

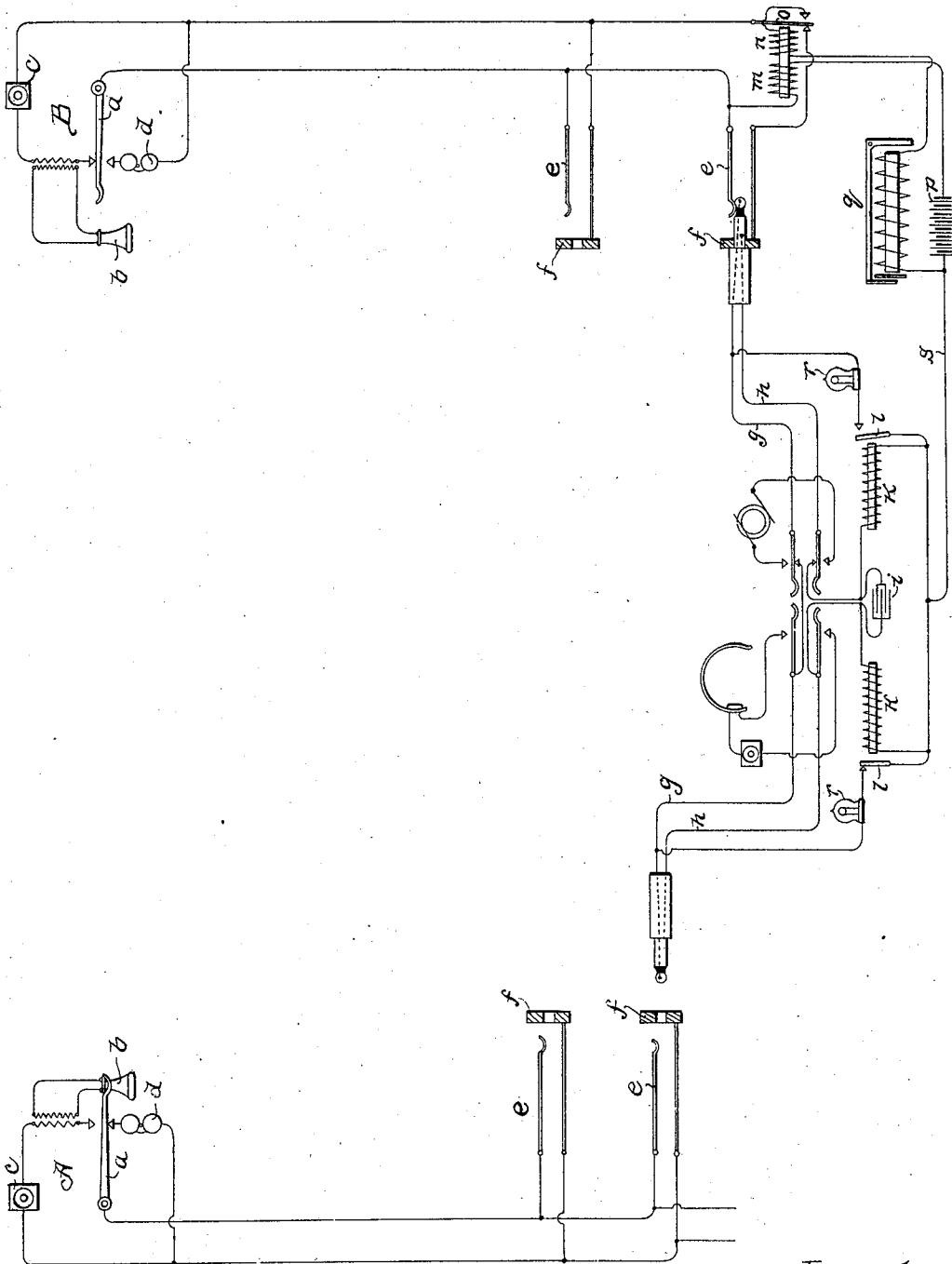
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Patented Dec. 10, 1901.

H. G. WEBSTER.  
TELEPHONE EXCHANGE SYSTEM.

(Application filed Dec. 31, 1900.)

