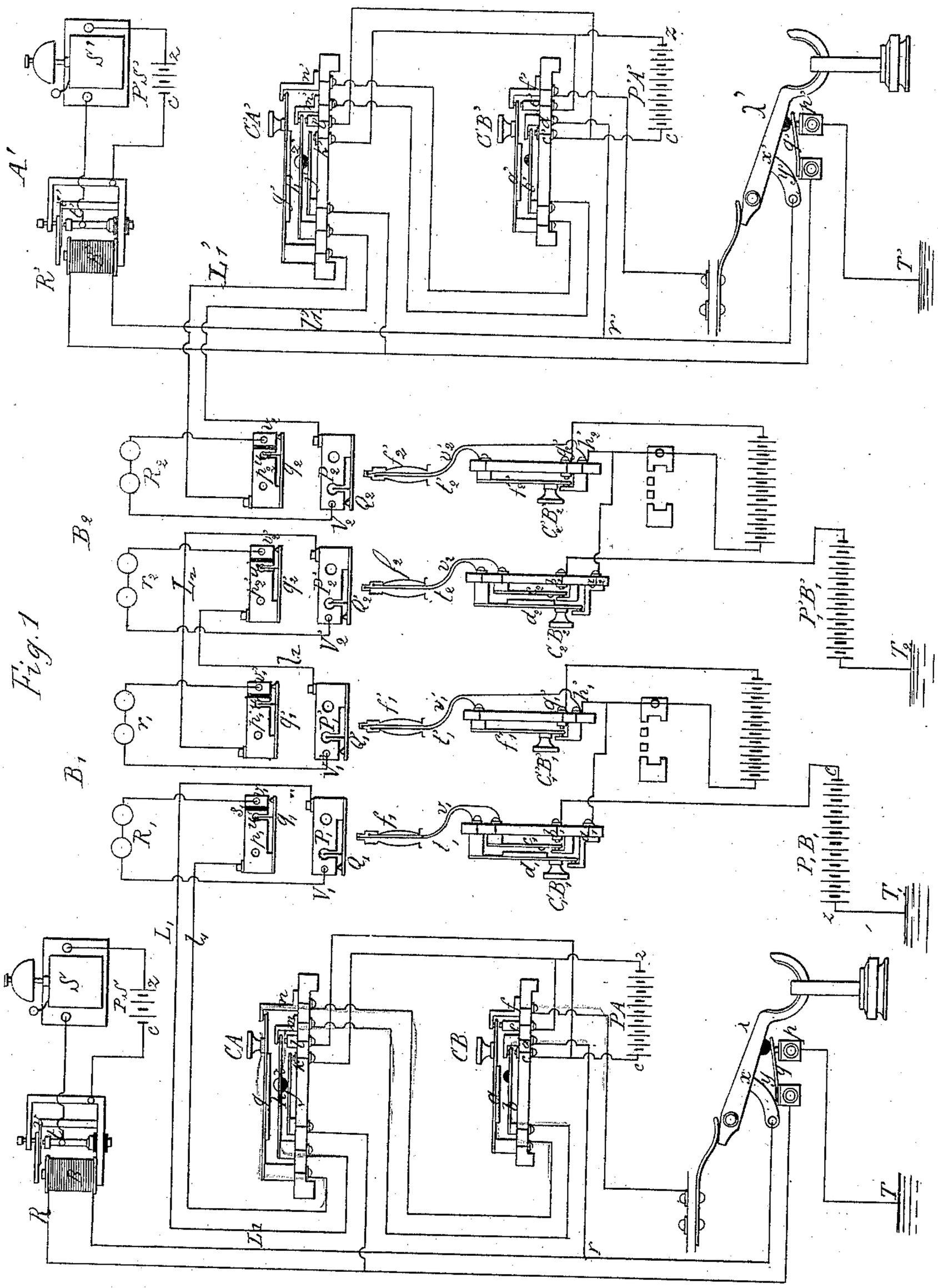

Fig. 1

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Fig. 2

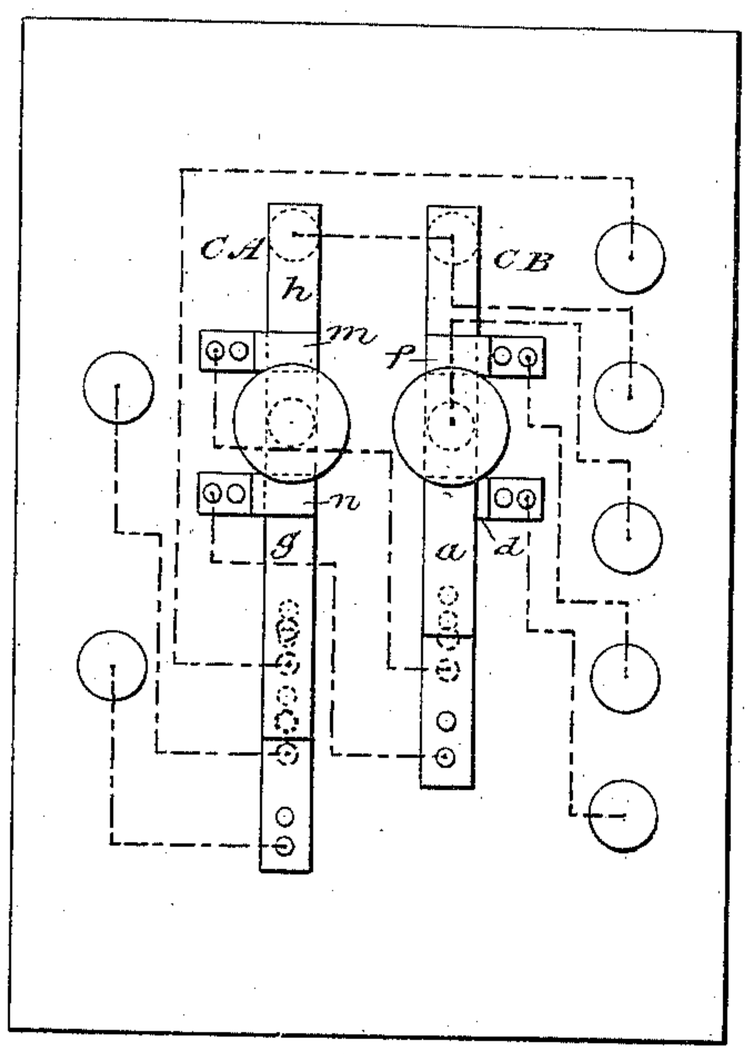


Fig. 3

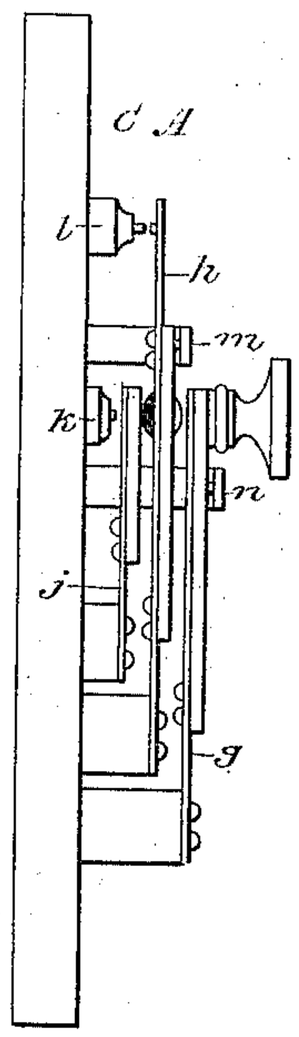


Fig. 4

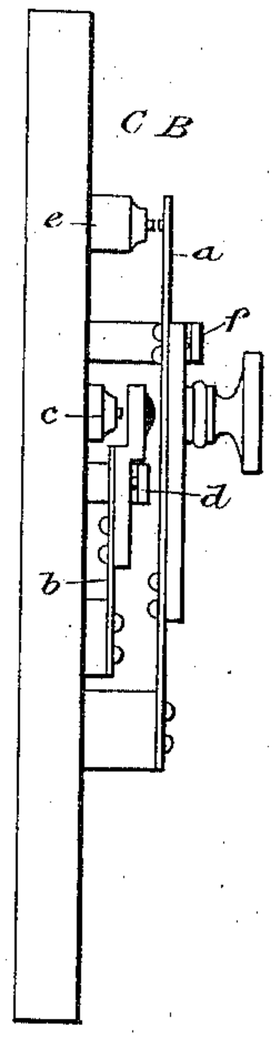


Fig. 5

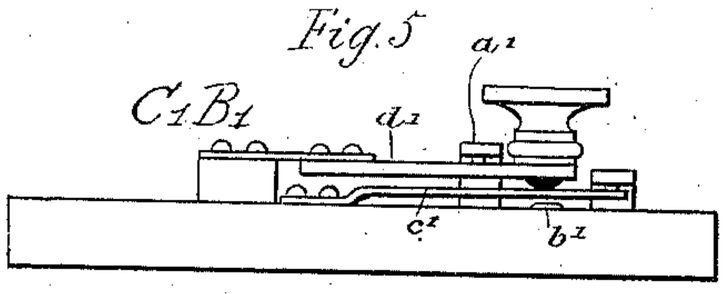


Fig. 7

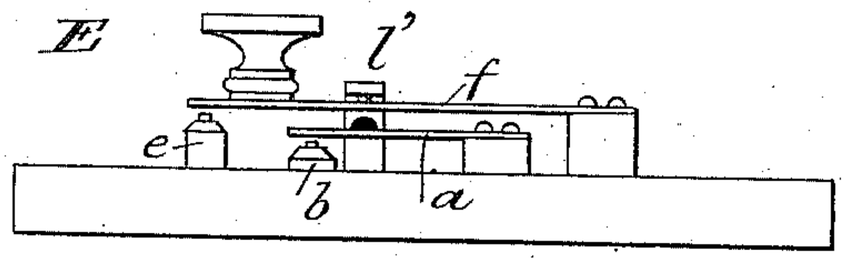


