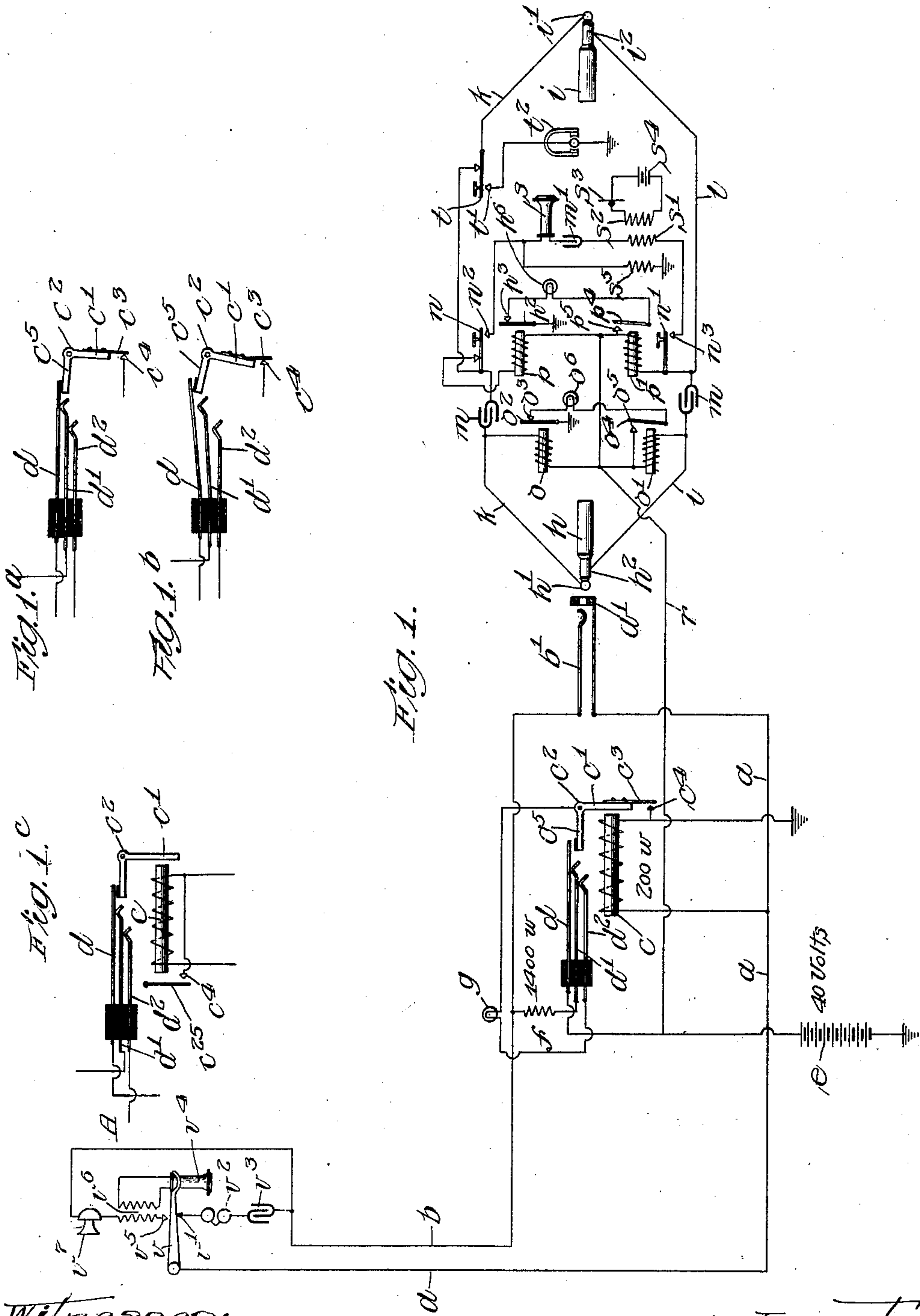


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H. G. WEBSTER.
TELEPHONE SYSTEM.

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TELEPHONE SYSTEM.

No. 897,236.

Specification of Letters Patent.

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To all whom it may concern:

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

My invention relates to improvements in telephone systems, my object being to provide improved signaling apparatus therein.