(No Model.)



Witnesses:

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 688,452, dated December 10, 1901.

Application filed December 31, 1900. Serial No. 41,642. (No model.)

*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 a certain new and useful Improvement in Telephone-Exchange Systems, (Case No. 2,) 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 telephone-exchange systems, and has for its object the provision of improved line-signaling mechanism at the exchange whereby the employment of the present complicated cut-off relays and associated switching mechanism may be dispensed with.

The invention has for its further object the provision of improved circuit arrangement and apparatus for the clearing-out annunciator-coils employed in telephone-exchange systems.

In accordance with my invention I employ for the line-indicating mechanism a differentially-wound relay the oppositely-wound coils of which when included in circuit with the battery serve to exert neutralizing effect upon each other, so that the armature of the relay will not be actuated. The armature of the relay normally rests against a normal contact that is connected with one terminal of a line-indicator, and the indicator and relay are so associated with the telephone-line that a subscriber in initiating a call will effect the passage of current through the coils of the relay and the said indicator or the electromagnet of the indicator to effect the operation of the same, the arrangement being such that the current flowing through the coils of the relay will not serve to remove its armature from the said normal contact, whereby the signal may be effected and maintained until the operator modifies the circuit conditions by means of her switching apparatus. For this purpose the operator's switching apparatus that is employed for connecting subscribers for conversation is preferably associated with switch parts that cooperate with the switching apparatus when the same is

operated in establishing connection to afford a path of lower resistance through one of the coils of the relay, the other coil thereby being practically shunted from circuit, so that the former will alone create a field to effect the attraction of the relay-armature. The armature when thus attracted is removed from the contact connected with the line-indicator, whereby said indicator and the idle relay-coil are cut out of circuit, the armature being thereupon brought into contact with an alternate-contact anvil, whereby the circuit through the active relay-coil is maintained and the line-annunciator preserves an open circuit during the establishment of a connection.

In effecting the control of the line relay and indicator by means of line-connecting apparatus I preferably employ an electromagnet in the cord-circuit, and I provide a switch controlled by the said electromagnet, which in its normal position will afford a local circuit for that coil of the relay that is to remain active, the said electromagnet being adapted for inclusion directly in the line-circuit when the relay-armature is attracted from its normal to its alternate position, whereupon the electromagnet serves to operate its associated switch to open the local circuit, the active coil of the relay and the said electromagnet being thereupon included, preferably, in a bridge of the circuit. A common battery is preferably employed and is preferably located between the active coil of the line-relay and the said electromagnet, the said active coil and electromagnet thereby affording the necessary impedance to prevent the shunting of voice-currents.

I will explain my invention more fully by reference to the accompanying drawing, that illustrates a multiple-switchboard system constructed in accordance with my invention. The invention, however, may be employed in connection with other systems.

In the drawing I have illustrated two telephone-stations A and B, each provided with a telephone switch-hook *a*, a telephone-receiver *b*, a transmitter *c*, and a signal-receiver *d*. The system illustrated is a com-

mon battery system, and therefore the substations are in this instance not provided with magneto-generators; but I do not wish to be limited to such a system. Each telephone-line extends by its limbs to the exchange and is there connected with the tip-line springs *e* and the sleeve-sockets *f*, two jacks of a multiple switchboard being here illustrated. Two plugs are preferably employed, having tips and sleeves connected by a tip-strand *g* and a sleeve-strand *h*. The sleeve-strand *h* includes a condenser *i*. Electromagnets *k k* are included in a conductor that is in shunt of the condenser, while switches *l l* are included in branches that connect the tip-strand with the sleeve-strand.