Fig. 6

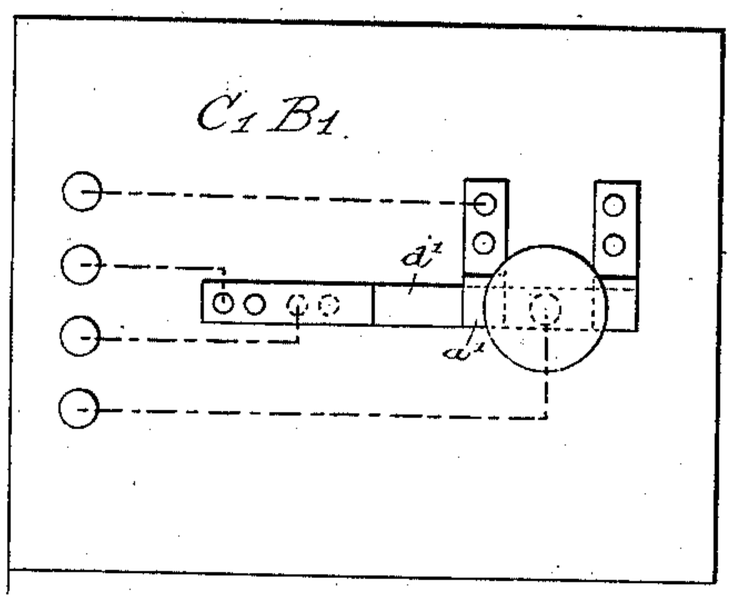
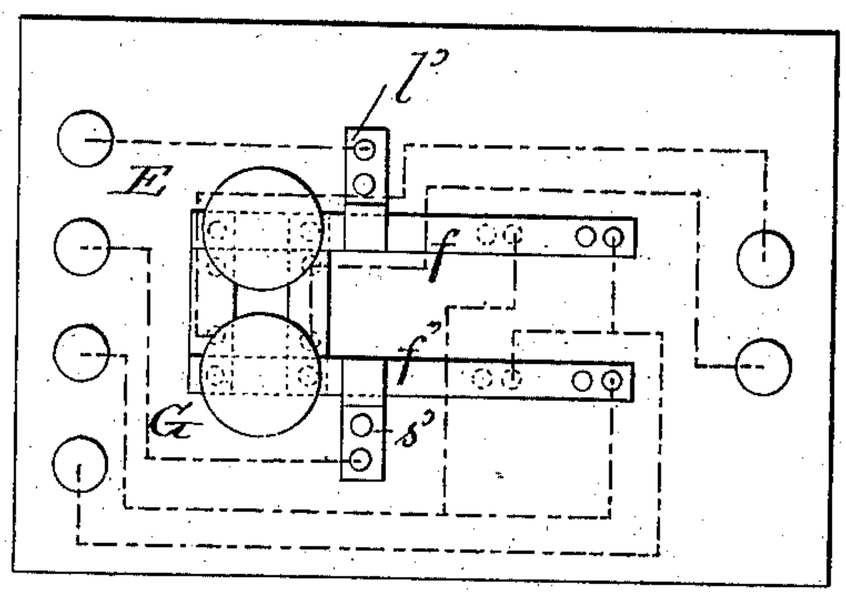


Fig. 8.



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L. A. BERTHON.

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Fig. 10

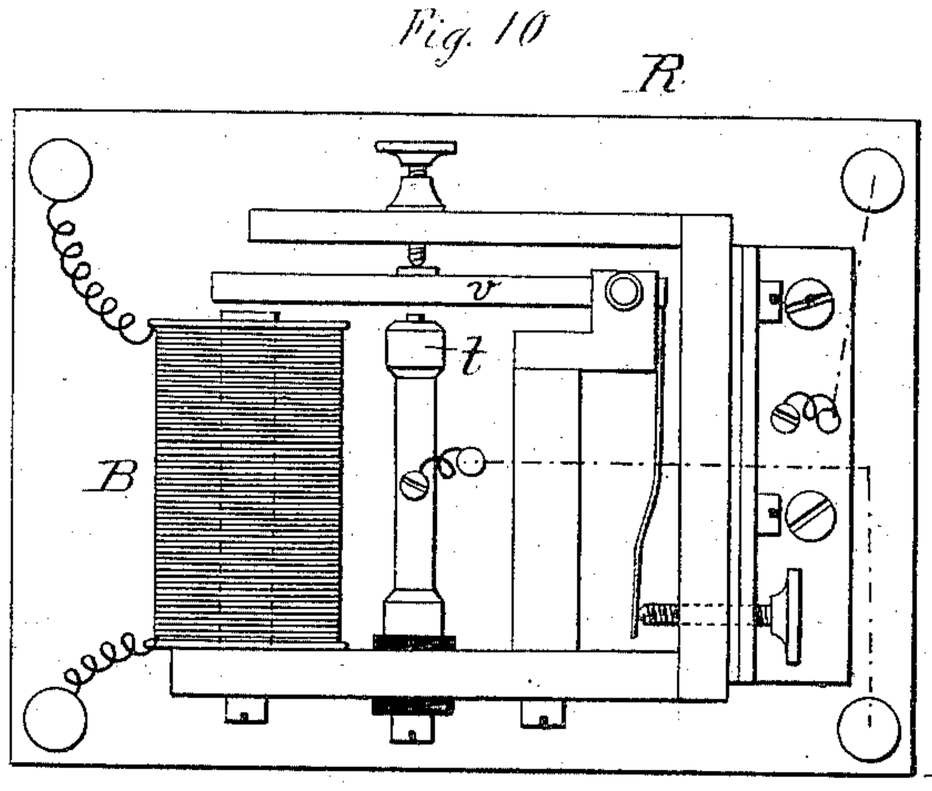
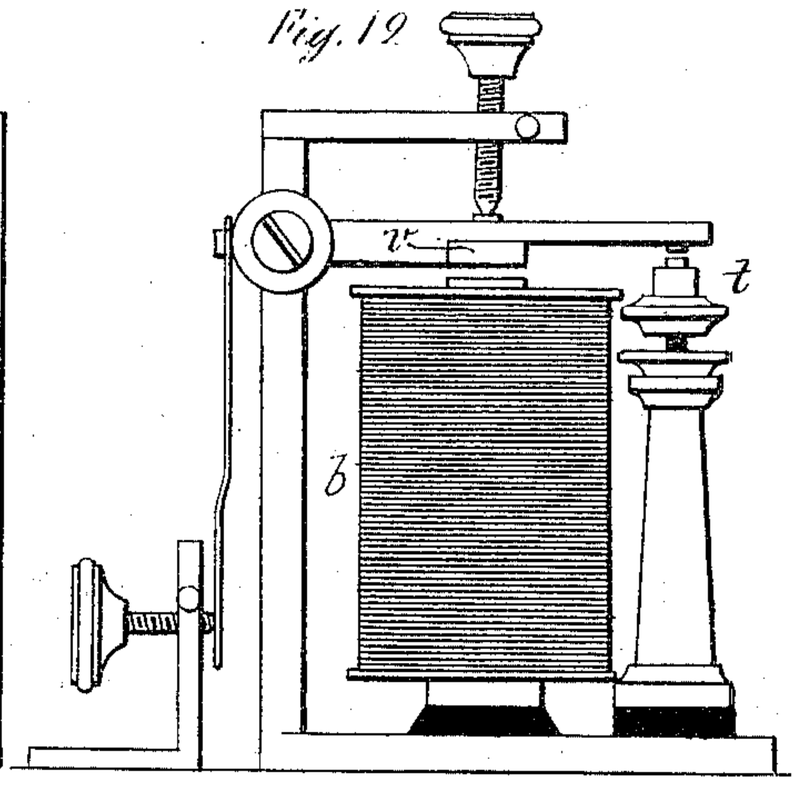


