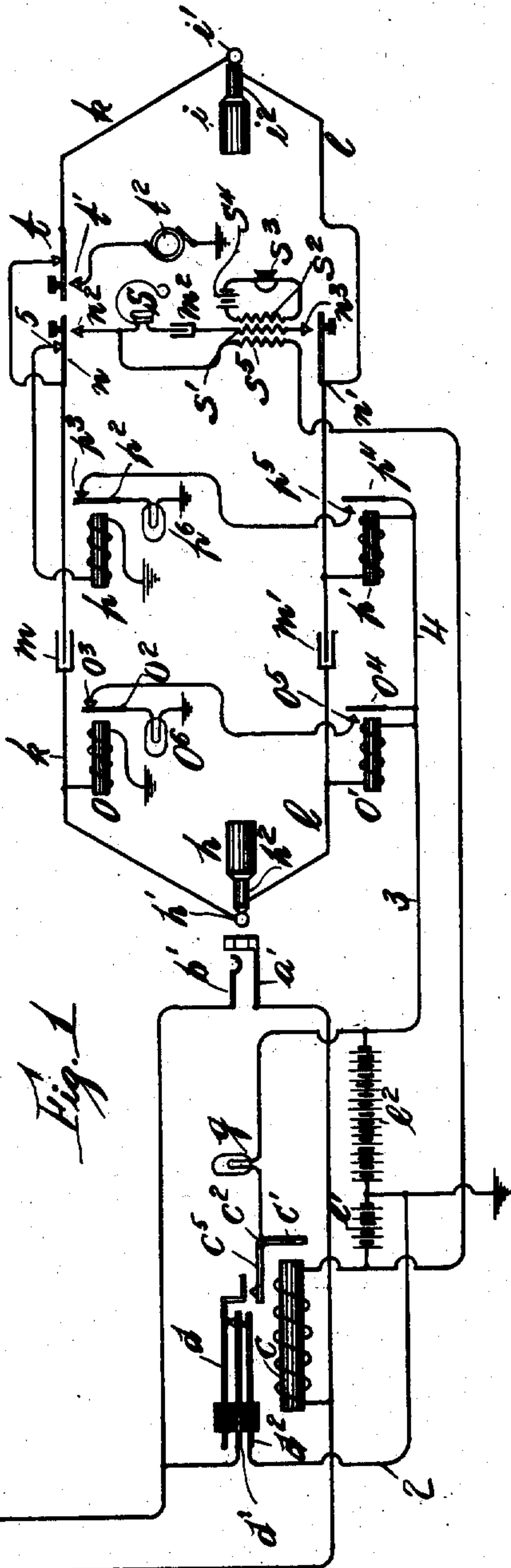
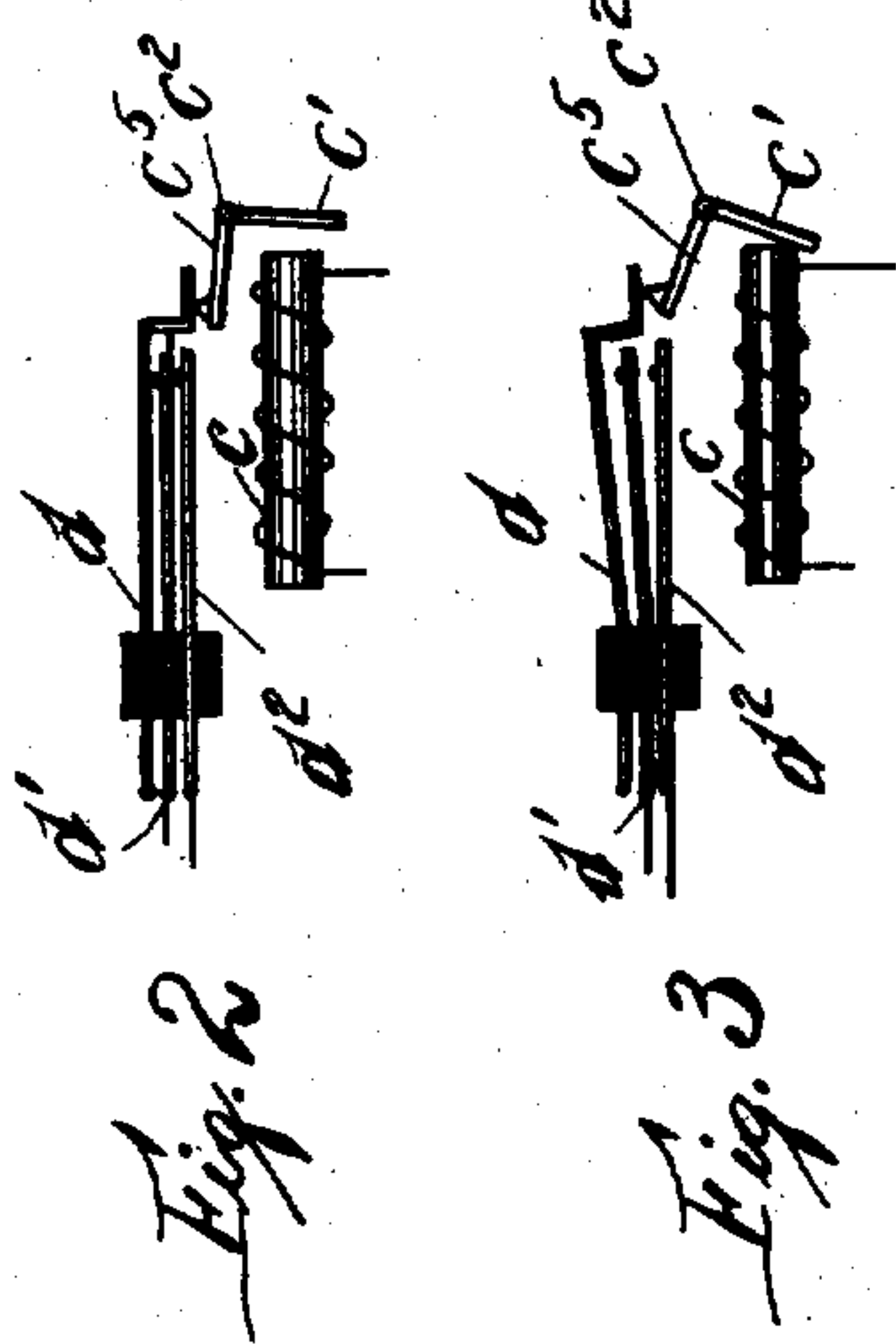


