No. 831,819. PATENTED SEPT. 25, 1906.

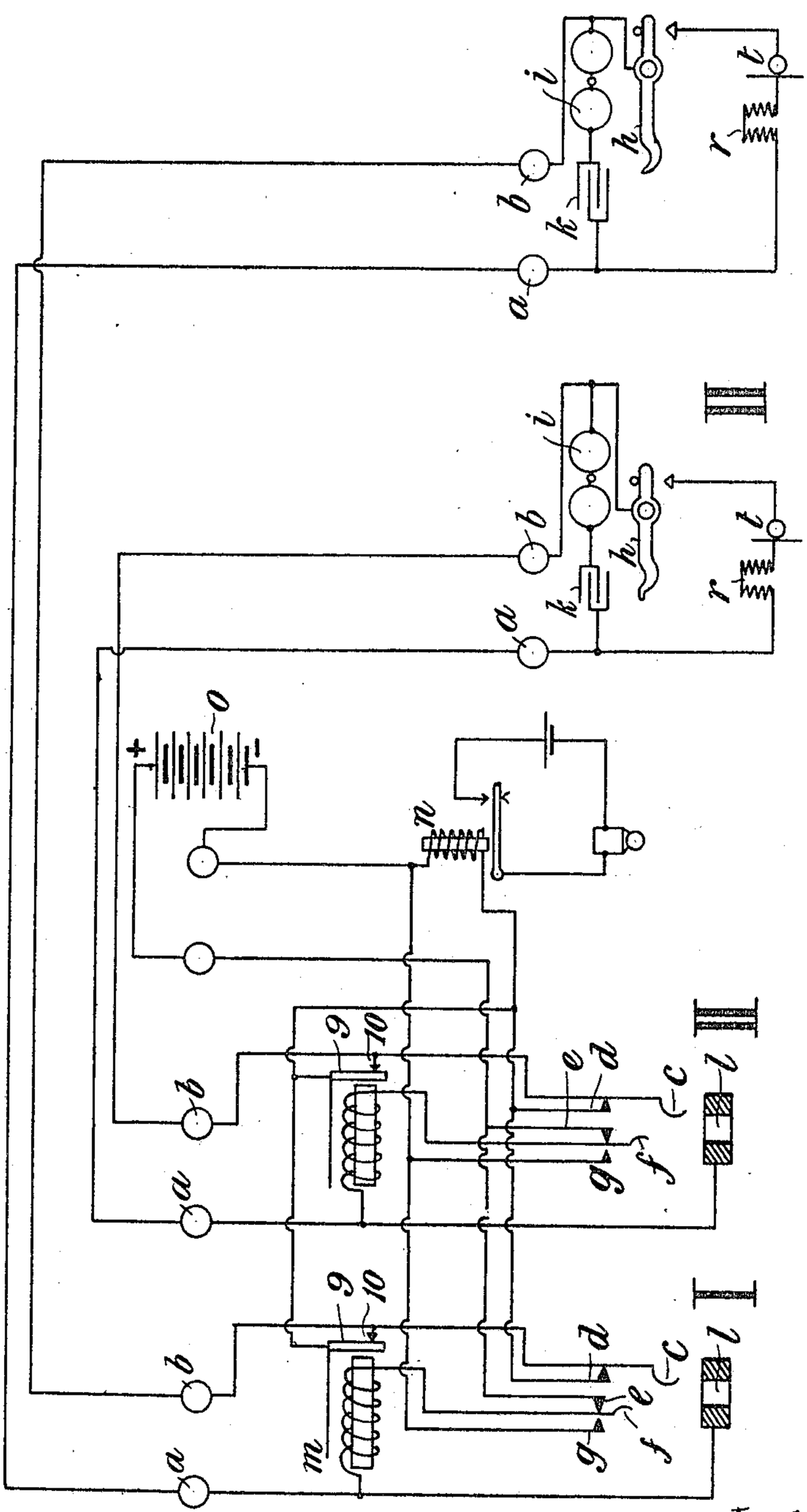
F. G. BELL.

TELEPHONE SYSTEM.

APPLICATION FILED OCT. 9, 1905.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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6 SHEETS—SHEET 2.

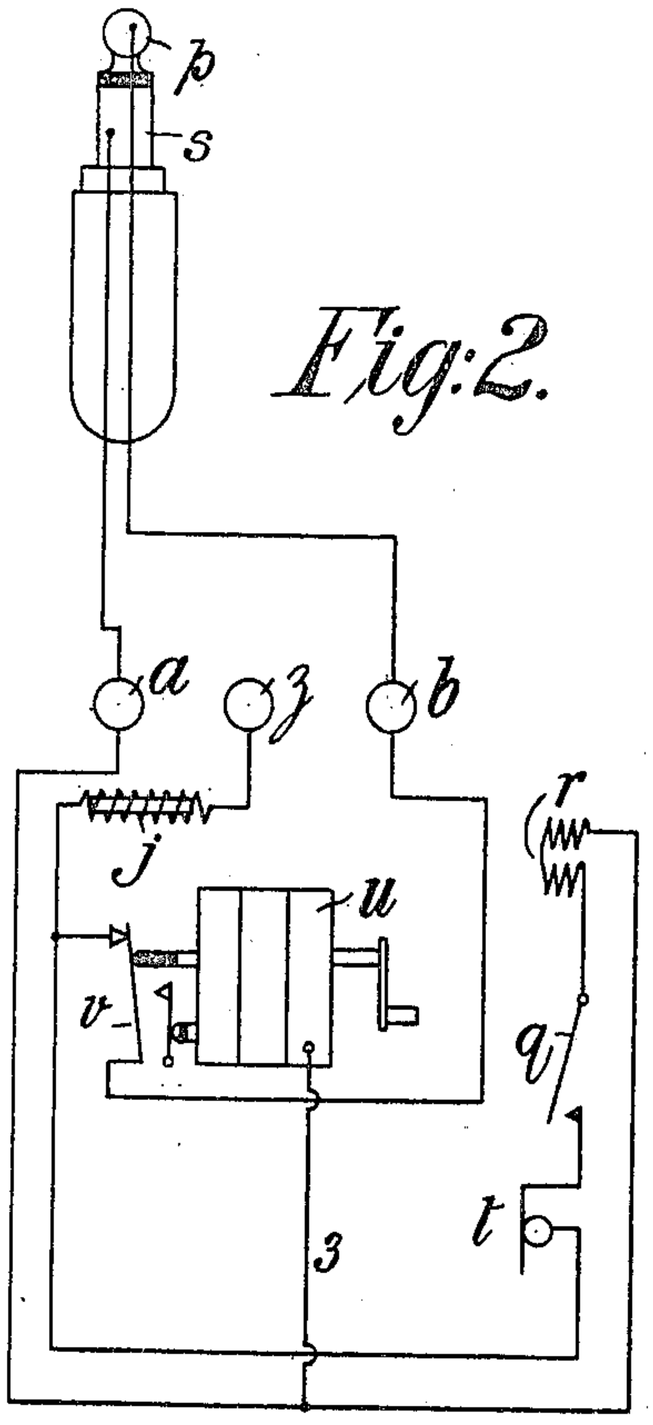

Fig: 2.

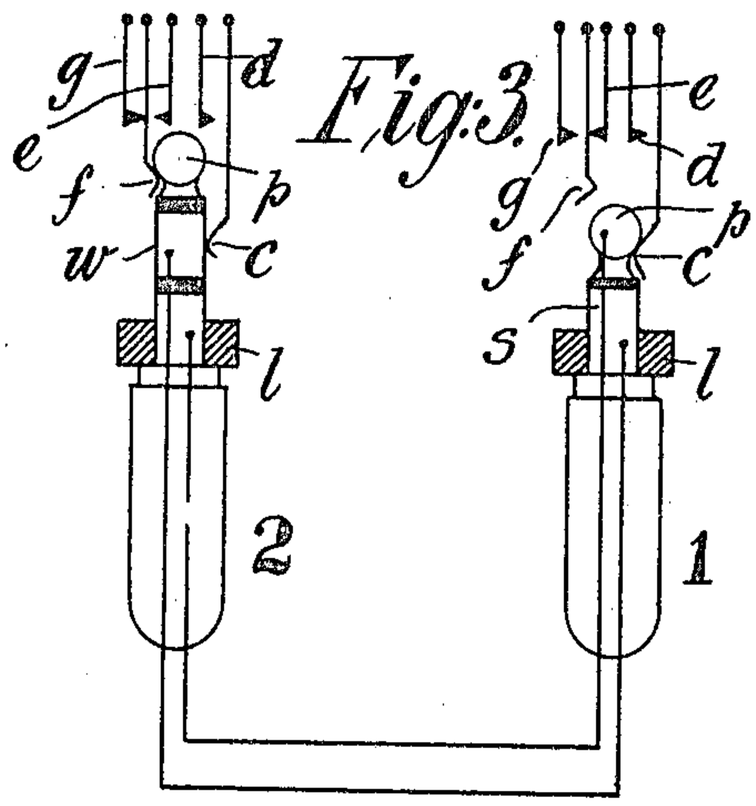

Fig: 3.

