

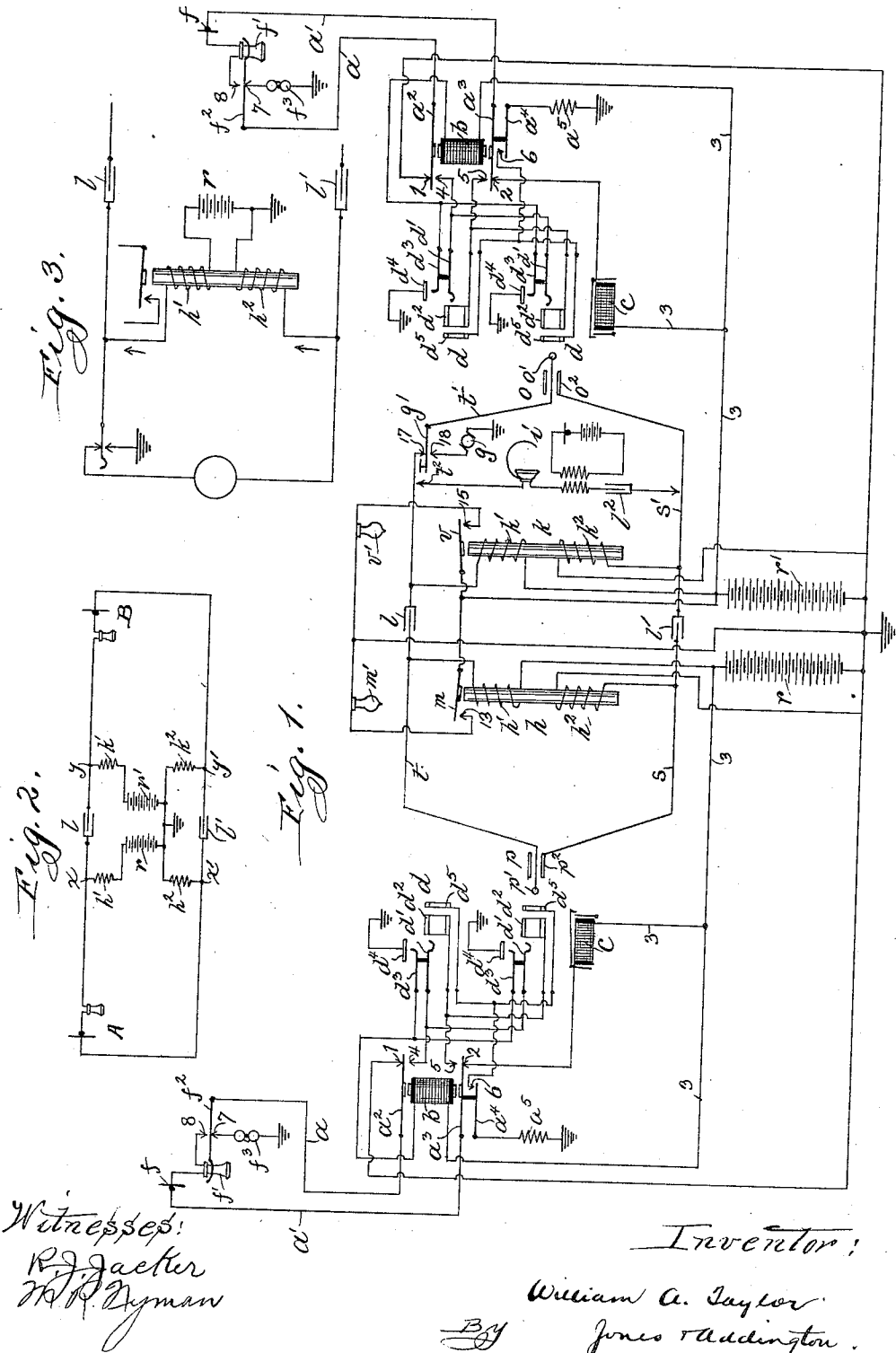
No. 821,898.

PATENTED MAY 29, 1906.

W. A. TAYLOR.

CENTRAL ENERGY TELEPHONE SYSTEM.

APPLICATION FILED FEB. 4, 1901. RENEWED SEPT. 17, 1904.



UNITED STATES PATENT OFFICE.

WILLIAM A. TAYLOR, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

CENTRAL-ENERGY TELEPHONE SYSTEM.

No. 821,898.

Specification of Letters Patent.

