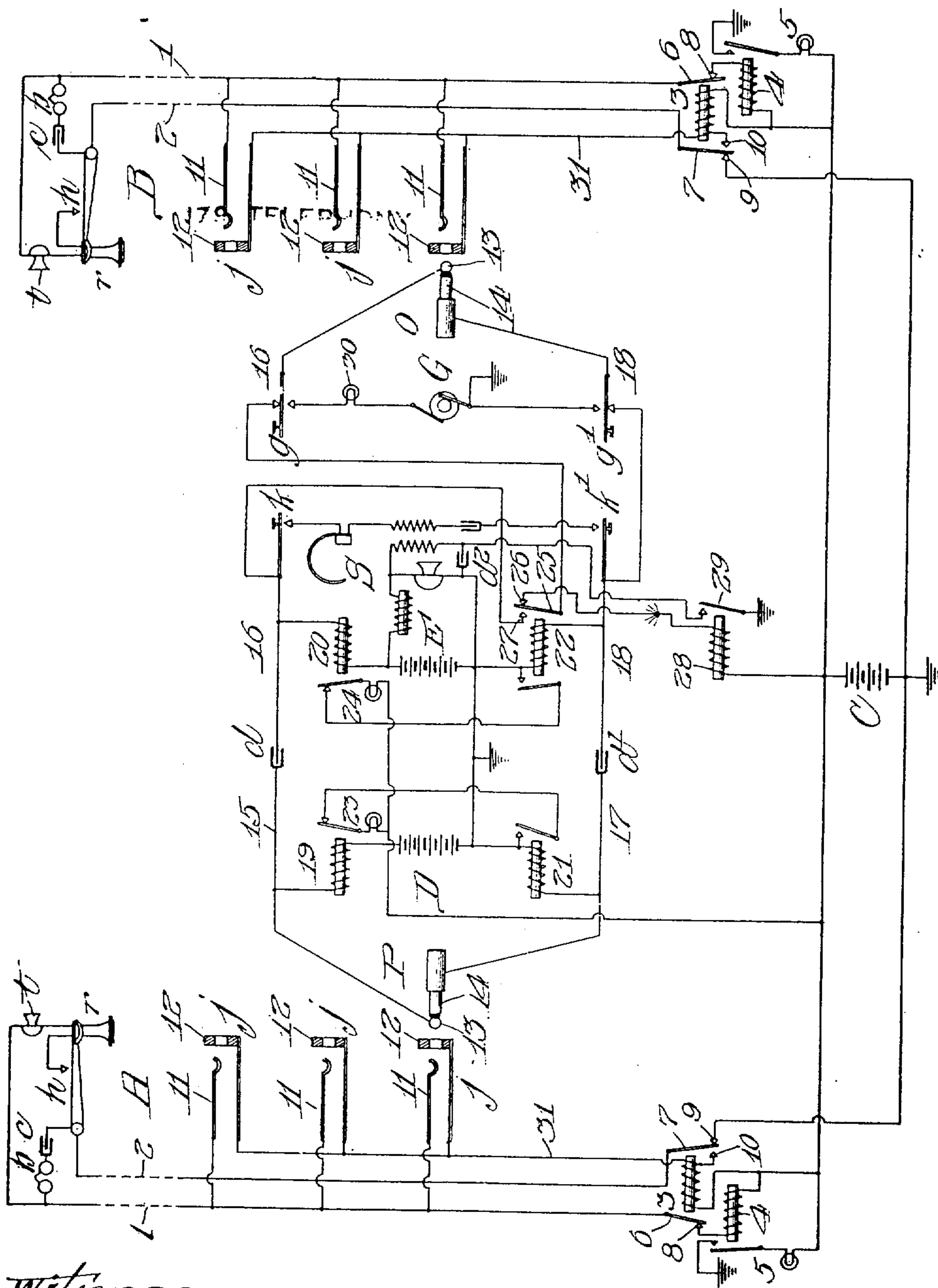


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H. G. WEBSTER.  
TELEPHONE EXCHANGE SYSTEM.  
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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

No. 835,802.

Specification of Letters Patent.

Patented Nov. 13, 1906.

Application filed December 16, 1904. Serial No. 237,147.

*To all whom it may concern:*

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, and a 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 drawing, forming a part of this specification.

