No. 684,366. Patented Oct. 8, 1901.

G. GRABE & L. POLINKOWSKY.

TELEPHONE EXCHANGE APPARATUS AND CIRCUITS.

(No Model.) (Application filed May 25, 1901.) 5 Sheets—Sheet 1.

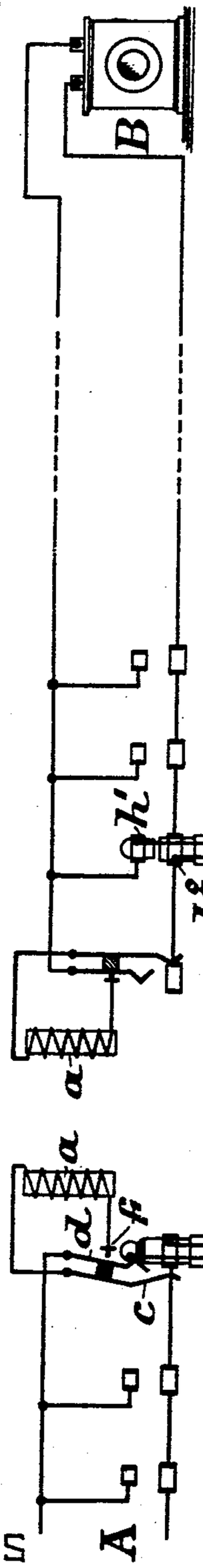

Fig. 1.

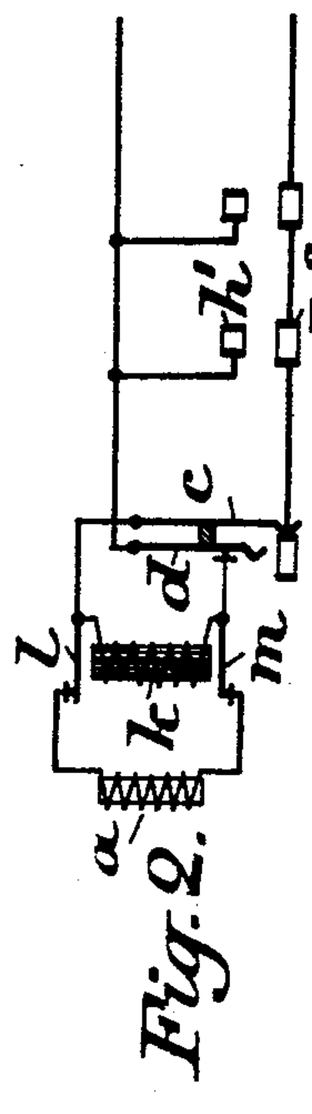

Fig. 2.

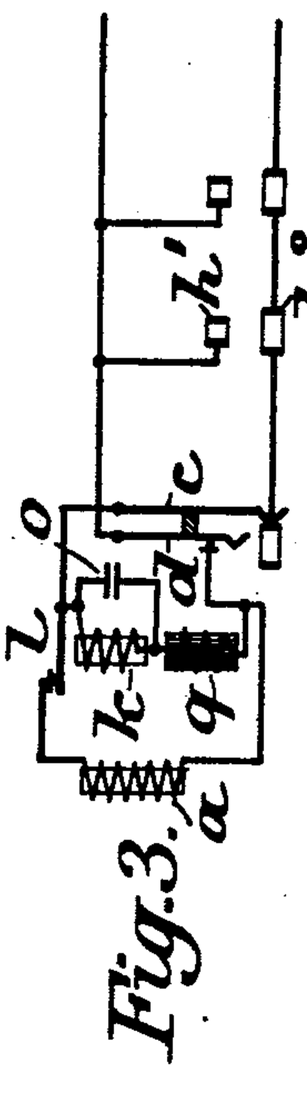

Fig. 3.

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No. 684,366. Patented Oct. 8, 1901.

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TELEPHONE EXCHANGE APPARATUS AND CIRCUITS.

(No Model.) (Application filed May 25, 1901.) 5 Sheets—Sheet 2.