Patented May 29, 1906.

Application filed February 4, 1901. Renewed September 17, 1904. Serial No. 224,805.

To all whom it may concern:

Be it known that I, WILLIAM A. TAYLOR, 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 Central-Energy Telephone 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 a central-energy telephone system, my object being to provide an improved form of signaling apparatus at the central station.

In an application of Francis W. Dunbar, filed December 19, 1900, Serial No. 40,385, a telephone system is disclosed wherein a relay is employed for operating the supervisory signal, the relay having two windings bridged across the talking-circuit. In order to render the windings opaque to the passage of talking-currents, the windings are provided upon opposite ends of a single core, whereby the windings possess impedance to prevent the passage of talking-currents. The windings are placed upon the core in opposition, so that when both windings are traversed by the charging-current the relay remains inert. The relay is actuated by unbalancing the windings—as, for instance, by sending current through one of the windings alone.

My invention contemplates a telephone system employing the general form of relay above described, the same being associated with the talking-circuits in a novel manner, as hereinafter more particularly described.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is a diagram illustrating two telephone-lines and the central-station apparatus for uniting the same for conversation. Fig. 2 is a diagram showing the talking-circuits of two connected subscribers' lines. Fig. 3 is a diagram illustrating the relay-windings and the circuit therethrough.

Like characters refer to like parts in the several figures.

The telephone-line A extends in two limbs a a' to the central station, where said limbs terminate, respectively, in the springs a^2 a^3 , the spring a^2 normally resting against back contact 1, which is connected to ground, the

spring a^3 normally resting against back contact 2, which is connected through individual annunciator c to conductor 3. The springs a^2 and a^3 carry armatures resting opposite the poles of a relay-magnet b , and the spring a^2 when attracted is adapted to engage front contact 4, which is connected with the line-springs $d' d'$ of the spring-jacks or switch-sockets $d d$. The spring a^3 is adapted when attracted to engage contact 5, which is connected with the sleeves $d^2 d^2$ of the spring-jacks. Moving with spring a^3 , but insulated therefrom, is a spring a^4 , connected to ground through a resistance a^5 and adapted when the relay is energized to engage contact 6, which is connected with the test-rings $d^5 d^5$. One end of the winding of relay b is connected with conductor 3 and the other end is connected with the contact-springs $d^3 d^3$, which springs are mounted to move with, but insulated from, the line-springs $d' d'$, respectively. When the plug is inserted in the spring-jack, the line-spring d' is moved by the tip thereof to carry the spring d^3 into engagement with the grounded contact d^4 .

The subscriber is provided at the substation with the usual microphone f , receiver f' , and switch-hook f^2 , adapted when the line is not in use to engage contact 7, which is connected through bell f^3 to ground. When the telephone is removed from the hook, the hook engages contact 8, which is connected with the telephone transmitter and receiver.

The telephone-line B (shown at the right of the drawings) is like the telephone-line A and is provided with the same parts and mechanism, and like parts have been indicated by the same reference characters employed in connection with line A.

The answering-plug p is provided with a tip p' and a sleeve p^2 , the former being connected with a strand t and the latter with a strand s . The calling-plug o is provided with a tip o' and a sleeve o^2 , the former being connected with strand t' and the latter with strand s' . The strands t and t' are united through a condenser l , and the strands s and s' are united through a condenser l' . Between the strands t and s the windings h' and h^2 of a relay h are provided, a battery r being interposed between said windings. Likewise between the strands t' and s' the windings k' and k^2 of a relay k are connected, a battery r'

being interposed between said windings. The windings of the relays are placed in opposition, so that as the battery-current traverses the same while the lines are connected for conversation the windings will neutralize each other, thereby rendering the relay inert. The conductors 3, extending to the telephone-lines, are connected with the batteries r and r' , and the other poles of said batteries are grounded. Opposite the pole of relay h a spring m is provided, carrying an armature and adapted when the relay is energized to engage contact 13. Contact 13 is connected through the lamp m' with one pole of the battery r' , and the spring m is connected with the opposite pole of said battery. Likewise the spring v of the relay k is connected with one pole of battery r' , and the contact 15 is connected through lamp v' to the opposite pole of said battery. The windings h' and h^2 of the relay h are wound upon the core in such a manner that when the battery-current flows through one of said windings h' out over the telephone-line and back through the winding h^2 the current will be in such a direction as to neutralize the core. Therefore while the battery-current flows through both windings the relay h remains unenergized. When, however, current is passed through one of the windings alone, the core will be polarized to attract its armature. Since the windings h' and h^2 are wound upon opposite ends of the core and are not superimposed, the talking-currents will meet impedance, which will prevent the same passing through the windings h' and h^2 . The relay thus opposes the passage of the talking-current, is neutralized during the passage of the battery-current through both windings, and is energized by the passage of the battery-current through one of the windings. The relay k is wound and constructed in the same manner as relay h .