My invention relates to telephone-exchange systems in which current for transmission and signaling is furnished from a central source located at the exchange and in which the cut-off relay which controls the normal connections of the line is actuated by current which flows over a portion of the talking-circuit when connection is made with the spring-jack or switching-terminal.

The object of my invention is to provide an improved organization of circuits and apparatus for systems of this class in which the source or sources of current which serve to energize the substation-transmitters may be associated with the cord connecting apparatus only and may be distinct and separate from that source associated with and furnishing current for the actuation of the apparatus which is individual to the various line-circuits. Among the advantages of such an arrangement may be included the possibility of using a comparatively low voltage source in normal connection with the lines, thus gaining a reduction in leakage and electrolytic action, a decrease in the volume of current set up in the line when a subscriber initiates a call, and a consequent reduction in the "click" which is heard in his receiver upon the insertion of a connecting-plug. A second advantage is that with my system it is possible to associate with the cord-circuit or with certain of the cord-circuits a source of current adapted for the particular group of lines with which the cord-circuits are to make connection or for any special purpose. For instance, where certain cords are used for connecting subscribers' lines for "long-distance" or "toll" service it is possible with my system to provide such cord-circuits with a source of current of greater strength than that which is necessary or desirable for normal transmission or for the normal operation of the cut-off relays and signal-controlling magnets individual to the lines. Other ad-

vantages of my improved system will be apparent from the following description.

In accordance with a preferred form of my invention I provide spring-jacks or switching-terminals at the central exchange, each having two contact-pieces corresponding to the two line-limbs. One of these contact-pieces may be permanently associated with the line, and the other contact-piece, which is also utilized as a testing-terminal, is normally disconnected from the individual line-limb and includes in its circuit the winding of a cut-off relay, the relay serving when energized to destroy the substation control of the calling-signal and to bring the said contact into direct connection with the line-limb. Cord connecting apparatus is provided whereby the insertion of a connecting-plug into a spring-jack closes the circuit of this relay through one of the talking-strands of the cord-circuit, and this circuit may also include the relay or impedance associated with a cord-circuit which serves to control the flow of transmission-current from the corresponding side of the talking-circuit. The central battery, which is normally connected with the line and which serves to energize the magnet controlling the display of a calling-signal, also serves to furnish current for the operation of the cut-off relay, and the resistance of the cut-off relay and the voltage of what may be called the "line-battery" are so proportioned that upon the insertion of a connecting-plug the current which flows from this battery to the cut-off relay will be entirely confined to the circuit which is completed through the cord-strand. The resistance of the cord-circuit apparatus and the voltage of what may be called the "transmission-battery" associated with the cord-circuit are such that current from this latter battery is confined to the talking-strands of the cord-circuit and the two limbs of the line and does not at any time flow through the winding of the cut-off relay. One arrangement of cord connecting apparatus which may be used with my invention provides a relay of comparatively low resistance associated with the sleeve-strand of the cord-circuit and the corresponding contact-piece of the connecting-plug and with the ground or office return, which serves when energized to complete a local circuit of the supervisory signal associated with the corresponding plug.



and provides a second relay of comparatively low resistance interposed between the tip-strand and the active terminal of the transmission-battery, which is controlled by current  
 5 flowing through the line-limbs and substation apparatus and serves when energized to open the circuit of the supervisory signal, and thus bring its display under the control of the subscriber. I have found in practice that in  
 10 such an arrangement as I have indicated the cut-off relay may have a resistance of eight hundred ohms, the two cord-relays a resistance of one hundred ohms each, the transmission-battery being of twenty-four volts, and  
 15 the line-battery having somewhat more than half this voltage (as fourteen or sixteen volts) with satisfactory results, although I do not limit myself to the specific proportions between these resistances and voltages.

20 My invention will be further understood from the accompanying drawing, which illustrates diagrammatically two complete line-circuits and appropriate cord connecting apparatus organized in accordance with a preferred form of my invention.