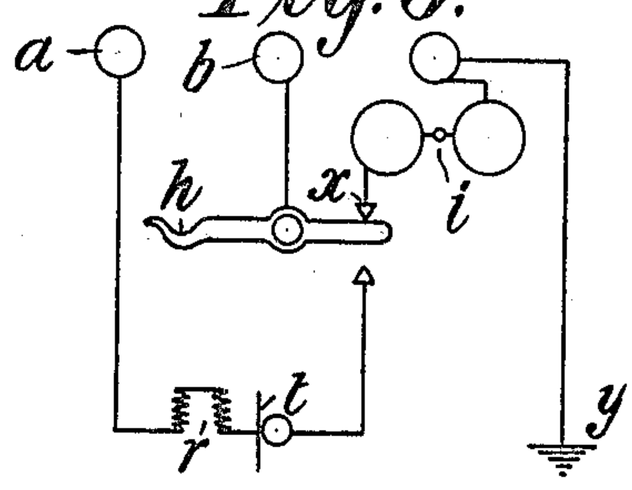

Fig: 6.

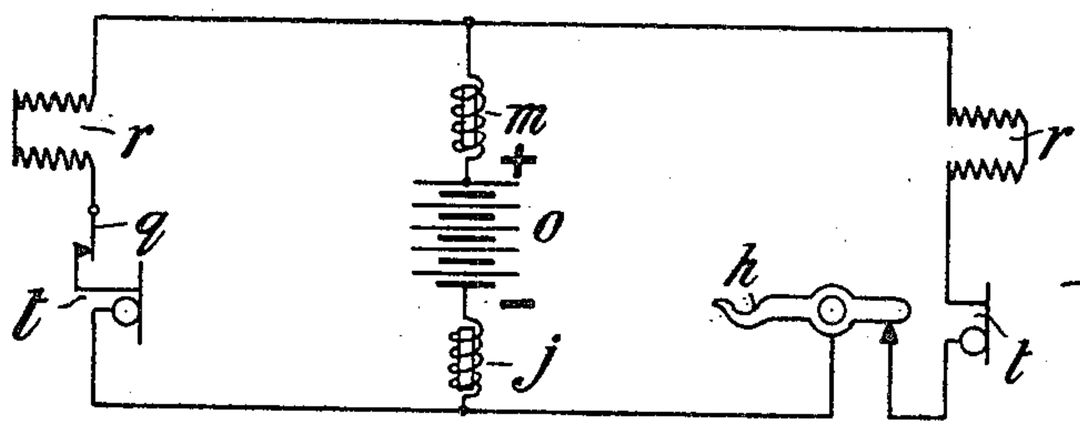

Fig: 4.

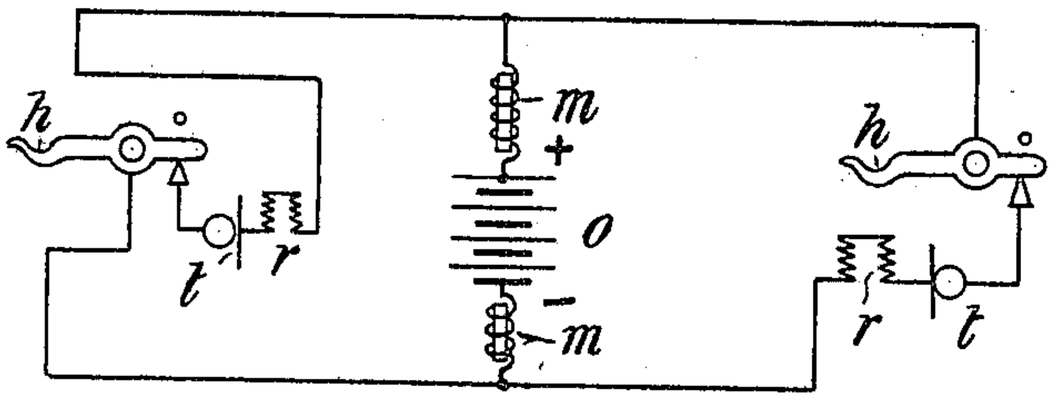

Fig: 5.

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6 SHEETS—SHEET 3.

Fig: 7.

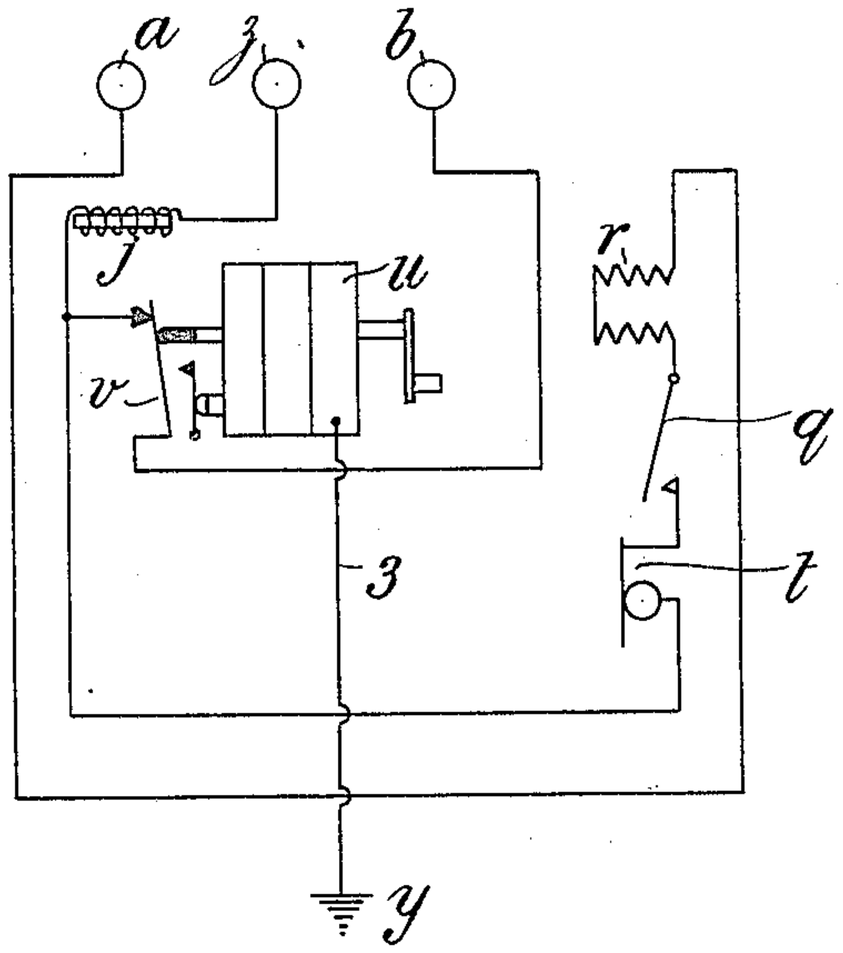
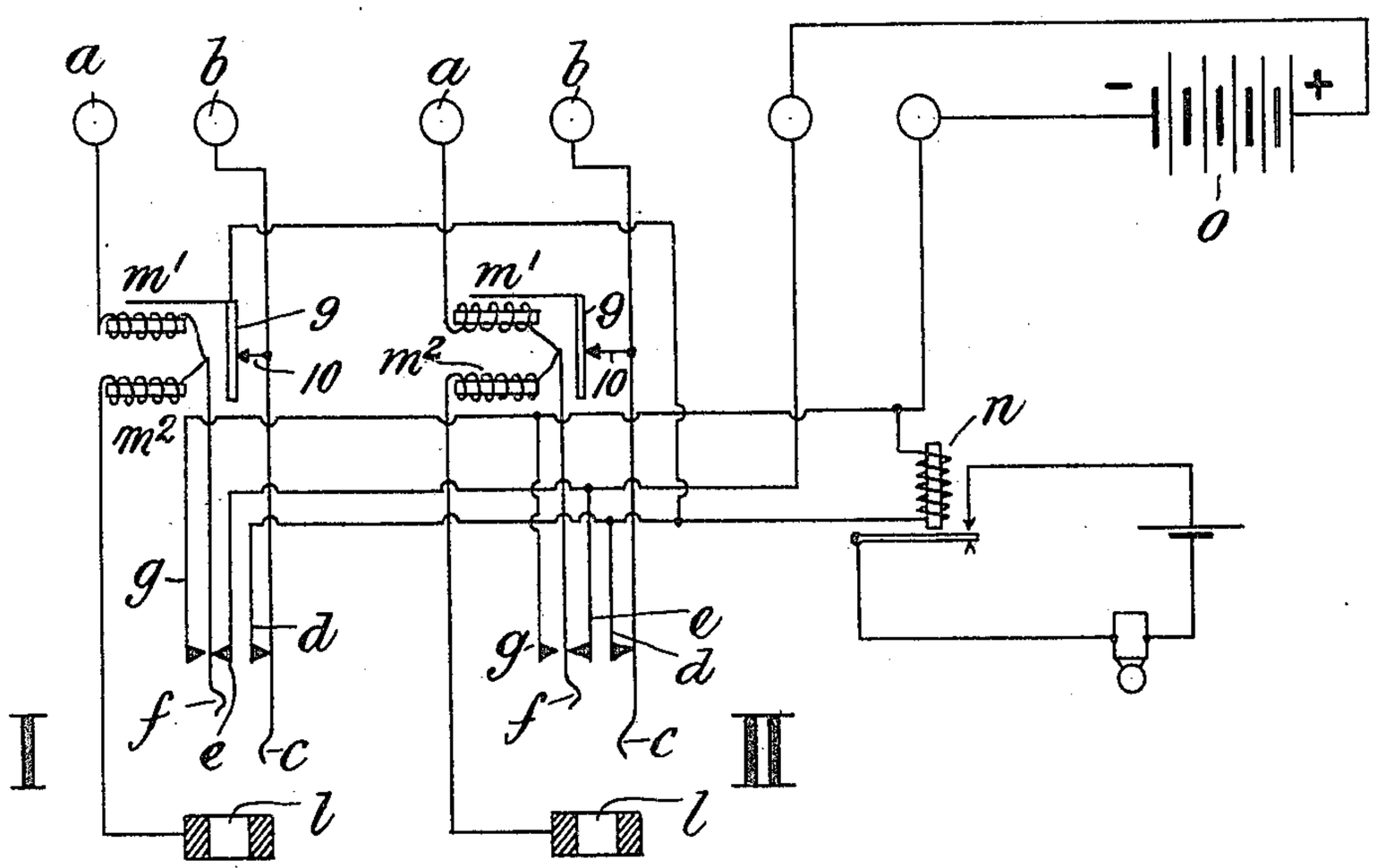