In the strand t' a ringing-key g' is provided normally resting against contact 17 and adapted when depressed to engage contact 18, which is connected to ground through generator g . The operator's telephone set i is adapted to be connected between the strands t' and s' , and a condenser l^2 is interposed in the circuit of the telephone set.

Assuming now that subscriber A is desirous of conversing with subscriber B, he lifts his receiver from the telephone-hook, thereby closing together the limbs a and a' at the substation. The circuit of battery r is thus closed over conductor 3, annunciator c , contacts 2 and a^3 , limb a' , limb a , contacts a^2 1, thence to the opposite pole of battery r . The individual annunciator c is thus actuated to convey to the operator the signal for connection, who thereupon lifts the answering-plug p and inserts the same in the spring-jack belonging to subscriber A. The insertion of the plug moves spring d^3 against contact d^4 , thereby

energizing the relay b , the circuit through said relay being traced from battery r through conductor 3, relay b , spring d^3 , contact d^4 to ground and back to the battery. The relay, being thus energized, attracts the armatures and moves springs a^2 and a^3 out of engagement, respectively, with contacts 1 and 2, thus disconnecting the annunciator c from circuit and moves said springs into engagement, respectively, with contacts 4 and 5, thus connecting the terminals of the spring-jacks with the limbs of the telephone-line. The insertion of the answering-plug also connects battery r in circuit through the windings h' and h^2 of relay h and through the strands t and s of the cord-circuit and the limbs a and a' of the line. Since the battery-current traverses both of the windings h' and h^2 , the core of the relay remains neutral and the relay remains unactuated. The operator then connects her telephone set i in circuit and receives the number of the called subscriber. Learning that connection is desired with subscriber B, she lifts the calling-plug o and touches the tip o' thereof to the test-ring d^5 belonging to the spring-jack of subscriber B. If subscriber B is busy, his relay b will be energized and test-ring d^5 will be connected to ground through contact 6 and spring a^4 . If the line be thus busy, the operator, upon touching the tip of plug o to the test-ring, will hear a click in her telephone-receiver; but, on the other hand, if the line be idle, she will hear no click and will know that the line is not busy. The click in the telephone is due to the fact that by touching the tip of the plug to the test-contact the potential at the point t^2 of strand t' is lowered, thereby permitting a current to flow through the operator's receiver. When the tip o' is not in contact with the test-ring, the point t^2 is of the same potential as the pole of the battery. When, however, the tip of the plug is touched to the test-ring, the circuit of the battery r' is closed from ground through winding k' , strand t' , tip o' , test-ring d^5 , contacts 6 and a^4 to ground. The resistance interposed between the pole of the battery and the point t^2 by the winding k' lowers the potential of the point t^2 on closed circuit, and this change of potential of the point t^2 with which the operator's telephone set is connected causes a momentary current to flow through the receiver, thereby causing a click therein.

Assuming that the operator finds the line of the called subscriber idle, she inserts the plug o therein and then depresses ringing-key g' , thereby sending current from generator g over strand t' , tip o' , spring d' , contacts 4 and a^2 , limb a , through bell f^3 , to ground. When the subscriber responds, he lifts his receiver from the hook, thus closing together the limbs a and a' at the substation. The circuit of battery r' is thus closed through windings k' and k^2 , strands t' and s' , and limbs a and a' .