No. 897,243.

PATENTED AUG. 25, 1908.

H. G. WEBSTER.  
TELEPHONE SYSTEM.

APPLICATION FILED NOV. 6, 1907.



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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

No. 897,243.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Original application filed March 27, 1903, Serial No. 149,833. Divided and this application filed November 6, 1907. Serial No. 400,971.

*To all whom it may concern:*

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has for its object the provision of improved signaling apparatus.

This application, which is a division of my prior application, Serial #149,833, filed March 27, 1903, is drawn to one species of the invention covered by said prior application.

In accordance with my invention, I provide at the central station a signal-controlling electromagnet which is under the joint control of the subscriber at the substation and the operator at the central office. This electromagnet is preferably a relay magnet having a single energizing winding and operating to control a suitable signal, such as a lamp. In operation, the relay is energized to a limited extent to cause the display of its signal by the closing of the line circuit at the substation, thus calling the attention of the operator to the fact that the subscriber desires a connection. It is further energized by the operator, preferably by the insertion of the connecting plug into the spring-jack or socket of the calling subscriber, to cause the effacement of said signal. Preferably, the initial energization is produced by including a battery of low voltage in circuit with the electromagnet winding and the further energization, by including a battery of higher voltage in circuit.

I have illustrated my invention in connection with a signal-controlling electromagnet in the form of a relay having a single armature adapted to partake of an initial movement under the control of the subscriber, and to partake of a final movement under the control of the operator, the initial movement serving to actuate the signal for the connection, and the final movement serving to render the signal inert. These movements may also be utilized for performing other functions, if desired. While I have thus shown the magnet with a single armature adapted to partake of the two distinctive movements, it is apparent that this selective operation may be procured in other ways, and I do not

therefore desire to limit myself to this particular feature of construction.

The specific character of the invention will be more fully understood upon reference to the following description, taken in connection with the accompanying drawing, and its novelty will be specifically pointed out in the appended claims.

Figure 1 of said drawing is a diagram illustrating my invention in connection with a two-wire metallic circuit telephone system; Fig. 2 is a detailed view, showing the armature of the relay in its intermediate position; and Fig. 3 is a similar view, showing the armature in its final position.

Throughout these views, like characters refer to like parts.