25 Like characters refer to corresponding parts in the drawing.

The subscriber's apparatus (shown at A) is represented as consisting of a telephone hook-switch *h*, a signal-bell *b*, condenser *c*, receiver *r*, and transmitter *t*, the bell and condenser being in permanent bridge of the two line-limbs and the circuit being closed through the receiver and transmitter upon the elevation of the hook-switch. Although I have  
 35 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, maintaining its upper contact open, and the condenser *c* prevents a normal flow of current from line-battery C at  
 45 the central office over the line-limbs. When 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  
 50 the transmitter *t* and receiver *r*, relay 4 at the central office will be operated by the flow of current from said battery C through the winding of relay 4, anvil 8, and armature 6, the two limbs of the line, and through armature 7 and anvil 9 to the return side of the battery. This flow of current through relay  
 55 4 causes its energization and the consequent illumination of calling-lamp 5. Each subscriber's line is provided with one or more spring-jacks *j*, each having contact-pieces 11 and 12 for limbs 1 and 2 of the line, respectively, contact-piece 11 being directly connected with limb 1 and contact-piece 12, which serves as a testing-terminal, being con-  
 65 nected through the winding of cut-off relay 3

to the active side of battery C. The illumination of signal-lamp 5 indicating to the operator that the subscriber has removed his receiver from its hook for the purpose of making a call, she inserts the answering-plug P into  
 70 a spring-jack *j* corresponding to the calling-signal, thus causing contact-piece 13 of the plug to engage contact-piece 11 of the spring-jack and contact-piece 14 of the plug to engage contact-piece 12 of the spring-jack. Current  
 75 will now flow from battery C through the winding of relay 3, conductor 31, plug and jack contact 12-14, strand 17 of the cord, and the winding of relay 21 to the return side of the battery. The current through this  
 80 circuit causes the energization of relay 3, and the actuation of armature 6 interrupts the circuit through limb 1 at anvil 8, while the the actuation of armature 7 interrupts the circuit through limb 2 at anvil 9, and its en-  
 85 gagement with anvil 10 connects this limb directly with conductor 31 and the circuit previously traced through relay 21. Relay 21 is also energized, closing the local circuit of the supervisory lamp 23 at its contact.  
 90 Current will now flow from battery D through relay 19, strand 15, plug and jack contact 13-11, limbs 1 and 2 of the line, conductor 31, plug and jack contact 12-14, and thence through strand 17, and relay 21 to the return  
 95 side of the battery D. This current serves to energize the substation-transmitter and also energizes relay 19, causing it to open the local circuit of supervisory lamp 23 and preventing its illumination as long as the circuit is  
 100 complete through the substation apparatus. After being informed with what line connection is desired, in this case that of subscriber B, the operator tests in the usual manner by touching the tip of her calling-plug O to the  
 105 contact-piece 12 of a jack associated with that line. It will be seen that under normal conditions no noise will be heard in the receiver of the operator's set S at this time, for the reason that contact-piece 13 of the calling-  
 110 plug is normally connected through the common test-relay 28 to the active side of battery C, with which contact-piece 12 is permanently connected. If, however, a connecting-plug is in a spring-jack of the line tested, this con-  
 115 tact-piece has its circuit completed to the return side of the battery through the associated cord-relay, and its electrical condition is thereby altered. In making the busy test under this condition current will flow from  
 120 battery C through relay 28, anvil 26, and armature 25 of the relay 22 associated with the testing-cord, and thence through strand 16 and contact-piece 13 to the return side of the battery, causing the energization of relay 28.  
 125 The engagement of armature 29 of this relay with its anvil or front contact short-circuits the condenser *d*<sup>2</sup> of the operator's circuit, thus causing a flow of current through the local winding of her induction-coil and pro-  
 130



ducing the click which indicates that the line is busy.