Fig: 8.



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6 SHEETS—SHEET 4.

Fig:9.

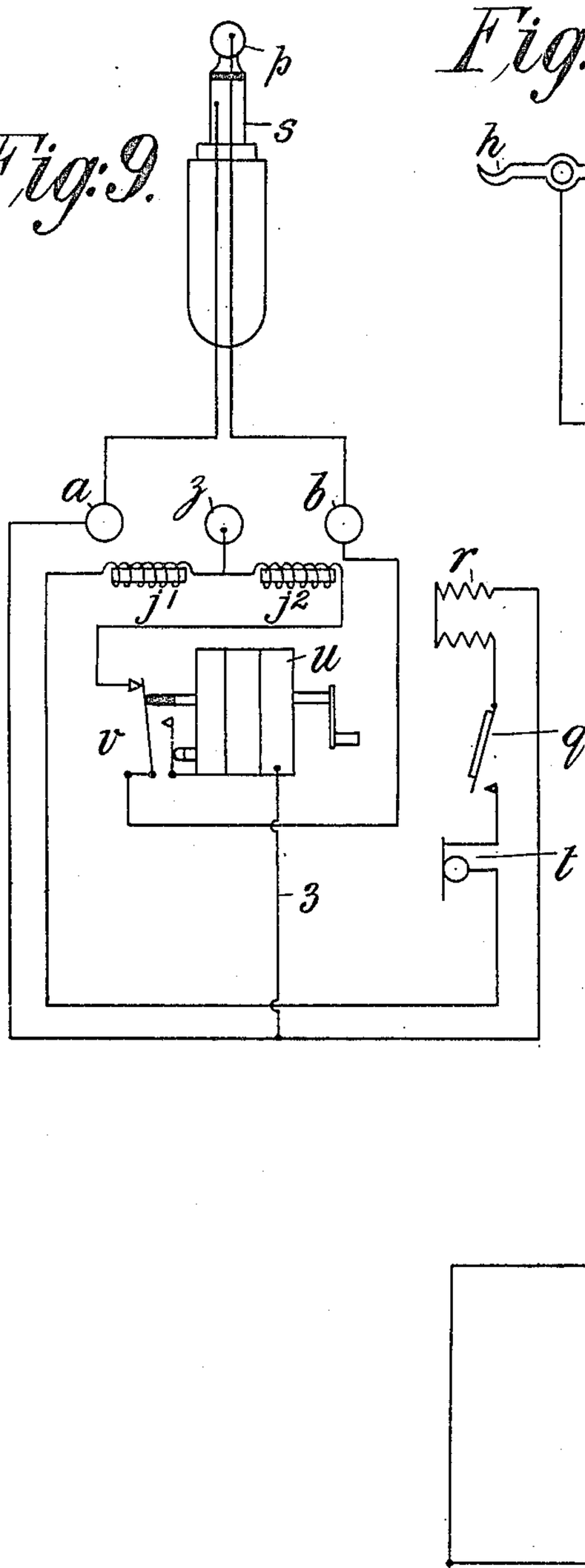


Fig:10.

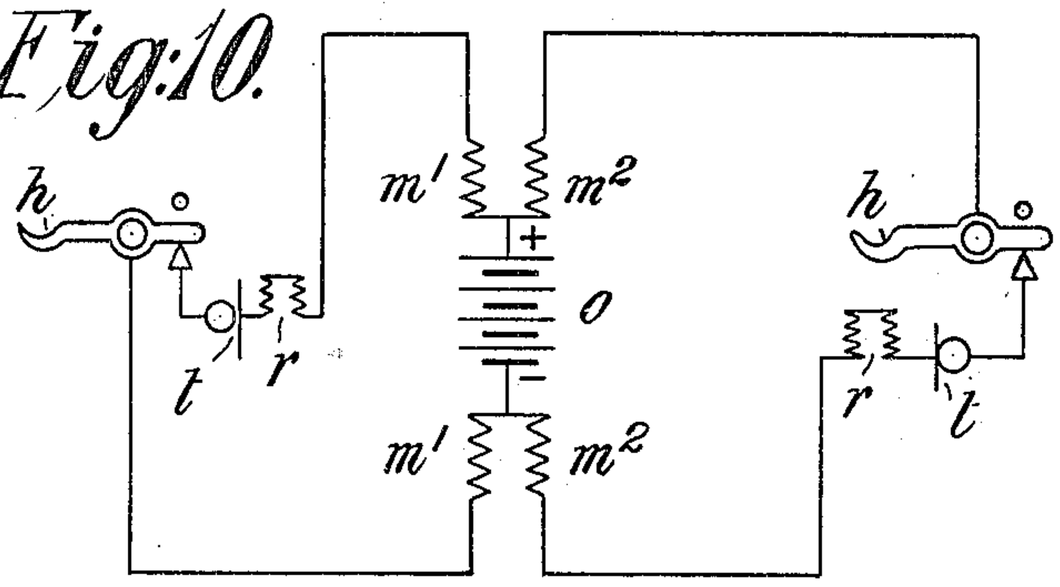
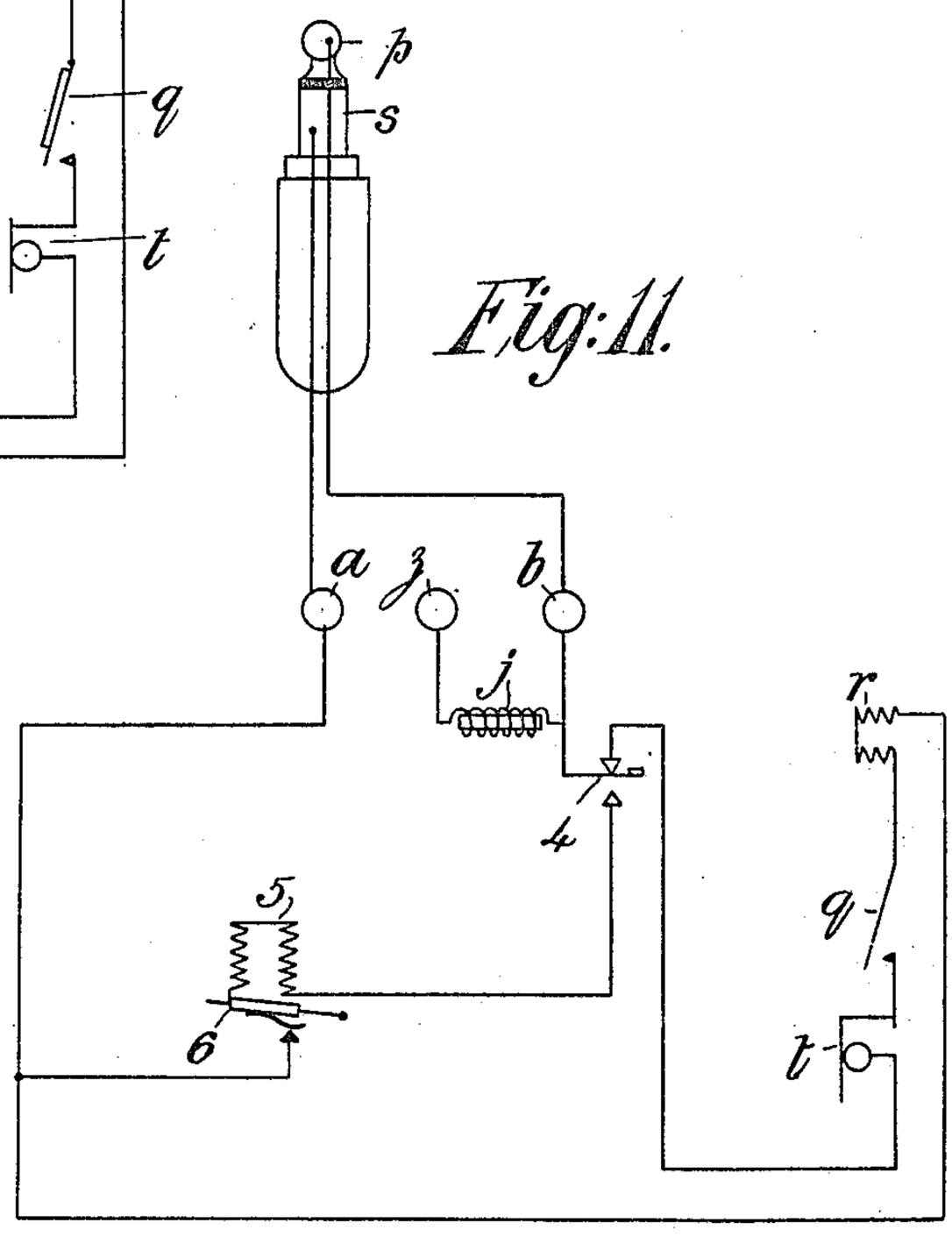