Referring first to Fig. 1, the telephone line extends from substation A in two line limbs  $a-b$  to the central station, where the limbs terminate, respectively, in the sleeve  $a'$  and spring  $b'$  of the spring-jack or connection socket. A relay  $c$  is provided, which is illustrated diagrammatically as a core and a winding provided thereon, and this relay is connected in circuit between limb  $a$  and ground. A battery  $e'$  of low voltage—say, ten volts—is included in circuit between the winding of the relay  $c$  and ground. The armature  $c'$  of the relay is pivoted at  $c^2$  and carries an arm  $c^5$ , which moves with the armature and is adapted electrically and mechanically to engage a contact-spring  $d$ . The spring  $d$  normally rests against a contact-spring  $d'$ , which in turn normally rests against a third contact-spring  $d^2$ . The contact-spring  $d'$  is connected to the limb  $b$  of the telephone line, and the contact-spring  $d^2$  is connected through the branch 2 to ground. A second battery  $e^2$ , of a voltage higher than the battery  $e'$ —say, thirty volts—is included in a branch extending from the pivot-point  $c^2$  of the armature  $c'$  to ground. This branch includes the signal  $g$ , which is preferably an electric lamp. The batteries  $e'$  and  $e^2$ , as shown, are arranged in series and with an intermediate common ground.

The connecting apparatus at the central station comprises plugs  $h-i$ , the plug  $h$  being provided with a tip  $h'$  and a sleeve  $h^2$ , while the plug  $i$  is provided with a tip  $i'$  and sleeve  $i^2$ . The tips are connected by means



of the tip-strands  $k-k$ , separated by a condenser  $m$ , while the sleeves are connected by means of the sleeve-strands  $l-l$ , similarly separated by condenser  $m'$ . There are four relays,  $o, o', p, p'$ , associated with the strands  $k-k$  and  $l-l$ . A conductor 3, extending from the live pole of the battery  $e^2$ , completes a path through the winding of the relay  $o'$  to the strand  $l$  on the answering side of the condenser  $m'$ , and a conductor 4 completes a circuit from the same pole of the battery  $e^2$ , through the winding of the relay  $p'$ , to the strand  $l$  at the calling side of the condenser  $m'$ . The relay  $o$  has its winding included in a grounded branch extending from the strand  $k$  at the answering side of the condenser  $m$ , and the winding of the relay  $p$  is included in a similar grounded branch extending from the strand  $k$  at the calling side of the condenser  $m$ . The latter branch is adapted to be broken at the contact 5 when the lever  $n$  of the listening-in key is moved from its normal position. The relay  $o$  is provided with a contact-spring  $o^2$  which normally rests against an anvil  $o^3$ , and the relay  $o'$  is provided with a similar contact-spring  $o^4$  which is normally out of contact with the anvil  $o^5$ . A signaling lamp  $o^6$  is included in a grounded branch extending from the contact  $o^2$ , the contact  $o^4$  is connected to the live pole of the battery  $e^2$ , and the anvils  $o^3$  and  $o^5$  are conductively united. Likewise, the relay  $p$  is provided with a contact-spring  $p^2$ , which normally rests against an anvil  $p^3$ , and the relay  $p'$  is provided with a contact-spring  $p^4$ , which normally remains out of engagement with an anvil  $p^5$ . A signaling lamp  $p^6$  is included in the grounded branch extending from the contact  $p^2$ , the contact  $p^4$  is directly connected to the live pole of the battery  $e^2$ , and the anvils  $p^3$  and  $p^5$  are electrically united. The levers  $n-n'$  of the listening-in key normally rest away from the anvils  $n^2-n^3$ , between which anvils the telephone-receiver  $s$ , the secondary winding  $s'$  of the induction coil, and the condenser  $m^2$  are included in series. The primary  $s^2$  of the induction coil, the transmitter  $s^3$  and the battery  $s^4$  are included in a local circuit. The tertiary winding  $s^5$  is included in a path extending from the anvil  $n^2$  to the live side of the low voltage battery  $e'$ . The ringing-key  $t$  is adapted, when depressed, to engage an anvil  $t'$  to which one pole of the generator  $t^2$  is connected, the other pole being connected to ground.