In accordance with my invention, I provide at the central station a signal controlling electromagnet which is under the control of the subscriber at the sub-station and is also under the control of the operator at the central station. This electromagnet 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 electromagnet is preferably constructed so that it is initially controlled 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 electromagnet is also adapted to be actuated by the operator, preferably by the insertion of the connecting plug in a spring jack or switching terminal of the subscriber's line. The initial actuation of the magnet may be utilized to light a lamp as the calling signal, and the final actuation of the magnet, 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 electromagnet in the form of a relay having a single armature adapted to partake of an initial movement under the control of the subscriber, and to partake of a final movement under the control of the operator, the initial movement serving to actuate the signal for the connection, and the final movement serving to render the signal inert; these movements may also be utilized for performing other functions 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 method of construction.

In its broader phases, my invention is described and illustrated in my application for

United States Letters Patent, Serial #149833, filed March 27, 1903. In the present application, which is a division of said prior application, I have illustrated my invention in connection with the signal controlling electromagnet in the form of a relay, having one energizing winding only which is normally included in series with a resistance or retardation coil, and is initially responsive to current controlled by the subscriber. The complete energization of the winding is, however, under the control of the operator whereby the said electromagnet may cause its signal controlling mechanism to assume a third position.

I have illustrated this application of my invention in the accompanying drawings, in which

Figure 1 is a diagram, illustrating my invention in connection with a two-wire metallic circuit telephone exchange system; Fig. 1^a is a detail view, showing diagrammatically the armature and switching contacts of the relay in the second intermediate position; Fig. 1^b is a detail view, showing diagrammatically the armature and switching contacts of the relay in their third or final position; Fig. 1^c is a detail view of a modification of the relay magnet.

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*¹ and spring *b*¹ 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*¹ of the relay is pivoted at *c*², and carries a contact spring, *c*³, adapted to make contact with anvil, *c*⁴. The arm, *c*⁵, which moves with the armature, carries upon its end a block of insulation which is adapted to engage and raise a contact spring, *d*, normally resting against a contact spring, *d*¹, 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*¹, 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^1 . 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^1 and a sleeve, h^2 , while the plug, i , is provided with a tip, i^1 , 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^1 , p , p^1 . A conductor, r , connects the positive pole of the battery, e , with the bridges containing the relays at points intermediate of the relays. Relay, o , is provided with contact spring, o^2 , normally resting against anvil, o^3 , and relay, o^1 , 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^1 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^1 , 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^1 of the induction coil are placed. A condenser, m^1 , 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^1 , 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^1 , 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.

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^1 , 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^1 is moved into the position shown in Fig. 1^a. 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^1 . The circuit through the lamp, g , is thus closed and may be traced from bat-

tery, e , through springs, d , d^1 , d^2 , lamp, g , armature, c^1 , 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^1 , strand l , sleeve h^2 , thimble a^1 , limb a , relay c to ground and back to the battery. Current also flows from wire r through relay o , strand k , tip h^1 , line spring b^1 , 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^b, in which position the spring, d , is lifted and spring, d^1 , is released and rises, breaking contact with spring, d^2 . The tension of spring, d^1 , 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^1 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 resistance f . 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^1 of plug i to the sleeve a^1 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 the relay p^1 , the circuit being traced from battery e over conductor r , thence through relay p^1 to strand l and sleeve i^2 , thence through thimble a^1 of the called 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*¹, line spring *b*¹ 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*¹ and *p*¹ 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 therethrough by the insertion of the plug in the spring-jack of the subscriber to thereby cause the relay armature to partake of its second or final movement, which movement serves to open the lamp circuit. This movement also serves to remove the normal battery connection from the tip side of the line. 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^c, 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*¹ upon the right is finally actuated to open the lamp circuit and disconnect the battery from the limb of the talking circuit.

It will be apparent that many modifications will occur to those skilled in the art, for securing a sufficient difference between the energization of the relay *c* when in circuit only with the subscriber's line and when energized from the cord circuit, whereby the said relay magnet may control two definite movements of its associated-switching apparatus to govern the display of its signal.

It will also be obvious to those skilled in the art that my invention is not confined in its application to a switch-board system of the character illustrated in the accompanying drawings, but that it may be applied to, and utilized in, other telephone exchange systems.

I claim:

1. In a telephone exchange system, the combination with a telephone line connect-

ing a sub-station 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 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 signal receiving electro-magnet 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 electro-magnet, a coil containing resistance connected in circuit with said energizing winding and line adapted to limit the energization of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding 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 electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation, a second signal controlling electro-magnet 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 electro-magnets.

2. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a coil containing resistance connected in circuit with said energizing winding and line adapted to limit the energization of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding 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 electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation.

3. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a coil containing resistance connected in circuit with said energizing winding and line adapted to limit the energization of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding to cause the signaling mechanism to assume a third position to efface said signal and a signal controlling electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation.

4. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a coil containing resistance connected in circuit with said energizing winding and line adapted to limit the energization of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding to cause the signaling mechanism to assume a third position to efface said signal, a signal controlling electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation, a second signal controlling electro-magnet 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 electro-magnets.

5. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a coil containing resistance connected in circuit with said energizing winding and line adapted to limit the energization of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding to cause the signaling mechanism to assume a third position to efface said signal.

6. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a coil containing resistance connected in circuit with said energizing winding and

line adapted to limit the energization of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding 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.

7. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a resistance device in series with said energizing winding for securing a limited energization only of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding to cause the signaling mechanism to assume a third position to efface said signal.

8. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a resistance device in series with said energizing winding for securing a limited energization only of said electro-magnet over the telephone line over the control of the sub-station 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 and said energizing winding to cause the signaling mechanism to assume a third position to efface said signal and a signal controlling electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation.

9. 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 for controlling the flow of current over the said line through 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 signal receiving electro-magnet 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 electro-magnet, a resistance device in series with said energizing winding for securing a limited energization only of said electro-magnet over the telephone line under the control of the sub-station 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 and said energizing winding to cause the signaling mechanism to assume a third position to efface said signal, a signal controlling electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation, a second signal controlling electro-magnet 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 electro-magnets.

10. In a telephone exchange system, the combination with a telephone line connecting a sub-station with the central office and provided with a switching terminal thereat, a signal receiving electro-magnet associated with said line having an energizing winding, a resistance external thereto, and a source of current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the sub-station, cord connecting apparatus adapted to make connection with the said switching terminal and to establish a new path for the greater flow of current through said energizing winding and switching terminal to cause

a greater energization of said magnet whereby the said signal is again effaced when the said line is switched for conversation, means whereby the operator may determine the
 5 idle or busy condition of a tested line, a signal controlling electro-magnet associated with said cord connecting apparatus and under the control of the sub-station switch when the telephone line is switched for con-
 10 versation, a second signal controlling electro-magnet associated with said cord connecting apparatus and energized over the said circuit established by the connection of the cord circuit to the telephone line and a supervi-
 15 sory signal jointly controlled by the said two electro-magnets.

11. In a telephone exchange system, the combination with a telephone line connect-
 20 ing a sub-station with the central office and provided with a switching terminal thereat, a signal receiving electro-magnet associated with said line having an energizing winding, a resistance external thereto, and a source of
 25 current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the sub-sta-
 30 tion, cord connecting apparatus adapted to make connection with the said switching terminal and to establish a new path for the greater flow of current through said energiz-
 ing winding and switching terminal to cause a greater energization of said magnet where-
 35 by the said signal is again effaced when the said line is switched for conversation, means whereby the operator may determine the idle or busy condition of a tested line and a
 40 signal controlling electro-magnet associated with said cord connecting apparatus and under the control of the sub-station switch when the telephone line is switched for con-
 versation.

12. In a telephone exchange system, the combination with a telephone line connect-
 45 ing a sub-station with the central office and provided with a switching terminal thereat, a signal receiving electro-magnet associated with said line having an energizing winding, a resistance external thereto, and a source of
 50 current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the sub-sta-
 55 tion, cord connecting apparatus adapted to make connection with the said switching terminal and to establish a new path for the greater flow of current through said energiz-
 ing winding and switching terminal to cause a greater energization of said magnet where-
 60 by the said signal is again effaced when the said line is switched for conversation and means whereby the operator may determine the idle or busy condition of a tested line.

13. In a telephone exchange system, the
 65 combination with a telephone line connecting

a sub-station with the central office and pro-
 vided with a switching terminal thereat, a signal receiving electro-magnet associated with said line having an energizing winding, a resistance external thereto, and a source of
 70 current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the sub-sta-
 75 tion, cord connecting apparatus adapted to make connection with the said switching terminal and to establish a new path for the greater flow of current through said energiz-
 ing winding and switching terminal to cause a greater energization of said magnet where-
 80 by the said signal is again effaced when the said line is switched for conversation, and a signal controlling electro-magnet associated with said cord connecting apparatus and
 85 under the control of the sub-station switch when the telephone line is switched for con-
 versation.

