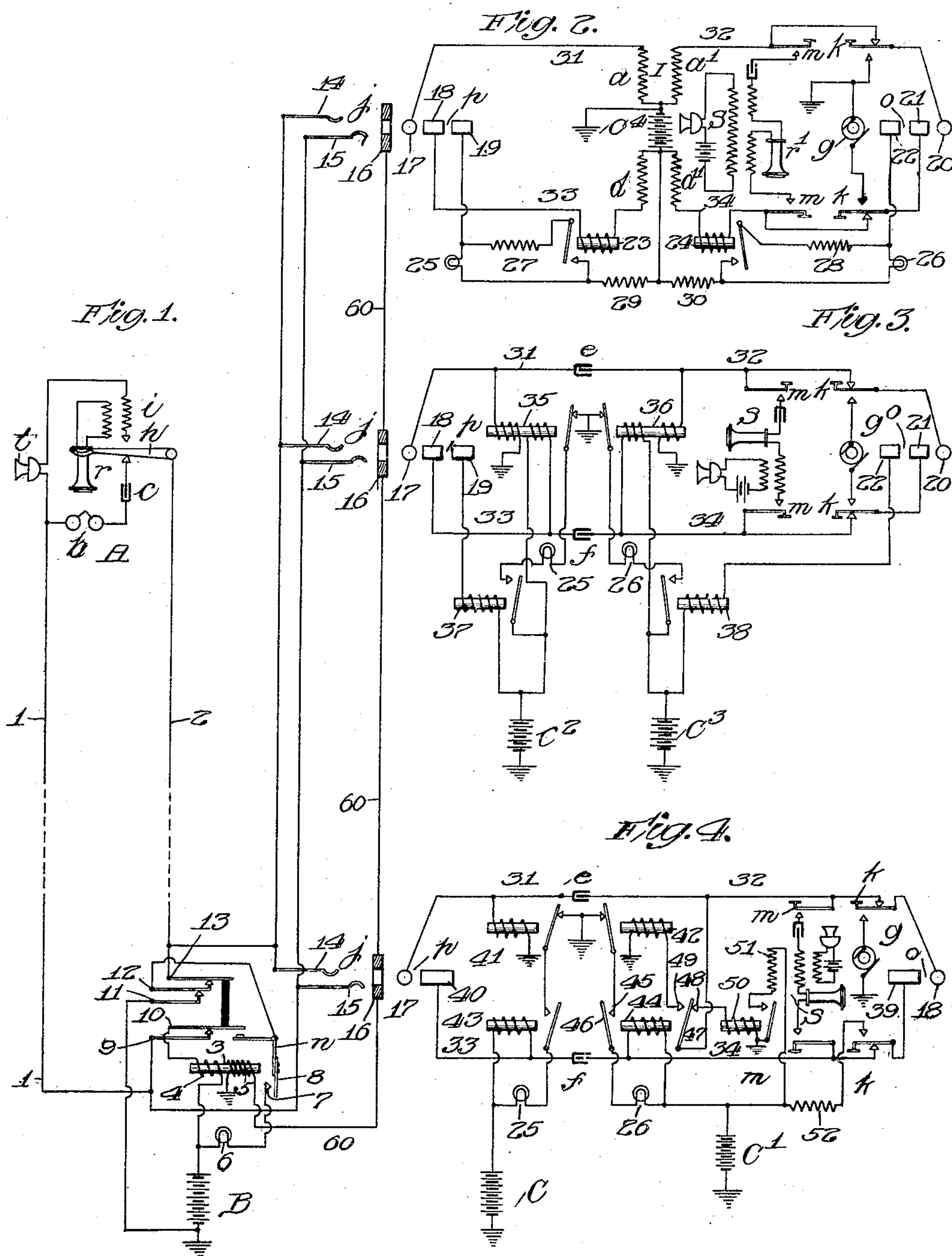


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H. G. WEBSTER.  
TELEPHONE EXCHANGE SYSTEM.  
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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

No. 897,233.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed August 4, 1904. Serial No. 219,415.

*To all whom it may concern:*

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

My invention relates to improvements in telephone exchange systems, my object being to provide simplified and improved circuit arrangements and signaling apparatus. In accordance with my invention I provide at the central station a signal controlling electromagnet having two energizing windings, one of which is normally in a circuit uniting the sub-station with the exchange, and controlled by the subscriber. The other winding is the circuit of a third conductor, which circuit is controlled by the operator. This electromagnet in a 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 into a spring jack or switching terminal of the subscriber's line. The initial actuation of the relay may be utilized to light a lamp as 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 the 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.