Fig. 9

Fig. 12



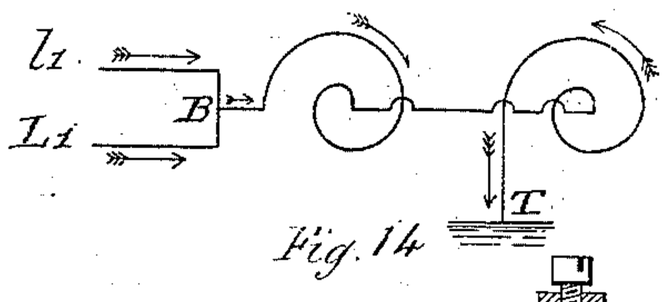


Fig. 14

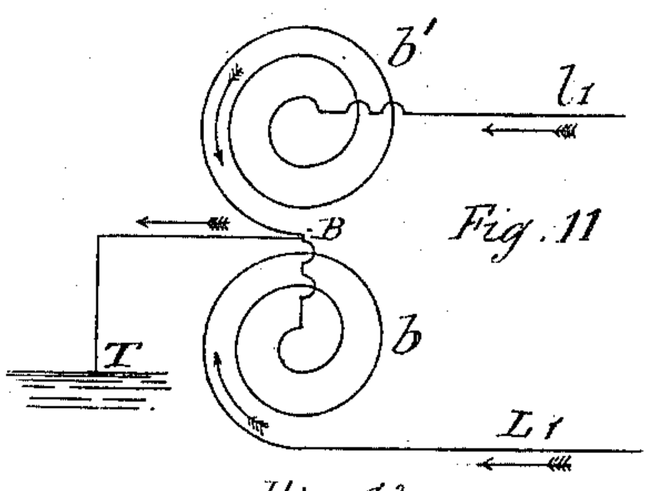


Fig. 11

Fig. 13

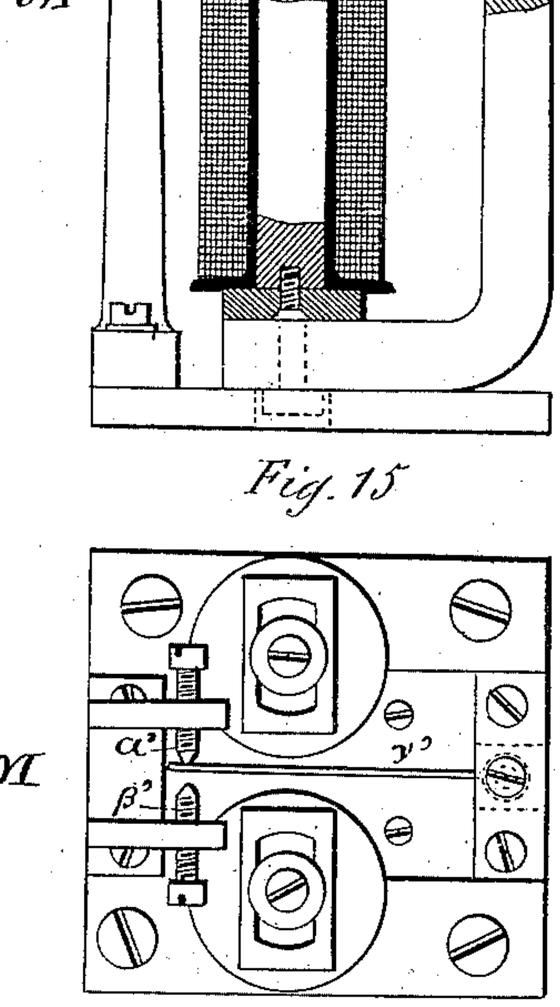
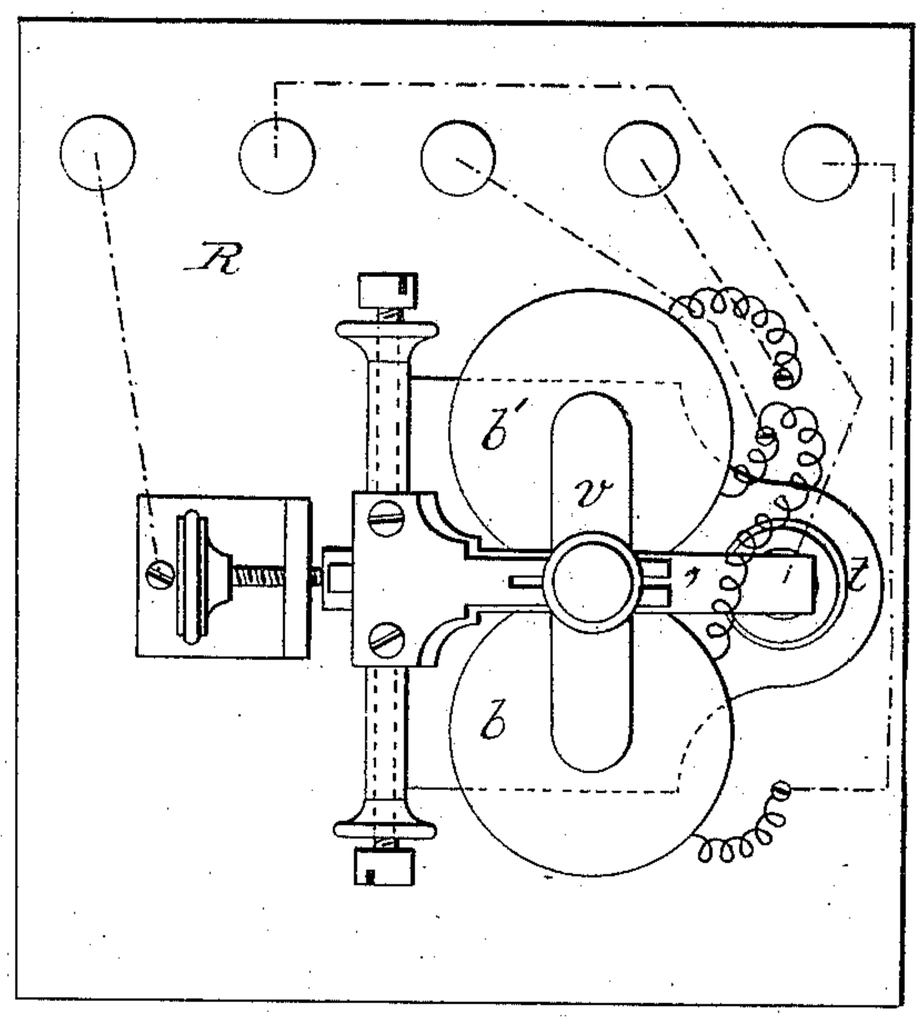


Fig. 15



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L. A. BERTHON.