14. In a telephone exchange system, the combination with a telephone line connect-
 90 ing a sub-station with the central office and provided with a switching terminal thereat, a signal receiving electro-magnet associated with said line having an energizing winding, a resistance external thereto, and a source of
 95 current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the sub-sta-
 100 tion, cord connecting apparatus adapted to make connection with the said switching terminal and to establish a new path for the greater flow of current through said energiz-
 ing winding and switching terminal to cause a greater energization of said magnet where-
 105 by the said signal is again effaced when the said line is switched for conversation, a signal controlling electro-magnet associated with said cord connecting apparatus and under
 the control of the sub-station switch when
 110 the telephone line is switched for conversation, a second signal controlling electro-mag-
 net associated with said cord connecting ap-
 115 paratus and energized over the said circuit established by the connection of the cord circuit to the telephone line, and a super-
 visory signal jointly controlled by the said two electro-magnets.

15. In a telephone exchange system, the combination with a telephone line connect-
 120 ing a sub-station with the central office and provided with a switching terminal thereat, a signal receiving electro-magnet associated with said line having an energizing winding, a resistance external thereto, and a source of
 125 current normally in circuit therewith adapted to energize said magnet to a limited extent only to cause it to display its signal when the line circuit is closed at the sub-sta-
 130 tion, and cord connecting apparatus adapted to make connection with the said switching

terminal and to establish a new path for the greater flow of current through said energizing winding and switching terminal to cause a greater energization of said magnet whereby the said signal is again effaced when the said line is switched for conversation.

16. In a telephone exchange system, the combination with a telephone line connecting a sub-station with the central office, a cord circuit at the central office for making connection with the said line, a signal receiving electro-magnet associated with said line, having an energizing winding connected to one side thereof, a resistance external to said winding, a normal connection extending from the other side of said line to a source of current adapted to complete the circuit through said winding and through said resistance, when the line circuit is closed at the sub-station, to energize said magnet to a limited extent only to cause a display of its signal, a connection from a source of current associated with said cord circuit adapted to cause a greater flow of current through said energizing winding without also passing through said external resistance, when the line is switched for conversation, whereby the said signal is effaced, means whereby the operator may determine the idle or busy condition of a tested line, a signal controlling electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation, a second signal controlling electro-magnet associated with said cord circuit and energized over the circuit established by the connection of the cord circuit to the telephone line, and a supervisory signal jointly controlled by the said two electro-magnets.

17. In a telephone exchange system, the combination with a telephone line connecting a sub-station with the central office, a cord circuit at the central office for making connection with the said line, a signal receiving electro-magnet associated with said line, having an energizing winding connected to one side thereof, a resistance external to said winding, a normal connection extending from the other side of said line to a source of current adapted to complete the circuit through said winding and through said resistance, when the line circuit is closed at the sub-station, to energize said magnet to a limited extent only to cause a display of its signal, a connection from a source of current associated with said cord circuit adapted to cause a greater flow of current through said energizing winding without also passing through said external resistance, when the line is switched for conversation, whereby the said signal is effaced, means whereby the operator may determine the idle or busy condition of a tested line, and a signal controlling electro-magnet associated with said cord circuit and under

the control of the sub-station switch when the telephone line is switched for conversation.

18. In a telephone exchange system, the combination with a telephone line connecting a sub-station with the central office, a cord circuit at the central office for making connection with the said line, a signal receiving electro-magnet associated with said line, having an energizing winding connected to one side thereof, a resistance external to said winding, a normal connection extending from the other side of said line to a source of current adapted to complete the circuit through said winding and through said resistance, when the line circuit is closed at the sub-station, to energize said magnet to a limited extent only to cause a display of its signal, a connection from a source of current associated with said cord circuit adapted to cause a greater flow of current through said energizing winding without also passing through said external resistance, when the line is switched for conversation whereby the said signal is effaced and means whereby the operator may determine the idle or busy condition of a tested line.

19. In a telephone exchange system, the combination with a telephone line connecting a sub-station with the central office, a cord circuit at the central office for making connection with the said line, a signal receiving electro-magnet associated with said line having an energizing winding connected to one side thereof, a resistance external to said winding, a normal connection extending from the other side of said line to a source of current adapted to complete the circuit through said winding and through said resistance, when the line circuit is closed at the sub-station, to energize said magnet to a limited extent only to cause a display of its signal, and a connection from a source of current associated with said cord circuit adapted to cause a greater flow of current through said energizing winding without also passing through said external resistance, when the line is switched for conversation, whereby the said signal is effaced.