I have illustrated a preferred application of my invention in the accompanying drawings in which

Figure 1 illustrates the line to the subscriber's station, the relay associated therewith and the switching terminals for the line, together with the various circuit connections. Fig. 2 shows one form of cord circuit adapted for association with the line circuit of Fig. 1, in which the connecting plugs have three contact pieces, the talking strands of the cord being inductively related by means of a repeating induction coil. Fig. 3 shows a somewhat similar cord circuit adapted for association with the same line and having three contact pieces for the plugs, but in which the talking strands of the cord are inductively united by means of condensers. Fig. 4 illustrates a somewhat different cord circuit adapted for connection with the line, in which the plugs have but two contact pieces and corresponding cord strands.

Like characters refer to like parts in the several figures.

Referring to Fig. 1 the subscriber's apparatus shown at A is represented as consisting of the telephone hook switch *h*, signal bell *b*, condenser *c*, receiver *r*, transmitter *t*, and induction coil *i* including the said receiver in its secondary winding.

Although I have shown but one arrangement it will be understood by those skilled in the art that various other arrangements of the subscriber's apparatus may be used, and I do not confine myself to the particular arrangement illustrated.

Under normal conditions the receiver hangs upon its hook switch, thus closing its lower contact and maintaining the upper contact open. The condenser *c* prevents a normal flow of current from battery B at the central office over the telephone line. When, however, the subscriber removes his telephone from its hook, thus closing the upper contact of hook switch *h* and establishing a relatively low resistance path for the flow of current through the transmitter



*t* and one winding of the coil *i*, the relay 3 at the central office will be operated by the flow of current from said battery B through winding 4 of the relay, contact springs 10 and 9, limbs 1—2 of the telephone line, contacts 13—12 and 11 of the relay, and thence to the office return or grounded side of the battery B. This flow of current through the energizing winding 4 is sufficient to cause the partial attraction of the armature *n* of the said relay, causing it to close the contacts 8—7. Said energizing winding 4 is of relatively low resistance and composed of relatively few turns, or otherwise made of low energizing capacity, so as to prevent the complete energization of the said relay and to limit the attraction of its armature. In order that the armature *n* may alter the contacts between the springs 9—10—11—12 and 13, it is necessary that the core of the relay be energized to a greater extent than can be secured through the winding 4. The closure of contact 8—7 established a path for the flow of current from battery B through lamp 6, contact 12—11 and to the other pole of said battery. This flow of current causes the illumination of the signal lamp 6 to indicate to the operator that the subscriber has removed his telephone from its hook for the purpose of making a call.

Each subscriber's line is provided with one or more spring jacks *j* each having contact pieces 14—15—16 arranged as indicated in the drawing. Each operator is provided with cord circuits adapted to unite the lines for conversation.

Referring now to the operation of the cord circuit of Fig. 2; on observing the calling signal the operator will insert the answering plug *p* into a spring jack *j* corresponding to the calling signal, thus causing contact pieces 17—18—19 of the plug to engage respectively with the contact pieces 14—15—16 of the spring jack. The contact 16—19 completes a circuit from battery C<sup>1</sup> through resistance 29, lamp 25, conductor 60, and winding 5 of the relay 3, to the ground or return side of battery C<sup>1</sup>. The windings 5 is so proportioned, having a relatively large number of turns, as to cause the complete energization of the relay 3 and the complete attraction of its armature *n*, thus altering the normal contacts between the springs 9—10—11—12—13. Contact between springs 11—12 and 13 is now broken, thus opening the circuit through the signal lamp 6 and disconnecting said lamp circuit from the line and also breaking the direct connection between limb 2 of the line and the return side of battery B. Contact between springs 9—10 is broken, thus disconnecting the winding 4 from the line circuit. As a result of the complete operation of said relay 3, the line signal 6 is effaced, the normal connections of winding 4 and battery B to the telephone line are

