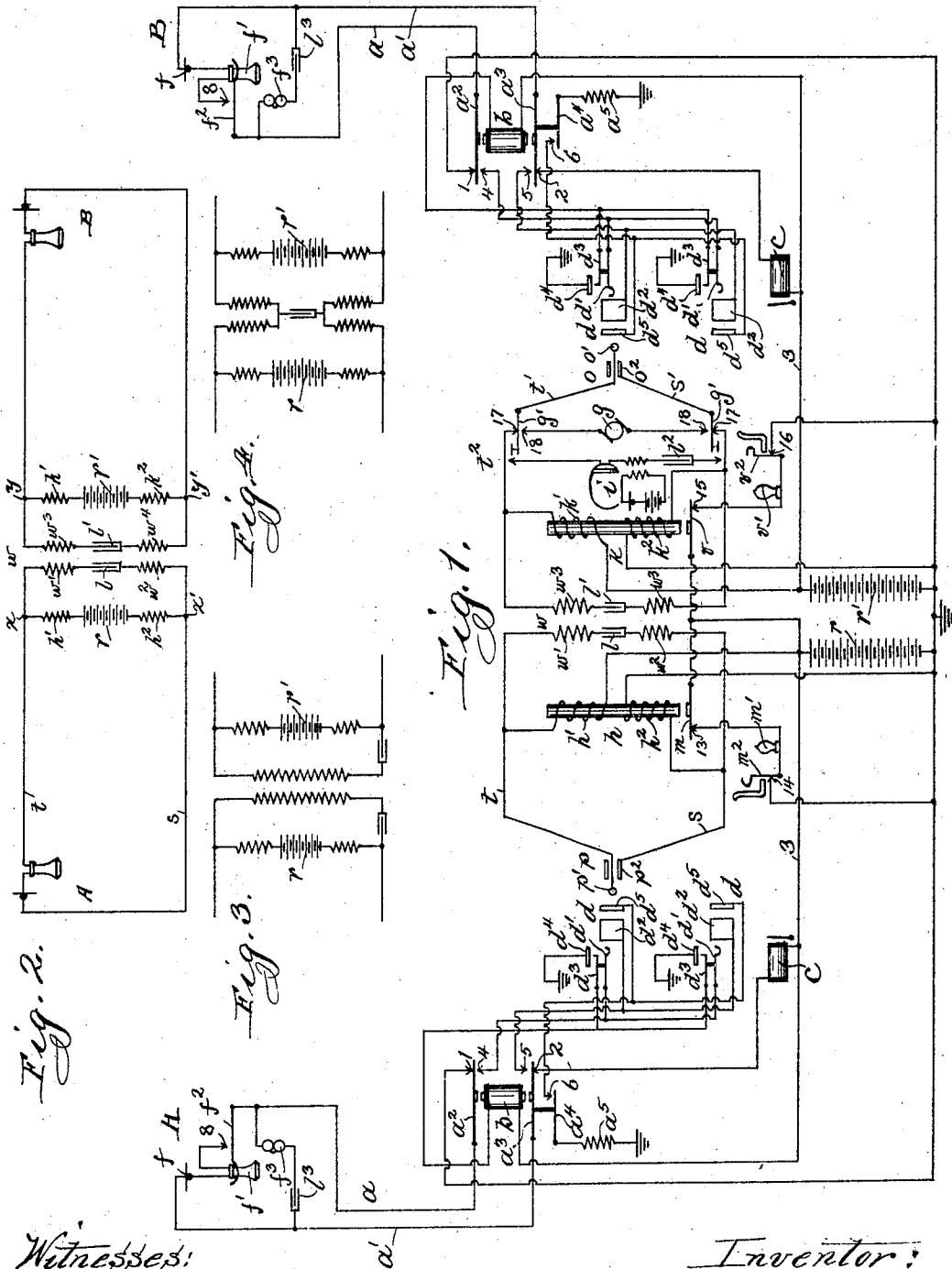


K. B. MILLER.
TELEPHONE SYSTEM.
APPLICATION FILED FEB. 4, 1901.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 796,441.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, KEMPSTER B. MILLER, 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 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 signal apparatus at the central station.

