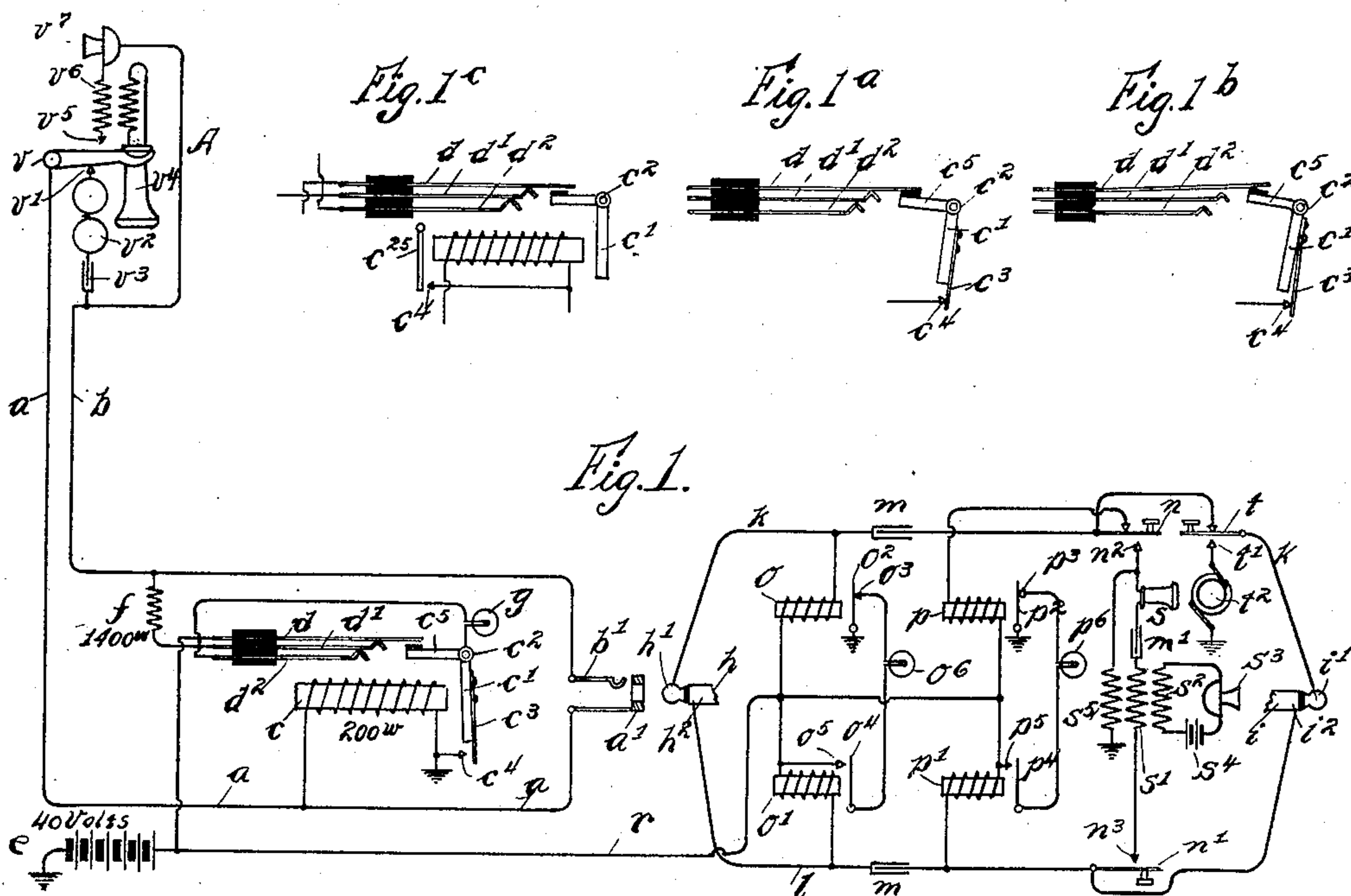
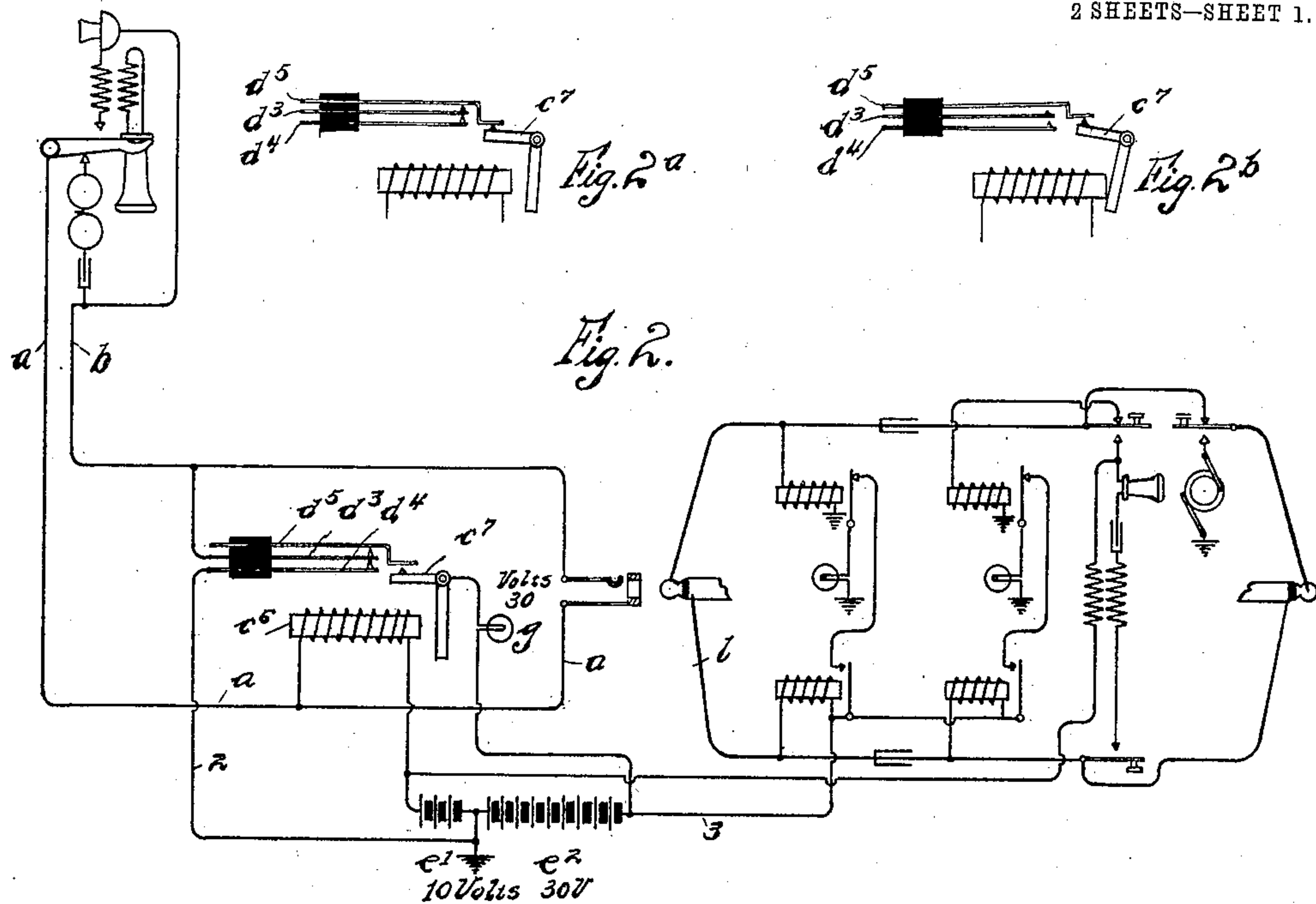


No. 897,232.

PATENTED AUG. 25, 1908.