Since the current flows through both of the windings of relay, the relay remains unactuated. The circuits during conversation are shown in Fig. 2. When subscriber A is talking and his microphone is actuated, variations of the resistance therein cause a corresponding variation of the difference of potential between the points x and x' , and this variation of difference of potential causes a correspondingly-varying current to traverse the condensers l and l' and the receiver of subscriber B. Likewise when subscriber B is talking the difference of potential between the points y and y' is varied, and correspondingly-varying currents are caused to traverse the condensers and the receiver of subscriber A. When the subscribers have completed their conversation and desire disconnection, they hang up their telephone-receivers, thereby separating limbs a a' at the substation and connecting limb a with ground. Lamps m' and v' are thus lighted to convey to the operator the signal for disconnection. Thus when subscriber A hangs up his telephone-receiver the circuit of battery r is closed from ground through winding h' , strand t , limb a , to ground at the substation; but one of the windings of the relay h being thus energized, the core thereof is polarized to attract its armature and close together contacts m and 13 , thereby lighting lamp m' . Similarly, the lamp v' is lighted by subscriber B in hanging up his telephone. The operator thereupon removes the plugs p and o from the respective sockets, and the circuits of the batteries are opened at the plug-terminals, and the relays are deenergized to extinguish the lamps. If one of the subscribers should desire an immediate reconnection with another subscriber, he may by vibrating his switch-hook in the usual manner cause the lamp to be alternately lighted and extinguished to thus convey the signal to the operator for reconnection.

I disclaim herein the matter claimed in the patent to Francis W. Dunbar for "Telephone-switchboard systems," dated November 12, 1901, No. 686,272.

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

1. The combination with a pair of telephone-lines, of condensers through which the same are adapted to be united for conversation, a signal-controlling electromagnet bridged between the two limbs of the talking-circuit of one of said lines, said electromagnet having two windings and possessing impedance to the passage of talking-currents, and a charging source of electricity adapted to send current through said windings in a direction to cause the same to neutralize each other, substantially as described.

2. The combination with a pair of telephone-lines, of condensers through which the

same are adapted to be united for conversation, a signal-controlling electromagnet bridged between the two limbs of the talking-circuit of one of said lines and having two windings and possessing impedance to the passage of talking-currents, a charging source of electricity and a switch at the substation for closing the circuit of said source through one or both of the windings of said electromagnet, substantially as described.

3. The combination with a pair of telephone-lines, of condensers through which the same are adapted to be united for conversation, a signal-controlling electromagnet bridged between the two limbs of the talking-circuit of one of said lines, said electromagnet having two windings possessing impedance to the passage of talking-currents, a charging source of electricity and a switch at the substation for closing the circuit of said source through both of the windings of said electromagnet, or for closing the same through one only of said windings, substantially as described.

4. The combination with a pair of telephone-lines, of a pair of condensers through which the same are adapted to be united for conversation, a signal-controlling electromagnet bridged between the two limbs of the talking-circuit of one of said lines, said electromagnet having two windings and possessing impedance to the passage of talking-currents, a charging source of electricity interposed between said windings, a third conductor connected with one pole of said source and a switch at the substation for closing the circuit of said source through both of said windings, or for closing the circuit of said source through one of said windings with return through said third conductor, substantially as described.

5. The combination with a pair of telephone-lines, of a pair of condensers through which the same are adapted to be united for conversation, a signal-controlling electromagnet bridged between the two limbs of the talking-circuit of each of said lines, each of said electromagnets having two windings and possessing impedance to the passage of talking-currents, a charging source of electricity adapted to be connected in circuit with the winding of each of said electromagnets, and a switch at each of the substations for controlling the passage of current through one or both of the windings of the electromagnet corresponding thereto, substantially as described.

6. The combination with a pair of telephone-lines, of cord connectors for uniting the same for conversation, a condenser interposed in each strand of said cord connector, a pair of signal-controlling electromagnets bridged between the said strands upon opposite sides of said condensers, each of said electromagnets having two windings and possessing impedance to the passage of talking-

currents, and a switch at each substation for sending current through one or both of the windings of the electromagnet connected with said substation, substantially as described.

7. The combination with a pair of telephone-lines, of a cord-circuit for uniting the same for conversation, a condenser interposed in each strand of the cord-circuit, a pair of signal-controlling electromagnets bridged between the strands of the cord-circuit upon opposite sides of said condensers, each of said electromagnets having two differential windings and possessing impedance to the passage of talking-currents, a source of current connected between the windings of each said electromagnet and adapted to send current over the metallic line through said windings for conversational purposes and to render said magnet neutral, and means controlled from each substation for sending an excess current from said source through one winding of the corresponding magnet to actuate the same, substantially as described.

8. The combination with a pair of telephone-lines, of a cord-circuit for uniting the same for conversation, a condenser interposed in each strand of said cord-circuit, an electromagnet connected between the strands of the cord-circuit upon each side of said condensers, said magnets having two differential windings possessing impedance to the passage of talking-currents, a source of current at the central office connected between said windings and adapted to send current over the metallic circuit for talking purposes, said magnet being neutral to said current during conversation, a supervisory signal controlled by each of the electromagnets, and means controlled from each substation for causing an excess current from the source to flow through one winding of the corresponding electromagnet to operate the same, substantially as described.