At the substation A, I have illustrated usual substation apparatus, comprising a telephone-hook  $v$  normally resting against an anvil  $v'$ , which is connected to a bell  $v^2$ , and condenser  $v^3$  to the limb  $b$  of the telephone line. The hook  $v$  is connected to the limb  $a$  of said telephone line. When the telephone-receiver  $v^4$  is removed from the hook  $v$ , the latter engages anvil  $v^5$ , which is

connected through the primary winding  $v^6$  and transmitter  $v^7$  to the limb  $b$  of the telephone line. Receiver  $v^4$  is included in a local circuit with the secondary winding  $v^8$  of the induction coil. The substation equipment, herein described, is merely illustrative and obviously any other desired equipment may be employed without departing from the spirit of the present invention.

Assuming that a party at substation A desires to converse with a party at another substation, he removes his telephone-receiver from its switch-hook and thus conductively unites the limbs  $a$  and  $b$  of the telephone line at the substation. A circuit, including low voltage battery  $e'$ , is thereby closed. This circuit extends from the live pole of said battery, through the winding of the relay  $c$ , limb  $a$ , hook-switch  $v$ , anvil  $v^5$ , primary winding  $v^6$ , transmitter  $v^7$ , limb  $b$ , contact-springs  $d'-d^2$  and branch 2 to the grounded side of the battery  $e'$ . This energizes the relay  $c$  sufficiently to bring the arm  $c^5$  and the spring-contact  $d$  into engagement, thereby closing a circuit from the live side of the battery  $e^2$ , through the signal lamp  $g$ , arm  $c^5$ , springs  $d, d', d^2$ , and conductor 2, to the grounded side of the battery  $e^2$ . This energization of the relay  $c$  is insufficient to cause the arm  $c^5$  to press against the spring  $d$  hard enough to press the springs  $d, d'$  and  $d^2$  apart in the manner illustrated in Fig. 3, but, without separating these springs, brings the arm  $c^5$  and spring  $d^2$  into electrical engagement in the manner shown in Fig. 2. The lamp  $g$ , being thus lighted, conveys to the operator the signal for connection.

It should be noted that the flow of current from the battery  $e^2$ , through the signal lamp  $g$ , does not interfere with the flow of current from the battery  $e'$  through the winding of the relay  $c$ , owing to the negligible resistance of the conductor 2, which is connected to the common ground. At this time, relay  $c$  is energized, as before, over a circuit extending from the live pole of battery  $e'$ , through the winding of said relay, over line limb  $a$ , through the substation, back over line limb  $b$ , through contacts  $d', d^2$  of relay  $c$ , and through conductor 2 to the grounded pole of the battery  $e'$ . Thereupon the operator inserts the plug  $h$  into the spring-jack belonging to the line of subscriber A, and thereby completes a second circuit through the winding of the relay  $c$  as follows: from the live pole of the battery  $e^2$ , through conductor 3, winding of the relay  $o'$ , strand  $l$ , sleeve  $h^2$  of the plug  $h$ , sleeve  $a'$  of the jack, limb  $a$ , the winding of the relay  $c$ , through the battery  $e'$  to the opposite pole of the battery  $e^2$ , thus including a potential of forty volts in circuit since the batteries  $e'$  and  $e^2$  are included in series by this connection. This circuit energizes the relay  $c$  sufficiently to draw the armature  $c'$  into the position



illustrated in Fig. 3 and thereby separate the springs  $d$ ,  $d'$  and  $d^2$ . This breaks the circuit of the signal lamp  $g$  and breaks the ground connection of the limb  $b$  of the telephone line. The operator now depresses her listening-in key and thus bridges her telephone in circuit and learns the wishes of the calling party. She then touches the tip  $i'$  of the plug  $i$  to the sleeve  $a$  of the spring-jack of the called subscriber and tests to ascertain whether or not the line is busy. If the line is busy, there will be a potential, due to both batteries  $e'$  and  $e^2$  upon the sleeve  $a'$ , by reason of the circuit through the relay  $o'$ , the strand  $l$ , and the relay  $c$ , by which the latter is given its greatest energization. Since, when the listening-in key lever  $n$  is depressed, the tip  $i'$  will be directly connected through the tertiary winding  $s^5$  of the induction coil to the live pole of the battery  $e'$ , it will have a potential less than that of the sleeve  $a'$  of the jack, and a momentary current will flow through the tertiary winding and produce a "click" in the receiver  $s$ , thus indicating the busy condition of the line. If, however, the line is not busy, the plug  $i$  will be inserted in the spring-jack and the ringing key  $t$  depressed to send a calling current over the line of the called party.