TELEPHONIC CIRCUIT AND APPARATUS.

No. 311,944. Patented Feb. 10, 1885.

Fig. 17

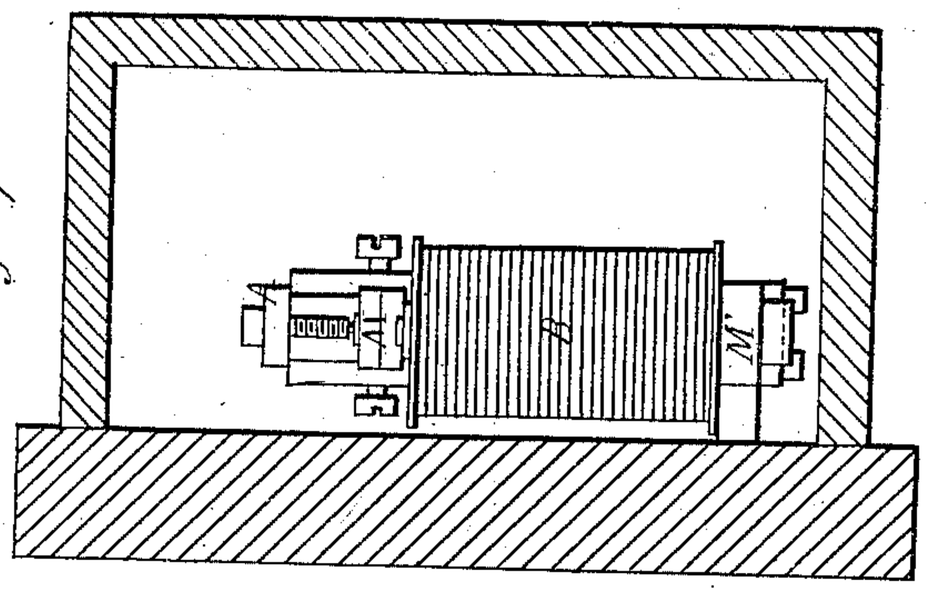


Fig. 19

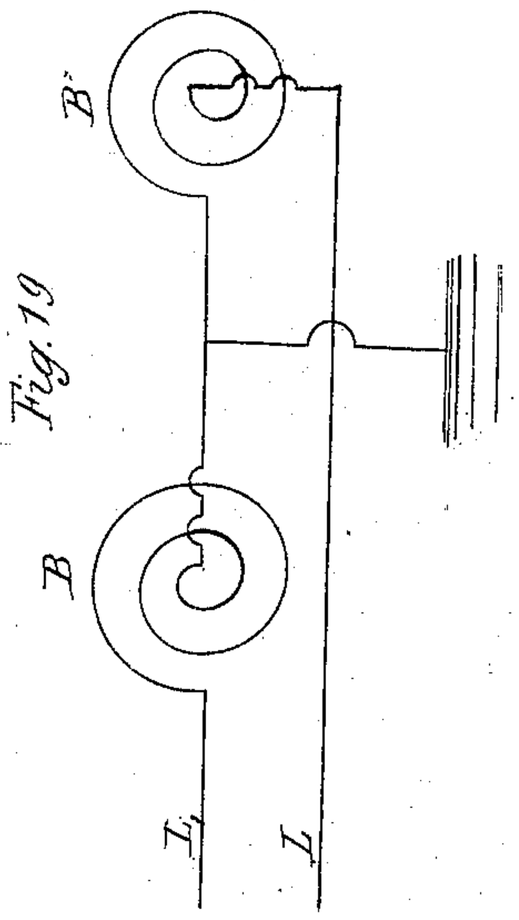


Fig. 16

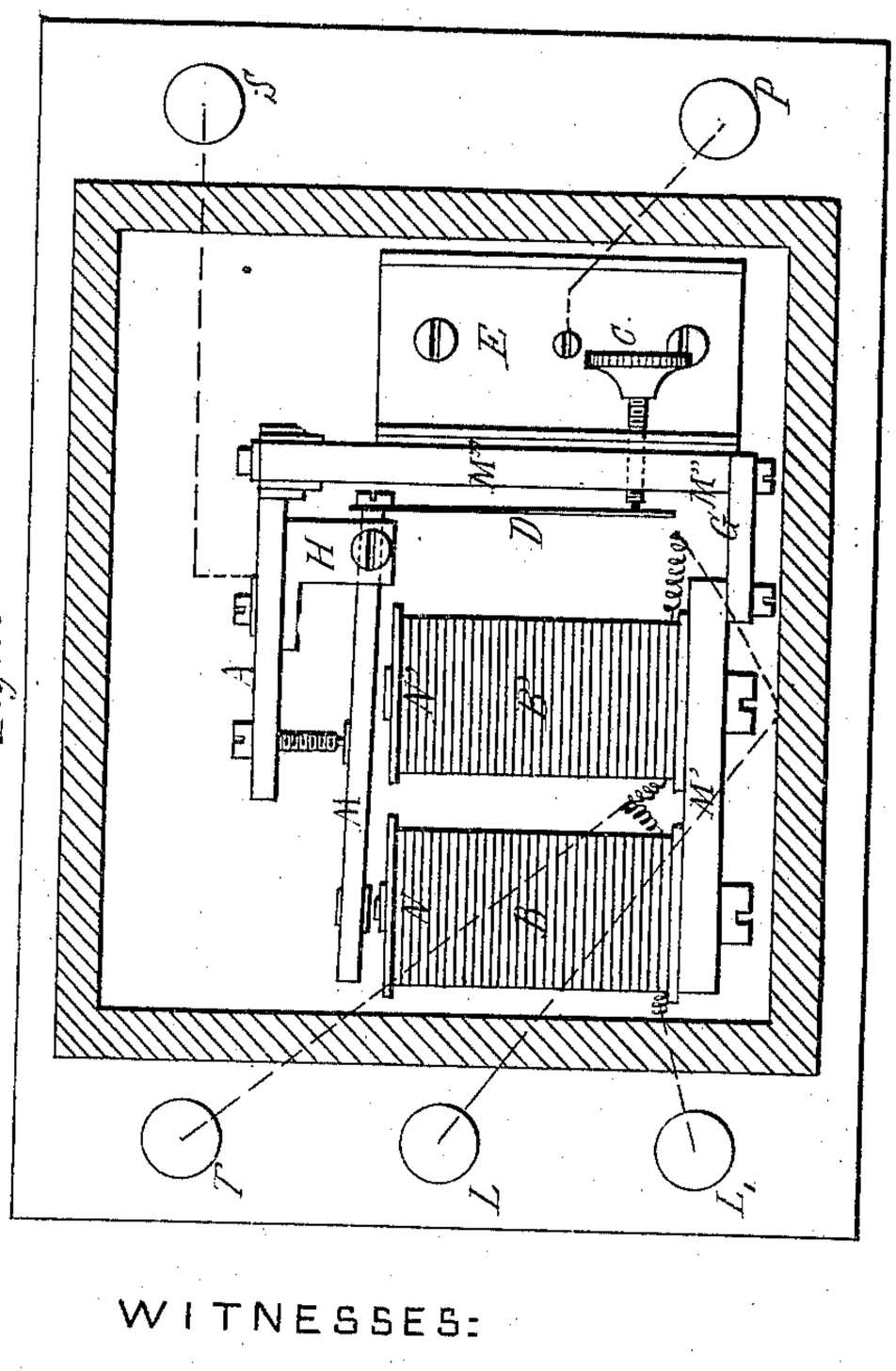
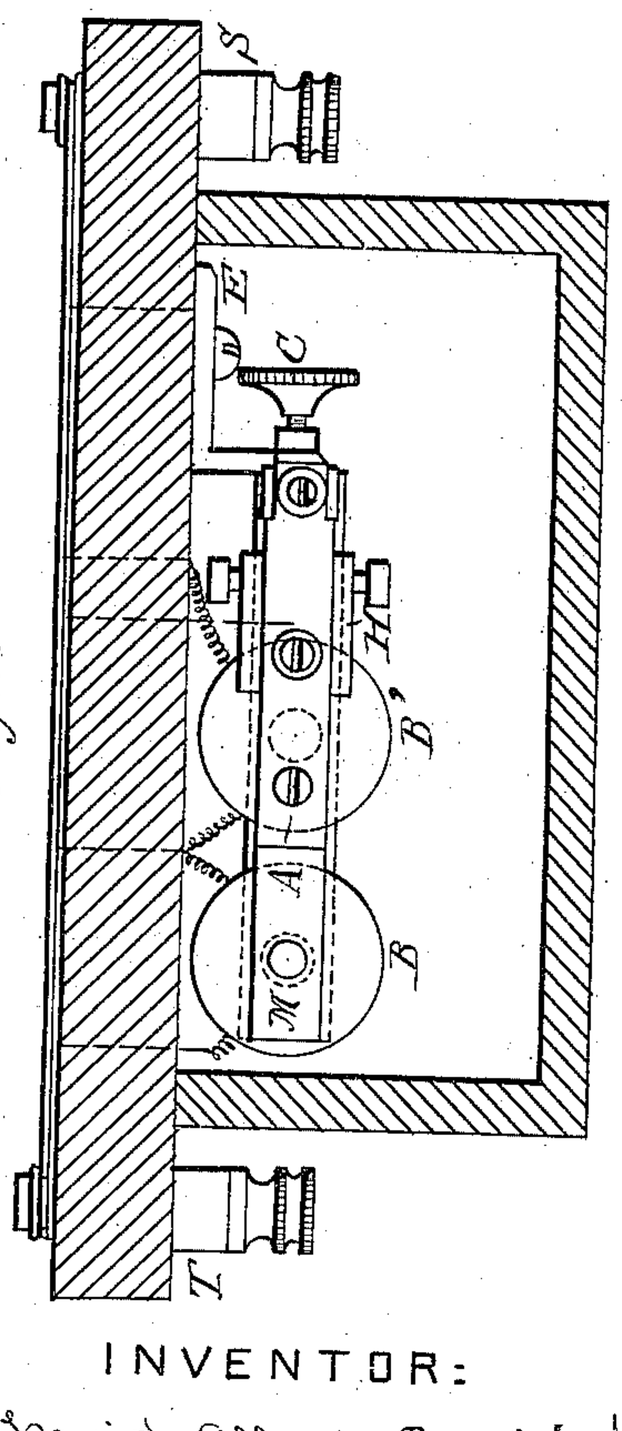


Fig. 18