9. The combination with a pair of telephone-lines, of a cord-circuit for uniting the same for conversation, a condenser interposed in each strand of the cord-circuit, a pair of signal-controlling electromagnets bridged between said strands, each of said electromagnets having two differential windings and possessing impedance to the passage of talking-currents, a source of current at the central office adapted to send current through said winding, and a switch at each substation for admitting current to flow from said source through both of the windings of said electromagnet during conversation and to render the same inoperative, or to permit the flow through one of said windings to operate the said electromagnet at the termination of the conversation, substantially as described.

10. The combination with a pair of telephone-lines, of a cord-circuit for uniting the

same for conversation, a condenser interposed in each strand of the cord-circuit, a signal-controlling magnet for each end of the cord-circuit and upon opposite sides of the condensers, each of said electromagnets having two differential coils connected between the opposite strands of the cord-circuit and possessing impedance to the passage of voice-currents, a source of grounded charging-current connected between said windings, and a hook-switch at the substation of each of said lines whereby the said source is allowed to send current over the metallic circuit of the corresponding line without energizing said electromagnet, or over one limb of said line and ground return to energize said electromagnet, substantially as described.

11. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines together for conversation, a condenser in each strand of the cord-circuit, a differential supervisory-signal-controlling magnet bridged across each end of the cord-circuit upon opposite sides of the condensers, a battery connected between the windings of each electromagnet and having one pole grounded, a supervisory signal controlled by each said electromagnet, a hook-switch and a grounded signaling-bell at the substation of each line, each said switch being adapted to close the circuit from said battery over one line-wire and through one electromagnet-winding and through the grounded bell when the receiver is upon the switch-hook whereby the electromagnet is operated and to close the circuit over the metallic line from said source when the receiver is displaced to render the electromagnet inoperative, substantially as described.

12. The combination with a pair of telephone-lines, of a cord-circuit to unite said lines for conversation, condensers in the opposite strands of the cord-circuit, a differential signal-controlling electromagnet for each end of the cord-circuit bridged thereacross and possessing impedance to the passage of voice-currents, a separate source of grounded charging-current connected between the windings of each of the electromagnets, and a switch at the substation of each of said lines whereby each said source is allowed to send current over the metallic line-circuit of the corresponding line without deenergizing said electromagnet and over one limb only of said line and ground return to energize said electromagnet, substantially as described.

13. The combination with a pair of telephone-lines, of condensers through which the same are adapted to be united for conversation, a signal-controlling electromagnet bridged between the two limbs of the talking-circuit of one of said lines, said electromagnet having two windings and possessing impedance to the passage of the talking-currents,

and a separate charging source of electricity for each line, one of said sources being adapted to send current through said windings in a direction to cause the same to neutralize each other, substantially as described.

14. The combination with a pair of telephone-lines, of a pair of condensers through which the same are adapted to be united for conversation, a signal-controlling electromagnet bridged between the two limbs of the talking - circuits of each said lines, each of said electromagnets having two differential windings and possessing impedance to the passage of talking-currents, a separate charging source of electricity adapted to be connected in circuit with the windings of each of said electromagnets, and means at each of the substations for controlling the passage of current through one or both of the said electromagnets corresponding thereto, substantially as described.

15. The combination with a pair of telephone-lines, of cord connectors for uniting the same for conversation, a condenser interposed in each strand of said cord connector, a pair of signal-controlling electromagnets bridged between the said strands upon opposite sides of said condensers, each of the said electromagnets having two windings possessing impedance to the passage of the talking-currents, a separate source of charging-current adapted to be connected in the metallic circuit with the windings of each of said electromagnets, a switch at each substation for permitting current to flow through one or both of the windings of the electromagnet connected with the said substation, substantially as described.

16. The combination with a telephone-line and a connection-terminal therefor normally in inoperative relation with said line, of a connecting-plug and cord-circuit adapted to cooperate with said line, condensers interposed in the strands of the cord-circuit, a supervisory signal-controlling electromagnet having two differential windings upon each side of the condensers, a battery connected between said windings and adapted to send current over the metallic line for conversation and through said windings, a switch at the subscriber's station, and means controlled by the insertion of the plug into the connection-terminal for placing said connection-terminal in operative relation with the line whereby said signal-controlling electromagnet is placed under the control of the subscriber, substantially as described.