In accordance with my invention I provide a repeating-coil through which the telephone-lines are adapted to be united for conversation, the charging source of electricity and the windings of the signal-controlling electromagnet being placed in a bridge between the two limbs of the talking-circuit.

The present invention contemplates means for preventing the charging source of electricity from becoming short-circuited through the windings of the repeating-coil, and to this end I preferably interpose a condenser in the bridge containing the windings of the repeating-coil, although the present invention contemplates any means for opening the circuit through the windings of the repeating-coil to prevent the passage therethrough of the current from the charging source.

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. Fig. 3 is a view of a modification in which the condenser is placed upon one side of the windings of the repeating-coil. Fig. 4 is a modification in which a single condenser is employed for both windings of the repeating-coil.

Like characters refer to like parts in the several figures.

The telephone-line A extends in two limbs a a' at 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 con-

tact 2, which is connected, through individual annunciator c , to conductor 3. The springs a^2 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^3 of the spring-jacks. Moving with spring a^3 , but insulated therefrom, is a spring a^4 , connected to ground through resistance a^5 and adapted when the relay is energized to engage contact 6, which is connected with the test-rings d^5 d^6 . 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 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 , normally resting out of engagement with contact 8. The bell f^3 and a condenser l^3 are connected between the two limbs a a' . 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 the line A.

The answering-plug p is provided with a tip p' and a sleeve p^2 , the former being connected with the 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 a strand t' and the latter with a strand s' . The strands t s and t' s' are united through a repeating-coil w , having windings w' and w^2 connected between the strands t and s and windings w^3 and w^4 connected between the windings t' and s' . In circuit with windings w' and w^2 is a condenser l , and in circuit with windings w^3 w^4 is a condenser l' . Be-

tween the strands t and s the windings h' and h'' of a relay h are provided, a battery r being interposed between said windings. Likewise between the strands t' and s' the windings h' and h'' of relay h are connected, the battery r' being interposed between said windings. The windings of the relays are in such a direction that the same assist each other in magnetizing the core. The conductors 3, extending to the telephone-lines, are connected some with the battery r and some with battery r' , and the opposite 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 deenergized 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 relay h 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 contacts m^2 and 14 of a plug-seat switch-controlled by plug p are interposed in the circuit of the lamp m' . Likewise the contacts v^2 and 16 of a plug-seat switch-controlled by plug o are interposed in the circuit of the lamp v' .

In the strands t' and s' the levers g' g' of the ringing-key are provided, said levers normally resting against contacts 17 17 and adapted when depressed to engage contacts 18 18, between which the generator g is connected. The operator's telephone set i is adapted to be connected between the strands t' and s' , and a condenser 12 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 limbs a a' at the substation. The circuit of battery r is thus closed over conductor 3, annunciator c , contact 2, spring a^3 , limbs a' , a spring a^2 , contact 1 to the opposite pole of battery r . The individual annunciator c is thus actuated to convey to the operator the signal for connection, and the operator 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 a^3 out of engagement, respectively, with contacts 1 and 2, thus disconnecting the annunciator 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' h'' of

relay h and through the strands t and s of the cord-circuit and the limbs a a' of the line. The removal of the answering-plug from its seat closes the circuit through lamp m' , thereby lighting the same. The insertion of the plug in the spring-jack closes circuit through the two windings of the relay, thereby energizing the same and opening the lamp-circuit at the contacts m and 13. The operator then connects her telephone set i in circuit in the usual manner and receives the number of the called subscriber. Learning that connection is desired with subscriber B, she lifts the answering-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 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 line-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 battery r' is on open circuit and the point t^2 is therefore 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 battery r' is closed from ground through the winding h' , strand t' , tip o' , test-ring d^5 , contacts 6 and a^4 to ground. The resistance thus interposed between the pole of the battery and the point t^2 by the winding h' 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 in the spring-jack thereof and then depresses the ringing-key g' , thereby sending current from generator g over strands t' s' and limbs a a' through the bell at the substation. When the subscriber responds, he lifts the receiver from the hook, thus closing together the limbs a a' at the substation. The circuit of battery r' is thus closed through windings h' h'' , strands t' s' , and limbs a a' . When the calling-plug o is removed from its seat, the circuit through lamp v' is closed and the lamp is lighted. When the called subscriber removes his telephone from the hook, current traverses the windings of the relay belonging to the called subscriber and the circuit through the lamp is thus opened at the contacts v and 15. The circuits during conversation are shown in Fig. 2. When the subscriber A is talking and the microphone is