H. G. WEBSTER.  
TELEPHONE SYSTEM.  
APPLICATION FILED MAR. 27, 1903.

2 SHEETS—SHEET 1.



WITNESSES:~

G. E. Mueller.  
A. H. Lyon

INVENTOR:~

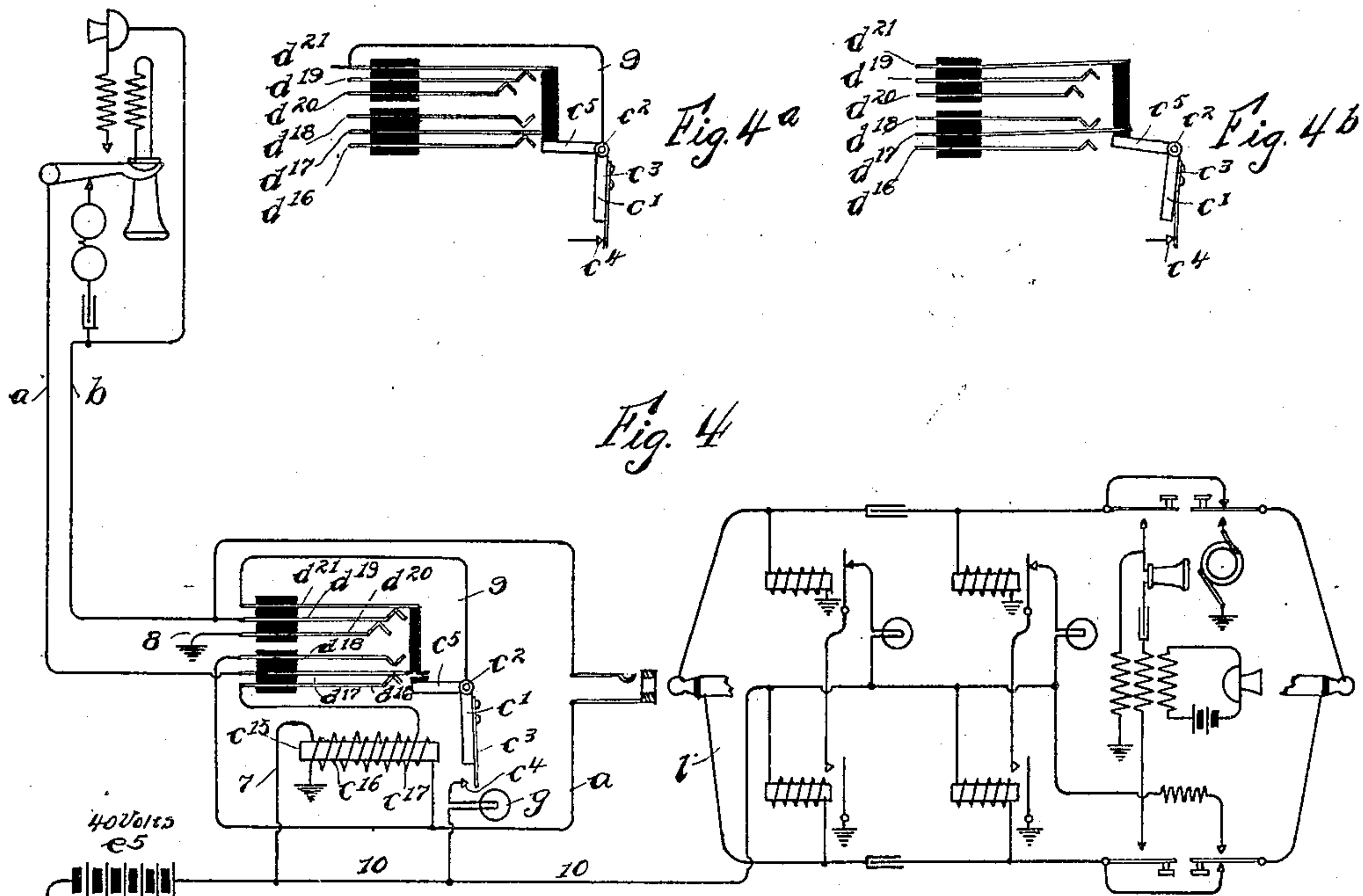
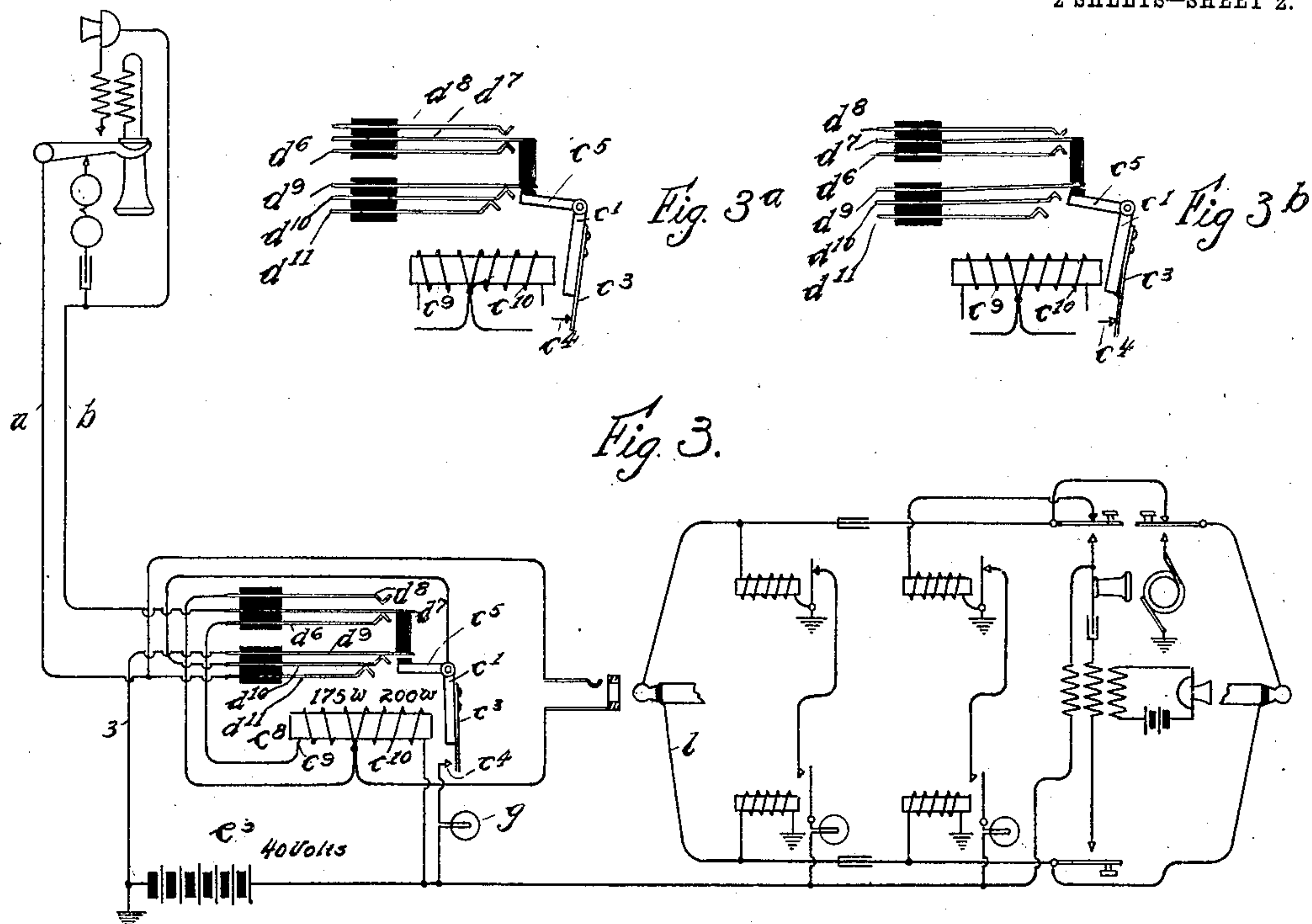
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2 SHEETS—SHEET 2.



WITNESSES:-

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# UNITED STATES PATENT OFFICE.

HARRY G. WEBSTER, OF CHICAGO, ILLINOIS, ASSIGNOR TO MILO G. KELLOGG, OF CHICAGO, ILLINOIS.

## TELEPHONE SYSTEM.

No. 897,232.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed March 27, 1903. Serial No. 149,833.

*To all whom it may concern:*

Be it known that I, HARRY G. WEBSTER, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to a telephone system, my object being to provide improved signaling apparatus.

In accordance with my invention I provide at the central station a signal controlling electro magnet which is under control of the subscriber at the sub-station, and is also under the control of the operator at the central station. This electro magnet in the preferred form of my invention is preferably a relay magnet which serves to control a signal, such as a lamp. The signal controlling electro magnet is preferably constructed so that it is initially operated by the subscriber at the sub-station, whereby a suitable signal may be actuated to call the attention of the operator to the fact that the subscriber desires a connection. The signal controlling electro magnet is also adapted to be actuated by the operator, preferably by the insertion of the connecting plug in the springjack or socket of the calling subscriber. The initial actuation of the magnet may be utilized to light the lamp of the calling signal, and the final actuation of the relay which is controlled by the operator may be utilized for rendering the signal inert.

I have illustrated my invention in connection with a signal controlling electro magnet 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 as 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.

My invention contemplates broadly any form of signal controlling electro magnet adapted to be under the control of the subscriber, and also under the control of the operator, whereby the relay is capable of accomplishing the desired results.

I have illustrated my invention in the accompanying drawing in which

Figure 1 is a diagram illustrative of my invention. Fig. 1<sup>a</sup> is a detail view showing the switch in its second or intermediate position. Fig. 1<sup>b</sup> is a detail view showing the switch in its final or third position. Fig. 1<sup>c</sup> is a detail view of a modification of the relay magnet. Fig. 2 shows a modification of my invention in which the relay magnet is adapted to be actuated first by a battery of low voltage, and finally by a battery of higher voltage. Fig. 2<sup>a</sup> is a detail view showing the armature of the relay magnet in its intermediate position. Fig. 2<sup>b</sup> is a detail view showing the armature in the final position. Fig. 3 is a diagram showing a modification wherein the relay is provided with series differential windings for producing the initial and final movements of the armature. Fig. 3<sup>a</sup> is a detail view of the relay and associated contacts showing the armature in the intermediate position. Fig. 3<sup>b</sup> is a similar view showing the armature in the final position. Fig. 4 shows a modification wherein the relay magnet is provided with two windings, one for producing the initial movement of the armature, the other for producing the final movement. Fig. 4<sup>a</sup> is a detail view of the relay magnet showing the armature in the intermediate position. Fig. 4<sup>b</sup> is a similar view showing the armature in the final position.

Like letters refer to like parts in the several figures.

Referring first to Fig. 1, the telephone line extends from the sub-station A in two limbs, *a*, *b*, to the central station, where the limbs terminate respectively in the sleeve *a'* and spring *b'* of the springjack 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 the limb *a* and the ground. The armature, *c'* of the relay is pivoted at *c*<sup>2</sup>, and carries a contact spring, *c*<sup>3</sup>,



adapted to make contact with anvil,  $c^4$ . The arm,  $c^5$  which moves with the armature carries upon the end a block of insulation which is adapted to engage and raise a contact spring,  $d$ , normally resting against a contact spring,  $d'$ , which latter contact spring normally rests against a third contact spring,  $d^2$ . The contact spring,  $d$ , is connected through battery  $e$  to ground. The contact spring,  $d'$ , is connected through a resistance coil,  $f$ , to the limb  $b$ , and the contact spring,  $d^2$ , is connected through lamp or other signal,  $g$ , to armature lever,  $c'$ . The anvil,  $c^4$ , is connected to ground.

The connecting apparatus at the central station comprises plugs  $h$  and  $i$ , 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 condenser  $m$ , while the sleeves are connected by means of the sleeve strands,  $l$ ,  $l$ . Bridged between the strands are the relays,  $o$ ,  $o'$ ,  $p$ ,  $p'$ . A conductor,  $r$ , connects the positive pole of the battery,  $e$ , with the bridges containing the relays at points intermediate with the relays. Relay  $o$  is provided with contact spring,  $o^2$ , normally resting against anvil,  $o^3$ , and relay  $o'$  is provided with contact spring,  $o^4$ , normally out of contact with anvil,  $o^5$ , a signaling lamp,  $o^6$ , being placed between the anvil,  $o^3$ , and the spring,  $o^4$ . Likewise, relay  $p$  is provided with contact spring,  $p^2$ , resting against anvil  $p^3$ , and relay  $p'$  is provided with contact spring  $p^4$  adapted to engage anvil  $p^5$ , the lamp,  $p^6$  being placed between the anvil,  $p^3$  and the spring,  $p^4$ . 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  $s$  and secondary winding,  $s'$  of the induction coil are placed. A condenser,  $m'$ , is also placed in this circuit. The primary,  $s^2$ , of the induction coil, transmitter  $s^3$ , and battery,  $s^4$ , are placed in a local circuit. The tertiary winding,  $s^5$ , is connected to ground. The ringing key,  $t$ , is adapted when depressed to engage anvil  $t'$  to which one pole of generator,  $t^2$ , is connected, the other pole being connected to ground.