20. In a telephone exchange system, the combination with a telephone line connecting a sub-station with the central office, a cord circuit at the central office for making connection with the said line, a signal receiving electro-magnet associated with said line having an energizing winding connected to one side thereof, a resistance external to said winding, a normal connection extending from the other side of said line to a source of current adapted to complete the circuit through said winding and through said resistance, when the line circuit is closed at the sub-station, to energize said magnet to a limited extent only to cause a display of its signal, a connection from a source of current as-

sociated with said cord circuit adapted to cause a greater flow of current through said energizing winding without also passing through said external resistance, when the line is switched for conversation, whereby the said signal is effaced, and a signal controlling electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation.

21. In a telephone exchange system, the combination with a telephone line connecting a sub-station with the central office, a cord circuit at the central office for making connection with the said line, a signal receiving electro-magnet associated with said line having an energizing winding connected to one side thereof, a resistance external to said winding, a normal connection extending from the other side of said line to a source of current adapted to complete the circuit through said winding and through said resistance, when the line circuit is closed at the sub-station, to energize said magnet to a limited extent only to cause a display of its signal, a connection from a source of current associated with said cord circuit adapted to cause a greater flow of current through said energizing winding without also passing through said external resistance when the line is switched for conversation, whereby the said signal is effaced, a signal controlling electro-magnet associated with said cord circuit and under the control of the sub-station switch when the telephone line is switched for conversation, a second signal controlling electro-magnet associated with said cord circuit and energized over the circuit established by the connection of the cord circuit to the telephone line, and a supervisory signal jointly controlled by the said two electro-magnets.

22. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over a circuit including a connected line and cord-circuit, a source of current at the central office, a resistance coil normally connected between one pole of said source and one side of said circuit, a controlling electromagnet having an energizing winding connected between the other pole of said source and the other side of said circuit, means under the control of the subscriber for completing a circuit through said resistance and winding to energize said magnet, means under the control of the operator for modifying said energization by including said winding in another circuit, and means for displaying a signal in response to said initial energization and to efface said signal in response to said modified energization.

23. A telephone system comprising a tele-

phone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over a circuit including a connected line and cord-circuit, a source of current at the central office, a resistance coil normally connected between one pole of said source and one side of said circuit, a controlling electromagnet having an energizing winding connected between the other pole of said source and the other side of said circuit, means under the control of the subscriber for completing a circuit through said resistance and winding to energize said magnet, means under the control of the operator for increasing said energization by including said winding in a circuit of less resistance, and means for displaying a signal in response to said initial energization and to efface said signal in response to said increased energization.

24. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over a circuit including a connected line and cord-circuit, a source of current at the central office, a resistance coil normally connected between one pole of said source and one side of said circuit, a controlling electromagnet having an energizing winding connected between the other pole of said source and the other side of said circuit, means controlled by said electromagnet means under the control of the subscriber for completing a circuit through said resistance and winding to energize said magnet means under the control of the operator for modifying said energization by including said winding in another circuit, and means for disconnecting said resistance coil from direct connection with said source of current in response to said modified energization.

25. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making connection to said line, means for holding conversation over a circuit including a connected line and cord-circuit, a source of current at the central office, a resistance coil normally connected between one pole of said source and one side of said circuit, a controlling electromagnet having an energizing winding connected between the other pole of said source and the other side of said circuit, means controlled by said electromagnet means under the control of the subscriber for completing a circuit through said resistance and winding to energize said magnet, means under the control of the operator for increasing said energization by including said winding in a circuit of less resistance, and means for disconnecting said resistance coil from direct connection

with said source of current in response to said increased energization.

26. A telephone system comprising a subscriber's line extending from a substation
5 to a central office, a cord-circuit for establishing connection with said line, means for holding conversation over a connected line and cord-circuit, an electromagnet adapted to be energized to different degrees, a non-inductive resistance associated therewith,
10 means under subscriber's and operator's control for utilizing said resistance to vary the energizations of said electromagnet, and means for displaying and effacing a signal
15 in response to said different degrees of energization.

27. A telephone system comprising a telephone line extending from a substation to a central office, a cord-circuit for making
20 connection to said line, means for holding

conversation over said line and cord-circuit, a controlling electromagnet associated with said line at the central office, means under the control of the subscriber for energizing said electromagnet by including a winding
25 of said magnet in a circuit of definite resistance, means under the control of the operator for modifying said energization by including said winding in a path of different resistance, and means for displaying a signal
30 in response to said initial energization and to efface said signal in response to said modified energization.

In witness whereof, I hereunto subscribe my name this 8th day of October, A. D.,
1904. 35

HARRY G. WEBSTER.

Witnesses:

A. H. DYSON,

CAROLYN WEBER.