broken, and limbs 1—2 of the line now terminate at springs 14—15 of the spring jacks *j* without intervening battery or earth connections. The flow of current through resistance 29 and winding 5 of the relay 3 would now illuminate lamp 25 were the subscriber's telephone not removed from the hook. The telephone being off its hook, however, a flow of current is established through relay 23 as follows:—from the active terminal of battery C<sup>1</sup> through winding *d* of the repeating coil, strand 33 of the cord circuit, contact 18—15 of the plug and jack, limbs 1—2 of the line, contact 14—17 of the plug and jack, strand 31 of the cord, and winding *a* of the repeating coil to the return side of battery C<sup>1</sup>. This flow of current energizes the relay 23 and closes by its contact the shunt path around lamp 25 including resistance 27. This path being of comparatively low resistance as compared with the lamp the latter remains unlighted at this time. Upon the actuation of the listening key *m m* the operator's set S is brought into inductive relation with the answering plug by means of windings *a' d'* of the repeating coil I, and the operator obtains the number of the connection desired. The busy test is secured by touching the plug tip 20 to the thimble 16 of the line wanted in the usual manner; if the line be idle there will be no flow of current as the thimble 16 and tip 20 are normally of the same potential. If, however, the line tested is connected for conversation, the potential of thimble 16 will be raised by its connection with the plug contact 19 or 22 of the cord used for such switch connection, and a flow of current will result from tip 20 through cord strand 32 and winding *a'*, causing the customary click in the operator's receiver *r'*. When plugging in to ring, circuit is completed from battery C<sup>1</sup> through resistance 30, lamp 26, contact 22—16 of the plug and spring jack, conductor 60, and winding 5 of relay 3 associated with the line to be called. As previously explained current flowing over this circuit causes the illumination of lamp 26 and the complete attraction of the armature of relay 3 disconnects the normal earth and battery connections of the line, and the signal associated therewith. The operator rings in the usual manner by depressing the ringing key *k k*. When the subscriber answers, a circuit being completed for relay 24 similar to that described previously for relay 23, the closure of the relay contacts extinguishes lamp 26. When both subscribers hang up, relays 23—24 are thus deenergized, their contacts separated, and lamps 25 and 26 illuminated, constituting the signal for disconnection. Upon the removal of the plugs all of the apparatus returns to the normal position shown in the drawings.

When the line is associated with the cord circuit of Fig. 3 its operation is the same as



that previously described. Upon the insertion of a plug, the subscriber's receiver being upon its hook switch, current flows from battery  $C^2$  through relay 37, plug and jack contact 19—16, conductor 60, and winding 5 of the relay 3, causing the complete attraction of its armature. The current flowing through this circuit also energizes relay 37, causing its contacts to close the circuit of lamp 25, from battery  $C^2$ , through the normally closed contacts of relay 35; to the return side of the battery, causing its illumination. When the subscriber answers a current from battery  $C^2$  flows through the windings of relay 35 and the limbs 1—2 of the line, causing the energization of relay 35, which by its contacts opens the circuit of lamp 25, extinguishing the same. The operator answers, tests, and rings in the usual manner and when switched for conversation the subscribers' conversational circuit is completed through condensers  $e-f$ . As in the case of Fig. 2 the two limbs of the line when switched for conversation terminate at contacts 14—15 of the jacks and are free from battery or earth connections.

When the line is associated with the cord circuit of Fig. 4 the operation is substantially that of the two previous figures, although the conditions are somewhat different. The subscriber calls in the manner previously described, the current through winding 4 of relay 5 causing a limited movement of armature  $n$  to close the circuit of the signal lamp 6. The plugs associated with the cord circuit are so constructed that when a plug is inserted (as the answering plug  $p$ ), contact 17 will engage spring 14 of the jack while contact 40 of the plug will engage spring 15 and thimble 16 of the jack. A circuit will thus be completed from battery  $C$  through relay 43, strand 33, contact 40—16 of the plug and jack, conductor 60 and winding 5 of the relay 3. Current flowing through this contact will cause the complete attraction of armature  $n$  as well as the energization of relay 43. If the subscriber's receiver were upon its hook switch the signal lamp 25 would now be illuminated by current from battery  $C$  flowing through the contacts of relay 43 and the normally closed contacts of relay 41. Inasmuch, however, as the receiver is removed, another circuit has been completed from battery  $C$  through contact 40—15 of the plug and spring jack, limbs 1—2 of the line, contact 14—17 of the spring jack and plug, strand 31 and relay 41 to the return side of the battery. Current through this circuit energizes relay 41, causing the separation of its contacts and prevents lamp 25 from lighting. After ascertaining the connection desired the operator tests in the usual way. If the line be busy a circuit will be closed