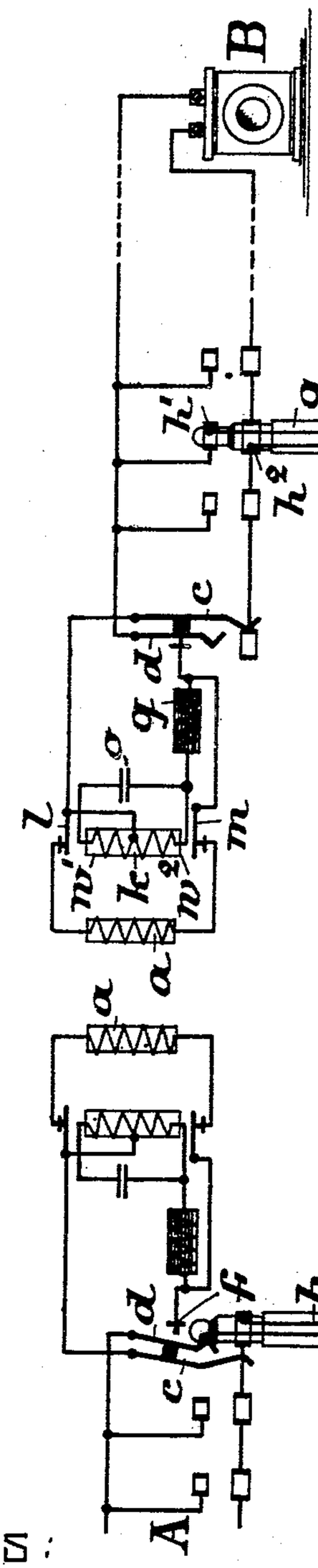

Fig. 4.

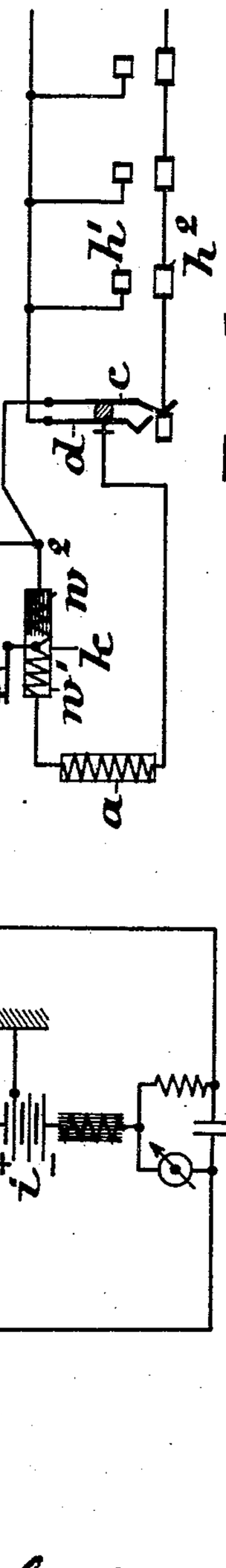

Fig. 5.

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TELEPHONE EXCHANGE APPARATUS AND CIRCUITS.

(Application filed May 25, 1901.)

(No Model.) 5 Sheets—Sheet 3.