Fig:11.



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No. 831,819. PATENTED SEPT. 25, 1906.

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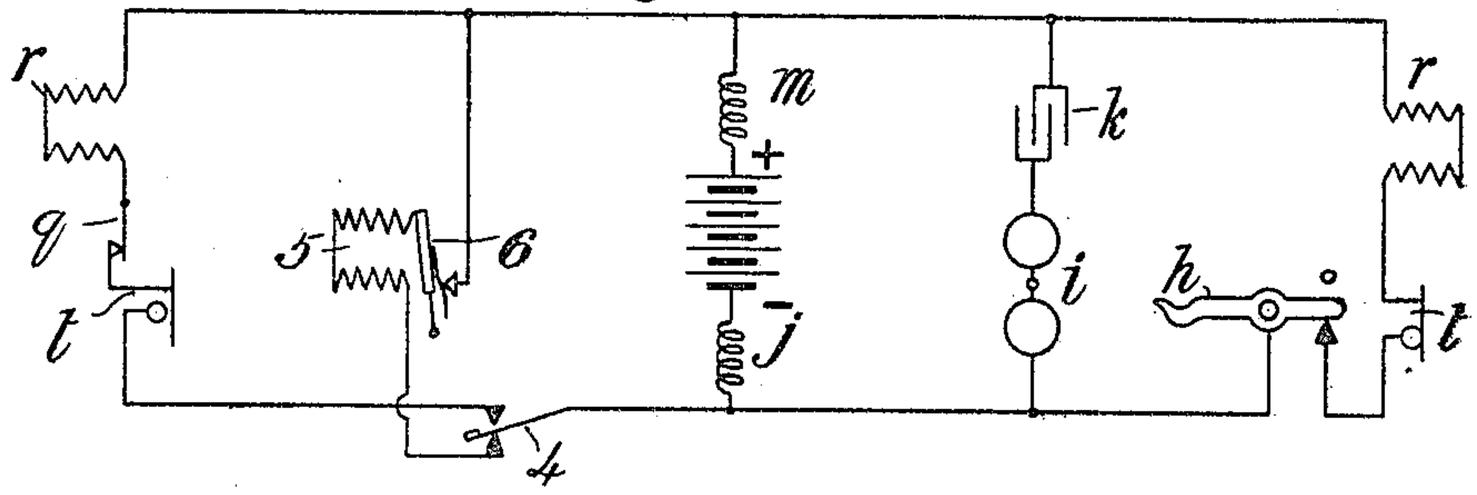
TELEPHONE SYSTEM.

APPLICATION FILED OCT. 9, 1905.

6 SHEETS—SHEET 5.

Fig: 12.



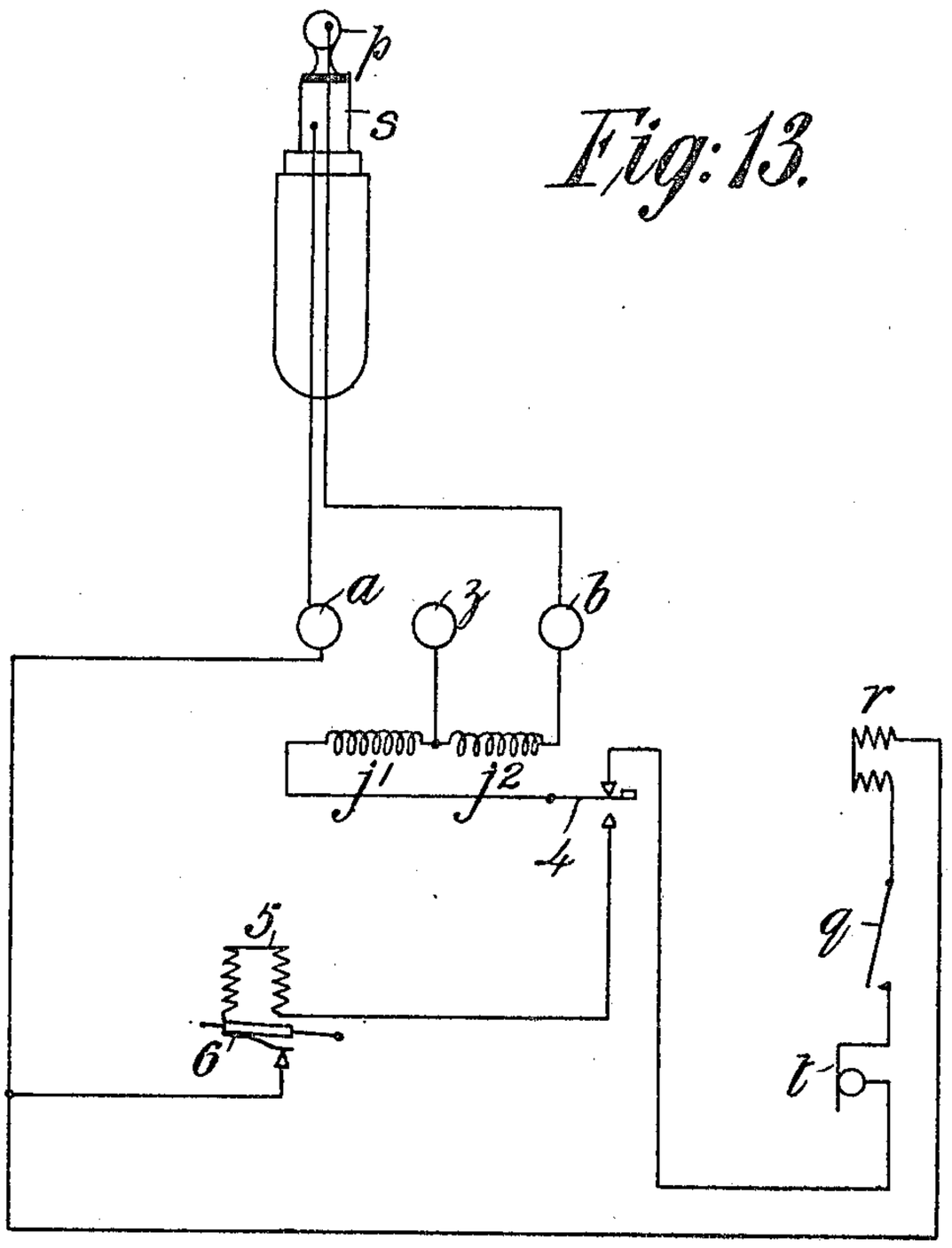


Fig: 13.

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6 SHEETS—SHEET 6.

Fig: 14.