from the thimble of the tested line to tip 18, through strand 32, contact 47—48 of relay 44, and through the high resistance winding of the test relay 50, which being energized completes by its contacts a circuit of battery  $C'$  through winding 51 of the operator's induction coil, causing the customary click. It will be noted that while making the test there is no other path for current flow from tip 18 and on account of the high resistance of test relay 50, little or no disturbance is produced upon the line of the tested subscriber. Upon inserting the calling plug, a circuit is completed from battery  $C'$  through relay 44, strand 34 of the cord, sleeve contact 39 of the plug, thimble 16, conductor 60, and relay winding 5 of the line desired. Current flowing through this circuit causes the complete actuation of the line relay 3 as well as the energization of relay 44. The energization of relay 44 breaks contact 47—48 and closes contact 47—49, thus disconnecting the test relay 50, and bringing relay 42 into connection with strand 32 of the cord. At the same time contact 45—46 of relay 44 is closed, completing the circuit of lamp 26 from battery  $C'$  through the normally closed contacts of relay 42; causing the illumination of the lamp. When the subscriber answers a circuit being completed for relay 42 similar to that described for relay 41, its contacts separate, extinguishing lamp 26. When the subscribers hang up, relays 41 and 42 become deenergized, their contacts assume the normal position, causing the illumination of lamps 25—26, and when the cord circuit is disconnected all parts assume the normal position shown in the drawing. In this case as in that of Fig. 3 the talking circuits of the connected subscribers are completed by means of condensers  $e-f$ .

When the cord circuit of Fig. 4 is used it is to be noted that while the lines are connected for conversation the talking circuit is free from direct or non-inductive earth or battery connections, although the winding 5 of relay 3 is left legged to one side of the line through the contact 16—40 of the plug and spring jack, and that when a subscriber is called the relay 3 is completely actuated by current from battery  $C'$  flowing through resistance 52, sleeve 39 of the calling plug, thimble 16, conductor 60 and winding 5, and that the circuit of ringing generator  $g$  includes contact 18—14, and contacts 15—39—16 of the plug and spring jack, limbs 1—2 of the line and the common circuits of the central office battery. While separate batteries  $B-C-C'-C^2-C^3$  and  $C^4$  have been indicated in the various figures, it will be well understood by those skilled in the art that in either of the three systems indicated a single source of current may be used. It is also to be understood that the various



grounds shown represent the return or grounded side of the central office battery or batteries.

I prefer to arrange the two windings 4—5 of the relay 3 so that the direction of magnetization of the relay 3 will be the same when energized by either winding, although it is only necessary that the strength of magnetization secured by winding 5 shall be of sufficient intensity to cause the complete attraction of the armature *n* and that the winding 4 shall produce a limited energization thereof sufficient only to cause the partial attraction of the said armature *n*.

It will also be obvious to those skilled in the art that my invention is not confined in its application to the switch board systems illustrated in the drawing, but that it may be embodied and utilized in other structures. Also that many modifications may be made without departing from the spirit of my invention, and I therefore do not wish to be limited to the precise structure shown, but

I claim:—

1. In a telephone exchange system the combination of a telephone line connecting a sub-station with the central office, a switching terminal having two contact pieces conductively associated with the two sides of said line and a testing contact piece adapted to be connected in a circuit local to the exchange, 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 sub-station, and having a second energizing winding in circuit with said testing contact piece, and a cord circuit adapted to make connection with the line contact pieces of said switching terminal, and to complete a circuit through the second energizing winding of said electromagnet to cause a greater energization thereof, whereby said signal is effaced and the normal connection of the first energizing winding is destroyed.

2. In a telephone exchange system the combination of a telephone line connecting a sub-station with the central office, a switching terminal having two contact pieces conductively united to the two limbs of the telephone line and a testing contact piece connected in a circuit local to the exchange, said testing contact piece being so arranged as to be brought into direct electrical connection with one of the said line contact pieces when a cord circuit is connected with said 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 sub-station, and having a second energizing winding in circuit with said testing contact piece, and a cord circuit adapted to make connection with the line contact pieces of said switching terminal, and to complete a circuit through the second energizing winding of said electromagnet to cause a greater energization thereof, whereby said signal is effaced and the normal connection of the first energizing winding is destroyed.