At the sub-station A I have illustrated a usual sub-station apparatus comprising telephone hook  $v$  normally resting against anvil  $v'$  which is connected through bell  $v^2$  and condenser  $v^3$  to limb  $b$ , the hook  $v$  being connected to limb  $a$ . When the telephone receiver,  $v^4$  is removed from the hook the latter engages anvil  $v^5$  which is connected through primary winding  $v^6$  and transmitter  $v^7$  to limb  $b$ . The receiver,  $v^4$ , is included in a local circuit with the secondary winding,  $v^7$ .

Assuming that subscriber A desires to be connected for conversation with another subscriber, he removes his telephone receiver from the switch hook and thus unites limbs  $a$

and  $b$  at the sub-station. The circuit of battery  $e$  is thereby closed through springs  $d$  and  $d'$ , resistance coil  $f$ , limbs  $b$  and  $a$ , relay  $c$  to ground and back to the battery. The relay is thereby actuated and the armature,  $c'$  is moved into the position shown in Fig. 1<sup>a</sup>. In this position the spring,  $c^3$ , makes contact with the anvil  $c^4$ , but spring  $d$  is not moved out of contact with spring  $d'$ . The circuit through the lamp  $g$  is thus closed and may be traced from battery  $e$  through springs  $d$ ,  $d'$ ,  $d^2$ , lamp  $g$ , armature  $c'$  and spring  $c^3$  and anvil  $c^4$  to ground. The lamp is thus lighted and conveys to the operator the signal for connection. Thereupon the operator lifts plug  $h$  and inserts the same in the spring-jack belonging to the subscriber A. Circuit of battery  $e$  is thus closed through relay  $c$  as follows: from battery  $e$ , conductor  $r$ , relay  $o'$ , strand  $l$ , sleeve  $h^2$ , sleeve or thimble  $a'$ , limb  $a$ , relay  $c$  to ground and back to the battery. A portion of the current also flows from limb  $r$  through relay  $o$ , strand  $k$ , tip  $h'$  line spring  $b'$ , limb  $b$ , limb  $a$ , through relay  $c$  to ground. It will be noted that when the subscriber first closes circuit through the relay, the resistance coil  $f$  is in series with the relay, and accordingly the current flowing through the relay is only sufficient to move the armature to carry the contact spring,  $c^3$ , into contact with the anvil,  $c^4$ ; when, however, circuit is closed by the insertion of the connecting plug it will be noted that this resistance,  $f$ , is not in circuit, and accordingly the relay is energized to a greater extent than before and the armature is carried into the position shown in Fig. 1<sup>b</sup>, in which position the spring  $d$  is lifted and spring  $d'$  is released and rises, breaking contact with spring  $d^2$ . The tension of spring  $d'$  is such as to tend to lift and break contact with spring  $d^2$ , being normally held in contact therewith by the tension of spring  $d$ . The separation of springs  $d$ ,  $d'$  and  $d^2$  breaks the circuit through lamp  $g$ , and the lamp is extinguished. At the same time that the lamp circuit is opened the relay serves to remove the battery from the limb  $b$  by supporting springs  $d$  and  $d'$ . The operator now depresses her listening key and thus bridges her telephone in circuit and receives the number of the called subscriber. Having ascertained the number of the called subscriber she touches the tip  $i'$  of plug  $i$  to the sleeve  $a'$  of the spring-jack of the called subscriber and thus tests to ascertain whether or not the line is busy. If the line is busy the battery  $e$  will be connected with the sleeve or thimble of the line, and the thimble will then be charged to a difference of potential from that of the earth and accordingly a current will flow through tertiary winding  $s^5$  to ground and the operator will hear a click in her receiver. If, however, the line is not busy, the plug  $i$  will be inserted in the spring-jack and the ringing key  $t$  is then



depressed to send a calling current over the line of the called subscriber. The insertion of the plug closes circuit through relay  $p'$ , the circuit being traced from battery  $e$  over conductor  $r$ , thence through relay  $p'$  to strand  $l$  and sleeve  $i^2$ , thence through thimble  $a'$  of the called for subscriber, limb  $a$ , relay  $c$  to ground. The local circuit containing the lamp  $p^6$  is thus closed and the lamp is lighted. When the called subscriber responds and lifts his receiver from the telephone hook, circuit is closed through relay  $p$  and the lamp circuit is broken, thereby extinguishing the lamp and indicating to the operator that the called subscriber has responded. The circuit through relay  $p$  may be traced from battery  $e$  through conductor  $r$  relay  $p$ , strand  $k$ , tip  $i'$ , line spring  $b'$  of the called subscriber, limbs  $b$  and  $a$ , through relay  $c$  to ground.

When the subscribers have completed their conversation both hang up their receivers and the relays  $o$  and  $p$  are thus deenergized, thereby closing the lamp circuits and lighting the lamps to convey to the operator the signal for disconnection. When the operator has withdrawn the plugs from the spring-jacks the relays  $o'$  and  $p'$  are deenergized and the lamp circuits are broken.

It will be noted that the relay  $c$  is partially or secondarily under the control of the subscriber at the sub-station, and that normally the subscriber is able to close the circuit through the relay to cause the initial movement of the armature and thereby light the lamp to give the signal for connection. The same relay is under the absolute control of the operator and circuit is closed there-through by the insertion of the plug in the spring-jack of the calling subscriber to thereby cause the relay armature to partake of its second or final movement, which movement serves to open the lamp circuit and extinguish the lamp. This movement also serves to remove the battery from the tip side of the line to balance the system. The relay is thus under the control of both the subscriber and the operator, and the necessity of employing two separate relays is dispensed with.

In Fig. 1<sup>c</sup> I have illustrated a modification wherein the relay magnet  $c$  is provided with two armatures, the armature  $c^{25}$  upon the left being initially actuated to close the local circuit through the lamp  $g$ , while the armature  $c'$  upon the right is finally actuated to open the lamp circuit and disconnect the battery from the limb of the talking circuit.

In Fig. 2 I have shown a modification wherein the relay is initially actuated by means of a battery of low voltage, in the present instance ten volts, the insertion of the plug serving to subject the relay to a battery of higher voltage, in the present instance forty volts. The initial and final actions of the relay are thus produced by varying the

strength of the current therethrough by varying the voltage impressed upon the circuit. The relay magnet,  $c^6$  is provided with a single winding, and when the subscriber at the sub-station removes his telephone from the hook, current is closed from ground through battery  $e'$ , relay  $c^6$ , limb  $a$ , limb  $b$ , contact spring  $d^3$ , contact spring  $d^4$ , conductor 2, back to battery. The initial movement of the armature is thus produced and the circuit of battery  $e^2$  is closed through lamp  $g$ , armature lever  $c^7$ , contact spring  $d^5$ , contact spring  $d^3$ ,  $d^4$ , conductor 2, back to battery. The flow of current from battery  $e^2$  through lamp  $g$  does not interfere with the flow of current from battery  $e'$  through the relay magnet  $c^6$ , owing to the negligible resistance of conductor 2 which is connected to the common return or ground. When the operator inserts her plug the circuit of batteries  $e'$  and  $e^2$  are closed through relay  $c^6$ , the circuit being from the batteries over conductor 3, through the relay and strand  $l$  to the sleeve of the plug thence to the sleeve of the spring-jack by limb  $a$ , through relay  $c^6$  back to the batteries. The current flowing through the relay being thus increased due to the batteries of 40 volts, the spring  $d^5$  is lifted and all of the springs are thus separated opening the lamp circuit and removing the ground from limb 5 of the talking circuit.

In Fig. 3 I have shown a modification wherein the relay is provided with two windings differentially wound. One of these windings is of higher resistance than the other, and the current is initially sent through the windings in series, in which case the winding of the higher resistance will predominate and the magnet will be weakly energized to produce the initial movement of the armature. Upon the insertion of the connecting plug one of these windings is shunted and the other winding is subjected to current which produces the final movement of the armature. The relay  $c^8$  is provided with two windings,  $c^9$ ,  $c^{10}$ , the winding  $c^9$  being illustrated as of low resistance, say 175 ohms, while the winding  $c^{10}$  is of 200 ohms resistance. When the subscriber removes his telephone from the hook the current of battery  $e^3$  passes through the winding  $c^{10}$ , then through winding  $c^9$ , spring  $d^6$ , spring  $d^7$ , limb  $b$ , limb  $a$ , spring  $d^{11}$ , spring  $d^{10}$ , spring  $d^9$ , conductor 3, back to the battery. Current is thus closed through the windings in series and the winding  $c^{10}$  predominates to cause the initial movement of the armature. Current from battery  $e^3$  thus flows through lamp  $g$ , contact  $c^4$ , spring  $c^3$ , armature  $c'$ , spring  $d^{10}$ , spring  $d^9$  conductor 3, back to the battery. When the operator inserts the connecting plug the circuit of battery  $e^3$  is closed through winding  $c^{10}$ , limb  $b$ , the sleeve of the jack, sleeve of the plug, strand  $l$ , through the relay to



the ground, thence back to the battery. Current may also pass through winding  $c^9$  thence by limbs  $b$  and  $a$  and conductor 3 back to the battery, but this circuit is of high resistance and the winding  $c^9$  is thus in effect short-circuited by the circuit through the plug circuit. The winding  $c^{10}$  thus predominates over winding  $c^9$  and causes the final movement of the armature. As spring  $d^7$  separates from spring  $d^6$  the winding  $c^9$  is cut out of circuit. The final action of the armature opens the lamp circuit, removes the ground from the limb  $a$  and cuts out the winding  $c^9$ .