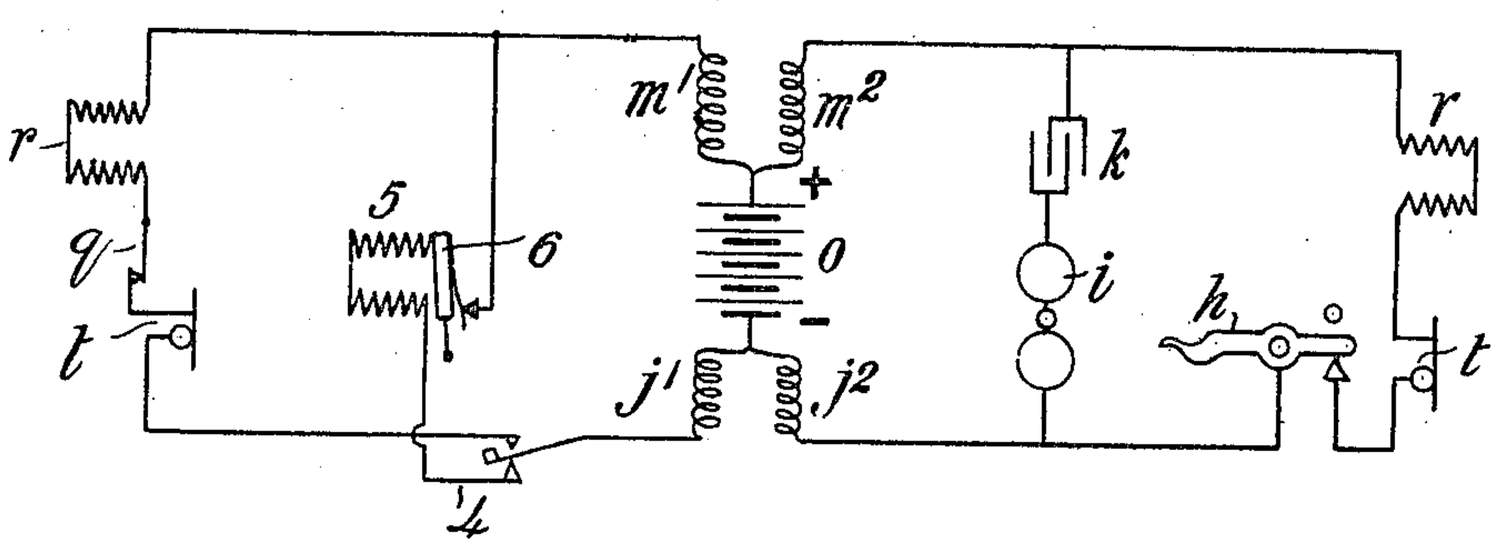
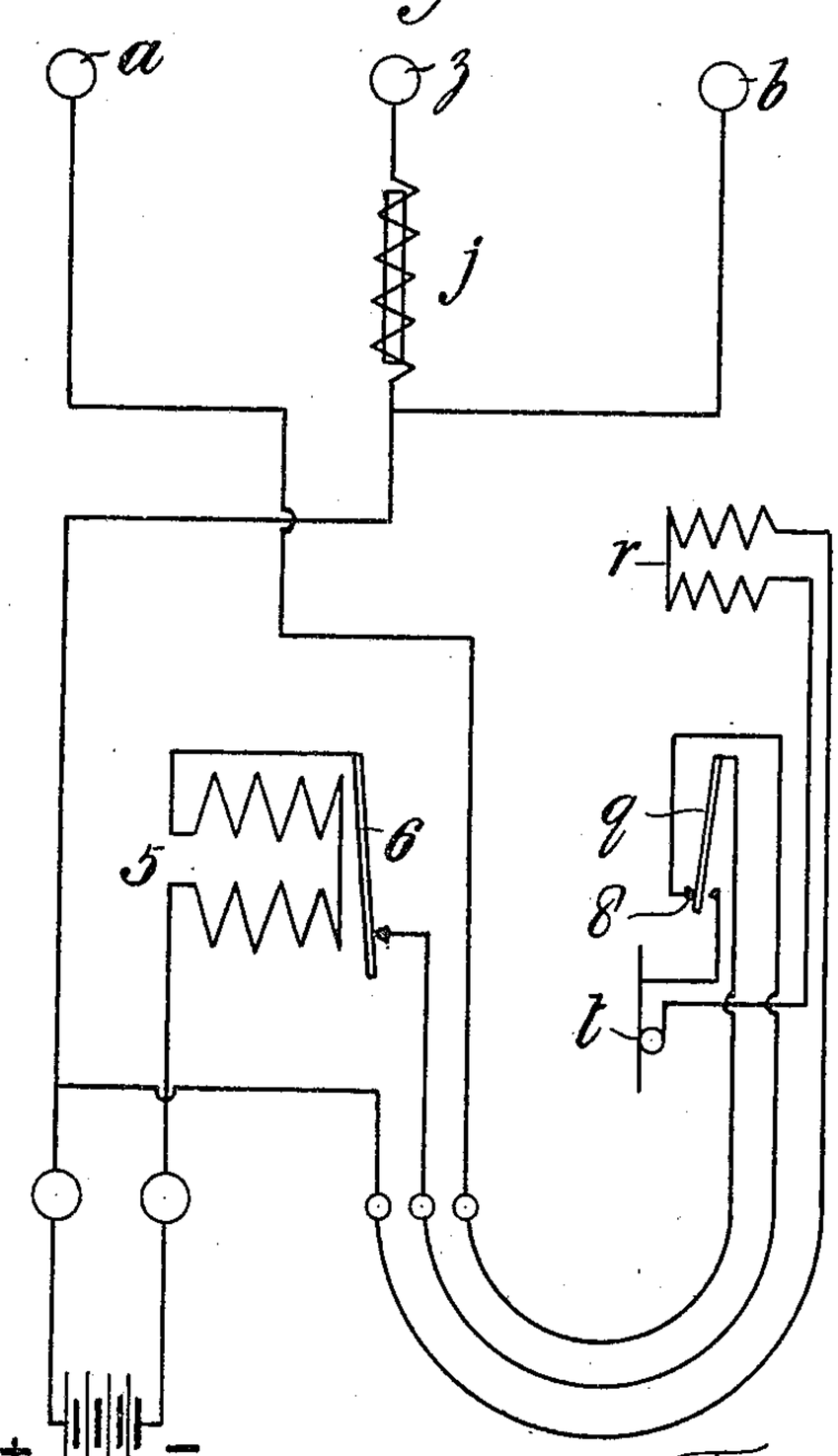


Fig: 15.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 831,819. Specification of Letters Patent. Patented Sept. 25, 1906.

Application filed October 9, 1905. Serial No. 281,974.

To all whom it may concern:

Be it known that I, FRANCIS GEORGE BELL, electrical engineer, a subject of the King of Great Britain, residing at 200 Upper Thames street, in the city and county of London, England, have invented new and useful Improvements in or Relating to Telephone Systems, of which the following is a specification.

This invention relates to telephone-exchange systems working with a common battery; and it has for its object to simplify and improve the indicating and switchboard arrangements and the calling and connecting apparatus of such systems.

According to this invention the line-indicator is made simultaneously to serve as a clearing-out indicator and impedance-coil and in some cases also as a translator and as a self-inductor for a special calling apparatus. Further, the arrangement of the operator's set is improved and a novel method of constructing and wiring the through communication-plugs is introduced, whereby a telephone system well balanced and arranged as a whole is secured.

In the accompanying drawings, Figure 1 shows two subscribers' stations and the connections therefor at the switchboard in one arrangement in accordance with the invention. Fig. 2 shows the operator's set for use with the switchboard shown in Fig. 1. Fig. 3 shows the through connecting-plugs. Fig. 4 is a diagram illustrating the connections when the operator is speaking with a subscriber. Fig. 5 shows the connections when two subscribers are in conversation. Fig. 6 shows a modified arrangement at the subscriber's station for calling with earth-return or common-return connection. Fig. 7 shows the arrangement of the operator's set for use when the subscriber's set is as in Fig. 6. Fig. 8 shows a modified arrangement at the switchboard. Fig. 9 shows the operator's set as modified for use with the switchboard arranged as in Fig. 8. Fig. 10 is a diagram of the connection when two subscribers are talking with this modified arrangement of the switchboard. Fig. 11 is a diagram of the operator's set with simple impedance j and with the special calling apparatus applied thereto. Fig. 12 illustrates the connections for the board shown in Fig. 1 when the operator is calling a subscriber by the arrangement shown in Fig. 11. Fig. 13 is a diagram of the operator's set with split impedance j' j^2 and with the special calling apparatus applied thereto. Fig. 14 similarly illustrates the connections for the apparatus as in Fig. 8 when the operator is calling a subscriber with the apparatus shown in Fig. 13. Fig. 15 shows the special calling apparatus applied in a somewhat different way in the operator's set.