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(No Model.)

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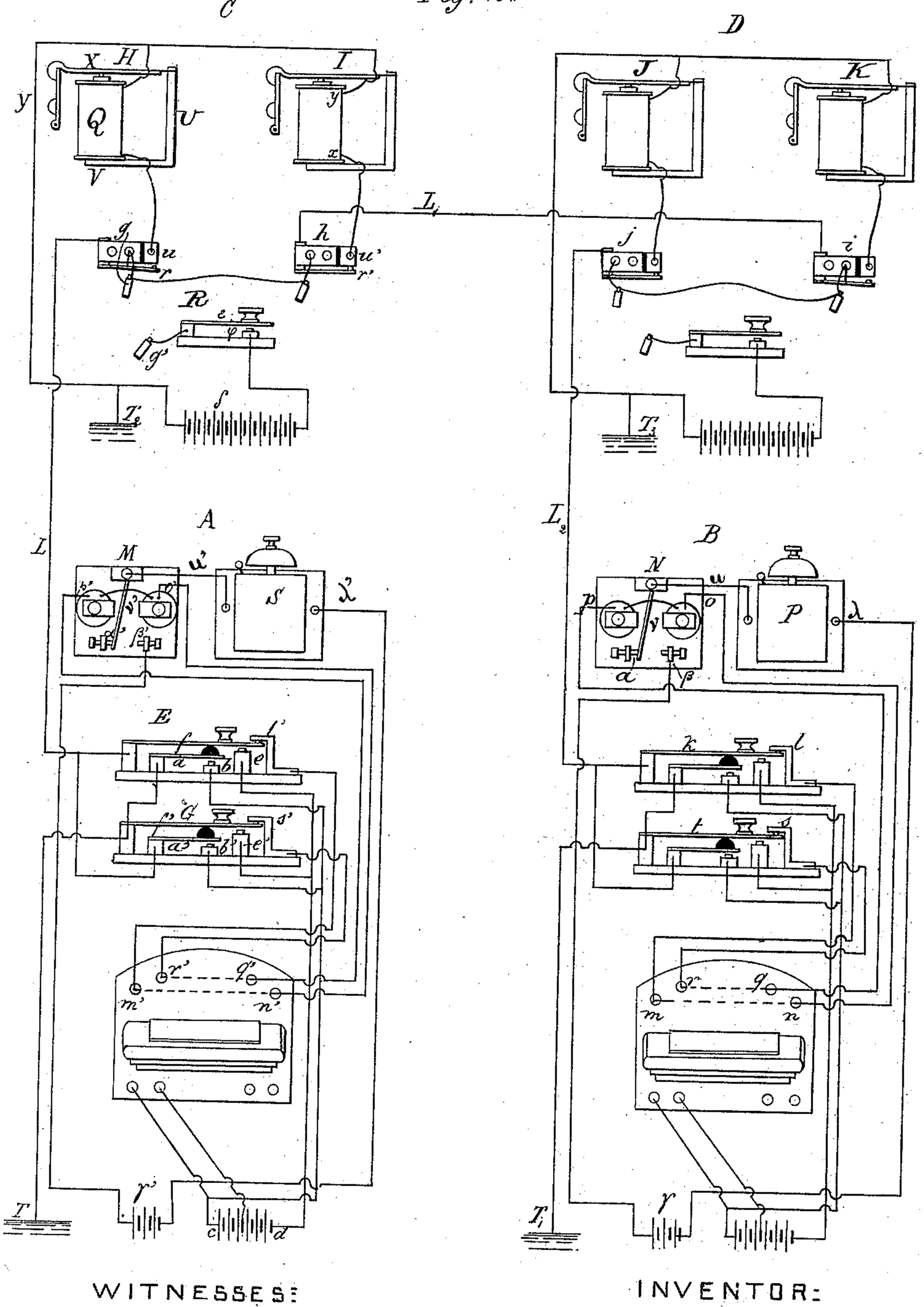
L. A. BERTHON.

TELEPHONIC CIRCUIT AND APPARATUS.

No. 311,944. Patented Feb. 10, 1885.

Fig. 20.



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UNITED STATES PATENT OFFICE.