Upon the insertion of the plug O and the actuation of the ringing-key levers *g g'* relay 3 is energized by current from battery C flowing through its winding, conductor 31, plug and jack contact 14-12, and thence through strand 18 to the office return shown in association with generator G. The circuit of the calling-generator G is at this time completed through resistance-lamp 30, strands 16-18 of the cord-circuit, contacts 13-11 and 14-12 of the plug and jack, and limbs 1 and 2 of the line. Upon the restoration of the ringing-key relays 3 and 22 are energized by current from battery C flowing through the winding of relay 3, conductor 31, plug and jack contact 14-12, strand 18, and the winding of relay 22 to the return side of the battery. The energization of relay 3 serves to control the normal connections of limbs 1 and 2, as previously described, and the energization of relay 22 closes the circuit of supervisory lamp 24, while the actuation of its armature 25 disconnects the common test-relay 28 at anvil 26 and engaging anvil 27 completes the circuit of strand 16 to relay 20 and condenser *d*. As soon as subscriber B answers current from battery E will flow through relay 20 over a circuit similar to that previously traced for battery D and relay 19, thereby extinguishing supervisory lamp 24 and energizing the substation-transmitter. The lines of the two subscribers are now inductively united for conversation by means of condenser *d*, interposed between strands 15 and 16, and condenser *d'*, interposed between strands 17 and 18. When either subscriber hangs up his receiver, it causes the illumination of the corresponding supervisory lamp, and the illumination of both lamps constitutes the customary disconnect-signal. It will be seen that the relay 3 is under all conditions energized by current from battery C and that this battery need not be adapted to and does not furnish current for talking purposes; also, that the current from battery D or E, which serves to energize the substation-transmitters, does not flow through the winding of relay 3 and that by properly proportioning the various resistances the batteries D or E, as well as battery C, may be given any voltage value desired.

It will be understood that the various grounds shown in the drawing represent the return side of the several batteries or the central-office ground; also, that while separate batteries D and E have been indicated these batteries may be one and the same. It will also be understood by those skilled in the art that various modifications of my invention may be made without departing from its spirit, and I therefore do not limit myself to the precise structure illustrated and described; but

I claim—

1. The combination with a telephone-line, and a connection-terminal therefor, of a signal-controlling electromagnet normally connected with said line, a relay for disconnecting said electromagnet from the line, a source of current associated with said relay, a cord-circuit terminating in a connecting-plug and adapted to be placed in conductive relation with the line, a source of electricity associated with the cord-circuit and adapted to be placed in metallic circuit of the line, and means for closing the circuit of said first-mentioned source through said relay when connection is made with the line, said relay-circuit including a talking-strand of the cord-circuit, a main terminal of the connecting-plug, a line-contact and a portion of the talking-limb of the telephone-line with suitable return, substantially as described.

2. The combination with a telephone-line, of line-contacts therefor, a signal-controlling electromagnet normally connected therewith, a relay for disconnecting said electromagnet from the line, a source of current associated with said relay, a cord-circuit terminating in a connecting-plug, a second source for supplying current for talking purposes, connected in bridge of said cord-circuit, and means for closing a circuit of said first-mentioned source through said relay, said circuit including a talking-strand of the cord-circuit, a main terminal of the connecting-plug, and a line-contact of the telephone-line, substantially as described.

3. The combination with a telephone-line, of contacts therefor, a signal-controlling electromagnet normally connected therewith, a relay for disconnecting said electromagnet from the line, a source of current associated with said relay, a cord-circuit terminating in a connecting-plug, a second source of current associated with said cord-circuit, the windings of said relay and said first-mentioned source of current being adapted to be included in shunt of a portion of one of the limbs of the telephone-line and said second source of current, and means for closing a circuit through said relay including a talking-strand of the cord-circuit, a terminal of the connecting-plug, a line-contact of the telephone-line and the portion of a talking-limb of the telephone-line extending between the said line-contact and the winding of said relay, substantially as described.

4. The combination with a telephone-line, of a connection-terminal at the central station, a signal-controlling electromagnet normally connected therewith, a relay for disconnecting said electromagnet from the line, a cord connector terminating in a connecting-plug, a source of current associated with said relay, said source being adapted when said connecting-plug is inserted in the connection-terminal to send current over a circuit in-



cluding a talking-strand of said cord connector, a terminal of the connecting-plug, a line-contact of the telephone-line, and the portion of a talking-limb of the telephone-line extending between said line-contact and the relay and a second source for supplying current for talking purposes connected in bridge of said cord connector, substantially as described.

5 5. The combination with a calling telephone-line and a connection-terminal normally disconnected therefrom, of a relay for connecting said connection-terminal with the line, a source of current associated with said relay, a cord-circuit terminating in a connecting-plug, a source of electricity adapted to be included in the metallic circuit of the line to furnish current for talking purposes, and means for closing the circuit of said first-mentioned source through said relay when connection is made with the line in response to the call, said relay-circuit including one of the main terminals of the connecting-plug and a line-contact of the telephone-line with suitable return, substantially as described.