In the arrangement shown in Fig. 1 the subscribers' stations I II are connected by pairs of line-wires with pairs of terminals a b on the switchboard. It will be convenient to refer to the lines as the "a line" and "b line," respectively, which are connected to the a and b terminals in each case and to letter all terminals connected to said lines as a and b, respectively. Each subscriber's set includes a receiver r, transmitter t, hook-switch h, (operated by hanging up and taking down the receiver,) and a bell i, bridged across the a and b lines by a condenser k, so that said bell can answer to alternating or pulsating but not to continuous currents.

There is a spring-jack on the switchboard for each subscriber, each jack having two movable springs c and f and three fixed springs or contacts d, e, and g. In front of each jack also is a collar l in direct electrical connection with the terminal of the a line. An indicator m is connected between the fixed spring f in each jack and the a line, while the movable spring c in each jack is directly connected to the b-line terminal. Each indicator is of the type in which the drop-plate is directly operated by the armature 9 and which therefore continues to indicate so long as a current passes through the indicator-coils. The drop does not return to its non-indicating position until the flow of current through the coil ceases and the armature is released. The armature 9 preferably touches a back contact 10 at all times when said armature is not attracted by the electromagnet m. The object of this is explained below.

The indicators have their coils wound on cores, so that said indicators will serve also as impedance-coils for the battery-circuits. No other impedance-coils are necessary in the speaking-circuits. o is the common battery of a suitable number of cells according to the size of the telephone-exchange which it oper-

ates. The plus terminal of this battery is connected only to the fixed spring *e* in each jack, while the — terminal is connected, on the one hand, directly to the fixed spring *g* of each jack, and, on the other hand, to the fixed spring *d* of each jack through a relay *n* or the like, serving to operate an audible or other signal common to all the stations connected to the board.

In the operator's set shown in Fig. 2 there are *a* and *b* terminals connected, respectively, with the sleeves *s* and tip *p* of the operator's plug. When this plug is inserted in a jack, the sleeve *s* contacts with collar *l* and is thus connected with the subscriber's *a* line, while the tip *p* presses back the spring *c*, connected to the subscriber's *b* line. The operator's *a* terminal is connected, on the one hand, through the receiver *r*, key *q*, transmitter *t*, and impedance-coil *j* with the terminal *z*, connected to the — (zinc) terminal of the common battery *o*. It is also connected by wire 3 with the calling-generator *u*, the switch *v* of which is normally connecting the *b* terminal to the impedance-coil *j*, but which automatically connects said terminal *b* to the generator *u* during calling in well-known manner.

The pair of through connecting-plugs 1 2 (shown in Fig. 3) are used to connect two subscribers. One plug differs from the other in that one, 1, has a sleeve *s* and tip *p* only, while the other, 2, has a sleeve *s*, a ring *w*, and a tip *p*. These parts in each plug are of course insulated, and the tip *p* of plug 1 is connected to the sleeve *s* of plug 2, as shown, while the sleeve *s* of plug 1 is connected to the ring *w* of plug 2. The tip of plug 2 has no electric connections, as it serves only as a mechanical device to operate the inner spring *f* of one jack in any pair placed in connection. The sleeves *s* always enter the collars *l*, while the tip of plug 1 (and of the operator's plug) and the ring *w* of plug 2 always press against the spring *c* of any jack in which they are inserted.

In operation with this system the battery *o* is normally connected, as will be seen, on the + side through the springs *e f* of the jacks with the *a* lines of all subscribers' stations and on the — side through the relay *n* and springs *d c* with the *b* lines; but owing to the use of a condenser *k* at each station no current can pass in any of the circuits. As soon, however, as a subscriber—*e. g.*, at station I—removes his telephone from the hook-switch *h* or otherwise closes his line-circuit the current of the common battery *o* passes over his *a* and *b* lines through his station by the contacts between springs *e f* and *d c* of the jacks, as above mentioned, and thus the relay or audible signaling device *n* at the central station is operated. The operator hearing the relay-signal and seeing the particular drop-signal of the indicator *m* of the station (I) which is calling, inserts her plug into the jack of the said calling-station; but as said plug only has a sleeve *s* and a tip *p* contact is only made by the plug with the collar *l* and first spring *c* in the jack, the innermost spring *f* being left in its normal position wherein it is connected with the + (carbon) terminal of the common battery *o* through the fixed spring *e*. For answering the call the operator presses the key *q*, connecting her telephone set between her *a* and *z* terminals, and the speaking-circuits are then as follows: from the + terminal of battery *o* through the springs *e f* in jack I and through the indicator-coil *m* of the station I which has called. From this point there are two paths open. The first is through the subscriber's line-wire *a* and his telephone set back by line *b* to the jack, through the spring *c* therein, the tip *p* of the operator's plug, operator's terminal *b*, the spring contact-switch *v* of the generator in the operator's set, the impedance-coil *j*, and back to the — terminal of the battery *o*. The second path is from the indicator-coil *m* through the collar *l* of the jack, the sleeve *s* of the plug, operator's *a* terminal, through operator's telephone set, the key *q* of which is closed, and the impedance-coil *j* back to the — battery terminal. Fig. 4 shows diagrammatically the circuits which are now closed, and it will be seen that the impedance-coil *j* balances the indicator *m* at the side of the circuit next to the — battery terminal, and as a perfect balance is thus obtained speaking can be effectually carried on between the operator and a subscriber. As will be seen later, (see Fig. 5,) the indicator-coil *m* of a second subscriber serves the purpose of the impedance-coil *j* when two subscribers are connected through to one another.

After receiving and answering a call the operator rings up the desired station—say II—by inserting her plug into the jack II of said station and operating the calling-generator *u*. The alternating current generated then passes from the generator *u* and *a* terminal of the operator's set through the collar *l* of the jack II directly through the lines *a* and *b* of station II and its condenser *k* and call-bell *i* and through the spring *c* of the jack, tip *p* of plug, operator's terminal *b*, and automatic switch *v* back to the generator *u*.

The call having been given and answered the operator connects the two stations by the through connecting-plugs 1 and 2. The plug 2, having a sleeve *s*, ring *w*, and tip *p*, makes contact with the collar *l* and spring *c* of its jack—say I—while simultaneously its tip *p* presses over the spring *f* from spring *e* to make contact with spring *g*, so that the indicator *m* of station I is disconnected from the + terminal of the common battery and is connected instead with the — terminal. At the other jack II the plug 1, having only a sleeve *s* and a tip *p*, the spring *f*, connected

with the indicator *m*, remains in contact with spring *e* and is thus in connection with the + battery terminal, while the sleeve *s* takes contact with the collar *l*, connected to line *a*, and the tip *p* with the spring *c* in the jack connected to the line *b*, this latter spring being thus pressed back away from spring *d*. The speaking-circuits (indicated diagrammatically in Fig. 5) are now as follows: from the + terminal of battery *o* through springs *e* and *f* of jack II, indicator *m*, after which the circuit is branched. The one branch goes over the *a* line to station II, through the instruments at that station back by the *b* line to spring *c* in the II jack, tip *p* of plug 1, and through the connecting-lead to sleeve *s* of plug 2, thence from collar *l* of jack I through indicator *m* of station I, springs *f* and *g*, (pressed together by the tip of plug 2,) and so back to the − battery terminal. The other branch is from the indicator *m* of station II through the collar *l* of jack II, sleeve *s* of plug 1, and by the connecting-lead to ring *w* of plug 2, spring *c* of jack I, the *b* line of station I to that station and back by the *a* line through indicator *m* of station I to springs *f* and *g*, as before, to the − battery terminal. It will be seen particularly clearly in Fig. 5 how exactly balanced the whole speaking system is with these connections—the two stations are connected in parallel between the terminals of the two indicators *m m* thus brought into action, and the high-frequency speaking-currents of course pass through the two stations as if they were directly connected in series. The indicators *m*, as before mentioned, have drops which only remain raised or visible so long as a current is passing, so that said indicators will return to their normal position when the current ceases to flow through them. It will be seen that this will not occur when the subscriber at one station only has hung up his receiver or otherwise broken his circuit, because, as seen in Fig. 5, the battery-current will continue to flow through both indicators *m* and one station even after the other is cut off. If, therefore, no special clearing-signal were given—*i. e.*, if the back contacts 10, explained below, were omitted—the indicators would serve to give the clearing-out signal, showing when both subscribers had finished their conversation, because the two indicator-drops would simultaneously return to their non-indicating position as soon as both subscribers had hung up their telephones; but the indicators are preferably arranged to give a clearing-out signal, as follows: The back contacts 10 of armatures 9 are connected to the *b* terminals in each case, and the armatures 9 themselves are all in electrical connection through the relay *n* with the − battery terminal. The armatures normally rest against the contacts 10, as before explained; but there can be no circuit through these contacts unless the through connecting-plugs 1 and 2 are in two jacks and the subscribers thus connected are not communicating. This is easily seen, for as long as a subscriber's telephone is on the hook *h* there is no circuit through his station, and the parts of the switchboard connected to the + battery terminal—*i. e.*, jack-springs *e* and *f*, indicator-coils *m*, *a* lines, and collars *l*—are insulated from all the other parts which are connected with the − terminal. As soon as the operator closes a circuit through his station his indicator operates, breaking the contact at 10. Further, if the through connecting-plugs are in two jacks the indicators of both jacks remain operative, and the contacts at 10 are broken until both subscribers hang up their telephones. Then, however, the following occurs: The armature of the jack in which the plug 2 is inserted falls, because the spring *f* in that jack is pressed away from the + spring *e* and there in no longer a connection through the other station and the collar *l* with the + battery terminal. Hence the contact 10 is closed by armature 9 of the indicator *m* in this jack. The same would happen in the other jack were it not that a circuit is now closed through the + spring *e* and spring *f* in this jack (in which plug 1 is inserted) through the indicator *m* of this jack, collar *l*, plug-lines to spring *c* in the first-mentioned jack, (in which plug 2 still is,) and thence through contact 10 and armature 9 to relay *n* and the − battery terminal. Hence the relay *n* will give a clearing-out signal calling the operator's attention to the fact that the conversation is finished and the relay-signal—*e. g.*, sounding of a buzzer—will continue to be given until the operator pulls out the through connecting-plugs, and thus breaks the circuit.