3. In a telephone exchange system the combination of a telephone line connecting a sub-station with the central office, 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 sub-station, a spring jack associated with the line having a contact piece connected with each of the two limbs of the line and a third contact piece connected with a second energizing winding of said electromagnet, and means at the central office for establishing a circuit through said third contact piece of the jack and said energizing winding of the electromagnet to cause a greater energization thereof, whereby the said signal is effaced and the normal connection of the said first energizing winding is destroyed.

4. In a telephone exchange system the combination of a telephone line connecting a sub-station with the central office, 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 sub-station, a spring jack associated with the line having a contact piece connected with each of the two limbs of the line and a third contact piece connected with a second energizing winding of said electromagnet, and switching apparatus at the central office adapted to make connection with said spring jack, including a source of current and a connection plug, said connection plug having two contact pieces, one adapted to register with one line contact piece of the spring jack, the other adapted to register with the other line contact piece and the third contact piece jointly, whereby connection is established with the line and a circuit is completed through the second energizing winding of said electromagnet to cause a greater energization thereof to efface the said signal and to destroy the normal connection of the said first energizing winding.

5. In a telephone exchange system the combination of a metallic telephone line conductively uniting a sub-station with the two line contact pieces of 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 third contact piece associated with said switching terminal, a cord circuit at the central office adapted to make connection with said switching terminal and to complete a circuit there-  
 5 through over the said telephone line, signaling mechanism, a signal receiving electro-  
 10 magnet controlling said mechanism having an energizing winding and source of current normally in circuit therewith adapted to se-  
 15 cure a limited energization only of said electro-  
 magnet over the telephone line under the  
 control of the sub-station switch, whereby a  
 limited movement of said signaling mechan-  
 20 ism is caused to display a signal, and a second  
 energizing winding for said electromagnet  
 connected with the third contact piece of  
 25 said switching terminal, and included 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 mech-  
 30 anism is caused to assume a third position to  
 efface said signal.

6. In a telephone exchange system the  
 combination of a metallic telephone line con-  
 ductively uniting a sub-station with the two  
 30 line contact pieces of 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 third con-  
 tact piece associated with said switching ter-  
 35 minal adapted to be brought into circuit with  
 one of the said line contact pieces upon the  
 insertion of a plug, a cord circuit at the cen-  
 tral office adapted to make connection with  
 said switching terminal and to complete a  
 40 circuit therethrough over the said telephone  
 line, a connection plug associated with said  
 cord circuit having two contact pieces only,  
 one of said contact pieces being adapted to  
 complete a connection between said third  
 45 contact piece and a line contact piece of  
 the switching terminal when connection  
 is made with said switching terminal,  
 signaling mechanism, a signal receiving  
 50 electromagnet controlling said mechan-  
 ism having an energizing winding and  
 source of current normally in circuit there-  
 with adapted to secure a limited energization  
 only of said electromagnet over the telephone  
 55 line under the control of the sub-station  
 switch, whereby a limited movement of said  
 signaling mechanism is caused to display a  
 signal, a second energizing winding for said  
 electromagnet connected with the third con-  
 60 tact piece of said switching terminal, and in-  
 cluded in a circuit established by the connec-  
 tion of said cord circuit to the telephone line,  
 and adapted to secure a greater energization  
 of said electromagnet whereby said signaling  
 65 mechanism is caused to assume a third posi-  
 tion to efface said signal.

7. In a telephone exchange system the  
 combination of a metallic telephone line con-  
 ductively uniting a sub-station with the two  
 line contact pieces of a switching terminal at  
 the central office, a switch at the sub-station  
 70 for controlling the flow of current over the  
 said line through the sub-station, a third con-  
 tact piece associated with said switching ter-  
 minal, a cord circuit at the central office  
 adapted to make connection with said switch-  
 75 ing terminal and to complete a circuit there-  
 through over the said telephone line, signal-  
 ing mechanism, a signal receiving electro-  
 magnet controlling said mechanism asso-  
 ciated with said telephone line, said electro-  
 80 magnet 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 sub-station switch,  
 85 whereby a limited movement of said signal-  
 ing mechanism is caused to display a signal,  
 a second energizing winding for said electro-  
 magnet connected with the third contact  
 piece of said switching terminal, and included  
 90 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  
 95 mechanism is caused to assume a third posi-  
 tion to efface said signal, and signaling mech-  
 anism associated with the cord circuit and  
 under control of the sub-station switch when  
 the telephone line is switched for conversa-  
 100 tion.