The line-signaling mechanism constructed in accordance with my invention comprises in its preferred embodiment a relay having oppositely or differentially wound coils *m n*, which create equal opposing effects. The armature *o* of the relay normally includes the coils of the relay in series with the common battery *p*, that may be of forty volts, and the line-indicator or the electromagnet of the line-indicator *q*, the said instrumentalities being preferably connected normally in bridge of the corresponding telephone-line, so that when a subscriber removes his telephone from its switch-hook a circuit is completed through the said instrumentalities whereby a calling-signal is manifested, which calling-signal is maintained as long as the coils *m* and *n* exert their opposing effects, the armature *o* then remaining in its normal position. When the operator inserts a plug in response to a signal or in connecting a called subscriber, current from the battery *p* is principally confined to a path that includes the helix *m*, the tip-line spring, the tip of the inserted plug, the separable contacts of the switch *l*, the clearing-out indicator *r*, and the conductor *s*, that is connected with the remaining terminal of the battery. The current is confined principally to this path, as the winding of the line-indicator magnet is preferably of comparatively high resistance—as, for example, five hundred ohms—while each winding of the relay is two hundred ohms. Each clearing-out indicator *r* may be in the form of a twenty-volt lamp, so that the circuit through the coil *m* is of much less resistance than the circuit through the coil *n*. The neutralizing effect of the coils of the relay is thus overcome, and the armature *o* is attracted toward its alternate contact. When the armature is thus attracted, the circuit through the line-indicator is opened and the magnet *k* of the line-indicator that may be wound to two hundred ohms is included in circuit with the line, the circuit being traced from the magnet *k* through the conductor *s*, the battery *p*, coil *m*, one limb of the telephone-line that is connected with the tip-line spring, and back through the sleeve or socket of the spring-jacks to the said electromagnet, which is thereupon energized to cut out the clearing-out

indicator. When the subscriber is through conversation, he practically opens the circuit through the magnet *k*, as the call-bells *d* are of high resistance, whereby the said electromagnet is deenergized and the passage of current through the corresponding indicator *r* effected to convey the proper signal.

It will be observed that I have provided a multiple-switchboard telephone-exchange system wherein a portion of one side of the telephone-line—that portion uniting similar switch parts of the spring-jacks—is adapted to form part of the test-circuit, which portion through the operation of a relay due to the completion of connection between lines becomes a part of the complete telephone-line. In other words, the multiple jack-wiring is used first as a local circuit for testing purposes and then as a line-circuit for purposes of communication between connected stations.

I have not seen fit to describe the operator's listening outfit, telephone outfit, and the signaling-generator employed at the exchange, as these instrumentalities are well known in the art.

While I have herein shown and particularly described the preferred embodiment of my invention, I do not wish to be limited to the precise disclosure herein set forth; but,

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

1. In a telephone-exchange system, the combination with a telephone-line extending from a subscriber's station to an exchange, of a line-relay at the exchange provided with differentially-wound coils, a line-indicator, means controlled by the said relay for governing the operation of the said indicator, means controlled by the subscriber for directing current through the said relay and line-indicator to effect the operation of the latter, and switching apparatus controlled by the operator for increasing the magnetizing effect of one of the coils of the relay above that produced by the other, to effect the operation of the said relay-controlled means and thereby cut out or render ineffective the line-indicator, substantially as described.

2. In a telephone-exchange system, the combination with a telephone-line extending from a subscriber's station to an exchange, of a relay provided with differentially-wound coils, a source of current, means controlled by the subscriber for including the said coils in circuit with the said source of current, a line-indicator adapted to be operated by the said current when thus included in circuit, means controlled by the said relay for cutting out the said indicator, and means controlled by the operator whereby the magnetizing effect due to one of the coils of the relay may be increased above that due to the other, to effect the operation of the relay-controlled means and thereby render ineffective the line-indicator, substantially as described.

3. In a telephone-exchange system, the combination with a telephone-line extending from a subscriber's station to an exchange, of a relay at the exchange provided with differentially-wound coils, a line-indicator, a switch adapted for operation by the said relay, a source of current adapted for inclusion in circuit with the said switch, the line-indicator and the coils of the relay, means at the subscriber's station for closing circuit through the said switch, line-indicator, battery and relay-coils, means controlled by the operator for producing a greater magnetizing effect in one of said coils above the other, whereby the said switch is operated, and means whereby the switch, when operated, will cut out or render ineffective the line-indicator and one of the relay-coils, and maintain the remaining relay-coil in a closed circuit, substantially as described.