25 6. The combination with a metallic telephone-line and a connection-terminal normally disconnected therefrom, of a relay for connecting said connection-terminal with the line, a source of current associated therewith, a cord-circuit terminating in a connecting-plug, a source of talking-current in bridge of said cord-circuit adapted to send current over the metallic circuit, and means for closing the circuit of said first-mentioned source through said relay when connection is made with the line, said relay-circuit including a talking-strand of the cord-circuit, a main terminal of the connecting-plug, a line-contact and a portion of the talking-limb of the telephone-line, substantially as described.

7. The combination with a telephone-line and a connection-terminal normally disconnected therefrom, of a relay for connecting said connection-terminal with the line, a source of current having its active pole normally connected to said terminal, a cord-circuit terminating in a connecting-plug, means for closing and maintaining a circuit of said source through said relay continuously during a connection and over a circuit including a talking-strand of the cord-circuit, a main terminal of the connecting-plug and a line-contact of the connection-terminal, and a second source for supplying current for talking purposes, connected in bridge of said cord-circuit, substantially as described.

8. The combination with a telephone-line and a connection-terminal normally disconnected therefrom, of a relay for connecting said connection-terminal with the line, a source of current associated with said relay, a cord-circuit terminating in a connecting-plug, a second source of current associated with

said cord-circuit, said first-mentioned source of current and the winding of said relay being adapted to be connected in shunt of a portion of one limb of the telephone-line and said second source of current, and means for sending current through said relay over a circuit including a talking-strand of the cord connector, a terminal of the connecting-plug, a line-contact of the telephone-line and the portion of a talking-limb of the telephone-line extending between the line-contact and the winding of said relay, substantially as described.

9. The combination with a telephone-line and a connection-terminal normally disconnected therefrom, of a relay for connecting said connection-terminal with the line, a source of current associated with said relay, said source and the winding of said relay being adapted to be connected in shunt of a portion of one limb of the telephone-line, a cord connector terminating in a connecting-plug, a source of current connected between the strands of said cord connector adapted to furnish current for talking purposes, and means whereby the insertion of the connecting-plug into the connection-terminal sends current from said first-mentioned source over a circuit including a talking-strand of said cord connector, a terminal of the connecting-plug, a line-contact of the telephone-line, and the portion of a talking-limb of the telephone-line extending between said line-contact and said relay, substantially as described.

10. The combination with a telephone-line adapted to be included in a talking-circuit, of a signal-controlling electromagnet normally connected therewith, a connection-terminal normally disconnected from said line, a relay for disconnecting said electromagnet from the line and for connecting said connection-terminal with the line, a source of current associated with said relay, a second source of current adapted to be connected in the metallic circuit of the line to furnish current for talking purposes, and means for closing a circuit of said first-mentioned source through said relay over a portion of the talking-circuit when connection is made with the line, substantially as described.

11. The combination with a telephone-line, of a connection-terminal normally disconnected therefrom, a relay for connecting said connection-terminal with the line, a source of current associated with said relay, a separate source of current adapted to be connected in the metallic circuit for talking purposes, means for operating said relay from said first-mentioned source when connection is made with the line by current flowing over a path including a portion of the talking-circuit, and means for sending a calling-current over the line of the called sub-



subscriber only and at the same time maintaining said relay in operative condition, substantially as described.

12. The combination with a telephone-line, of one of the talking contacts of a spring-jack associated with the said line, said contact being normally disconnected from the line, a plug, a cord-circuit, a battery associated with the said circuit adapted to be included in the metallic circuit of the line to furnish current for talking purposes, a second source of current and a relay operated from said second source of current over a portion of the talking-circuit to connect said contact with the line during such use, substantially as described.

13. The combination with a metallic telephone-line, of a talking contact forming a part of a connection-terminal for the line, said contact being normally disconnected therefrom, a central source of current associated with the line and adapted to be included in the metallic circuit of the line when a connection exists to furnish current to the substation-transmitters for talking purposes, means for disconnecting said contact from the line when the line is not in use, a second source of current, means operated by current from said second source over a portion of the talking-circuit to connect the contact with the line when the line is in use, and testing apparatus to cooperate with said contact to indicate the condition of the line, substantially as described.