actuated, variation of the resistance therein causes 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 windings w' and w^2 , thereby inducing corresponding currents in windings w^3 and w^4 , which pass through 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 will be caused to pass through the receiver of subscriber B.

When the subscribers have completed their conversation and desire disconnection, they hang up their telephone-receivers, thereby opening the circuit of the batteries through the relays. The relay-contacts are thus closed together to permit the lighting of the lamp. Thus when subscriber A hangs up his telephone-receiver the circuit of battery r through the windings of relay h is opened at the substation and the contacts m and 13 are permitted to close together, thereby closing circuit through lamp m' . In the same manner the subscriber B in hanging up his telephone opens the circuit through relay k , thereby lighting the lamp v' . When the plugs are returned to their seats, the lamp-circuits are opened at the contacts of the plug-seat switches. 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, No. 686,272, dated August 12, 1901.

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 a repeating-coil 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, a source of electricity adapted to be connected in circuit with said electromagnet, and means for preventing the current therefrom from passing through the winding of the repeating-coil associated therewith, substantially as described.

2. The combination with a pair of telephone-lines, of a repeating-coil through which the same are adapted to be united for conversation, a source of electricity and an impedance element bridged between the two limbs of the talking-circuit of one of said lines, like parts associated with the other line, and means for preventing the current from said source or sources from passing through the winding of the repeating-coil associated therewith, substantially as described.

3. The combination with a pair of telephone-lines, of a repeating-coil through which the same are adapted to be united for conversation, a signal-controlling electromagnet and a source of electricity bridged between the two limbs of the talking-circuit of each of said lines, a switch at each substation for controlling the circuit of said source through said electromagnet, and means for preventing the current from said source from passing through the winding of the repeating-coil, substantially as described.

4. The combination with a pair of telephone-lines of a repeating-coil through which the same are adapted to be united for conversation, a signal-controlling electromagnet and a charging source of electricity bridged between the two limbs of the talking-circuit of each of said lines, a switch at each substation for controlling the passage of current through the signal-controlling electromagnet connected therewith, and a condenser interposed in the circuit of each of the windings of said repeating-coil to prevent the passage of the current from said source through said windings, substantially as described.

5. The combination with a pair of telephone-lines, of a repeating-coil through which the same are adapted to be united for conversation, a signal-controlling electromagnet and a source of electricity bridged between the two limbs of the talking-circuit of both of said lines, and means for preventing the winding of the repeating-coil from short-circuiting said source of electricity, substantially as described.

6. The combination with a pair of telephone-lines, of a repeating-coil to connect said lines for conversation, a pair of circuit-controlling electromagnets, one connected in parallel with each winding of said repeating-coil, means for sending charging-currents through said electromagnets, a switch at each substation for controlling the circuit through the electromagnet corresponding to said line, supervisory signals controlled by the electromagnets and means for rendering the windings of said repeating-coil opaque to the passage of the charging-currents, substantially as described.

7. The combination with a pair of telephone-lines, of a repeating-coil to connect said lines for conversation, a pair of signal-controlling electromagnets bridged across the circuit one on either side of the repeating-coil, means for sending charging-current through said electromagnets, a switch at each substation controlling the circuit through the electromagnet corresponding to that line, a supervisory signal controlled by each magnet and a condenser in circuit with each repeating-coil winding to render the same opaque to the passage of charging-currents, substantially as described.