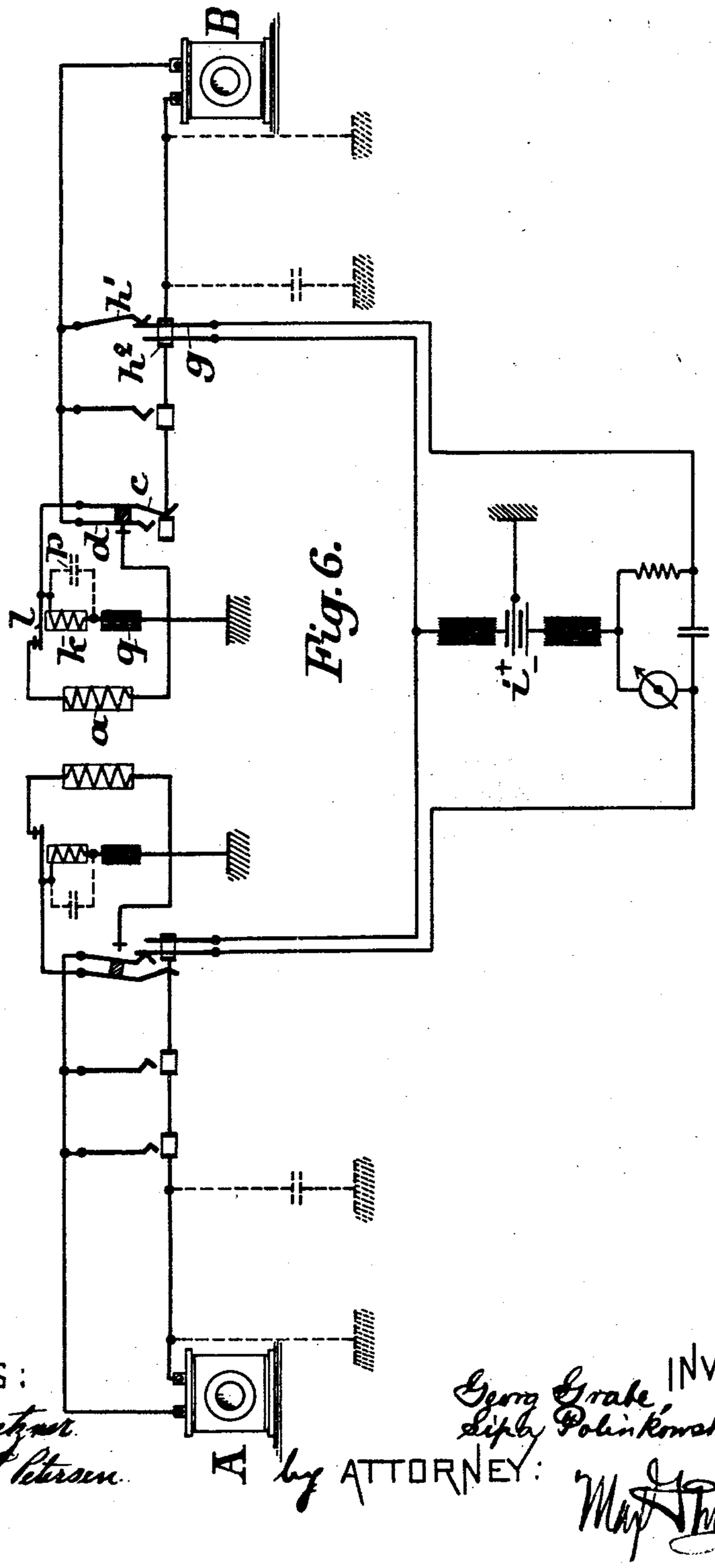

Fig. 6.

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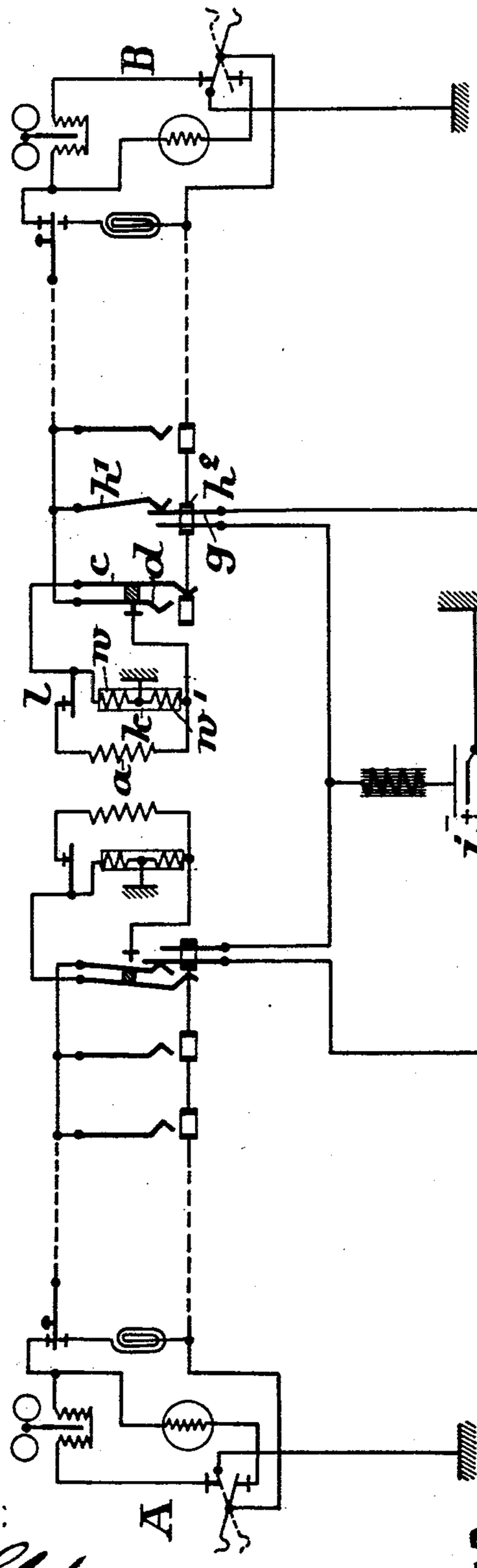
TELEPHONE EXCHANGE APPARATUS AND CIRCUITS.