In Fig. 4 I have shown a modification wherein the relay is provided with two separate windings, one a signaling winding of comparatively low energizing capacity which is cut out when the circuit is closed through a second winding of high energizing capacity by the insertion of the connecting plug. In this manner the calling circuit is kept normally separated from the local controlling circuit of the relay. The relay  $c^{15}$  is provided with two windings,  $c^{16}$ ,  $c^{17}$ . When the subscriber removes his telephone from the hook the circuit of battery  $e^5$  is closed over conductor 7, through signaling winding  $c^{17}$ , thence through spring  $d^{16}$ , spring  $d^{17}$ , limb  $a$ , limb  $b$ , spring  $d^{19}$ , spring  $d^{20}$ , conductor 8, back to battery. The initial movement of the armature is thus produced and circuit of battery  $e^5$  is closed through lamp  $g$ , contact  $c^4$ , spring  $c^3$ , armature  $c'$ , conductor 9, spring  $d^{21}$ , spring  $d^{19}$ , spring  $d^{20}$  and conductor 8, back to battery. When the operator inserts the connecting plug, a circuit of battery  $e^5$  is closed over conductor 10, through the relay to strand  $l$ , thence through the sleeve of the plug and the sleeve of the jack to limb  $a$ , thence through winding  $c^{16}$  to ground and back to battery. The relay is thus energized to produce the final movement of the armature. This final movement serves to open the lamp circuit, to open the circuit through the winding  $c^{17}$ , to connect the line to the winding  $c^{16}$  and to remove the ground from the limb  $b$ .

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a telephone exchange system, a central station and a subscriber's station and a line circuit interconnecting them, a source of current at the central station and means at the subscriber's station to control the flow of current in the line, a signal controlling magnet at the central station normally connected to line and adapted to display a signal in response to current changes therein, an operator's connective means and connections therefrom to the signal controlling magnet together with mechanism under the control of the said magnet whereby upon making

connection with the line the operator will actuate said magnet to cut off its own line connection.

2. In a telephone exchange system, the combination with a line running from a substation to a central station conductively connected to a switching terminal thereat when switched for conversation, a common source of current at the central station adapted to supply talking and signaling current to said line, a normally open signal circuit at the central station, a source of current in said circuit, an electrically operated signal in said circuit, an electromagnetic switching device adapted when energized to a certain extent to close a break in said circuit, and when energized to a greater extent to open said circuit, means for causing one degree of energization from said substation and means for causing the other degree of energization from said central station.

3. In a telephone exchange system, the combination with a telephone line running from a substation to a central station conductively connected to a switching terminal thereat when switched for conversation, of a common source of current at the central station adapted to supply talking and signaling current to said line, a normally open local signaling circuit at the exchange, an electrically operated signal in said local circuit, a non-polarized electromagnetic switching device adapted to close said circuit when energized to a certain extent due to a control exercised from the substation, and to cause a break in said circuit when energized to a greater extent due to a control exercised from the central station, and means for exercising said substation and central station controls.

4. In a telephone exchange system, the combination with a local signaling circuit at the central station, of a source of current in said circuit, an electrically operated signal in said circuit, a telephone line provided with a switching terminal at the central station conductively united to a substation, and a non-polarized electromagnetic switching device adapted to cause a closure of said circuit when energized to a limited extent due to the passage of current controlled from the substation, and to open said circuit when energized to a greater extent due to a current controlled from the central station.

5. In an electric signaling system, the combination with a signaling circuit, of a source of current in said circuit, an electrically operated signal in said circuit, an electromagnet having a core and suitable energizing windings connected to a circuit conductively uniting two controlling stations, means whereby a limited energization of said core controlled from one station causes a closure of said signaling circuit, and means whereby an in-



creased energization of the same character controlled from another station causes a break in said circuit.

6. In an electric signaling system, the combination with a signaling circuit, of a source of current in said circuit, an electrically operated signal in said circuit, an electromagnet having a core and suitable energizing windings connected to a circuit conductively uniting two controlling stations, means whereby a certain energization of said core controlled from one station causes a closure of said signaling circuit, and means whereby an energization of the same character but of different strength controlled from another station causes a break in said circuit.

7. In combination, a conductor uniting two control stations, associated switching mechanism normally in a certain condition, an electromagnet for controlling said mechanism operative in response to a given energization to cause a second condition of said switching mechanism and to a modified energization to cause a third condition of said mechanism, means controlled from one station to produce said given energization, and means under the control of the other station to produce said modified energization always by the closing of the same circuit path through said electromagnet.

8. A telephone system comprising a conductor extending between two stations, switching mechanism normally in a certain condition, an electromagnet for controlling said mechanism associated with said conductor and operative in response to a given energization to cause a second condition of said switching mechanism and to a modified energization to cause a third condition of said mechanism, means controlled from one station for producing said given energization, and means under the control of the other station to produce said modified energization always by the closing of the same circuit path through said electromagnet.

9. A telephone system comprising a conductor extending from a substation to a central office, switching mechanism at the central office normally in a certain condition, an electromagnet for controlling said mechanism associated with said conductor and operative in response to a given energization to cause a second condition of said switching mechanism and to a modified energization to cause a third condition of said mechanism, means under the control of the subscriber for producing said given energization, and means under the sole control of the operator for producing said modified energization always by the closing of the same circuit path through said electromagnet.

10. A telephone system comprising a conductor extending from a substation to a central office, switching mechanism at the cen-

tral office normally in a certain condition, 65 an electromagnet for controlling said mechanism associated with said conductor and operative in response to a given energization to cause a second condition of said switching mechanism and to a modified energization 70 of the same character but of different strength to cause a third condition of said mechanism, means under the control of the subscriber for producing said given energization, and means under the sole control of the 75 operator for producing said modified energization always by the closing of the same circuit path through said electromagnet.

11. A telephone system comprising a conductor extending from a substation to 80 a central office, switching mechanism at the central office normally in a certain condition, an electromagnet for controlling said mechanism associated with said conductor and operative in response to a given energization 85 to cause a second condition of said switching mechanism and to a modified energization of the same character and over the same magnetic circuit to cause a third condition of said mechanism, means under the control 90 of the subscriber for producing said given energization, and means under the sole control of the operator for producing said modified energization always by the closing of the same circuit path through said electromagnet. 95

12. A telephone system comprising a conductor extending from a substation to a central office, switching mechanism at the central office normally in a certain condition, an 100 electromagnet for controlling said mechanism associated with said conductor and operative in response to a given energization to cause a second condition of said switching mechanism and to an increased energization 105 of the same character and over the same magnetic circuit to cause a third condition of said mechanism, means under the control of the subscriber for producing said given energization, and means under the sole control of the 110 operator for producing said increased energization always by the closing of the same circuit path through said electromagnet.

13. In an electric signaling system, the combination with a local signal circuit at a central station and a signal included in said 115 circuit, of an electromagnet comprising a core and suitable windings, means whereby said local circuit is closed when said core is subjected to a limited magnetization controlled from a substation, over a circuit 120 conductively uniting the two controlling stations, and means whereby said circuit is opened when said core is subjected to an increased magnetizing effect controlled from the central station. 125

14. A telephone system comprising a conductor extending from a substation to a central office, a local circuit at the central



office, a signal included in said circuit, an electromagnet for controlling said circuit, means for closing said circuit in response to a given energization of said magnet and  
 5 opening said circuit in response to a modified energization of said magnet, means under the control of the subscriber for producing said given energization and means under the sole control of the operator for producing  
 10 said modified energization always by the closing of the same circuit path through said electromagnet.

15 15. A telephone system comprising a telephone line conductively uniting a sub-station to a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to establish connection between said line and link-circuit, switching mechanism at the central office  
 20 normally in a certain condition, an electromagnet for controlling said mechanism associated with said connected line and link-circuit and operative in response to a given energization to cause a second condition of  
 25 said mechanism and to a modified energization to cause a third condition of said mechanism, means under the control of the subscriber for producing said given energization, and means operative upon the insertion of  
 30 said plug into said jack to produce said modified energization.

16. A telephone system comprising a conductor extending between signal sending and signal receiving stations, a local circuit  
 35 at the receiving station directly controlled at two points, electrically actuated means included in said local circuit, an electromagnet at the receiving station, means for closing said circuit at one point in response to a  
 40 given energization of said magnet and opening said circuit at the other point in response to a modified energization of said magnet, means under the control of the sending station for producing said given energization,  
 45 and means under the sole control of the receiving station for producing said modified energization always by the closing of the same circuit path through said electromagnet.

17. A telephone system comprising a conductor extending between signal sending and signal receiving stations, a local circuit  
 50 at the receiving station having two control points, one normally open and the other normally closed, electrically actuated means included in said local circuit, an electromagnet at the receiving station, a signal included in said local circuit, means for closing the circuit of the normally open point in response to a given energization of said magnet and  
 55 opening said circuit at the normally closed control point in response to a modified energization of said magnet, means under the control of the signal sending station for producing said given energization, and means  
 60 under the sole control of the signal receiving

station for producing said modified energization always by the closing of the same circuit path through said electromagnet.

18. In an electric signaling system, the combination with a signal sending and a  
 70 signal receiving station conductively united by a line circuit, of a signal circuit at the receiving station having two serially included switches, an electromagnet, means whereby a limited energization of said magnet  
 75 causes an actuation of one of said switches, and means whereby an increased energization of said magnet controlled from the signal receiving station causes an actuation of the other switch. 80

19. In an electric signaling system, the combination with a signal sending station, of a signal receiving station, a metallic circuit conductively uniting the two stations  
 85 controlled at two points, a normally open local signal circuit at the receiving station, a source of current in said circuit, an electrically operated signal in said circuit, and an electromagnetic switching device adapted when energized by a current controlled from  
 90 the sending station to close a break in said circuit, and when energized by a current controlled from the receiving station to cause an increased movement of said switching device in the same direction to open  
 95 said circuit.

20. In an electric signaling system, the combination with a signal sending station, of a signal receiving station, a metallic circuit conductively uniting said stations controlled  
 100 at two points, a local signal circuit at the receiving station adapted to be controlled at two points, a source of current in said circuit, an electrically operated signal in said circuit, and an electromagnet switching mechanism  
 105 adapted when energized to a limited extent by current controlled from the sending station to effect a control of said signal circuit at one of said points, and when energized to a greater extent by a current controlled from  
 110 the receiving station to effect the control of said signal circuit at the other point.