The system can be equally well arranged for working with a common return in the calling-circuits, each station then having a third terminal connecting the bell with such common-return line or earth, while one generator-terminal is connected to said return line or earth, as the case may be.

Figs. 6 and 7 show the modifications in the subscribers' stations and the operator's set, respectively, for this purpose. At the subscribers' stations the switches *h* have contacts *x*, which they rest against when the receivers are on the hooks, and the bells *i* are connected to these contacts, on the one hand, and to earth or a common return *y* on the other hand. In the operator's set the wire 3 is similarly connected to a common return or earth *y* instead of being connected with the wire from the *a* terminal. The ringing in this case is effected by the generator *u* over the *b* terminal of operator's set, operator's plug-tip *p*, subscriber's jack-spring *c*, *b* terminal, *b* line to hook-switch *h* at subscriber's

set, and (as the receiver is on the hook) by contact x through the bell i to the common return or earth y. The speaking-circuits remain as before.

Where it is required to have translators in order to obtain induced speaking-currents capable of operating over long distances, the indicators m may be arranged to work as translators. In such case the indicator-coils are split, so that the current going to one station passes through one part of the coil and the current to the other station through the other part. Each portion then serves as a translator for the other. This is shown in Figs. 8, 9, and 10, which correspond with Figs. 1, 2, and 5, above explained, for the simple type of indicator. The arrangement of Fig. 8 differs from that of Fig. 1 only in that the indicators have split windings $m' m^2$, connected, respectively, with the a terminal and the collar l. In the operator's set, Fig. 9, the arrangement differs from that of Fig. 2 only in that the impedance-coil is split into two parts $j' j^2$, with the connection to the terminal z between them, while the part j' is connected to the speaking instruments t and r and the part j^2 to the generator-switch v. The calling and speaking circuits with this modified arrangement are substantially the same as with the first-described arrangement, the only difference being that each of the parallel battery-circuits during speaking contains the parts m' of one indicator and m^2 of the other, or one of the impedance-coil parts $j' j^2$ in place of one of the indicator parts. The diagram Fig. 10 will make this clear. In speaking, the high-frequency current in one part of the indicator-coil serves to induce corresponding current impulses in the other part, and these impulses will operate effectively in the receivers of stations at considerable distances. In this case, therefore, the calling-indicators serve also as impedance-coils, clearing-out indicators, and translators. They may further serve as self-inductors in a special calling apparatus, as explained below. If there are no back contacts 10 to armatures 9, the clearing-out signal is only a visible one given by both drops of two communicating stations falling back simultaneously when the second subscriber hangs up his telephone, as before explained with reference to Fig. 1. If, however, the contacts 10 are provided, the relay n is caused to give an audible or other suitable clearing-out signal, as already explained.

With the special calling apparatus about to be described a magneto-generator becomes unnecessary in the operator's set. Fig. 11 shows one arrangement for the purpose. The talking instruments r t and the key q are in lines normally connected between the operator's a and b terminals, with a connection through the impedance j to the z terminal, and a key 4 is provided for cutting out the speaking set and connecting a vibrator across the lines. This vibrator is similar to that used in an electric bell—*i. e.*, it has an electromagnet 5 and an armature 6, adapted to alternately make and break the circuit of the magnet. With this device after the operator has plugged in to the line to be called she has only to press the key 4. Current from the common battery o then passes through the springs e and f of the jack of the station to be called, the indicator m, the collar l, sleeve s of operator's plug to the a terminal of the operator's set, thence through the contact of armature 6, the coils of electromagnet 5, the key 4, and impedance-coil j to the z terminal of the operator's set and so to the — terminal battery. The armature 6 is thus attracted by the magnet 5 breaking the circuit above mentioned and stopping the flow of battery-current. The magnet is thus deënergized, the armature makes contact again, and a vibrating action is thus set up just as in an electric bell. At every break of the circuit during the vibration a very powerful self-induced current will be set up in the indicator and impedance-coils, and this current passes through the a and b lines of the subscriber to be called and acts through the condenser k to ring a polarized bell i at the subscriber's station.

Fig. 12 shows a diagram of the connections when simple indicator-coils m and impedance-coils j are used. The battery-current when it flows passes through the indicator and impedance coils in the reverse direction to that of the self-induced current, and consequently the self-induced current of the indicator-coil is assisted and increased by the self-induced current in the impedance-coil, and vice versa.

Fig. 13 shows the operator's set for calling with the special apparatus when split impedances $j' j^2$ are used, and Fig. 14 gives a diagram corresponding with Fig. 12, but showing the operator's split impedance-coil and the subscriber's split indicato-coil $m' m^2$. The action in this case is similar to that of Fig. 12; but the current impulses in the subscriber's calling-circuit on "break" in the operator's battery-circuit are due to a large extent to actual induction from indicator-coil m' to coil m^2 and impedance-coil j' to coil j^2. The advantage of this method of calling lies partly in the saving of the cost of an expensive generator and partly in the convenience which results from the giving of the call by simply pressing a key instead of by turning a generator-handle.

The self-inducing effect would be obtained in the calling apparatus if the impedance-coil of the operator's set were omitted or if a simple impedance j, as in Fig. 11, were used with double indicator-coils m' m^2, and I do not, therefore, limit myself to the use of such a coil or any one type of coil with this special calling device; but said device is applicable to all common-battery telephone installations in which there are impedances of suitable

type in connection with the line-circuits, either in the form of the indicators or as separate impedance-coils.

I desire to make it clear that I do not limit myself to any particular mechanical devices for effecting most of the operations hereinbefore mentioned.

The system is applicable to subscribers' sets of any type now usual. The relay or other common signaling apparatus at the central station may also of course take a number of forms and may give a visible or other signal, as is desired, and although I prefer the well-balanced arrangement wherein the two indicators are on opposite sides of the battery both indicators may be in some cases arranged on one side of the battery, while the other features of my invention and the calling arrangement which are applicable in such cases are retained. The device illustrated in Fig. 15, for example, is claimed to be within the scope of this invention. Fig. 15 shows one or two small modifications of the special calling apparatus. In this case an additional battery 7 is provided in the operator's set for increasing the strength of the calling-current, and in place of a separate switch 4 for operating the calling apparatus a back contact is provided at 8, against which the operator's hand-key *q* rests in its normal position. The calling-circuits are the same as above described, the only difference being that the battery 7 provides more current, if required, while the back contact 8 makes it possible for the one key *q* to be used for both calling and speaking purposes. The operator with this device has only to plug into the jack of the subscriber to be called, leaving the key *q* untouched, and the vibrating apparatus 5 6 will give the required call. By pressing the key *q* the operator will bring herself into speaking communication with the called station while simultaneously cutting out the calling apparatus 5 6. Similar arrangements are obviously applicable with split impedance-coils, as in Fig. 13; but it is needless to go further into such details.

What I claim is—

1. In a common-battery telephone system, the combination of the battery, the subscribers' stations and connecting-lines, a switching apparatus and an indicator at the central station in connection with each subscriber's station, and means for connecting the switching devices to bring two subscribers into communication, the switching apparatus, connecting means and indicators all being such that the two indicators of two communicating subscribers will be connected between the battery and the subscribers' stations one indicator at each terminal of the battery and that the two indicators will both remain on the lines when a conversation is proceeding, will serve together to give the line indications, the clearing-out signals and will also serve as impedance-coils in the system.