The insertion of the plug  $i$  closes circuit through the relay  $p'$  as follows: extending from the live pole of the battery  $e^2$ , through the conductors 3 and 4, the winding of the relay  $p'$ , the strand  $l$ , sleeve  $i^2$ , sleeve  $a'$  of the jack of the line of the called party, a portion of the limb  $a$ , the winding of the relay  $c$ , the low voltage battery  $e'$  of the called party's line to ground and thence by the ground path to the grounded pole of the battery  $e^2$  of the calling party's line. This will sufficiently energize the relay  $p'$  to draw its contact  $p^4$  into engagement with the anvil  $p^5$  and close the grounded branch through the signal lamp  $p^6$ , causing it to light. This same circuit will energize the relay  $c$ , associated with the line of the called party, sufficiently to separate the spring-contacts  $d$ ,  $d'$  and  $d^2$  associated therewith, and thereby remove the control of the associated signal  $g$  from said party. As soon as the called party responds and lifts his receiver from the telephone hook, a circuit is closed from the battery  $e'$ , through the winding of the relay  $c$ , limbs  $a$  and  $b$  of the telephone line of said party, the strand  $k$  and the winding of the relay  $p$ , to ground. This will sufficiently energize the relay  $p$  to cause it to attract its contact  $p^2$  and thereby break the circuit of the lamp  $p^6$  and cause its extinguishment, thereby indicating to the operator that the called party has responded. In a similar manner, when the plug  $h$  was inserted in the jack of the substation A, the relays  $o$  and  $o'$  were energized so as to close the circuit of the lamp  $o^6$  at the anvil  $o^5$  and

break the same at the anvil  $o^3$ . Thus, while both subscribers are in conversation and their receivers are removed from their hooks, the lamps  $o^6$  and  $p^6$  are extinguished; but as soon as either party hangs up his receiver, the corresponding relay  $o$  or  $p$  is deenergized and the associated contacts are brought together, thereby completing the lamp circuit and causing it to be displayed. When both lamps are thus displayed, it is a signal to the operator for disconnection, and as soon as she withdraws plugs  $h$  and  $i$ , the lamps  $o^6$  and  $p^6$  will be extinguished and the parts returned to normal position.

Obviously, many alterations and modifications may be made in the structure disclosed herein, without departing from the spirit and scope of my invention. I, therefore, do not wish to be limited to the specific matter disclosed, but aim to cover, by the terms of the appended claims, all such alterations and modifications.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and link-circuit, a signal associated with said connected line and cord-circuit, current sources of different potentials, a controlling electromagnet for said signal, means under the control of the subscriber for energizing said electromagnet by current from one of said sources, means under the control of the operator for energizing said electromagnet by current from another of said sources, and means responsive to the one energization to display said signal and to the other energization to efface said signal.

2. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and link-circuit, a call signal associated with said line at the central office, current sources of different potentials, a controlling electromagnet for said signal, means under the control of the subscriber for energizing said electromagnet by current from one of said sources, means under the control of the operator for energizing said electromagnet by current from another of said sources, and means responsive to the initial energization to display said signal and to the subsequent energization to efface said signal.

3. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and link-circuit, a call signal associated with said line at the central office, current sources of relatively



high and low potentials, a controlling electromagnet for said signal, means under the control of the subscriber for energizing said electromagnet by current supplied from said low potential source, means under the control of the operator for displacing said low potential supply by a supply from said high potential source, and means responsive to the initial energization to display said signal and to the modified energization to efface said signal.

4. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, a signal, a controlling electromagnet for said signal, a battery, means for closing a circuit through a number of cells of said battery, and an energizing winding of said electromagnet, means for including a different number of cells of said battery in circuit with an energizing winding of said electromagnet, and means responsive to the one energization to display said signal and to the other energization to efface said signal.

5. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, a signal, a controlling electromagnet for said signal, a battery, means under the control of the subscriber for closing a circuit through a number of the cells of said battery and an energizing winding of said electromagnet, means under the control of the operator for including a different number of cells of said battery in circuit with an energizing winding of said electromagnet, and means responsive to the one energization to display said signal and to the other energization to efface said signal.

6. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and link-circuit, a signal, a controlling electromagnet for said signal, a battery, means under the control of the subscriber for closing a circuit through part of the cells of said battery and an energizing winding of said electromagnet, means under the control of the operator for including a greater number of cells of said battery in series with said energizing winding, means responsive to the former energization to establish one condition of said signal and means responsive to the latter energization to establish another condition of said signal.

7. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, a signal, a controlling electromagnet for said

signal, a battery, part of the cells of said battery and an energizing winding of said electromagnet being in bridge of said telephone line, means at the substation for closing circuit through said bridge, means under the control of the operator for closing a circuit through a different number of cells of said battery and an energizing winding of said electromagnet, and means responsive to the different resulting energizations of said electromagnet to produce different operative conditions of said signal.

8. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, a signal, a controlling electromagnet for said signal, a battery, part of the cells of said battery and an energizing winding of said electromagnet being in bridge of said telephone line, means at the substation for closing a circuit through said bridge, means under the control of the operator for closing a circuit through more cells of said battery and an energizing winding of said electromagnet, and means responsive to the different resulting energizations of said electromagnet to produce different operating conditions of said signal.

9. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, a signal, a controlling electromagnet for said signal, a battery, part of the cells of said battery and an energizing winding of said electromagnet being in bridge of said telephone line, means at the substation for closing a circuit through said bridge, means under the control of the operator for completing a circuit over a portion of the talking circuit and through a larger number of cells of said battery and an energizing winding of said electromagnet, and means responsive to the different energizations of said electromagnet to produce different operating conditions of said signal.

10. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, a signal, a controlling electromagnet for said signal, a battery, a tap from an intermediate point in said battery normally connected to the tip side of said line, a normal connection from one pole of said battery through an energizing winding of said electromagnet to the sleeve side of said line, and a connection from the other pole of said battery to the sleeve side of said cord-circuit.

11. A telephone system comprising a telephone line extending from a substation to a



central office, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, a signal, a controlling electromagnet for said signal, a battery, a tap from an intermediate point in said battery normally connected to the tip side of said line, a connection from one pole of said battery through an energizing winding of said electromagnet to the sleeve side of said line, a connection from the other pole of said battery to the sleeve side of said cord-circuit, a supervisory relay winding in said latter connection, and a second supervisory relay winding included in circuit between the tip side of the cord-circuit and the intermediate tap of said battery.

12. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a signal receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the substation, and a cord connecting apparatus adapted to make connection with said switching terminal and to establish a new path for the greater flow of current through said energizing winding and switching terminal to cause a greater energization of said magnet whereby the said signal is again effaced when the said line is switched for conversation.

13. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a signal receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the substation, a cord connecting apparatus adapted to make connection with said switching terminal and to establish a new path for the greater flow of current through said energizing winding and switching terminal to cause a greater energization of said magnet whereby the said signal is again effaced when the said line is switched for conversation, a signal controlling electromagnet associated with said cord connecting apparatus and under the control of the substation switch when the telephone line is switched for conversation, a second signal controlling electromagnet associated with said cord connecting apparatus and energized over the said circuit established by the connection of the cord-circuit to the telephone line, and a supervisory signal jointly controlled by the said two electromagnets.

14. In a telephone exchange system, the

combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a signal receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the substation, cord connecting apparatus adapted to make connection with said switching terminal and to establish a new path for the greater flow of current through said energizing winding and switching terminal to cause a greater energization of said magnet whereby the said signal is again effaced when the said line is switched for conversation, and a signal controlling electromagnet associated with said cord connecting apparatus and under the control of the substation switch when the telephone line is switched for conversation.

15. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office, a cord-circuit at the central office for making connection with said line, a signal receiving electromagnet associated with said line having an energizing winding connected to one side thereof, a normal connection extending from the other side of said line to a source of current of limited potential adapted to complete the circuit through said winding when the line circuit is closed at the substation to energize said magnet to a limited extent only to cause the display of its signal, and a connection from a source of current of greater potential to said cord-circuit and adapted to cause a greater flow of current through said energizing winding when the line is switched for conversation whereby the said signal is effaced.

16. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office, a cord-circuit at the central office for making connection with said line, a signal receiving electromagnet associated with said line having an energizing winding connected to one side thereof, a normal connection extending from the other side of said line to a source of current of limited potential adapted to complete the circuit through said winding when the line circuit is closed at the substation to energize said magnet to a limited extent only to cause the display of its signal, a connection from a source of current of greater potential to said cord-circuit and adapted to cause a greater flow of current through said energizing winding when the line is switched for conversation whereby the said signal is effaced, and a signal controlling electromagnet associated with said cord-circuit and under the control of the substation switch when the telephone line is switched for conversation.