21. In an electric signaling system, the combination with a signal at a signal receiving station, of an electromagnet connected to  
 115 a circuit conductively uniting said station with another controlling station, and adapted through the agency of suitable armature mechanism to control the operation of said signal, means whereby the partial magneti-  
 120 zation of said magnet due to a current controlled from a signal sending station causes an actuation of said armature mechanism to cause said signal to assume an abnormal operative condition, and means whereby an in-  
 125 creased magnetization of the same character due to a current controlled from the signal receiving station causes further actuation of said armature mechanism to cause said signal to assume its normal condition, there be- 130



ing no movement of any part of said armature mechanism in opposition to the magnetic influence of said electromagnet.

22. A telephone system comprising a telephone line conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to establish connection between said line and link-circuit, a local circuit at the receiving station directly controlled at two points, electrically actuated means included in said local circuit, an electromagnet adapted through the agency of suitable armature mechanism to effect the control of said local circuit at both points, means under the control of the subscriber to energize said magnet to cause its armature mechanism to close said local circuit at one point of the control, and means operative upon the insertion of said jack into said plug to modify said energization to cause a further actuation of said armature mechanism to open said local circuit at the other point of control, there being no movement of said armature mechanism in opposition to the attractive force exercised by said electromagnet.

23. A telephone system comprising a telephone line conductively uniting a substation with a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to establish connection between said line and link-circuit, a local circuit at the central office having two control points, one normally open and the other normally closed, a signal included in said local circuit, an electro-magnet having suitable armature mechanism adapted to control said circuit at said points, means under the control of the subscriber for energizing said magnet to cause its armature mechanism to close said local circuit at the normally open point, and means operative upon the connection of said link-circuit to said line to modify said energization to cause said armature mechanism to open said circuit at the normally closed control point, there being no movement of said armature mechanism contrary to the magnetic force exerted by said electromagnet.

24. In an electric signaling system, the combination with a signal, of an electromagnet adapted through the agency of suitable armature mechanism to control the operation of said signal, means whereby an energization of said magnet due to a current controlled from a signal sending station causes the actuation of said armature mechanism to cause said signal to assume an abnormal operative condition, and means whereby an energization of the same character but of different strength controlled from the signal receiving station and always produced by the closing of the same circuit path through said electromagnet, causes a further actuation of

said armature mechanism whereby said signal is prevented from assuming said abnormal operative condition, there being no movement of any part of said armature mechanism contrary to the magnetic force of said electromagnet.

25. In a telephone exchange system, the combination with a telephone line provided with a switching terminal at the central office conductively united thereto when the line is switched for conversation, of a relay serving as a line relay when energized to a limited extent by currents controlled from a telephone substation and serving as a cut-off relay to alter the telephone line connections, and serving also to efface the associated line signal when energized to a greater extent by currents controlled from the exchange.

26. In a common battery telephone exchange system, the combination with a telephone line extending from a substation to an exchange and provided thereat with a switching terminal conductively connected thereto when the line is switched for conversation, of a signal circuit at the exchange, a source of current in said circuit, an electrically operated signal in said circuit, a non-polarized electromagnetic switching device normally in circuit with said telephone line, means located at the associated substation for controlling a limited energization of said electromagnetic device to close a break in said signal circuit, and means located at the exchange for controlling a greater energization of said electromagnetic device over substantially the same magnetic circuit to operate the same as a cut-off relay.

27. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange and provided thereat with a switching terminal conductively connected thereto when the line is switched for conversation, of a signal circuit at the exchange, a source of current in said circuit, an electrically operated signal in said circuit, an electromagnetic switching device normally in circuit with said telephone line, means located at the associated substation for secondarily controlling a limited energization of said electromagnetic device to close a break in said signal circuit, and means located at the exchange for absolutely controlling a greater energization of said electromagnetic device thereby operating the same as a cut-off relay.

28. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange and provided thereat with a switching terminal conductively connected thereto when the line is switched for conversation, of a signal circuit at the exchange, a source of current in said circuit, an electrically operated signal in said circuit, an electromagnetic switching device normally in circuit with said telephone line,



means located at the associated substation for secondarily controlling a limited energization of said electromagnetic device to close a break in said signal circuit, and means located at the exchange for absolutely controlling a greater energization of said electromagnetic device due to current flowing over a portion of the talking circuit to open the signal circuit and to operate the same as a cut-off relay.

29. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange and provided thereat with a switching terminal conductively connected thereto when the line is switched for conversation, of cord connecting apparatus at the exchange for connecting said line with another for conversation, a relay normally included in circuit with said line, a line signal controlled by said relay, means whereby the closure of the line circuit at the substation causes an energization of said relay to cause the display of said signal, and means whereby the connection of said cord connecting apparatus with said line causes an increased energization of said relay to cause its operation as a cut-off relay and the restoration of said line signal.

30. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange and provided thereat with a switching terminal conductively connected to the line when the line is switched for conversation, of cord connecting apparatus at the exchange for connecting said line with another for conversation, a relay normally included in circuit with said line, a line signal controlled by said relay, means whereby the closure of the line circuit at the substation causes an energization of said relay to cause the display of said signal, and means whereby the connection of said cord connecting apparatus with said line causes an increased energization of said relay to cause its operation as a cut-off relay.

31. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange, of an electromagnetic signal controlling device at the exchange normally in circuit with said telephone line, means located at the substation for secondarily controlling a limited energization of said electromagnetic device to display its signal, and means located at the exchange for absolutely producing and discontinuing a greater energization of said electromagnetic device to operate it as a cut-off relay always by the opening and closing of the same circuit path through said device.

32. A telephone system comprising a telephone line conductively uniting a substation to a jack at the central office, a link-circuit, a connecting plug adapted to be inserted into said jack to establish connection between said line and link-circuit, a local cir-

cuit at the central office, a signal and source of current included in said circuit, an electromagnet controlling said circuit, means for closing said circuit in response to a given energization of said magnet and opening said circuit in response to a modified energization of said magnet, means under the control of the subscriber for producing said given energization, and means under the control of the operator for producing said modified energization.

33. In a telephone exchange system, a relay serving as a line relay when energized to a limited extent by currents controlled from a substation over a main circuit conductively uniting said substation with the relay and the exchange and serving as a cut-off relay to alter the telephone line connections when energized to a greater extent by currents controlled from the exchange.

34. In a telephone exchange system, a main line circuit conductively uniting a substation with the central office, an electromagnetic device serving to control a line signal when energized to a limited extent by currents controlled from the substation, and serving as a cut-off relay to alter the telephone line connections when energized to a greater extent by currents controlled through the operator's cord connecting apparatus.

35. In a telephone exchange system, a main line circuit conductively uniting a substation with the central office, a relay serving as a line relay when energized to a limited extent by currents controlled from the substation and serving as a cut-off relay to alter the telephone line connections when energized to a greater extent by currents flowing over a portion of the talking circuit and controlled from the exchange.

36. In a telephone exchange system, the combination with a telephone line conductively extending from a substation to an exchange, of a signal circuit at the exchange, a source of current in said circuit, an electrically operated signal in said circuit, an electromagnetic switching device normally in circuit with said telephone line, means located at the associated substation for secondarily controlling a limited energization of said electromagnetic device to close a break in said signal circuit, and means located at the exchange for absolutely controlling a greater energization of said electromagnetic device by a flow of current over a portion of the said telephone line.

37. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange and provided thereat with a connection terminal conductively connected thereto when the line is switched for conversation, of a signal circuit at the exchange, a source of current in said circuit, an electrically operated signal in said circuit, an electromagnetic switching



device normally in circuit with said telephone line, means located at the associated substation for secondarily controlling a limited energization of said electromagnetic device to close a break in said signal circuit, and means located at the exchange for absolutely controlling a greater energization of said electromagnetic device due to current flowing over a portion of the talking circuit to open the signal circuit.

38. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange, of a line jack at the exchange adapted for connection with said telephone line, cord connecting apparatus at the exchange for connecting said line with another for conversation, a relay at the exchange normally connected in a circuit with the telephone line, a line signal controlled by said relay, means whereby an energization of said relay over a circuit controlled from the substation causes an actuation of said relay to cause a display of said signal, and means whereby the connection of said cord connecting apparatus with a jack associated with said line causes an energization of said relay due to currents passing over a portion of the talking circuit to cause a restoration of said signal and to break the normal circuit containing the telephone line and said relay.

39. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange, of a line jack at the exchange conductively united to said telephone line, cord connecting apparatus at the exchange for establishing connection to said line and connecting said line with another for conversation, a relay at the exchange connected in circuit with the telephone line, a line signal controlled by said relay, means whereby an energization of said relay over a circuit controlled from the substation causes an actuation of said relay to cause a display of said signal, and means whereby the connection of said cord connecting apparatus with a jack associated with said line causes an energization of said relay due to currents passing over a portion of the talking circuit to cause a restoration of said signal.

40. In a telephone exchange system, the combination with a telephone line extending from a substation to an exchange, of a line jack at the exchange adapted for connection with said telephone line, cord connecting apparatus at the exchange for connecting said line with another for conversation, a relay at the exchange normally connected in a circuit with the telephone line, a local signal circuit controlled by said relay, means whereby a limited energization of said relay over a circuit controlled from the substation causes an actuation of said relay to permit the display of said signal, and means whereby

the connection of said cord connecting apparatus with a jack associated with said line causes a greater energization of said relay due to currents passing over a portion of the talking circuit to cause a restoration of said signal and to break the normal circuit containing the telephone line and said relay.

41. In a telephone exchange system, the combination with a telephone line conductively extending from the substation to a switching terminal at an exchange, of cord connecting apparatus at the exchange for connecting said line with another for conversation, a relay at the exchange normally connected in circuit with the telephone line, a line signal controlled by said relay, means whereby an energization of said relay over a circuit controlled from the substation causes an actuation of said relay to cause the display of said signal, and means whereby the connection of said cord connecting apparatus with said line causes a greater energization of said relay whereby the display of said signal is prevented.

42. In a telephone exchange system, the combination with a telephone line conductively extending from a substation to a switching terminal at an exchange, of cord-connecting apparatus at the exchange for connecting said line with another for conversation, a relay normally included in circuit with said line, a local signal circuit, two switches in said local signal circuit controlled by said relay, means whereby the closure of the line circuit at the substation causes a limited energization of said relay to cause the actuation of one of said switches, and means whereby the connection of said cord-connecting apparatus with said line causes a greater energization of said relay to cause an actuation of the other switch.