8. The combination with a cord connector

terminating in connecting-plugs, of a repeating-coil interposed between said plugs, a pair of signal-controlling electromagnets, one in parallel with each winding of said repeating-coil, means for sending charging-currents through the windings of said electromagnets, condensers in the path of current through said repeating-coil windings to render the same opaque to the passage of said charging-currents, a plug-seat switch for each of said plugs, and a pair of supervisory signals for the cord connector, one controlled by one of said electromagnets and corresponding plug-seat switch, and the other controlled by the other electromagnet and the corresponding plug-seat switch, substantially as described.

9. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil in the cord-circuit to inductively unite its two ends, a pair of signal-controlling electromagnets, one connected in parallel with each winding of said repeating-coil, means for sending a continuous current through said electromagnets, a switch at each substation for controlling the circuit through the corresponding electromagnet, supervisory signals controlled by said electromagnets, and means for rendering the windings of said repeating-coil opaque to the passage of charging-currents, substantially as described.

10. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil in the cord-circuit to inductively unite its two ends, a pair of signal-controlling electromagnets, one connected in parallel with each winding of said repeating-coil, means for sending a continuous current through said electromagnets, a switch at each substation for controlling the circuit through the corresponding electromagnet, and a condenser in circuit with each winding of said repeating-coil to render the same opaque to the charging-currents, substantially as described.

11. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil inductively connecting the two ends of the cord-circuit, a pair of signal-controlling electromagnets connected with the cord-circuit, one in parallel with each winding of said repeating-coil, a separate source of current for sending current through each said electromagnet, a switch at each substation for controlling the circuit through the electromagnet and source corresponding to said line, a supervisory signal controlled by each magnet and means for rendering the windings of said repeating-coil opaque to the passage of charging-currents, substantially as described.

12. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil inductively connecting the two ends of the cord-

circuit, a pair of signal-controlling electromagnets connected with the cord-circuit, one in parallel with each winding of said repeating-coil, a separate source of current for sending current through each said electromagnet, a switch at each substation for controlling the circuit through the electromagnet and source corresponding to said line, and a condenser for rendering the windings of said repeating-coil opaque to the passage of charging-currents, substantially as described.

13. The combination with two telephone-lines, of a repeating-coil to unite said lines for conversation, a condenser in the circuit of each winding of said repeating-coil, and a charging source of electricity and an impedance element bridged between the limbs of each of the connected telephone-lines, substantially as described.

14. The combination with two telephone-lines, of a repeating-coil to unite said lines for conversation, and a charging source of electricity and a signal-controlling electromagnet bridged between the limbs of each of the connected telephone-lines, said repeating-coil windings being opaque to current from said source, substantially as described.

15. The combination with a pair of telephone-lines, of a cord-circuit terminating in connecting-plugs to connect said lines for conversation, a repeating-coil in the cord-circuit to inductively unite its two ends, a pair of signal-controlling electromagnets one connected in parallel with each winding of said repeating-coil, means for sending a continuous current through said electromagnets, a switch at each substation for controlling the circuit through the corresponding electromagnet, means to render the windings of said repeating-coil opaque to the passage of charging-current, a plug-seat switch for each of the plugs, and a pair of supervisory signals for the cord-circuit, one signal controlled by one of the electromagnets and corresponding plug-seat switch and the other signal controlled by the other electromagnet and the corresponding plug-seat switch, substantially as described.

16. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a connecting-plug for each end of the cord-circuit, a repeating-coil inductively connecting the two ends of the cord-circuit, a pair of signal-controlling electromagnets connected with the cord-circuit one in parallel with each winding of said repeating-coil, a separate source of current for sending current through each of said electromagnets, a switch at each substation for controlling the circuit through the electromagnets and source corresponding to said line, means for rendering the windings of said repeating-coil opaque to the passage of charging-current, a plug-seat switch for each of the plugs, and a supervisory signal for each

end of the cord-circuit controlled by the corresponding plug-seat switch and electromagnet, substantially as described.