(Application filed May 25, 1901.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 7.



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No. 684,366. Patented Oct. 8, 1901.

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TELEPHONE EXCHANGE APPARATUS AND CIRCUITS.

(No Model.) (Application filed May 25, 1901.) 5 Sheets—Sheet 5.

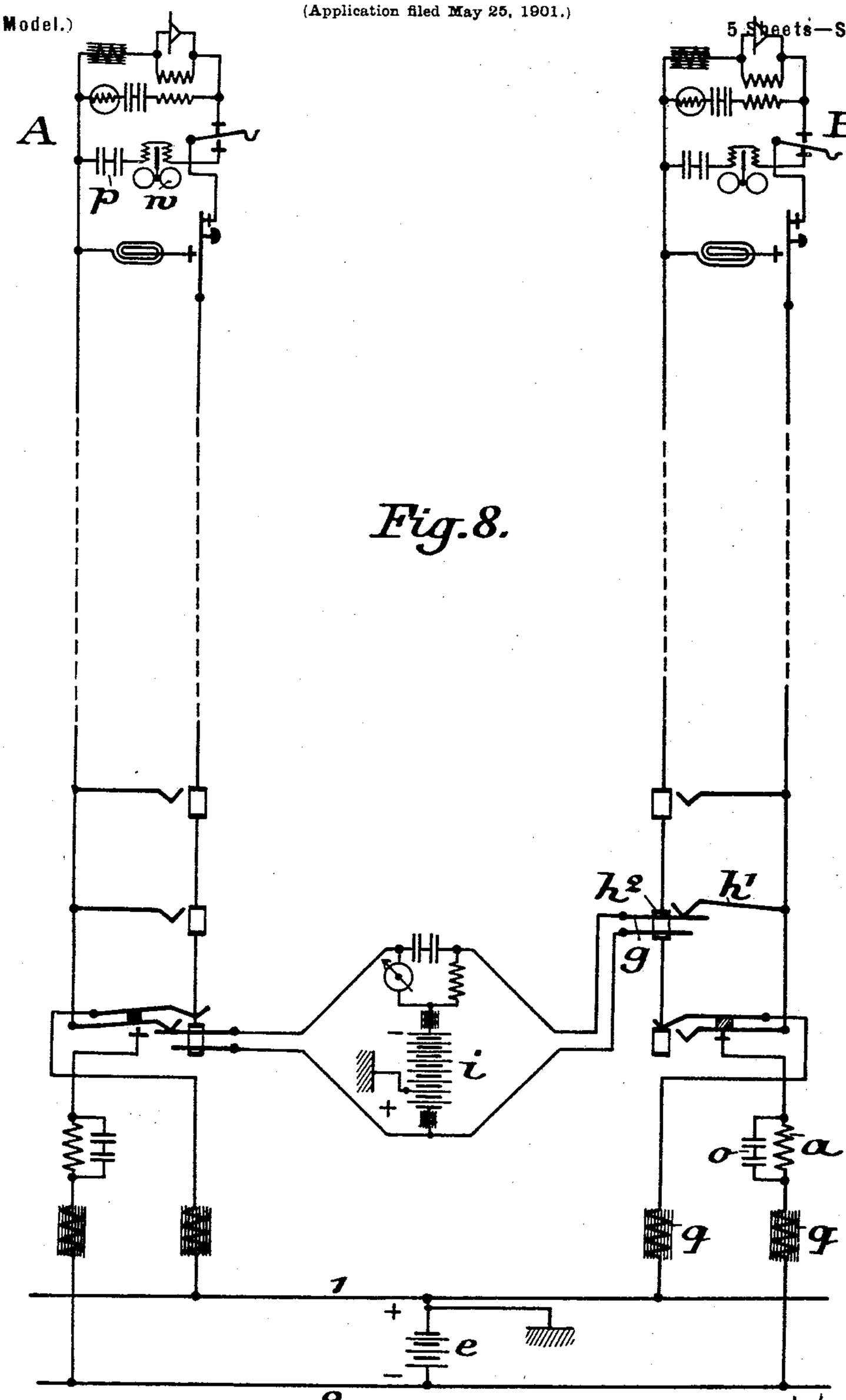

Fig. 8.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE APPARATUS AND CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 684,366, dated October 8, 1901.

Application filed May 25, 1901. Serial No. 61,941. (No model.)

To all whom it may concern:

Be it known that we, GEORG GRABE, engineer, a subject of the German Emperor, residing at 84 Ringerstrasse, Deutsch-Wilmersdorf, near Berlin, and LIPA POLINKOWSKY, mechanical engineer, a subject of the Russian Emperor, residing at 11 Neuenburgerstrasse, Berlin, Germany, have invented certain new and useful Improvements in Telephone-Exchange Apparatus and Circuits; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to telephonic installations with multiple switchboards and parallel branched simple subscribers' jacks; and has for its object, on plugging a subscriber's jack, to put a call-signal out of action without the use of special metallic conductors in addition to the metallic line conductors for transmitting the speaking or calling currents, which include the call-signal. According to the present invention this is effected on the plugging of a subscriber's jack by causing the current of a central-station battery connected with the plug-cords to pass through the introduced plug and through that part of one of the simple line-jacks which serves simultaneously as conductor of the speaking-current into the line-circuit, so as to influence the call-signal, either directly or through the action of a cut-out electromagnet, in such manner that, after the plugging, a calling-current sent through the line-wire is no longer capable of actuating the call-signal.

On the accompanying drawings are shown various arrangements of apparatus for carrying out the said method of operating, in which only the call-signal of the called subscriber is put out of action according to the present invention, while the call-signal of the calling subscriber is mechanically cut out by means of the answering-plug.