17. In a telephone exchange system, the



combination with a telephone line connecting a substation with the central office, a cord-circuit at the central office for making connection with said line, a signal receiving electromagnet associated with said line having an energizing winding connected to one side thereof, a normal connection extending from the other side of said line to a source of current of limited potential adapted to complete the circuit through said winding when the line circuit is closed at the substation to energize said magnet to a limited extent only to cause the display of its signal, a connection from a source of current of greater potential to said cord-circuit and adapted to cause a greater flow of current through said energizing winding when the line is switched for conversation whereby the said signal is effaced, a signal controlling electromagnet associated with said cord-circuit and under the control of the substation switch when the telephone line is switched for conversation, a second signal controlling electromagnet associated with said cord-circuit and energized over the said circuit established by the connection of the cord-circuit to the telephone line, and a supervisory signal jointly controlled by the said two electromagnets.

18. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office, a cord-circuit at the central office for making connection with said line, a signal receiving electromagnet associated with said line having an energizing winding and source of current of limited potential in circuit therewith adapted to cause a limited energization of said magnet to cause the display of its signal when the line circuit is closed at the substation, and a source of current of greater potential adapted to be included in circuit with said energizing winding when the said line is switched for conversation to cause an increased energization of said magnet to efface the said signal.

19. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office, a cord-circuit at the central office for making connection with said line, a signal receiving electromagnet associated with said line having an energizing winding and source of current of limited potential in circuit therewith adapted to cause a limited energization of said magnet to cause the display of its signal when the line circuit is closed at the substation, a source of current of greater potential adapted to be included in circuit with said energizing winding when the said line is switched for conversation to cause an increased energization of said magnet to efface the said signal, and a signal controlling electromagnet associated with said cord-circuit and under the control of the substation switch

when the telephone line is switched for conversation.

20. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office, a cord-circuit at the central office for making connection with said line, a signal receiving electromagnet associated with said line having an energizing winding and source of current of limited potential in circuit therewith adapted to cause a limited energization of said magnet to cause the display of its signal when the line circuit is closed at the substation, a source of current of greater potential adapted to be included in circuit with said energizing winding when the said line is switched for conversation to cause an increased energization of said magnet to efface the said signal, a signal controlling electromagnet associated with said cord-circuit and under the control of the substation switch when the telephone line is switched for conversation, a second signal controlling electromagnet associated with said cord-circuit and energized over the said circuit established by the connection of the cord-circuit to the telephone line, and a supervisory signal jointly controlled by the said two electromagnets.

21. In a telephone exchange system, the combination with a telephone line connecting a substation with a switching terminal at the central office, a switch at the substation for controlling the flow of current over the said line through the substation, a cord-circuit at the central office adapted to make connection with said switching terminal and to complete a circuit therethrough over said telephone line, a signal controlling electromagnet associated with said telephone line and normally responsive to currents therein controlled either by the substation switch or by the connection of the cord-circuit to the line at the central office, an energizing winding for said electromagnet permanently connected between one contact of said switching terminal and one terminal of the source of current and adapted to be energized over the corresponding strand of the cord-circuit and to cause the complete energization of said electromagnet when the cord-circuit is connected to the line, a normal connection extending from an intermediate point of said source of current to the opposite side of the telephone line to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch when the cord-circuit is not connected to said line, a normally effaced line signal controlled by said electromagnet, means for causing the display of the said line signal when the said electromagnet is energized to a limited extent, and means for effacing said signal when the said relay is energized to a greater extent.



22. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a switch at the substation for controlling the flow of current over the said line through the substation, a signal controlling electromagnet associated with said telephone line having an energizing winding connected between one contact of said switching terminal and one terminal of a source of current, a connection extending from an intermediate point of said source of current to the opposite side of said telephone line adapted to cause a limited energization only of said electromagnet under the control of the substation switch to cause a limited movement only of the signaling mechanism associated with said electromagnet whereby the signal is displayed, and a cord-circuit at the central office adapted to make connection with said switching terminal and to complete a circuit from the other terminal of said source of current through said energizing winding to cause a greater energization of said electromagnet whereby the said switching mechanism is caused to assume a third position to efface said signal.

23. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a switch at the substation for controlling the flow of current over the said line through the substation, a signal controlling electromagnet associated with said telephone line having an energizing winding connected between one contact of said switching terminal and one terminal of a source of current, a connection extending from an intermediate point of said source of current to the opposite side of said telephone line adapted to cause a limited energization only of said electromagnet under the control of the substation switch to cause a limited movement only of the signaling mechanism associated with said electromagnet whereby the signal is displayed, a cord-circuit at the central office adapted to make connection with said switching terminal and to complete a circuit from the other terminal of said source of current through said energizing winding to cause a greater energization of said electromagnet whereby the said switching mechanism is caused to assume a third position to efface said signal, and a signal controlling electromagnet associated with said cord-circuit and under the control of the substation switch when the telephone line is switched for conversation.

24. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a switch at the substation for controlling the

flow of current over the said line through the substation, a signal controlling electromagnet associated with said telephone line having an energizing winding connected between one contact of said switching terminal and one terminal of a source of current, a connection extending from an intermediate point of said source of current to the opposite side of said telephone line adapted to cause a limited energization only of said electromagnet under the control of the substation switch to cause a limited movement only of the signaling mechanism associated with said electromagnet whereby the signal is displayed, a cord-circuit at the central office adapted to make connection with said switching terminal and to complete a circuit from the other terminal of said source of current through said energizing winding to cause a greater energization of said electromagnet whereby the said switching mechanism is caused to assume a third position to efface said signal, a signal controlling electromagnet associated with said cord-circuit and under the control of the substation switch when the telephone line is switched for conversation, a second signal controlling electromagnet associated with said cord-circuit and energized over the said circuit established by the connection of the cord-circuit to the telephone line, and a supervisory signal jointly controlled by the said two electromagnets.

25. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a switch at the substation for controlling the flow of current over the said line through the substation, a signal controlling relay associated with said telephone line having an energizing winding connected between one contact of said switching terminal and one terminal of a source of current, a connection extending from an intermediate point of said source of current to the opposite side of said telephone line adapted to cause a limited energization only of said relay under the control of the substation switch to cause a limited movement only of the relay contacts and to complete a circuit through the signal, and a cord-circuit at the central office adapted to make connection with said switching terminal and to complete a circuit from the other terminal of said source of current through said energizing winding to cause a greater energization of said relay whereby the relay contacts are caused to assume a third position to efface said signal.

26. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a switch at the substation for controlling the flow of current over the said line through the substation, a signal controlling relay asso-



ciated with said telephone line having an energizing winding connected between one contact of said switching terminal and one terminal of a source of current, a connection  
 5 extending from an intermediate point of said source of current to the opposite side of said telephone line adapted to cause a limited energization only of said relay under the control of the substation switch to cause a limited  
 10 movement only of the relay contacts and to complete a circuit through the signal, a cord-circuit at the central office adapted to make connection with said switching terminal and to complete a circuit from the other  
 15 terminal of said source of current through said energizing winding to cause a greater energization of said relay whereby the relay contacts are caused to assume a third position to efface said signal, and a signal controlling  
 20 electromagnet associated with said cord-circuit and under the control of the substation switch when the telephone line is switched for conversation.

27. In a telephone exchange system, the  
 25 combination with a telephone line connecting a substation with the central office and provided with a switching terminal thereat, a switch at the substation for controlling the flow of current over the said line through the  
 30 substation, a signal controlling relay associated with said telephone line having an energizing winding connected between one con-

tact of said switching terminal and one terminal of a source of current, a connection  
 35 extending from an intermediate point of said source of current to the opposite side of said telephone line adapted to cause a limited energization only of said relay under the control of the substation switch to cause a limited  
 40 movement only of the relay contacts and to complete a circuit through the signal, a cord-circuit at the central office adapted to make connection with said switching terminal and to complete a circuit from the other  
 45 terminal of said source of current through said energizing winding to cause a greater energization of said relay whereby said contacts are caused to assume a third position to efface said signal, a signal-controlling electro-  
 50 magnet associated with said cord-circuit and under the control of the substation switch when the telephone line is switched for conversation, a second signal controlling electromagnet associated with said cord-circuit and  
 55 energized over the said circuit established by the connection of the cord-circuit to the telephone line, and a supervisory signal jointly controlled by the said two electromagnets.

In witness whereof, I hereunto subscribe my name this 1st day of November, 1907. 60

HARRY G. WEBSTER.

Witnesses:

JAMES G. KELLOGG,  
 G. E. MUELLER.