2. In a common-battery telephone system, the combination of the battery, the subscribers' stations and connecting-lines, a switching apparatus, and an indicator at the central station in connection with each subscriber's station, an operator's set including an impedance-coil and calling apparatus, and means for connecting the switching devices to bring the operator and a subscriber, or two subscribers into communication, said switching apparatus, connecting means and indicators being such that the indicators, or one indicator and the operator's impedance-coil, will become connected to opposite terminals of the common battery with the two telephone sets in parallel between the terminals of the indicators, or the indicator and impedance-coils, and that the indicators will serve to give the line indications, the clearing-out signals, and will also serve as impedance-coils.

3. In a common-battery telephone system, the combination of the common battery, the subscribers' stations and connecting-lines, indicators at the central station each in connection with one subscriber's lines, switching devices each in connection with one subscriber's station and with the indicator therefor and adapted to normally connect said indicator with one terminal of the common battery, and means for connecting any two stations through their switching devices, said means such that the indicator of one connected station has its connection changed from one terminal of the common battery to the other when the connection between two stations is made.

4. In a common-battery telephone system, the combination of the common battery, the subscribers' stations and connecting-lines, indicators at the central station each in connection with one subscriber's lines, jacks each having springs respectively in connection with the common-battery terminals, the indicator and the lines of one subscriber's station, and a pair of plugs with connecting-wires, said plugs adapted to be inserted in the jacks to connect two stations, and one of said plugs adapted to change the connection of the indicator through its jack from one terminal of the common battery to the other.

5. In a common-battery telephone system, the combination of the common battery, the subscribers' stations and connecting-lines, indicators at the central station each in connection with one subscriber's line, jacks each having springs respectively in connection with the common-battery terminals, the indicator and the lines of one subscriber's station, and a pair of plugs with connecting-wires, said plugs adapted to be inserted in the jacks to connect two stations, said plugs and connecting-wires such that they connect

one terminal of the common battery through the coils of one subscriber's indicator to the subscribers' stations in parallel, and through said stations to the other subscriber's indicator, through the coils of said indicator back to the other terminal of the common battery, whereby a balanced communicating system is produced.

6. In a common-battery telephone system, the combination of the battery, the subscribers' stations and connecting-lines, a switching apparatus and an indicator at the central station in connection with each subscriber's station, a signaling-relay and means connecting it with the battery and switching devices, means for connecting the switching devices, to bring any two subscribers' stations into communication, and connections adapted to be made by the indicators when not indicating such that a battery-circuit is established through the switching devices and means connecting same, and through the signaling-relay when both subscribers have broken their speaking-lines, whereby a clearing-out signal controlled by the indicator is given by the signaling-relay until the connection between the switching devices is broken.

7. In a common-battery telephone system, the combination of the common battery, the subscribers' stations and connecting-lines, indicators at the central station each in connection with one subscriber's lines, jacks each having springs respectively in connection with the common-battery terminals, the indicator and the lines of one subscriber's station, a pair of plugs with connecting-wires, said plugs adapted to be inserted in the jacks to connect two stations, a signaling-relay and means for connecting it to the battery and to a part in each jack, and connections adapted to be made by the indicators when not indicating such that a circuit is established from one battery-terminal through part of one jack, the through connecting-plugs, part of the other jack, and through the signaling-relay back to the other battery-terminal when both connected subscribers break their speaking-circuits, whereby a clearing-out signal controlled by the indicator is given which persists until the through connecting-plugs are withdrawn.

8. In a common-battery telephone system, the combination of the common battery, the subscribers' stations and connecting-lines, indicators each including two coils wound on the core, one of said indicators connected to the line of each subscriber, switching devices one in connection with each subscriber's station and the indicator thereof, and means for connecting the switching devices of any two stations, said means and switching devices such that the stations are connected to the common battery in parallel circuits each with one coil of one indicator and one coil of the other included therein, whereby the indicators will also serve as impedance-coils and translators for the respective speaking-circuits.

9. In a common-battery telephone system, the combination of the common battery, the subscribers' stations and connecting-lines, indicators each including two coils wound on the core, one of said indicators connected to the line of each subscriber, switching devices one in connection with each subscriber's station and the indicator thereof, an operator's set including a split impedance-coil and calling apparatus, means for connecting the operator's set with any one station, and through connecting means adapted to connect the switching devices of any two stations, said connecting means such that two stations, or the operator's set and one station, may be connected thereby to the common battery in parallel circuits each circuit including one coil of one indicator and one coil of the other or of the split impedance, whereby balanced speaking-circuits are produced.

10. In a common-battery telephone system, the combination of the common battery, the subscribers' stations and connecting-lines, indicators each including two coils wound on the core, one of said indicators connected to the line of each subscriber, switching devices one in connection with each subscriber's station and the indicator thereof, a signaling-relay and means connecting it with the battery and switching devices, means for connecting the switching devices of any two stations, said means and switching devices such as to connect the subscriber's sets and halves of the indicators in parallel balanced circuits on the terminals of the common battery, and connections adapted to be made by the indicators when not indicating such that a battery-circuit is established through the switching devices and means connecting them and through the relay when both subscribers have broken their speaking-lines, whereby a clearing-out signal is given by the relay until the connections between the switching devices are broken.

11. In a telephone system the combination of a common battery, the subscribers' stations each including telephone instruments and an audible signaling apparatus, connecting-lines for the subscribers' stations, an operator's set including a vibrator and key therefor, adapted to connect said vibrator directly across the operator s telephone-wires, an impedance, and means for connecting the operators set and a subscriber's lines in parallel to the terminals of the common battery through the impedance, whereby the pulsations of current allowed to pass through the battery and impedance by the vibrator are enabled to produce current impulses in the subscribers' lines which impulses in turn operate the subscribers' signaling apparatus.

12. In a telephone system the combination

of a common battery, the subscribers' stations each including telephone instruments and an audible signaling apparatus, connecting-lines for the subscribers' stations, an operator's set including a vibrator and a key therefor adapted to connect said vibrator directly across the operator's telephone-wires, indicators the coils of which are adapted to act as impedances in connection with each subscriber's lines, and means for connecting the battery and one indicator-coil in parallel to the operator's and one subscriber's sets, whereby the pulsations of current allowed to pass through the battery and coil by the vibrator are enabled to produce current impulses in the subscribers' lines which impulses in turn operate the subscriber's signaling apparatus.

13. In a telephone system the combination of a common battery, the subscribers' stations each including telephone instruments and an audible signaling apparatus, connecting-lines for the subscribers' stations; an operator's set including a vibrator and key therefor, means for connecting the operator's set to a subscriber's lines, an impedance-coil in the operator's set, indicator-coils in connection with the lines of each subscriber's station, and means for connecting the battery between the impedance-coil and indicator of the operator's set and subscriber's station respectively which are in communication, whereby the pulsations of current allowed to pass by the vibrator are enabled to produce current impulses in the lines which impulses in turn operate the subscriber's signaling apparatus.

14. In a telephone system the combination of a common battery, the subscriber's stations each including telephone instruments and an audible signaling apparatus, connecting-lines for the subscriber's stations, an operator's set including a vibrator and key therefor, means for connecting the operator's set to a subscriber's lines, a split impedance-coil in the operator's set, split indicator-coils in connection with each subscriber's lines, and means for connecting the battery between the impedance and indicator coils of the operator's and subscriber's sets which are in communication in such a way that the pulsations of current allowed to pass by the vibrator through one circuit are able to produce, in the impedance and indicator coils, induced current impulses in the other circuit capable of operating the subscriber's signaling apparatus.

15. In a telephone system the combination of a central battery, subscriber's stations each including telephone instruments and audible signaling apparatus, indicators with split coils, one indicator for each subscriber's set, an operator's set including a vibrator and key therefor, means for connecting the operator's set and a subscriber's station in balanced parallel circuits on the central-battery terminals, means for connecting two subscribers' stations in balanced parallel circuits on the central-battery terminals, a signaling-relay at the central station, and means controlled by the indicators and station-connecting means for closing the circuit of the relay when two communicating subscribers break their speaking-circuits.

16. In a telephone system the combination of a common battery, the subscribers' stations each including telephone instruments and an audible signaling apparatus, connecting-lines for the subscribers' stations, an operator's set including telephone instruments, a vibrator, a two-way key adapted to connect either the telephone instruments or the vibrator to the line-wires of the operator's set, an impedance, and means for connecting the battery and impedance in parallel to the operator's and one subscriber's sets, whereby the pulsations of current allowed to pass through the battery and impedance by the vibrator are enabled to produce current impulses in the subscribers' lines which impulses in turn operate the subscriber's signaling apparatus.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANCIS GEORGE BELL.

Witnesses:
HUBERT A. GILL,
LEON E. HAYNES.