The same parts are indicated by the same letters of reference in all the figures.

Figure 1 is a diagrammatic view showing two substations connected across an exchange-board embodying our invention; Figs. 2 and 3, detail diagrammatic views illustrating two other modifications embodying our invention; Fig. 4, a view similar to Fig. 1, showing still another modification of our invention; Fig. 5, a detail diagrammatic view of still another modification of our invention; Figs. 6, 7, and 8, views similar to Fig. 1, showing further modified forms of our invention.

Fig. 1 shows two subscribers' circuits A and B connected to a central station. In the arrangements shown at Figs. 2 and 3, on the other hand, there are only shown those parts of the arrangements which differ from that shown in the first example in respect of the present invention. In the arrangement shown at Fig. 1 the call-signal magnets a a' are polarized for producing the desired effect. When the subscriber connected to circuit A for the purpose of calling the central station sends an alternating current or a continuous current of definite direction into the circuit, the call-signal a will be released. The operator then introduces in the known manner the answering-plug b into the answering-jack, so that by removing the jack-springs c d from the jack-socket or the contact f the call-signal is cut off at both poles from the circuit, and the operator then inquires the number of the desired substation. By the introduction of the connecting-plug g into the connecting-jack h' h^2 of the desired subscriber's circuit B, in which the call-signal a is still in condition for calling, the speaking connection between the two subscribers through the plug-cable is established, and at the same time a central-station battery i, which is connected bridgewise with the plug-cable and which in the case under consideration serves simultaneously as a testing and closing signal battery, is connected to the circuit of the desired subscriber. The current from this battery passes through the windings of the call-signal magnet a in such direction that the polarity thereof is increased. This increase of the polarity of the call-signal magnet has the effect that a calling-current, which is sent through the line-circuit while the latter is plugged, is not sufficient to release or bring into action the call-signal.