43. In a telephone exchange system, the combination with a telephone line connecting a sub-station with a switching terminal at the central office, a switch at the sub-station, 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 relay connected with said cord circuit included in circuit with a talking source of current and responsive to current controlled by the switch at the substation, another relay connected with said cord circuit energized over a circuit established by the connection of said cord circuit to the telephone line and not under the control of the switch at the sub-station, a supervisory signal jointly controlled by said relays, a third relay 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 having an energizing winding permanently connected to one contact of said switching



terminal and adapted to absolutely control the complete operation of said relay when the cord circuit is connected to the line, means for securing a limited energization only of said relay over the telephone line under the control of the sub-station switch when the cord circuit is not connected to said line, a normally effaced line signal controlled by said relay, means for causing the display of the said line signal when the said relay is energized to a limited extent, means for effacing said signal when the said relay is energized to a greater extent, means whereby the operator may determine the busy or idle condition of a tested line, and means for freeing said telephone line from non-inductive branch or earth connections when connected with the cord circuit.

44. In a telephone exchange system, the combination with a telephone line connecting a sub-station with a switching terminal at the central office, a switch at the sub-station, 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 relay connected with said cord circuit and responsive to current controlled by the switch at the sub-station, another relay connected with said cord circuit energized over a circuit established by the connection of said cord circuit to the telephone line and not under the control of the switch at the sub-station, a supervisory signal jointly controlled by said relays, a third relay associated with said telephone line and normally responsive to currents therein controlled either by the sub-station switch or by the connection of the cord circuit to the line at the central office having an energizing winding permanently connected to one contact of said switching terminal and adapted to absolutely control the complete operation of said relay when the cord circuit is connected to the line, means for securing a limited energization only of said relay over the telephone line under the control of the sub-station switch when the cord circuit is not connected to said line, a normally effaced line signal controlled by said relay, means for causing the display of the said line signal when the said relay is energized to a limited extent, means for effacing said signal when the said relay is energized to a greater extent, and means for freeing said telephone line from non-inductive branch or earth connections when connected with the cord circuit.

45. In a telephone exchange system, the combination with a telephone line connecting a sub-station with a switching terminal at the central office, a switch at the sub-station, 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 relay connected

with said cord circuit and responsive to current controlled by the switch at the sub-station, another relay connected with said cord circuit energized over a circuit established by the connection of said cord circuit to the telephone line and not under the control of the switch at the sub-station, a supervisory signal jointly controlled by said relays, a third relay associated with said telephone line and normally responsive to currents therein controlled either by the sub-station switch or by the connection of the cord circuit to the line at the central office, having an energizing winding permanently connected to one contact of said switching terminal and adapted to absolutely control the complete operation of said relay when the cord circuit is connected to the line, means for securing a limited energization only of said relay over the telephone line under the control of the sub-station switch when the cord circuit is not connected to said line, a normally effaced line signal controlled by said relay, means for causing the display of the said line signal when the said relay is energized to a limited extent and means for effacing said signal when the said relay is energized to a greater extent.

46. In a telephone exchange system, the combination with a telephone line conductively uniting a substation with a switching terminal at the central office, a switch at the sub-station, 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 relay 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 having an energizing winding permanently connected to one contact of said switching terminal and adapted to absolutely control the complete operation of said relay when the cord circuit is connected to the line, means for securing a limited energization only of said relay 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 relay, means for causing the display of said line signal when the said relay is energized to a limited extent, means for effacing said signal when the said relay is energized to a greater extent, means whereby the operator may determine the busy or idle condition of a tested line and means for freeing said telephone line from non-inductive branch or earth connections when connected with the cord circuit.

47. In the telephone exchange system, the combination with a telephone line conductively uniting a substation with a switching terminal at the central office, a switch



at the substation for controlling the flow of signaling 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 magnet 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 having an energizing winding permanently connected to one contact of said switching terminal and adapted to absolutely control the complete operation of said magnet when the cord circuit is connected to the line, means for securing a limited energization only of said magnet over the telephone line under the control of the sub-station switch when the cord circuit is not connected to said line, a normally effaced line signal controlled by said magnet, means for causing the display of the said line signal when the said magnet is energized to a limited extent, means for effacing said signal when the said magnet is energized to a greater extent, and means whereby the operator may determine the busy or idle condition of a tested line.

48. In a telephone exchange system, the combination with a telephone line conductively uniting a substation with a switching terminal at the central office, a switch at the substation for controlling the flow of signaling 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 a portion of the talking circuit a non-polarized signal controlling magnet 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, having an energizing winding permanently connected to one contact of said switching terminal and adapted to absolutely control the complete operation of said magnet when the cord circuit is connected to the line, means for securing a limited energization only of said magnet over the telephone line under the control of the sub-station switch when the cord circuit is not connected to said line, a normally effaced line signal controlled by said magnet, means for causing the display of the said line signal when the said magnet is energized to a limited extent, and means for effacing said signal when the said relay is energized to a greater extent.

49. In a telephone exchange system, the combination with a telephone line conductively uniting a substation with a switching terminal at the central office, a switch at the substation for controlling the flow of signal-

ing 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 magnet 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 having an energizing winding permanently connected to one contact of said switching terminal and adapted to absolutely control the complete operation of said magnet when the cord circuit is connected to said line, means for securing a limited energization only of said magnet 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 magnet, means for causing the display of the said line signal only while the said magnet is energized to a limited extent, and means for effacing said signal when the said magnet is energized to a greater extent.

50. In a telephone exchange system, the combination with a telephone line conductively uniting a substation with a switching terminal at the central office, a switch at 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 magnet connected with said cord circuit and responsive to currents controlled by the switch at the substation, a second signal controlling magnet 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 having an energizing winding permanently connected to one contact of said switching terminal and adapted to absolutely control the complete operation of said magnet when the cord circuit is connected to said line, means for securing a limited energization only of said magnet 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 magnet, means for causing the display of the said line signal only while the said magnet is energized to a limited extent, means for effacing said signal when the said magnet is energized to a greater extent, means whereby the operator may determine the busy or idle condition of a tested line, and means for freeing said telephone line from non-inductive branch or earth connections when connection is made with the cord circuit.

51. In a telephone exchange system, the combination with a telephone line conductively uniting a substation with a switching



terminal at the central office, a switch at the substation for controlling the flow of signaling 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 there-  
 5 through over said telephone line, a signal controlling magnet connected with said cord circuit included in circuit with a source of current and responsive to currents controlled  
 10 by the switch at the substation, a signal controlling electromagnet associated with said telephone line normally responsive to currents therein controlled either by the sub-  
 15 station switch or by the connection of the cord circuit to the line at the central office, associated signaling mechanism controlled by said magnet, means for securing a limited energization only of said magnet over the  
 20 telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a certain limited movement of said signaling mechanism is caused to display a signal, an energizing  
 25 winding adapted to energize said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the said signaling mechanism to assume a third position to efface  
 30 said signal, and means whereby the operator may determine the busy or idle condition of a tested line.

52. In a telephone exchange system, the combination with a telephone line conduct-  
 35 ively uniting 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  
 40 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 non-polarized  
 45 electromagnet associated with said telephone line normally responsive to currents therein controlled either by the substation switch or  
 50 by the connection of the cord circuit to the line at the central office, associated signaling mechanism controlled by said magnet, means for securing a limited energization only of  
 55 said magnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a certain limited movement of said  
 60 signaling mechanism is caused to display a signal, and an energizing winding adapted to energize said magnet to a greater extent over a circuit established through the cord circuit  
 when connected to the line and to cause the said signaling mechanism to assume a third position to efface said signal.

53. In a telephone exchange system, the combination with a telephone line conduct-  
 65 ively uniting 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  
 70 over said telephone line, a signal controlling magnet associated with said cord circuit included in circuit with a source of current and controlled by the switch at the substation,  
 75 a non-polarized signal controlling electromagnet associated with said telephone line normally responsive to currents therein controlled either by the substation switch or by  
 80 the connection of the cord circuit to the line at the central office, associated signaling mechanism controlled by said magnet, means for securing a limited energization only of  
 85 said magnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a certain limited movement of said  
 signaling mechanism is caused to display a signal, and an energizing winding adapted to energize said magnet to a greater extent over a circuit established through the cord circuit  
 90 when connected to the line and to cause the said signaling mechanism to assume a third position to efface said signal.

54. In a telephone exchange system, the combination with a telephone line conduct-  
 95 ively uniting 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  
 100 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 receiving  
 105 electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith, and normally responsive to currents controlled  
 110 by said substation switch, associated signaling mechanism controlled by said electromagnet, means for securing a limited energization only of said electromagnet over the  
 115 telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a limited movement of said signaling mechanism is  
 120 caused to display a signal, and means for energizing said magnet to a greater extent over a circuit established through the cord when  
 connected to the line and to cause the signaling mechanism to assume a third position to efface said signal.

55. In a telephone exchange system, the combination with a telephone line conduct-  
 125 ively uniting 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  
 130 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 receiving



electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, means for securing 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 the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism to assume a third position to efface said signal, and means whereby the operator may determine the idle or busy condition of a tested line.

56. In a telephone exchange system, the combination with a telephone line conductively uniting 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 there-through over said telephone line, a signal receiving electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, means for securing 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 the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism to assume a third position to efface said signal, means whereby the operator may determine the idle or busy condition of a tested line, 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.

57. 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 receiving electromagnet associated with said telephone line

having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, means for securing 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 the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism to assume a third position to efface said signal, means whereby the operator may determine the idle or busy condition of a tested line, 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.

58. 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 receiving electromagnet associated with said telephone line having an energizing winding and source normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, means for securing 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 the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism 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 sig-



nal jointly controlled by the said two electromagnets

59. In a telephone exchange system, the combination with a telephone line conductively uniting 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 receiving electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, means for securing 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 the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism 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.

60. In a telephone exchange system, the combination with a telephone line conductively uniting 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 receiving electromagnet with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, a normal connection extending from one side of the telephone line and adapted to limit the energization of said electromagnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a limited movement of said signaling mechanism is caused to display a signal, and means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism to assume a third position to efface said signal.

61. In a telephone exchange system, the combination with a telephone line conduct-

ively uniting 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 receiving electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, a normal connection extending from one side of the telephone line and adapted to limit the energization of said electromagnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism to assume a third position to efface said signal, and means whereby the operator may determine the idle or busy condition of a tested line.