14. The combination with a telephone-line, of a test-terminal normally disconnected therefrom, a relay for connecting said test-terminal with the line, a source of current associated therewith, testing apparatus, a cord-circuit terminating in a connecting-plug, supervisory signaling apparatus associated with the cord-circuit, a source of electricity also associated with the cord-circuit, means for closing the circuit of said last-mentioned source over the telephone-line to operate the said supervisory apparatus, and means for closing the circuit of said first-mentioned source through said relay when connection is made with the line, said relay-circuit including one of the main terminals of the connecting-plug and a line-contact of the telephone-line with suitable return, substantially as described.

15. The combination with a telephone-line and a connection-terminal therefor, having a contact normally disconnected from the line, of a connecting-plug and cord-circuit to cooperate with said line, a supervisory signal-controlling magnet and a battery associated with said cord-circuit, a telephone-transmitter and a switch at the subscriber's station, and means including a separate source of current controlled by the insertion of the plug into the jack for connecting said contact with the line by current flowing over a path

including a portion of the talking-current, whereby current is furnished to said transmitter and said magnet is placed under the control of the subscriber, substantially as described.

16. The combination with a metallic telephone-line adapted to be included in a talking-circuit, of a line-signal and a cut-off relay for the line, a source of current for energizing said relay, a cord-circuit, a separate source of current associated with the cord-circuit adapted to furnish current for talking purposes, and means for closing circuit through said relay and said first-mentioned source over a portion of one side of the talking-circuit when connection is made with the line to render the line-signal inoperative, substantially as described.

17. The combination with a telephone-line and a cord-circuit adapted to be included in a talking-circuit, of a line-signal and a cut-off relay for the line, a source of current associated with said relay, means for closing circuit from said source through said relay over a portion of one side of the talking-circuit, including a portion of the telephone-line and the cord-circuit, and a second source for supplying current for talking purposes, connected in bridge of said cord-circuit, substantially as described.

18. The combination with a telephone-line and a connection-terminal in the form of a spring-jack, of a connecting-plug and a cord-circuit, a central source of current associated with said circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord-circuit and operated from said source of current, and a relay actuated from a separate source of current by the insertion of said plug into, and its withdrawal from, said jack for controlling a connection of said jack with said line, said relay being actuated by current flowing over a portion of a strand of the cord-circuit, a talking contact of the plug and jack and a portion of the telephone-line, substantially as described.

19. A telephone system comprising a telephone-line, an electrically-actuated signal and a source of current associated with said line, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, means normally under the control of the subscriber for displaying said signal by closing a circuit through said source of current, a relay for placing said signal beyond the control of the subscriber, a second source of current associated with the cord-circuit, and means under the control of the operator for energizing said relay and supplying current for talking purposes by completing two parallel paths, one path including an energizing-winding of said relay and said first-mentioned source of current and said second path including said



second source of current and a portion of the telephone-line.

20. A telephone system comprising a telephone-line, an electrically-actuated signal  
5 and a source of current associated with said line, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, means normally  
10 under the control of the subscriber for displaying said signal by closing a circuit through said source of current, a relay for placing said signal beyond the control of the subscriber, a second source of current asso-  
15 ciated with the cord-circuit, and means under the control of the operator for energizing said relay and supplying current for talking purposes by completing two parallel paths, one path including an energizing-winding of said relay and said first-mentioned source of  
20 current, and the second path including said second source of current and portions of both telephone-line limbs.

21. A telephone system comprising a telephone-line, an electrically-actuated signal  
25 and a source of current associated with said

line, a cord-circuit for making connection to said line, means for holding conversation over said line and cord-circuit, means normally under the control of the subscriber for displaying said signal by closing a circuit  
30 through said source of current, a relay for placing said signal beyond the control of the subscriber, a second source of current associated with the cord-circuit, and means under the control of the operator for energizing said  
35 relay and supplying current for talking purposes by completing two parallel paths, one path including an energizing-winding of said relay and said first-mentioned source of current, and the second path including said sec-  
40 ond source of current, a strand of the cord-circuit, and portions of both telephone-line limbs.

In witness whereof I hereunto subscribe my name this 10th day of December, A. D. 1904. 45

HARRY G. WEBSTER.

Witnesses:

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