LOUIS ALFRED BERTHON, OF PARIS, FRANCE, ASSIGNOR TO THE SOCIÉTÉ GÉNÉRALE DES TÉLÉPHONES, OF SAME PLACE.

TELEPHONIC CIRCUIT AND APPARATUS.

SPECIFICATION forming part of Letters Patent No. 311,944, dated February 10, 1885.

Application filed October 16, 1884. (No model.) Patented in France February 28, 1883, No. 154,019; in Belgium April 5, 1884, No. 64,751; in England April 5, 1884, No. 6,013, and in Italy May 28, 1884, No. 16,849.

To all whom it may concern:

Be it known that I, LOUIS ALFRED BERTHON, a citizen of the French Republic, and a resident of Paris, France, have invented certain Improvements in Telephonic Circuits and Apparatus, of which the following is a specification.

I have been granted Letters Patent for this invention in the following countries: France, February 28, 1883, No. 154,019; Belgium, April 5, 1884, No. 64,751; England, April 5, 1884, No. 6,013, and Italy, May 28, 1884, No. 16,849.

The object of my invention is to enable two subscribers of the same telephonic system (where their lines are once connected by the intermediary of one or more central offices) to call up each other by a bell, with the aid of a special key, without deranging their own apparatuses or those of the intermediate central offices; hence the name of "direct call" which I have applied to this system. Inversely, any subscriber whatever may, with the aid of another key, call up the central office without actuating the bell of the subscriber with which he has been in communication. Thus it will be seen that my system permits of both the direct call and the simple or office call. In order to realize these results—namely, the double call—I place at the station of each subscriber two keys, which permit him to send the current of the call-battery in two different ways on the line in such a manner that one actuates either the call indicators or annunciators at the central offices or the bell of one or the other subscriber.

Before proceeding to describe my invention further, I will say that in the annexed drawings, which illustrate it, Figure 1 is a diagram showing the whole arrangement of circuits and apparatuses, including stations of two subscribers and two intermediate central offices. Fig. 2 is a plan view showing the key for the direct call and the key for the "office call" mounted on one base. Fig. 3 is a side elevation of the first-named key, and Fig. 4 is a side elevation of the last-named key. Figs. 5 and 6 are respectively an elevation and plan of the key used in the central office to call subscribers furnished with the direct call. Figs. 7 and 8 are respectively an elevation and plan of the key employed by the subscriber to reverse the current when polarized apparatus is used, as will be described. Fig. 9 is a diagram illustrating the manner of winding the bobbin-wires of the subscriber's relay, and Fig. 10 shows this relay in elevation. Fig. 11 is a diagram illustrating another method of winding the bobbins of the relay. Fig. 12 is an elevation, and Fig. 13 a plan, of this type of relay. Figs. 14 and 15 are respectively a section and plan of the polarized relay of the subscriber, which will be hereinafter described. Figs. 16 and 17 are elevations, and Fig. 18 is a plan, of one form or type of relay; and Fig. 19 is a diagram showing the method of winding the bobbin-wires and arranging the connections. This relay will be fully described hereinafter. Fig. 20 is a diagram showing the arrangement of the circuits and apparatuses when polarized apparatuses are employed.

Referring now to Fig. 1, which shows the apparatuses at the stations of two subscribers, A and A′, and at two intermediate central offices, B′ and B², and the connecting-circuits, I will proceed to describe in detail the various arrangements and operations of the parts employed in effecting the several objects of my invention.

I. *Direct call on double-wire lines.*—We will consider in turn the several cases that present themselves.

1. *Simple call of office* B′ *by subscriber* A.—The movement of the current is as follows: By pressing on office-call key C B, the current from battery P A departs by copper pole *c*, traverses key C B at contacts *c b*, traverses key C A by way of the contacts *m h*, reaches the central office B′ by line-wire L′, arriving at the front plate, P′, of the jack, traverses the relay R′, which is actuated, closing a bell-circuit. The operator is thus advised that subscriber A requests communication. The current leaves relay R′, comes to the back plate, *p′*, of the jack by the movable

contact v' q', reaches the line-wire l', comes to the station A, traverses key C A by way of g n and the key C B (on which one has pressed) by a e, and from thence it reaches the zinc pole z of battery P A, thus completing the circuit.

2. *Call of subscriber* A *by the office* B'.—Put the copper pole c of the battery P' B' (of which zinc pole z is always connected with earth) in communication with the two line-wires l' L' by pressing on key C' B', and by introducing the pin f' into the right-hand hole of the jack P' p' of subscriber A, so as to send the current from battery P' B' into relay R of bell S at the station of the subscriber A, then to earth T. There are two manipulations to make:

(a) Introduce pin f' into the right-hand hole in jack P' p', at which are attached the two line-wires L' and l' of subscriber A, so as to put in communication the two wires t' and v' of the flexible cord with the two plates P' p' as well as with the line-wires L' l'. In order to render the diagram more clear, I have represented the two plates of the jack arranged one above the other; but in reality they are superposed and insulated from each other. The introduction of the pin, as described, has the further effect of lowering the stud u' of plate q', which are in one piece, so as to break the contact v' q', and prevent a derived current from traversing relay R'.

(b) On pressing key C' B', the pin f' being in place in the right-hand hole of the jack, the current circulates as follows: from earth T' to zinc pole z of the battery P' B', through this battery to key C' B', and from block b' through spring-plates c' and d' of the key C' B'. The current now travels parallel in the two wires t' v', and reaches line-wires l' and L' by way of the jack P' p'. We will now follow, first, the current on line L', and then on line l' up to the point r, where we will find that the two currents, moving in the same direction, come together again. On the line L' the current passes from spring-plate h (of key C A) at the bridge m, from spring-plate b (of key C B) at the bridge d, and from thence to r. On the line l' the current traverses the key C A from g to n, and the key C B from a to f, passes from x to y, and attains the junction r. From r the whole current passes into the relay R, and reaches the earth T by the intermediary of contact q p, which contact is effected only when the lever λ is depressed, as shown in the drawings, by hanging the telephone on its hooked end. The current, leaving the earth T' at the central office B', arrives at the earth T at station of subscriber A, and thus completes the circuit, traversing the relay R, which it actuates. The armature v of relay R, in touching the contact t, closes the local circuit t v, P S, S of bell S of the subscriber A, who thus receives a call.

3. *Call of central office* B^2 *by central office* B'.—Introduce pin f'' into jack p'' P'', and press a key, C'' B'', to send on a complete metallic circuit the current from the battery P'' B'' into relay r^2 at central office B^2. Otherwise this call is not peculiar to my system.

4. *Direct call between subscribers.*—In order to make this call, the subscriber—A, for example—must request the two intermediate central offices, B' and B^2, to connect his two wires with those of the subscriber, A', he wishes to call. To do this the operator at B' must connect the lines L' and L^2 on the one hand and the lines l' and l^2 on the other hand by a flexible connector provided with pins similar to f'. At the office B^2 the operator must connect lines L^2 L'' and l^2 l'' in the same manner. The relays R' and r^2 must be cut out of the circuit, and the relays R^2 and r' left in derivation, in order that subscriber A, by pressing in key C B, can call B'; also subscriber A' can call A. The communications being thus established, in order that A' may be called by A, it is sufficient for A to press on key C A to put the zinc pole z of battery P A to earth T, and to unite the line-wires L' and l' in such a way that if these two line-wires have the same resistance the difference of potential is null at the central offices B' and B^2, at the points of attachment V^2 and v^2 and V'' and v'' of each of the relays R^2 and r' left in derivation, and which, therefore, will not be actuated by the passage of the current thus sent, while the relay R' at station A' will be actuated and the local circuit of bell S' be closed.