The arrangement of the invention shown

at Fig. 2 is distinguished from that above described in that the current of the local battery, which is connected up by means of the connecting-plug, does not directly influence the call-signal, but by acting upon a cut-out electromagnet disconnects the same from the line-circuit during the continuance of the plugging. The call-signal *a*, which, as in the previous case, is polarized, is connected to the line-circuit through the armatures *l* and *m* of the electromagnet *k*, connected in parallel thereto. The cut-out electromagnet *k* possesses a high degree of self-induction. A calling-current sent by the subscriber into the line-circuit is enabled to actuate the call-signal, which only possesses slight self-induction, before the electromagnet *k* can cut out the call-signal by the attraction of its armatures *l* and *m*, as the arriving current impulse in consequence of the high self-induction of the coil of the cut-out electromagnet is considerably retarded in its increase in the latter. On introducing the connecting-plug into the jacks h' h^2 the electromagnet *k* as also the call-signal *a* are actuated by a current coming from the local battery *i* in such a direction that the electromagnet cannot actuate the call-signal in consequence of its polarization. The magnet *k* is, however, excited by this current, and by the attraction of its armatures *l* and *m* effects the cut-out at both poles of the call-signal magnet *a* from the line-circuit while the plugging continues. In consequence of the high self-induction of the magnet-coil *k* the passage of the speaking-current through the same from the one side of the line-circuit to the other is prevented. This arrangement of the apparatus could be modified in such wise that the call-signal magnet *a* is not polarized, but is provided with the least possible self-induction and a higher ohmic resistance than the coil *k* of the cut-out electromagnet, which is connected in parallel and has a high self-induction. Before connecting up the station-battery by the insertion of the connecting-plug in one of the subscriber's jacks a calling alternating current sent through the line-circuit will therefore in consequence of the high self-induction of the magnet-coil only actuate the call-signal, or will at any rate release this before the electromagnet *k* can attract its armatures *l* and *m*. The continuous current of the station-battery connected up by the plug, and which has a less intensity than the calling-current, flows both through the winding of the call-signal *a* and that of the cut-out electromagnet. In consequence of the high ohmic resistance of the call-signal winding this current does, however, not attain sufficient strength in such winding for actuating the call-signal, while the core of the magnet-coil *k* (which has much less ohmic resistance) will be sufficiently magnetized thereby to attract the armatures *l* and *m*, and thereby to cut out the call-signal. The same action might be obtained by giving the call-signal a less degree of sensitiveness than the cut-out electromagnet instead of a high ohmic resistance.

In the arrangement at Fig. 3 a cut-out electromagnet *k* is also used, arranged in parallel with the call-signal *a*, and which electromagnet has its armatures arranged so that when the said electromagnet is not energized the call-signal will be included in the circuit of the branch lead of the line-circuit which starts from the springs *c* and *d* of the answering-plug. In series with the winding of the cut-out magnet *k* (with which is combined bridgewise a polarizing-cell *o*, or it might be a condenser) is placed a choking-coil *q*. A portion of the current from the station-battery, which is connected to the line-circuit by the introduction of the calling-plug into one of the line-jacks h' h^2, passes through the windings of *k* and *q*, while another portion passes through the call-signal magnet. The latter is, however, not put in action, because it is either so polarized that only a current in the contrary direction can actuate it or because the sensitiveness or the resistance of this magnet are suitably proportioned to the cut-off electromagnet. The electromagnet *k*, on the other hand, is excited by the said current, and by the attraction of its armature *l* cuts out the call-signal *a* from the line-circuit. If the line is not plugged, a calling alternating current will actuate the call-signal *a*, but not the cut-out magnet *k*, because the choking-coil *q* in front of it only allows a small branch current to pass through, which then finds a better passage through the cell *o* than through the magnet-windings. The choking-coil also has for its object to prevent the weakening of the speech by the branching off of the speaking-currents into the branch circuit of the cut-out device.

In the arrangement shown at Fig. 4, which again represents two subscribers' circuits A and B, connected through a central station, the cut-out electromagnet *k* has two windings w' and w^2, which on the passage of a current neutralize each other and of which w' is barred against a continuous current of a certain pressure by means of a polarizing-cell *o* or several such. The choking-coil *q* in front of the electromagnet *k* serves the same purpose as described with reference to Fig. 3. The small portion of the calling alternating current which can still penetrate through it branches off through the windings w' and w^2 of the cut-out magnet, so that the iron core thereof is not excited on the above-mentioned ground, only the coil-signal being actuated. The current from battery *i*, connected to the line by the calling-plug *g*, on the other hand, is stopped by polarizing-cell *o*, placed before the winding w', and can only pass through the winding w^2. The cut-out electromagnet is therefore actuated by this current and cuts the call-signal *a* off from the line-circuit by the attraction of its armatures *l* and *m*.