4. In a telephone-exchange system, the combination with a telephone-line extending from a subscriber's station to an exchange, of a differentially-wound relay, operator's means for connecting the said telephone-line with a second telephone-line, circuit connections whereby the operator's connecting means may effect a greater magnetizing effect in one of the relay-coils with reference to the other, and a switch controlled by the relay and operated thereby when the magnetizing effects of its coils are thus unbalanced, and serving, when operated, to cut out or render ineffective the remaining coil of the relay and the line-indicator, substantially as described.

5. In a telephone-exchange system, the combination with a telephone-line extending from a subscriber's station to an exchange, of a line-relay at the exchange provided with differentially-wound coils, a source of current, means controlled by the subscriber for including the said relay in circuit of said source of current, whereby the relay remains inoperative, a line-indicator also adapted for inclusion in circuit of the source of current by the said subscriber's means, a local circuit at the exchange, an operator's switching apparatus for connecting subscribers for conversation, means coacting with said switching apparatus serving to close the said local circuit through one of the windings of the relay when the said switching apparatus is manipulated to connect the subscribers for conversation, the said local circuit being of lower resistance than the circuit closed by the subscriber through the line relay and indicator, whereby the magnetization due to the said coil included in the local circuit, is increased above that due to its companion coil, and a switch that is adapted thereupon to be actuated by the relay to cut out or render ineffective the line-indicator, substantially as described.

6. In a telephone-exchange system, the combination with a telephone-line extending from a subscriber's station to an exchange, of a line-relay at the exchange provided with differen-

tially-wound coils, a source of current, means controlled by the subscriber for including the said relay in circuit of said source of current, whereby the relay remains inoperative, a line-indicator also adapted for inclusion in circuit of the source of current by the said subscriber's means, a local circuit at the exchange, an operator's switching apparatus for connecting subscribers for conversation, means coacting with said switching apparatus serving to close the said local circuit through one of the windings of the relay when the said switching apparatus is manipulated to connect the subscribers for conversation, the said local circuit being of lower resistance than the circuit closed by the subscriber through the line relay and indicator, whereby the magnetization due to the said coil included in the local circuit, is increased above that due to its companion coil, a switch that is adapted thereupon to be actuated by the relay to cut out or render ineffective the line-indicator, a switch included in the local circuit, an electromagnet for actuating the said switch to open the local circuit, and means whereby the switch controlled by the relay may, when actuated, close circuit through the said electromagnet, substantially as described.

7. In a telephone-exchange system, the combination with a telephone-line extending from a subscriber's station to an exchange, of a line-relay at the exchange provided with differentially-wound coils, a source of current, means controlled by the subscriber for including the said relay in circuit of said source of current, whereby the relay remains inoperative, a line-indicator also adapted for inclusion in circuit of the source of current by the said subscriber's means, a local circuit at the exchange, an operator's switching apparatus for connecting subscribers for conversation, means coacting with said switching apparatus serving to close the said local circuit through one of the windings of the relay when the said switching apparatus is manipulated to connect the subscribers for conversation, the said local circuit being of lower resistance than the circuit closed by the subscriber through the line relay and indicator, whereby the magnetization due to the said coil included in the local circuit, is increased above that due to its companion coil, a switch that is adapted thereupon to be actuated by the relay to cut out or render ineffective the line-indicator, a switch included in the local circuit, an electromagnet for actuating the said switch to open the local circuit, means whereby the switch controlled by the relay may, when actuated, close circuit through the said electromagnet, a clearing-out indicator included in the local circuit, and means whereby, when a subscriber is through conversation, circuit through the said electromagnet will be opened and the local circuit restored to effect a clearing-out signal, substantially as described.

8. In a telephone-exchange system, the com-

bination with a telephone-line extending from  
 a subscriber's station to an exchange, of a  
 relay at the exchange provided with differ-  
 entially-wound coils, an indicator, means  
 5 controlled by the said relay for governing  
 the operation of the said indicator, means con-  
 trolled by the subscriber for directing current  
 through the said relay and indicator to con-  
 trol the operation of the latter, and switching  
 10 apparatus for increasing the magnetizing ef-  
 fect of one of the coils of the relay above that  
 produced by the other, to effect the operation  
 of the said relay-controlled means and there-  
 by a change in the operative condition of the  
 15 said indicator, substantially as described.