Movement of the current.—When the key C A is pressed at station A, the current leaves the copper pole of battery P A, enters the key C A at l, passes thence by spring-plates h and g, through which it gains the lines L' and l'. The double current traverses office B' by means of the flexible connector which connects plates p' p'' and P' P'' of the two jacks. From thence it gains lines L^2 l^2, traverses office B^2 the same as office B', and we have seen that it cannot actuate the relays r' and R^2 left in derivation. The current arrives at station A' by way of the two line-wires L'' and l''. We will now follow the current on each of the two line-wires L'' and l'' up to their junction at r'. For line L'': spring-plate g', bridge n', thence through key C' B' by way of spring-plate a' and bridge f', through contact x' y', and thence to r'. The wire l'' arrives at key C' A' by way of spring-plate h', passes to bridge m', traverses key C' B' by spring-plate b' and bridge d', and thus gains the point at junction r' with L''. From r' the whole current reaches the relay R', which it traverses and actuates. The armature v' of this relay, in contacting with t', puts the bell S' in circuit with the battery P' S', the bell is sounded, and subscriber A' is called. In passing out of relay R' the current reaches earth T' by way of contact q' p'. Now, the zinc pole z of battery P A is also connected with earth, because by pressing on key C A the block k is put in con-

tact with spring-plate *j*, which is connected to earth T by way of contacts *p q*.

Note.—It is evident that if the two subscribers A and A′ were put in communication by the intermediary of only one central office B′ the effect and result would be the same. In the call of subscriber A′ by subscriber A there would simply be one manipulation less—namely, the call of office B^2 by office B′.

I will now describe the special apparatus employed in my system just described. This is of two kinds—namely, the keys and relays.

Keys.—The keys have either two or three spring-plates, separated either by metal or insulating material. On pressing down on the one button the spring-plates are made to contact either with each other or with other parts (the blocks) at the same time that they abandon their contacts with certain parts (the bridges) with which they are in contact when at rest, and which contacts it is necessary to break. In Fig. 2—which is a plan showing the direct-call key C A and the office-call key C B mounted on one base—the former is shown at the left and the latter at the right. Fig. 3 shows the direct-call key in elevation, and Fig. 4 the office-call key in elevation. The direct-call key C A has three spring-plates, *g*, *h*, and *j*, the plate *g* bearing the operating-button. *m* and *n* are the bridges bearing the normal contacts. *k* and *l* are the blocks bearing the opposite contacts. The office-call key C B has but two spring-plates, *a* and *b*, the plate *a* bearing the operating-button. *f* and *d* are the bridges bearing the normal contacts. *e* and *c* are the blocks bearing the opposite contacts. The key used at the central offices to call the subscribers furnished with the direct-call—that is to say, the key lettered C′ B′—is illustrated in Figs. 5 and 6. This key—which is the same as key C′ B′ and C^2 B^2 in Fig. 1—has two spring-plates, *d′* and *c′*, the former of which bears the operating-button. *a′* is the bridge provided with the normal contact for *d′*, and *b′* is the block bearing the lower contact for *c′*. The construction and operation of these keys will be readily understood from the drawings.

Relays.—The relays placed at the stations of the subscribers are peculiarly constructed. They are of two different types or kinds, and they may be intercalated in the line in two different ways to accomplish the same purpose, which is to close a local bell-circuit with the aid of like currents.

First type of relay.—See Figs. 9 and 10. In the relays R R′ at the houses or stations of the subscribers the inner extremities of the wires are, as shown in the diagram Fig. 9, wound on each bobbin of the relay and connected together. The exterior extremities of said wires are connected, one to the point B and the other to the earth. They are ordinary two-bobbin relays. (Shown in elevation in Fig. 10.) This relay is intercalated between the point B and the earth, and it is actuated by a current formed by the union of two other currents, which arrive at the same time on the lines L′ and *l′*. An ordinary two-bobbin relay placed on the wire going from the point B of junction of the lines L′ and *l′* to the earth permits of solving the problem of a direct call between subscribers, such as presents itself in the case we have described; but a case may present itself where relays placed in this manner will sometimes cause inconvenience. This is where two subscribers are connected in direct call by but one office with very short lines. The greatest part of the call-current at the central office, finding no resistance to its flow by way of L′ B *l′*, will pass by that way, while a very feeble portion of the current will pass through the relay in derivation at the office, this relay presenting a considerable resistance, (two hundred ohms.) This relay, then, will not be actuated and the subscriber will find it impossible to call the central office. There is, however, a means of avoiding this inconvenience, which I will now point out. This consists in intercalating in the lines L′ and *l′* suitable resistances, in order that the derivation at the central office may be sufficient; but as there are some resistances which are of no use, the use of a resistance may be avoided by employing another type of relay, which I will now describe.

Second type of relay.—This relay is illustrated in Figs. 11, 12, and 13. In this construction the attachment of the bobbin-wires differs from that previously described. The line-wires L′ and *l′* are attached, the one to the exterior extremity of the wire of one bobbin and the other to the interior extremity of the wire of the other bobbin, while the interior extremity of the wire of the first-named bobbin is connected to the exterior extremity of the last-named bobbin. The point B of junction of the two lines L′ and *l′* with the earth is placed on the wire which unites the interior extremity of the wire of bobbin *b′* to the exterior extremity of the wire of bobbin *b*. It results from this special mode of attachment that the relay will only be actuated when the line-wires L′ *l′* shall be traversed simultaneously by two currents in the same direction, for in this case two poles of contrary names will be formed in each of the bobbins *b′* and *b*, while, if there are two currents in opposite directions circulating in the two wires, two poles of the same name will be formed in bobbins *b′* and *b*, and the relay will not be actuated. This last construction of the relay, although introducing into the circuit a greater resistance than that of an ordinary two-bobbin relay, is preferable to the latter, because it solves the problem of direct call in a general way and is suited to lines of any length. In Figs. 16, 17, 18, and 19 I have shown a variety or modification of the second type of relay seen in Figs. 11, 12, and 13, wherein the construction is more economical, at the same time that it occupies very nearly the same

space as the relays R R′, so that we may substitute one for the other on the table bearing all the direct-call apparatus. The pieces M M′ M″ are of soft iron, as well as the cores N N′ of the two bobbins B B′. The brass arm A is insulated electrically from the standard M″. The point of the screw C, which regulates the tension of the retracting-spring D, is insulated. The two extremities of a local circuit comprising a battery and a bell end at the binding-posts P (battery) and S, (bell). The binding-post P is in communication with the brass plate or block E, the brass connecting-piece G, the iron tie-piece M′, and the core N of bobbin B. The standard M″ and piece G may be made from one piece of brass. The binding-post S is in communication with the brass arm A, the brass bracket H, and the armature M. It results from this that if the armature M and core N come in contact the local bell-circuit will be closed. This attraction will take place in the following cases: If two currents moving in the same direction and parallel on the two line-wires L and L′ arrive at and traverse the bobbins B B′ and then reach the earth T, they determine at the ends of cores N and N' poles of opposite polarity or contrary names, and the armature M will be attracted. If, on the contrary, the current arriving by line L′ traverses first the bobbin B and then bobbin B′ and returns by the line L′, the poles determined at the ends of the bobbin-cores will be of like polarity or of the same name, and the armature M will not be attracted. We see, then, that this relay is actuated by two currents together moving in the same direction, arriving by the two line-wires L and L′, gaining the earth T after having traversed the bobbins B and B′, while a current moving through a complete metallic circuit does not actuate it.

II. *Direct call with polarized apparatus on single or double wire lines.*—This system consists in providing the subscribers and the intermediate central offices connected for direct call with polarized apparatus. A current in one direction actuates the apparatuses of the subscribers, and a current in the opposite direction operates the apparatuses at the central offices. It is essential that all the polarized apparatuses shall be traversed in one direction by the current, which implies that the apparatuses are necessarily placed in derivation to earth if the lines are single-wire lines, or in derivation on the two wires if the lines are double-wire lines. This is the basis of the system.

The apparatuses necessary in this system are:

At the subscribers: first, a key for changing the current; second, a polarized relay. In other respects the telephonic station may be provided in the usual or any way.