Fig. 5 shows an arrangement in which the

polarized call-signal magnet a is connected in series with the cut-out magnet k, having the reverse polarity. The latter has two windings w' and w^2, of which w' has a small resistance and small self-induction, while w^2 has a high resistance and high self-induction. When in the condition of rest, the winding w^2 is short-circuited through the armature l, the electromagnet being made of such sensitiveness that the armature is actuated already at the commencement of every current impulse of corresponding polarity. On the passage of a calling alternating current the winding w^2 will therefore be continuously put in and out of circuit. The calling-currents passing through the call-signal are consequently of different strength with reference to the call-signal, according to their direction, the current impulses whose direction is opposed to the polarity of the electromagnet k being the stronger ones, because they only pass through the winding w' in consequence of the short-circuiting of winding w^2. As the call-signal magnet has the contrary polarity to that of the short-circuiting magnet, the said stronger current impulses can actuate the former if the corresponding line-circuit is not plugged at the central station. The continuous current which is connected to the line-circuit by the calling-plug has such a direction that it strengthens the polarity of the call-signal magnet. The short-circuiting magnet k, having the reverse polarity of the call-signal magnet, is, however, permanently actuated by the said current, so that the inductive winding w^2 is connected up in front of the call-signal during the time of the plugging. A calling-current now passing through the line-circuit will therefore be choked by the winding w^2, so that neither the short-circuiting magnet nor the call-signal can be actuated thereby. The inductive winding w^2 serves as a choking-coil, as will be obvious to those skilled in the art.

In the arrangement shown at Figs. 6 and 7 the call-signal is cut off from the line-circuit by means of an electromagnetic switch whose magnet-winding is interpolated between the jack-circuit and earth, so that on the plugging of a jack a current passes through it from a station-battery connected to earth, which actuates the cut-out electromagnet.

In the arrangement shown at Fig. 6 the full lines relate to telephone installations with metallic return-line conductor, while the dotted lines only relate to installations with earth-return conductors. The call-signal a is polarized and is connected with the plug-circuit through the armature l of the cut-out electromagnet k, which on the one hand is connected with the lead passing from the spring c of the answering-plug and on the other hand with earth. The calling alternating current effects the release of the call-signal; but even with earth-return it does not actuate the cut-out electromagnet k, because of the choking-coil q, placed in front of it. The current of the battery i, which is put in connection by the plugging of the line-jack h' h^2 by means of the calling-plug g, has such a direction that the call-signal a does not call. The part current from this battery passing through earth excites the cut-out electromagnet k, so that the call-signal is cut off from the jack-circuit during the continuance of the speaking connection. In the case of an earth-return conductor a branching of the current of the battery i may be prevented by the introduction of a polarization-cell or a condenser in the earth connection of the socket-circuit, as indicated by dotted lines. In order to prevent action of calling-currents upon the cut-out electromagnet k, the latter is bridged over by a polarized cell p.

In the arrangement shown at Fig. 7 the cut-out electromagnet k has upon one and the same core two oppositely-connected windings w w'. One end of each of these windings is connected with the one side of the plug-circuit containing the call-signal a. The other two connected ends are put to earth. The oppositely-connected windings w w' of the cut-out electromagnet have such relation to each other that a current passing through both windings in series from the metal return-line circuit has no action upon the iron core, because the magnetizing action of the two windings neutralize each other. A calling-current passing through the metal return-line circuit can, therefore, not actuate the cut-out electromagnet. The battery i, connected by the calling-plug g to the jack-circuit, consists of two equal groups of elements having the same-named poles arranged opposite to each other and connected to earth. Consequently a current is sent from the battery through earth to the cut-out magnet k, where it branches equally into the windings w w', whence it passes on the one hand through jack-spring c and neck of the plug g and on the other hand through spring d and point of the plug back to the battery. The two windings of the cut-out electromagnet consequently have currents passing through them in a direction to support each other, therefore, in their magnetizing action on the iron core, so that the armature l will be attracted and the call-signal be cut out from the line-circuit.