8. In a telephone exchange system the  
 combination of a metallic telephone line con-  
 ductively uniting a sub-station with the two  
 line contact pieces of a switching terminal at  
 the central office, a switch at the sub-station  
 105 for controlling the flow of current over the  
 said line through the sub-station, a third con-  
 tact piece associated with said switching ter-  
 minal, a cord circuit at the central office  
 adapted to make connection with said switch-  
 110 ing terminal and to complete a circuit there-  
 through over the said telephone line, signal-  
 ing mechanism, a signal receiving electro-  
 magnet associated with said telephone line  
 said electromagnet controlling said mechan-  
 115 ism 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 sub-station switch  
 120 whereby a limited movement of said signaling  
 mechanism is caused to display a signal, a  
 second energizing winding for said electro-  
 magnet connected with the third contact  
 piece of said switching terminal, and included  
 125 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  
 130 mechanism is caused to assume a third posi-



tion to efface said signal, signaling mechanism associated with the cord circuit and under control of the sub-station 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.

9. In a telephone exchange system the combination of a metallic telephone line conductively uniting a sub-station with the two line contact pieces of 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 third contact piece associated with said switching terminal adapted to be brought into circuit with one of the said line contact pieces upon the insertion of a plug, 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, a connection plug associated with said cord circuit having two contact pieces only, one of said contact pieces being adapted to complete a connection between said third contact piece and a line contact piece of the switching terminal when connection is made with said switching terminal, signaling mechanism, a signal receiving electromagnet controlling said mechanism associated with said telephone line said electromagnet 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 sub-station switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet connected with the third contact piece of said switching terminal and 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 signaling mechanism associated with the cord circuit and under control of the sub-station switch when the telephone line is switched for conversation.

10. In a telephone exchange system the combination of a metallic telephone line conductively uniting a sub-station with the two line contact pieces of 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 third contact piece associated with said switching terminal adapted to be brought into circuit with one of the said line contact pieces upon the insertion of a plug, a cord circuit at the central office adapted to make connection with said switching terminal and to complete a circuit therethrough over the said tele-

phone line, a connection plug associated with said cord circuit having two contact pieces only, one of said contact pieces being adapted to complete a connection between said third contact piece and a line contact piece of the switching terminal when connection is made with the line, signaling mechanism, a signal receiving electromagnet controlling said mechanism associated with said telephone line, said electromagnet 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 sub-station switch whereby a limited movement of said signaling mechanism is caused to display a signal, a second energizing winding for said electromagnet connected with the third contact piece of said switching terminal and 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, signaling mechanism associated with the cord circuit and under control of the sub-station 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.

11. In a telephone exchange system, the combination of a telephone line connecting a substation with the central office, an electromagnet having an energizing winding normally in circuit with said line, a call signal controlled by said electromagnet, a spring-jack associated with the line having a contact-piece connected with each of the two limbs of the line and a third contact-piece connected with an energizing winding of said electromagnet, switching apparatus at the central office adapted to make connection with said springjack, said apparatus including a source of current and a connecting plug having contact-pieces adapted to register with the two line contact-pieces and the third contact-piece of said jack, whereby when connection is established with the line a circuit will be completed through an energizing winding of said electromagnet to destroy the substation control of said call signal.

12. In a telephone exchange system, the combination of a telephone line connecting a substation with the central office, an electromagnet having an energizing winding normally in circuit with said line, a call signal adapted to be displayed upon the closing of the line circuit, a springjack associated with the line having a contact-piece connected with each of the two limbs of the line and a third contact-piece connected with an energizing winding of said electromagnet, switching apparatus at the central office adapted to



make connection with said springjack, said apparatus including a source of current and a connecting plug having contact-pieces adapted to register with the two line contact-pieces of the springjack and to modify the circuit connections of the third contact-piece of said springjack, whereby when connection is established with the line the cir-

cuit connections of said electromagnet will be altered.

In witness whereof, I hereunto subscribe my name this 28th day of July, A. D., 1904.

HARRY G. WEBSTER.

Witnesses:

KEMPSTER B. MILLER,  
GRACE MITCHELL.