9. In a telephone-exchange system, the com-  
 bination with a telephone-line extending from  
 a subscriber's station to an exchange, of a  
 bridge-conductor at the exchange across the  
 20 telephone-line, a differentially-wound relay,  
 a battery and a line-indicator included in the  
 said bridge, a switch adapted for operation  
 by the said relay to cut out or render ineffect-  
 ive one of the coils of the relay and the  
 25 line-indicator, and means controlled by the  
 operator for producing a preponderating mag-  
 netizing effect in the remaining coil of the re-  
 lay to effect the actuation of the said switch,  
 substantially as described.

10. In a multiple-switchboard telephone-  
 exchange system, the combination with sub-  
 scribers' telephone-lines extending from sub-  
 scribers' stations to the exchange and each  
 there connected with the several jacks upon  
 35 the different sections of the multiple board,  
 one limb of each line extending to test con-  
 tact portions of the jacks, a switch at the ex-  
 change being included in this limb of the line  
 for opening and closing the same, an electro-  
 40 magnet for operating the switch, cord-con-  
 necting apparatus serving to energize the  
 magnet to operate the switch, and testing  
 means, substantially as described.

11. In a multiple-switchboard telephone-  
 45 exchange system, the combination with sub-  
 scribers' telephone-lines extending from sub-  
 scribers' stations to the exchange and each  
 there connected with the several jacks upon  
 the different sections of the multiple board,  
 50 one limb of each line extending to test con-  
 tact portions of the jacks, a switch at the ex-  
 change being included in this limb of the line  
 for opening and closing the same, an electro-  
 magnet for operating the switch, cord-con-  
 55 necting apparatus serving to energize the  
 magnet to operate the switch, and a local test-

circuit including the portion of the limb of  
 the telephone-line extending to the test con-  
 tact portions of jacks, substantially as de-  
 scribed.

12. In a telephone-exchange system, the  
 combination with a telephone-line extending  
 from a subscriber's station to an exchange, of  
 a relay at the exchange provided with differ-  
 60 ferentially-wound coils, an indicator, means  
 controlled by the said relay for governing  
 the operation of the said indicator, means con-  
 trolled by the subscriber for directing current  
 through the said relay to control the opera-  
 70 tion of the indicator, and switching apparatus  
 for increasing the magnetizing effect of one  
 of the coils of the relay above that produced  
 by the other to effect the operation of the said  
 relay-controlled means and thereby a change  
 75 in the operative condition of the said indi-  
 cator, substantially as described.

13. In a telephone-exchange system, the  
 combination with a telephone-line extending  
 from a subscriber's station to an exchange, of  
 a relay at the exchange provided with dif-  
 80 ferentially-wound coils, an indicator, means  
 controlled by the said relay for governing  
 the operation of the said indicator, means con-  
 trolled by the subscriber for directing current  
 through the said relay to control the opera-  
 85 tion of the indicator, and operator's switching  
 apparatus at the exchange for increasing the  
 magnetizing effect of one of the coils of the  
 relay above that produced by the other to ef-  
 90 fect the operation of the said relay-control-  
 ling means and thereby a change in the op-  
 erative condition of the said indicator, sub-  
 stantially as described.

14. In a telephone-exchange system, the  
 combination with a telephone-line extending  
 95 from a subscriber's station to an exchange, of  
 a relay at the exchange provided with dif-  
 ferentially-wound coils, an indicator, means  
 controlled by the said relay for governing  
 the operation of the said indicator, means con-  
 100 trolled by the subscriber for directing current  
 through the differentially-wound coils of the  
 relay, and switching apparatus for directing  
 current through the relay at the exchange to  
 change the operative condition of the indi-  
 105 cator, substantially as described.

In witness whereof I hereunto subscribe my  
 name this 8th day of December, A. D. 1900.

HARRY G. WEBSTER.

Witnesses:

ALF. STROMBERG,  
 H. A. CANNON.