At the central office: first, a polarized annunciator or indicator; second, an ordinary call-key; third, a call-battery connected to earth.

Fig. 20 is a diagram showing the arrangement of polarized apparatus and the various circuits, connections, &c. Suppose the polarized apparatus arranged in such a manner that a current obtained by putting the zinc at the station of the subscriber A to earth and the copper to the line will actuate the polarized relay at the station of subscriber B, and will be without effect on the polarized indicators at the offices C and D. It will result from this that A, by pressing key E, can ring up B, and that by pressing key G he can ring up office C.

1. *Direct call of* B *by* A. We will follow the current obtained by pressing on key E: earth T, spring-plate *a*, block *b*, zinc *c*, copper *d* of the call-battery, block *e*, spring-plate *f*, line L, pin *g* inserted in the jack, flexible connector joining *g* and *h*, pin *h*, line L′, pins *i j*, line L², spring-plate *k*, bridge *l*, binding-posts *m* and *n*, binding-posts *o* and *p*, between which is arranged the polarized relay, binding-posts *q* and *r*, bridge *s*, spring-plate *t*, and earth T′. Thus the circuit is completed through the earth. We have seen that the current has passed from *o* to *p* through the polarized relay N, and the result is that its armature swings from contact *α* to contact *β* thus closing the local circuit of bell P. This local circuit is as follows: *β γ λ u v β*.

We have examined the principal circuit, leaving aside several derivations, which I will now consider.

First. At the station of subscriber A there are no derivations.

Second. At office C: The annunciator H is cut out, the pin *g* cutting the spring-plate *r* out from the piece *u*. The annunciator I is in derivation through the spring-plate *r′*, the piece *u′* from *x* to *y* in I, and thence to earth T², which completes the circuit.

Third. At office D: Annunciator K is cut out and J is in derivation.

Fourth. At the station of subscriber B there are no derivations.

2. *Call of office* C *by the subscriber* A. This call is effected by pressing key G. The circuit is as follows: earth T, spring-splate *f′*, block *e′*, copper *d*, zinc *c*, block *b′*, spring-plate *a′*, and line L. The current thus reaches office C, where two cases present themselves namely:

First. Communication is established between A and B, as indicated in the diagram. Then the current divides into three derivations, as we have seen in respect of the current for calling from A to B. One part passes into the annunciator I, which is arranged in such a way as to be actuated by the current. A second part passes into the annunciator J, which is also actuated if the call-battery is sufficiently powerful or the line L² sufficiently short. Finally, a third part is derived into

the polarized relay N, which is not actuated, the direction of the current not being suitable.

Second. The communication not being established between A and B, all the current passes into annunciator H at office C.

3. *Call of subscriber* A *by office* C.—Substitute pin *g'* for pin *g* and press on key R. The circuit is as follows: earth T^2, battery δ, block φ, spring-plate ε, pin *g'*, jack-line L, spring-plate *f*, bridge *l'*, binding-posts *m' n'*, bridge *s'*, spring-plate *f'*, and earth T, which completes the circuit. The current traverses the polarized relay M, (between binding-posts *o'* and *p'*,) and, as the battery δ and relay M are constructed in such a way that the relay M will be actuated, its armature contacting with β' closes battery γ' on the bell S.

4. *Apparatus.*—Figs. 7 and 8 illustrate on a larger scale the keys E and G, placed at the station of a subscriber for reversing the current. Figs. 14 and 15 show on a larger scale the polarized relay M of the subscriber. The key employed at the central office is sufficiently illustrated in Figs. 5 and 6. The polarized annunciator is shown in Fig. 20. Q U V is a magnet of such a kind that the armature X is drawn, while at rest, to the bobbin-core. If a current in the proper direction is passed into the bobbin, the pole of the core facing the armature X, taking the same polarity as that of the armature, the latter is repulsed, and is held away by the detent Y. This direct call with polarized relays can be as well applied to double-wire lines, the earth T T' T^2 T^3 being replaced by a return-wire. With double-wire lines I can also effect the direct call through the following arrangement:

I can employ one of the wires exclusively for the direct call between subscribers by connecting both extremities of this wire with earth, and I then utilize the other wire for office calls by connecting both of its extremities with earth. For speaking I would use both wires, automatically cutting off the earth-connections. It will be understood that the relays in the offices should be intercalated in the second wire of the circuit.

I will say in explanation of Fig. 1 that the lever devices shown at the subscribers' stations A and A′ at the lower corners of the figure represent the ordinary hooks on which the telephones are hung.

Having thus described my invention, I claim—

1. The combination, with a telephonic circuit, substantially as described, comprising the circuit-wires, the relays at the central offices and at the stations of the subscribers, the batteries, the jacks, and the keys at the central office or offices, of the local bell-circuits and bells at the stations of the subscribers and at the central office or offices, and the special keys C A and C B, for effecting, respectively, the direct call and the office call, said keys being constructed and arranged to operate substantially as described.

2. The combination of a telephonic circuit having double-wire lines, for use as a complete metallic circuit for ordinary telephonic purposes, with the means, substantially as described, for automatically connecting both ends of said line-wires with the earth for effecting a direct call between subscribers, whereby both wires form one line for the travel of the current in one direction, while the earth is utilized for the return side of the circuit, substantially as set forth.

3. In a telephonic circuit having a double-wire line, the combination, with said circuit, its relays and bell-circuits and bells, of the keys C A and C B at the station of the subscriber, constructed substantially as shown and described, and the call-key C′ B′ at the central office, constructed substantially as set forth, which admits of completing the metallic circuit (*a*) when at rest, on the telephonic apparatus at the station of the subscriber; (*b*) at the time of the call of a subscriber, on the battery at his station, substantially as set forth.

4. The special direct-call key C A, provided with three spring-plates, *g*, *h*, and *j*, of which two operate when the button is pressed to join the two line-wires, and then to establish the communication of the line thus formed with one of the poles of the subscriber's battery, the other pole of which is connected to earth by the third plate of the key, substantially as set forth.

5. A direct-call telephonic circuit, substantially as described, having a bell-relay placed at the station of the subscriber on the earth or ground wire which ends at the junction of the two line-wires, the relay serving to close the local circuit for sounding one or more bells, substantially as set forth.

6. In the telephonic system for effecting direct call between subscribers, substantially as set forth, the special relay having two bobbins, the wires on which are wound inversely, as set forth, said relay being arranged at the junction of the two line-wires, and the earth or ground wire ending at the junction of the two line-wires between the bobbins of the relay, such relay, when placed at the station of a subscriber, serving as a supplementary resistance in the metallic circuit, and assuring thus sufficient derivation for the annunciator at the office in the case of the call of this office by the subscriber, substantially as and for the purposes set forth.

7. The combination of the office-call key C B, provided with the means described for breaking two back or normal contacts and making three opposite contacts simultaneously when pressed, the call-battery P A, the key C A, the line-wires L′ *l'*, the jack P′ *p'*, and the relay R′ at the central office B′, where-

by the latter office is called, said key C A forming by its back contacts a part of the circuit, substantially as described and shown.

8. The combination of the direct-call key C A, provided with the means described for breaking two normal or back contacts and making three opposite contacts simultaneously when pressed, the battery P A put in circuit by pressure on the key through opposite contact *b* and plates *h* and *g*, the two line-wires forming a divided circuit that becomes one circuit at *r'*, the key C' B' forming a part of one of these circuits, the key C' B' forming a part of the other circuit, the circuit from *r'* to earth T', the relay R', which forms a part of this latter circuit, and the circuit from the pole *z* of the battery P A to earth, which is closed by contact of block *k* with spring-plate *j* when the key C A is pressed, substantially as described and shown.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

LOUIS ALFRED BERTHON.

Witnesses:
ROBT. M. HOOPER,
AMAND RITTER.