62. In a telephone exchange system, the combination with a telephone line conductively uniting 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 connections with said switching terminal and to complete a circuit therethrough over said telephone line, a signal-receiving electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said sub-station switch, associated signaling mechanism controlled by said electromagnet, a normal connection extending from one side of the telephone line and adapted to limit the energization of said electromagnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism to assume a third position to efface said signal, means whereby the operator may determine the idle or busy condition of a tested line, and means for freeing said telephone line from non-inductive branch or earth connections when connected with the cord circuit.

63. 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 sub-station 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 receiving electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, a normal connection extending from one side of the telephone line and adapted to limit the energization of said electromagnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism to assume a third position to efface said signal, means whereby the operator may determine the idle or busy condition of a tested line, 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, a supervisory signal jointly controlled by the said two electromagnets, and means for freeing said telephone line from non-inductive branch or earth connections when connected with the cord circuit.

64. In a telephone exchange system, the combination with a telephone line conductively uniting 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 receiving electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, a normal connection extending from one side of the telephone line and adapted to limit the energization of said electromagnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a limited movement of said signaling mechanism is

caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism 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, and means for freeing said telephone line from non-inductive branch or earth connections when connected with the cord circuit.

65. 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 receiving electromagnet associated with said telephone line having an energizing winding and source of current normally in circuit therewith and normally responsive to currents controlled by said substation switch, associated signaling mechanism controlled by said electromagnet, a normal connection extending from one side of the telephone line and adapted to limit the energization of said electromagnet over the telephone line under the control of the substation switch when the cord circuit is not connected to the line whereby a limited movement of said signaling mechanism is caused to display a signal, means for energizing said magnet to a greater extent over a circuit established through the cord circuit when connected to the line and to cause the signaling mechanism 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.

66. In a signaling system, the combination with a signal-receiving electromagnet having two energizing windings associated with a main line circuit conductively uniting two controlling stations, said electromagnet being located intermediate of said stations, a source of current normally included in circuit with one of said energizing windings, said source of current and energizing winding being adapted to cause a limited energization only of said electromagnet over the main circuit under the control of one of said stations whereby the said electromagnet is caused to



display its signal, and means for securing a greater energization of said electromagnet over a circuit established through said second energizing winding under the control of the second station whereby the said electromagnet is caused to efface said signal.

67. In a signaling system, the combination with a signal-receiving electromagnet having two energizing windings associated with a main line circuit conductively uniting two controlling stations, a source of current normally included in circuit with one of said energizing windings, said source of current and energizing winding being adapted to cause a limited energization only of said electromagnet over the main circuit under the control of one of said stations whereby the said electromagnet is caused to display its signal, means for securing a greater energization of said electromagnet over a circuit established through said second energizing winding under the control of the second station whereby the said electromagnet is caused to efface said signal, and means for interrupting the normal circuit through said first energizing winding when the second winding is energized.

68. In a signaling system, the combination with a signal-receiving electromagnet having two energizing windings controlled respectively from two stations united by a main line circuit, a source of current normally included in circuit with one of said energizing windings, said source of current and energizing winding being adapted to cause a limited energization only of said electromagnet over the main circuit under the control of one of said stations whereby the said electromagnet is caused to display its signal, means for securing a greater energization of said electromagnet over a circuit established through said second energizing winding under the control of the second station whereby the said electromagnet is caused to efface said signal, and means for interrupting the normal circuit through said first energizing winding when the second winding is energized.

69. In a signaling system, the combination with a signal-receiving electromagnet associated with a main line circuit conductively uniting two controlling stations, associated signaling mechanism controlled by said electromagnet, an energizing winding for said electromagnet normally included in circuit with a source of current and adapted to cause a limited energization only of said electromagnet over the main line circuit under the control of one of said stations whereby a limited movement of said signaling mechanism is caused to display a signal, and a second energizing winding for said electromagnet of greater energizing capacity under the control of said second station adapted to cause a greater energization of said electromagnet to cause the said signaling mechanism to as-

sume a third position to efface the said signal.

70. In a signaling system, the combination with a signal-receiving electromagnet associated with a main line circuit conductively uniting two controlling stations, associated signaling mechanism controlled by said electromagnet, an energizing winding for said electromagnet normally included in circuit with a source of current and adapted to cause a limited energization only of said electromagnet over the main line circuit under the control of one of said stations whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity under the control of said second station adapted to cause a greater energization of said electromagnet to cause the said signaling mechanism to assume a third position to efface the said signal and means for interrupting the normal circuit through said first energizing winding when the second winding is energized.

71. In a signaling system, the combination with a signal-receiving electromagnet associated with a main line circuit uniting two controlling stations, associated signaling mechanism controlled by said electromagnet, an energizing winding for said electromagnet normally included in circuit with a source of current and adapted to cause a limited energization only of said electromagnet over the main line circuit under the control of one of said stations whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity under the control of said second station adapted to cause a greater energization of said electromagnet to cause the said signaling mechanism to assume a third position to efface the said signal, and means for interrupting the normal circuit through said first energizing winding when the second winding is energized.

72. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a switching terminal, a signal-receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said electromagnet to a limited extent only to cause the display of its signal when the said line circuit is closed at the substation, and a cord circuit adapted to make connection with said switching terminal and to complete a circuit through a second energizing winding for said electromagnet to cause a greater energization thereof whereby the said signal is effaced and the normal connection of the first energizing winding destroyed.

73. In a telephone exchange system, the



combination with a telephone line connecting a substation with the central office and provided thereat with a switching terminal, a switch at the substation for controlling the flow of current over the said line through the substation, a signal-receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said electromagnet to a limited extent only to cause the display of its signal when the said line circuit is closed at the substation, a cord circuit adapted to make connection with said switching terminal and to complete a circuit through a second energizing winding for said electromagnet to cause a greater energization thereof whereby the said signal is effaced and the normal connection of the first energizing winding destroyed 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.

74. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a switching terminal, a switch at the substation for controlling the flow of current over the said line through the substation, a signal-receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said electromagnet to a limited extent only to cause the display of its signal when the said line circuit is closed at the substation, a cord circuit adapted to make connection with said switching terminal and to complete a circuit through a second energizing winding for said electromagnet to cause a greater energization thereof whereby the said signal is effaced and the normal connection of the first energizing winding destroyed, 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 a circuit established by the connection of the cord circuit to the telephone line, and a supervisory signal jointly controlled by said two electromagnets.

75. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a switching terminal, a switch at the substation for controlling the flow of current over the said line through the substation, a signal-receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said electromagnet to a limited extent only to cause the display of its signal when the said line circuit is closed at the substation, a cord

circuit adapted to make connection with said switching terminal and to complete a circuit through a second energizing winding for said electromagnet to cause a greater energization thereof whereby the said signal is effaced and the normal connection of the first energizing winding destroyed, 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 a circuit established by the connection of the cord circuit to the telephone line, a supervisory signal jointly controlled by said two electromagnets, and means whereby the operator may determine the busy or idle condition of a tested line.

76. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a switching terminal, a signal-receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said electromagnet to a limited extent only to cause the display of its signal when the said line circuit is closed at the substation, a cord circuit adapted to make connection with said switching terminal and to complete a circuit through a second energizing winding for said electromagnet to cause a greater energization thereof whereby the said signal is effaced and the normal connection of the first energizing winding destroyed, and means whereby the operator may determine the busy or idle condition of a tested line.

77. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a switching terminal, a switch at the substation for controlling the flow of current over the said line through the substation, a signal-receiving electromagnet associated with said line having an energizing winding and source of current normally in circuit therewith adapted to energize said electromagnet to a limited extent only to cause the display of its signal when the said line circuit is closed at the substation, a cord circuit adapted to make connection with said switching terminal and to complete a circuit through a second energizing winding for said electromagnet to cause a greater energization thereof whereby the said signal is effaced and the normal connection of the first energizing winding destroyed, 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, and means whereby the operator may determine the busy or idle condition of a tested line.



78. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet included in a circuit established by the connection of said cord circuit to the telephone line and adapted to secure a greater energization of said electromagnet whereby the signaling 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 a circuit established by the connection of the cord circuit to the telephone line, a supervisory signal jointly controlled by said two electromagnets, and means whereby the operator may determine the busy or idle condition of a tested line.

79. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet included in a circuit established by the connection of said cord circuit to the telephone line and adapted to secure a greater energization of said electromagnet whereby said signaling 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 a circuit established by the connection of the cord circuit to the telephone line, and a supervisory signal jointly controlled by said two electromagnets.

80. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet included in a circuit established by the connection of said cord-circuit to the telephone line and adapted to secure a greater energization of said electromagnet whereby said signaling 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.

81. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet included in a circuit established by the connection of said cord-circuit to the telephone line and adapted to secure a greater energization of said electromagnet whereby said signaling mechanism



is caused to assume a third position to efface said signal, and means whereby the operator may determine the busy or idle condition of a tested line.

5 82. In a telephone exchange system, the combination with a telephone line conductively uniting a substation with a switching terminal at the central office, a switch at the substation for controlling the flow of current  
10 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, and a second energizing winding for said electromagnet included in a circuit established by the connection of said cord-circuit to the telephone line and adapted to secure a greater energization of said electromagnet whereby said signaling mechanism is caused to assume a third position to efface said signal.

83. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity connected to one contact of said switching terminal and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal, a source of current associated with said cord-circuit and adapted to furnish current over said telephone line when switched for conversation, a signal-controlling electromagnet associated with said cord-circuit and connected to one side thereof, adapted to be placed in circuit with said

source of current and telephone line when the line is switched for conversation whereby said signal-controlling magnet is placed under the control of the substation switch, a second signal controlling electromagnet associated with said cord-circuit and connected to the other side thereof, adapted to be placed in circuit with said source of current and said energizing winding of greater energizing capacity when the line is switched for conversation whereby said signal-controlling electromagnet is not under the control of the substation switch, a supervisory signal jointly controlled by said two electromagnets, and means whereby the operator may determine the busy or idle condition of a tested line.

84. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism, and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity connected to one contact of said switching terminal and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal, a source of current associated with said cord-circuit and adapted to furnish current over said telephone line when switched for conversation, and a signal controlling electromagnet associated with said cord-circuit and connected to one side thereof, adapted to be placed in circuit with said source of current and telephone line when the line is switched for conversation whereby said signal-controlling magnet is placed under the control of the substation switch.

85. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism, and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity connected to one contact of said switching terminal and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal, a source of current associated with said cord-circuit and adapted to furnish current over said telephone line when switched for conversation, a signal-controlling electromagnet associated with said cord-circuit and connected to one side thereof, adapted to be placed in circuit with said



anism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, and a second energizing winding for said electromagnet of greater energizing capacity connected to one contact of said switching terminal and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal.

86. In a telephone exchange system, the combination with a telephone line conductively uniting 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity connected to one contact of said switching terminal and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal, a source of current associated with said cord-circuit and adapted to furnish current over said telephone line when switched for conversation, a signal-controlling electromagnet associated with said cord-circuit and connected to one side thereof, adapted to be placed in circuit with said source of current and telephone line when the line is switched for conversation whereby said signal-controlling magnet is placed under the control of the substation switch, and means whereby the operator may determine the busy or idle condition of a tested line.

87. In a signaling system, the combination with a signal-receiving electromagnet having two energizing windings, a main line uniting two controlling stations, a source of current, means under the control of one of said stations for completing a circuit over the main line and through one of said windings to

cause a limited energization only of said electromagnet whereby said electromagnet is caused to display its signal, means under the control of the second station for securing a greater energization of said electromagnet over a circuit established through said second winding whereby said electromagnet is caused to efface said signal, and means actuated by said electromagnet for completing a conductive path between said stations.

88. In a telephone exchange system, the combination with a telephone line uniting a substation with a central office and provided thereat with a switching terminal conductively connected thereto and having a normal connection to ground from a point intermediate of the testing contact of said switching terminal and the telephone line whereby said terminal is normally maintained at the potential of the said ground, 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet included between said testing contact and said ground connection in a circuit established by the connection of said cord-circuit to the telephone line and adapted to secure a greater energization of said electromagnet whereby said signaling mechanism is caused to assume a third position to efface said signal, and means for establishing a second conductive connection between the said testing contact and the telephone line around said second energizing winding and said ground connection when the said line is switched for conversation to cause the said testing terminal to assume a different potential whereby the operator may determine the idle or busy condition of a tested line.

89. In a telephone exchange system, the combination with a telephone line uniting a substation with a central office and provided thereat with a switching terminal conductively connected thereto and having a normal connection to ground from a point intermediate of the testing contact of said switching terminal and the telephone line whereby said terminal is normally maintained at the potential of the said ground, 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet included between said testing contact and said ground connection in a circuit established by the connection of said cord-circuit to the telephone line and adapted to secure a greater energization of said electromagnet whereby said signaling 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, and means for establishing a second conductive connection between the said testing contact and the telephone line around said second energizing winding and said ground connection when the said line is switched for conversation to cause the said testing terminal to assume a different potential whereby the operator may determine the idle or busy condition of a tested line.

90. In a telephone exchange system, the combination with a telephone line uniting a substation with a central office, provided thereat with a switching terminal conductively connected thereto and having a normal connection to ground from a point intermediate of the testing contact of said switching terminal and the telephone line whereby said terminal is normally maintained at the potential of the said ground, 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet included between said testing contact and said ground connection in a circuit established by the connection of said cord-circuit to the telephone line and adapt-

ed to secure a greater energization of said electromagnet whereby said signaling 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 a circuit established by the connection of the cord circuit to the telephone line, a supervisory signal jointly controlled by said two electromagnets, and means for establishing a second conductive connection between the said testing contact and the telephone line around said second energizing winding and said ground connection when the said line is switched for conversation to cause the said testing terminal to assume a different potential whereby the operator may determine the idle or busy condition of a tested line.

91. In a telephone exchange system, the combination with a telephone line uniting a substation with a central office, provided thereat with a switching terminal conductively connected thereto and having a normal connection to ground from a point intermediate of the testing contact of said switching terminal and the telephone line whereby said terminal is normally maintained at the potential of the said ground, 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity connected between the testing contact of said switching terminal and said ground connection and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal, a source of current associated with said cord-circuit and adapted to furnish current over said telephone line when switched for conversation, a signal-controlling electromagnet associated with said cord-circuit and connected to one side thereof, adapted to be placed in circuit with said source of current and telephone line when the line is switched for conversation whereby



said signal-controlling magnet is placed under the control of the substation switch, a second signal-controlling electromagnet associated with said cord-circuit and connected to the other side thereof, adapted to be placed in circuit with said source of current and said energizing winding of greater energizing capacity when the line is switched for conversation whereby said signal-controlling electromagnet is not under the control of the substation switch, a supervisory signal jointly controlled by said two electromagnets, and means for establishing a second conductive connection between the said testing contact and the telephone line around said second energizing winding and said ground connection when the said line is switched for conversation to cause the said testing terminal to assume a different potential whereby the operator may determine the idle or busy condition of a tested line.

92. In a telephone exchange system, the combination with a telephone line uniting a substation with a central office, provided thereat with a switching terminal conductively connected thereto and having a normal connection to ground from a point intermediate of the testing contact of said switching terminal and the telephone line whereby said terminal is normally maintained at the potential of the said ground, 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity connected between the testing contact of said switching terminal and said ground connection and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal, a source of current associated with said cord-circuit and adapted to furnish current over said telephone line when switched for conversation, a signal-controlling electromagnet associated with said cord-circuit and connected to one side thereof, adapted to be placed in circuit with said source of current and telephone line when the line is switched for conversation whereby said signal-controlling magnet is placed under the control of the sub-

station switch, and means for establishing a second conductive connection between the said testing contact and the telephone line around said second energizing winding and said ground connection when the said line is switched for conversation to cause the said testing terminal to assume a different potential whereby the operator may determine the idle or busy condition of a tested line.

93. In a telephone exchange system, the combination with a telephone line uniting a substation with a central office, provided thereat with a switching terminal conductively connected thereto and having a normal connection to ground from a point intermediate of the testing contact of said switching terminal and the telephone line whereby said terminal is normally maintained at the potential of the said ground, 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 the said telephone line, signaling mechanism, a signal-receiving electromagnet associated with said mechanism and said telephone line having an energizing winding and source of current normally in circuit therewith adapted to secure a limited energization only of said electromagnet over the telephone line under the control of the substation switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet of greater energizing capacity connected between the testing contact of said switching terminal and said ground connection and adapted to be included in a circuit established by the connection of said cord-circuit to the telephone line whereby the said signaling mechanism is caused to assume a third position to efface said signal, a source of current associated with said cord-circuit and adapted to furnish current over said telephone line when switched for conversation, and means for establishing a second conductive connection between the said testing contact and the telephone line around said second energizing winding and said ground connection when the said line is switched for conversation to cause the said testing terminal to assume a different potential whereby the operator may determine the idle or busy condition of a tested line.

94. A telephone system including a circuit extending between two stations, switching mechanism normally in a certain condition, a controlling electromagnet therefor and a source of current both in bridge of said circuit, means under the control of one station for energizing said magnet below a certain limit to cause a second condition of said switching mechanism, and means under the control of the other station for energizing



said magnet above said limit to cause a third condition of said switching mechanism.

95. A telephone system including a telephone line extending between two stations, means for holding conversation over said line switching mechanism normally in a certain condition, a controlling electromagnet therefor and a source of current both in bridge of the talking circuit thus established, means under the control of one station for energizing said magnet below a certain limit to cause a second condition of said switching mechanism, and means under the control of the other station for energizing said magnet above said limit to cause a third condition of said switching mechanism.

96. A telephone system including a telephone line extending from a substation to a central office, a link-circuit for making connection to said line, means for holding conversation over said line and link-circuit, switching mechanism normally in a certain condition, a controlling electromagnet therefor and a source of current both in bridge of the talking circuit thus established, means under the control of the subscriber for energizing said magnet below a certain limit to cause a second condition of said switching mechanism, and means under the control of the operator for energizing said magnet above said limit to cause a third condition of said switching mechanism.

97. A telephone system comprising a telephone line extending in two limbs from a substation to a central station, a two contact connection terminal having its contacts conductively united to said limbs when the line is switched for conversation, a two contact connecting plug and a link-circuit for making connection to the line, means for holding conversation over said line and link-circuit when thus connected, a signaling circuit including a signal and source of current, an electromagnet having an energizing winding connected to the circuit extending between the stations, means whereby a limited energization of said electromagnet controlled from one station causes a closure of said signaling circuit, and means whereby an increased energization of the same character controlled from the other station causes a break in said signaling circuit.

98. A telephone system comprising a telephone line extending in two limbs from a substation to a central station, a two contact connection terminal having its contacts conductively united to said limbs when the line is switched for conversation, a two contact connecting plug and a link-circuit for making connection to the line, means for holding conversation over said line and link-circuit

when thus connected, a local signal circuit at the central station, a signal included in said circuit, a controlling electromagnet having a core and suitable windings associated with the circuit extending between said stations, means whereby said local circuit is closed when said core is subjected to a limited magnetization controlled from one station, and means whereby said local circuit is opened when said core is subjected to an increased magnetization controlled from the other station.

99. A telephone system comprising a telephone line extending in two limbs from a substation to a central station, a two contact connection terminal having its contacts conductively united to said limbs when the line is switched for conversation, a two contact connecting plug and a link-circuit for making connection to the line, means for holding conversation over said line and link-circuit when thus connected, a local signal circuit at the central station, a signal included in said circuit, two switches serially included in said signal circuit, a controlling electromagnet associated with the circuit extending between said stations, means whereby a limited energization of said magnet controlled from one station causes an actuation of one of said switches, and means whereby an increased energization of said magnet controlled from the other station causes an actuation of the other switch.

100. A telephone system comprising a telephone line extending in two limbs from a substation to a central station, a two contact connection terminal having its contacts conductively united to said limbs when the line is switched for conversation, a two contact connecting plug and a link-circuit for making connection to the line, a relay at the exchange connected to the circuit extending between the stations, a signal controlled by said relay in response to different energizations thereof, means whereby an energization of said relay over a circuit controlled from the substation causes an actuation of said relay to establish a certain abnormal condition of said signal, and means whereby the connection of said connecting plug to said connection terminal causes an actuation of said relay to establish another abnormal condition of said signal.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

HARRY G. WEBSTER.

Witnesses:

W. CLYDE JONES,  
M. R. ROCHFORD.