Fig. 8 is an arrangement of the invention for telephone installations with common microphone and call batteries. The action of this arrangement is in principle the same as that described with reference to Fig. 1. The current of the common call-battery put in action by the lifting off of the telephone-receiver and which usually releases the call-signal is prevented from so acting on the call-signal by a current which is sent into the line-circuit by the introduction of the calling-plug into a line-jack, such current coming from the common microphone-battery included in the plug-circuit. The line-circuits of two subscribers' stations A B (shown in connection) terminate after passing through all

the jacks *h* in two parallel circuit branches 1 2, containing in bridgewise connection the call-battery *e*. The current of this call-battery common to all the line-circuits is after lifting off the telephone-receiver from the hook-switch, as indicated for station A, closed through the hook-switch and the branch of the line-circuit containing the microphone, the primary winding of the induction-coil, and a choking-coil. On hanging on the telephone-receiver—*i. e.*, in the position of the hook-switch, as shown at station B—no current flows from the battery *e* through the line-circuit to the call-signal *a* in consequence of the barring action of the polarization cells or condensers *p*, arranged before the alternate-current alarm *w*. The polarization-cells *o*, which are connected in parallel to the call-signal, have the object of protecting the polarized call-signal in the known manner against any disturbing influence through excessively-strong continuous currents. Choking-coils *q*, arranged in both branches of the jack-circuits, prevent a weakening branching off of the speaking and calling alternating currents. The battery *i*, connected to the line-circuit by the calling-plug *g*, is in this case at the same time the central microphone-battery. The current of this battery acts in opposition to the current of the call-battery *e* relatively to the polarized call-signal *a* of the subscriber B, which is still in readiness for calling in the jack-circuit, so that the said call-signal *a* cannot be released by the call-battery on the lifting off of the telephone-receiver at the desired station.

Having now particularly described and ascertained the nature of our said invention and the manner in which the same is to be performed, we declare that what we claim is—

1. In a branch terminal multiple exchange-board, the combination, with a substation-circuit, and an individual annunciator included therein, of electromagnetic means included in said circuit and arranged to prevent the actuation of said annunciator, said electromagnetic means being arranged to be actuated by a current of different character from that which will actuate the annunciator, means for supplying current to actuate the annunciator and separate means for supplying current to actuate the said electromagnetic means.

2. In a telephone system, the combination, with a substation-circuit, of two electromagnetic devices connected to said circuit, one device being an annunciator and the other device being an apparatus for rendering the annunciator inoperative, said devices being arranged to be actuated each by a current of different character from that which will actuate the other device, and means for supplying to the devices the two kinds of current necessary to actuate each device.

3. In a branch terminal multiple exchange-board, the combination, with a pair of substation-lines, jacks connected to said lines in parallel with each other, and an individual annunciator inside the jacks and bridging the pair of substation-lines, of means for supplying two kinds of current to the substation-lines inside the jacks, and electromagnetic means operated by one only of said two kinds of current and arranged to render the annunciator inoperative.

4. In a branch terminal multiple exchange-board, the combination, with a substation-circuit, and jacks in connection therewith, of means for supplying two kinds of current to the substation-circuit inside said jacks, an individual annunciator in said circuit inside the jacks and arranged to be actuated by one kind of current, and means for preventing the actuation of said annunciator, said means being arranged in parallel with the annunciator and arranged to be operated by the other kind of current.

5. In a branch terminal multiple exchange-board, the combination, with a substation-circuit, jacks connected therewith, a plug arranged to enter any desired jack, a plug-circuit connected therewith, and means for supplying two kinds of current to the plug-circuit and to the substation-circuit respectively, of an individual annunciator located in the substation-circuit and in parallel with the plug-circuit, said annunciator being arranged to be actuated by the current supplied to the substation-circuit only, and means arranged to be actuated by the current supplied to the plug-circuit and to render the annunciator inoperative.

In testimony whereof we have affixed our signatures in presence of two witnesses.

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LIPA POLINKOWSKY.

Witnesses:
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WOLDEMAR HAUPT.