17. The combination with a telephone-line, and a connection-terminal in the form of a spring-jack, of a central source of current associated with the line-circuit to furnish current for talking purposes, a cord-circuit, condensers interposed in the strands of the cord-circuit, a supervisory signal-controlling electromagnet having differential coils bridged

across the cord-circuit upon one side of the condensers and possessing impedance to the passage of voice-currents, the windings of said electromagnets being connected in the path of current from said source over the metallic line, and a relay actuated from said source by the insertion of the plug into and its withdrawal from said jack for controlling the operative relation of said jack with the line, substantially as described.

18. In a telephone system, a metallic circuit-line, a connection-terminal in the form of a spring-jack normally not in operative relation with said line, a connecting-plug and a cord-circuit, condensers interposed in the strands of the cord-circuit, a line-signaling device normally in operative relation with said line, a central source of current and a supervisory signal-controlling electromagnet associated with said line and cord-circuit, said magnet having two differential windings bridged across the cord-circuit and possessing impedance to the passage of voice-currents, said source being connected between said windings and adapted to furnish current for talking purposes, and a relay actuated from said source when the plug is inserted in said jack to place said device in inoperative relation with said line and said jack in operative relation with said line, substantially as described.

19. The combination with a telephone-line, of a line-signal therefor, a cord-circuit to establish conversational circuits with the line, condensers interposed in the strands of the cord-circuit, a source of current associated with the cord-circuit and adapted to be included in the metallic line to furnish current for talking, a supervisory signal-controlling electromagnet bridged across the cord-circuit and having differential windings disposed one in each side of the path of current from said source over the metallic line, said magnet being actuated when the magnetic effects in its coils are unbalanced, and a cut-off device for the line energized from said source when a connection is established by the cord-circuit with the line to render said line-circuit inoperative and at the same time without unbalancing said supervisory signal-controlling electromagnet or operating said line-signal by the act of making the connection, substantially as described.

20. The combination with a telephone-line, of a connection-terminal therefor normally disconnected from the line, a line-signaling device for the line, a cord-circuit, condensers interposed in the strands of the cord-circuit, a source of current to send current over the metallic line for talking, a supervisory signal-controlling electromagnet bridged across the cord-circuit and having differential windings disposed in the path of current from said source over the line-circuit, said magnet being rendered neutral by cur-

rent over the metallic circuit during conversation and energized by current over one side of the line at the termination of the conversation, a cut-off relay for the line to connect
5 said terminal with the line, and means to energize said relay from said source by the act of connecting the cord-circuit with the line without operating said signal by current over its circuit or unbalancing said electromagnet,
10 substantially as described.

21. In a telephone system, the combination of subscribers' lines, a suitable jack connected with each line, an operator's cord-circuit provided with plugs adapted for insertion in said jacks, a condenser in each talking-
15 strand of said cord-circuit, two independent sources of current bridged across the cord-circuit at each side of said condensers, said sources of current thereby being adapted to
20 supply current to the lines through the talking-strands of the cord-circuit, suitable supervisory relay-coils interposed between the said cord-strands and the said independent sources of current, and supervisory signal devices
25 controlled by said relay-coils, substantially as described.

22. In a telephone system, the combination of subscribers' lines, subscribers' hook-switches for opening and closing the line-circuits, jacks connected with the lines, an operator's cord-circuit provided with plugs adapted for insertion in said jacks, a condenser in each talking-strand of the cord-circuit, two independent sources of current
35 bridged across the cord-circuit at points each side of said condensers, relays having their coils interposed between the cord-strands and the said independent sources of current, and supervisory lamps associated with the
40 cord-circuit and having normally open local circuits controlled by said relays, said lamps being adapted to light up or glow when the line-circuits are opened by said switches, substantially as described.

23. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling devices at the central office, of a cord-circuit to establish connections between the lines for conversation, said cord-circuit having a strand in
50 each side of the talking-circuit, a condenser interposed in each strand, means at the central office for supplying current to the lines for conversation, supervisory relay-windings
55 connected between said means for supplying current and said cord-strands upon each side of the said two condensers, and supervisory signals controlled by said windings, substantially as described.

24. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling devices at the central office, of a cord-circuit to establish connections between the lines for conversation, said cord-circuit having a strand in
65

each side of the talking-circuit, a condenser interposed in each strand, means at the central office for supplying current to the lines for conversation, supervisory relay-windings connected between said means for supplying
70 current and said cord-strands upon each side of the said two condensers, a normally inoperative supervisory signal for each end of the cord-circuit controlled respectively by the said windings on the same side of the condensers,
75 the excitation of one of the said windings on each side of the condensers causing the operation of the corresponding signal and the simultaneous excitation of the associated winding causing the said signal to become in-
80 operative, substantially as described.

25. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling devices at the central office, of a cord-circuit to establish
85 connections between the lines for conversation, said cord-circuit having a strand in each side of the talking-circuit, a condenser interposed in each strand, current-supplying means bridged across the cord-circuit at each
90 side of said condensers to supply current to the lines for talking, supervisory relay-windings interposed in the connections between the said means and each of the cord-strands, a supervisory signal for each end of the cord-
95 circuit, the said windings serving to prevent the passage of voice-currents and to control the operation of the said signals during connections, substantially as described.

26. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling devices at the central office, of a cord-circuit to establish connections between the lines for conversation, said cord-circuit having a strand in
105 each side of the talking-circuit, a condenser interposed in each strand, current-supplying means bridged across the cord-circuit at each side of said condensers to supply current to the lines for talking, a supervisory relay for
110 each end of the cord-circuit having double windings, one winding interposed between said means and one strand and the other winding interposed between the said means and the other strand on the same side of the
115 condensers, and a supervisory signal controlled by each said relay during connections, substantially as described.

27. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling devices at the central office, of a cord-circuit to establish connections between the lines for conversation, said cord-circuit having a strand in
125 each side of the talking-circuit, a condenser interposed in each strand, means at the central office for supplying current to the lines for conversation, supervisory relay-windings connected between said means for supplying
130 current and said cord-strands upon each side

of the said two condensers, a normally inoperative supervisory signal for each end of the cord-circuit controlled respectively by the said windings on the same side of the condensers, one of said windings for each signal being energized by current from said means over one side of the talking-circuit when a connection exists to thereby cause the operation of the signal, and the other associated winding being energized by current from said source over the other side of the talking-circuit to thereby render the said signal inoperative, substantially as described.

28. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling devices at the central office, of a cord-circuit to establish connections between the lines for conversation, said cord-circuit having a strand in each side of the talking-circuit, a condenser interposed in each strand, current-supplying means bridged across the cord-circuit at each side of said condensers to supply current to the lines for talking, supervisory windings interposed in the connections between the said means, and each of the cord-strands, a supervisory signal for each end of the cord-circuit, one winding on each side of the condensers being energized over one of the strands of the cord-circuit and a third conductor to cause the operation of the associated signal and the other winding on the same side of the condensers being energized over the metallic line to render the said signal inoperative, substantially as described.

29. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling devices at the central office and normal ground connections at the substations, of a cord-circuit to establish connections between the lines for conversation, said cord-circuit having a strand in each side of the talking-circuit, a condenser interposed in each strand, means at the central office for supplying current to the lines for conversation, supervisory relay-windings connected between said means for supplying current and said cord-strands upon

each side of the said two condensers, a normally inoperative supervisory signal for each end of the cord-circuit controlled respectively by the said windings on the same side of the condensers, one of said windings for each signal being energized by current from said means over one side of the talking-circuit and the substation ground connection when a connection exists to thereby cause the operation of the supervisory signal, and both windings being energized from said source over the metallic line during conversation to render said signal inoperative.

30. In a telephone system, the combination with subscribers' lines having connection-terminals and line-signaling device at the central office and grounded signaling-bells at the substations, of a cord-circuit to establish connections between the lines for conversation, said cord-circuit having a strand in each side of the talking-circuit, a condenser interposed in each strand, means at the central office for supplying current to the lines for conversation, supervisory relay-windings connected between said means for supplying current and said cord-strands upon each side of the said two condensers, a normally inoperative supervisory signal for each end of the cord-circuit controlled respectively by the said windings on the same side of the condensers, one of said windings for each signal being energized by current from said source over one side of the talking-circuit and through the corresponding grounded bell at the substation when a connection exists to thereby cause the operation of the supervisory signal, and both windings being energized by current from said source over the metallic line during conversation to render the said signal inoperative.

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

WILLIAM A. TAYLOR.

Witnesses:

JOHN HENRY LEUDI,

WILLIAM KAISLING.