17. The combination with a pair of telephone-lines, of a cord-circuit terminating in connecting-plugs to connect said lines for conversation, a repeating-coil in the cord-circuit to inductively unite its two ends, a pair of signal-controlling electromagnets one connected in parallel with each winding of said repeating-coil, means for sending a continuous current through said electromagnets, a switch at each substation for controlling the circuit through the corresponding electromagnet, means to render the windings of said repeating-coil opaque to the passage of charging-current, a pair of supervisory signals for the cord-circuit operated over local circuits controlled at one point by the said electromagnets so as to render the said signals inert when the magnets are energized, and other means to complete said local circuit at another point when connections are established with the lines for conversation and to open them when the connecting-plugs are not in use, substantially as described.

18. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil in the cord-circuit to inductively unite its two ends, a pair of signal-controlling electromagnets, one connected in parallel with each winding of said repeating-coil, means for sending a continuous current through said electromagnets, a switch at each substation for controlling the circuit through the corresponding electromagnet, a plug-seat switch for each end of the cord-circuit, and a signal for each end of the cord-circuit controlled by the associated magnets and plug-seat switches, substantially as described.

19. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil inductively connecting the two ends of the cord-circuit, a pair of signal-controlling electromagnets connected with the cord-circuit, one in parallel with each winding of said repeating-coil, a separate source of current for sending current through each said electromagnet, and a switch at each substation for controlling the circuit through the electromagnet and source corresponding to said line, substantially as described.

20. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil inductively connecting the two ends of the cord-circuit, a pair of signal-controlling electromagnets connected with the cord-circuit, one in parallel with each winding of said repeating-coil, a separate source of current for sending current through each said electromagnet, and a switch at each substation for controlling the circuit through the electromagnet and source

corresponding to said line, substantially as described.

21. The combination with two telephone-lines, of a cord-circuit to unite said lines for conversation, the ends of said cord-circuit being separated by an inductive device, and a separate charging source of electricity and an impedance element bridged between the strands of each end of a cord-circuit whereby current is independently supplied to each line for talking, substantially as described.

22. The combination with two telephone-lines, of a cord-circuit to connect said lines together for conversation, a repeating-coil inductively joining the two ends of the cord-circuit, and a separate charging source of electricity and an impedance element bridged between the limbs of each end of the cord-circuit, substantially as described.

23. The combination with two telephone-lines, of a repeating-coil to unite said lines for conversation, a charging source of electricity and a signal-controlling electromagnet bridged between the limbs of each of the connected telephone-lines, a plug-seat switch for each end of the cord-circuit, and supervisory signals controlled by said switches and electromagnets, substantially as described.

24. The combination with two telephone-lines, of an inductive device to unite said lines for conversation, a charging source of electricity and a signal-controlling electromagnet bridged between the limbs of each of the connected telephone-lines, a plug-seat switch for each connecting-plug, and a signal associated with each line during conversation and controlled by the joint action of said plug-seat switch and said signal-controlling electromagnet, substantially as described.

25. The combination with a pair of telephone-lines, of a cord-circuit to connect said lines for conversation, a repeating-coil to inductively unite the two ends of the cord-circuit, a pair of signal-controlling electromagnets bridged across the cord-circuit one on either side of the repeating-coil, means for sending charging-current through said electromagnets, and a switch at each substation controlling the circuit through the electromagnet corresponding to that line, substantially as described.

26. The combination with a cord connector terminating in connecting-plugs, of a repeating-coil interposed between said plugs, a pair of signal-controlling electromagnets, one in parallel with each winding of said repeating-coil, means for sending charging-currents through the windings of said electromagnets during conversation, a plug-seat switch for each of said plugs, and a pair of signaling devices one controlled by one of said electromagnets and corresponding plug-seat switch and the other controlled by the other electromagnet and the corresponding plug-seat switch, said seats being arranged when the

plugs are placed therein to prevent the display of said signals and at other times to permit the display thereof, substantially as described.

27. The combination with the telephone-lines of a telephone-exchange, of a cord-circuit to unite said lines for conversation, a repeating-coil interposed in the cord-circuit to conductively separate and inductively unite the two ends of the cord-circuit, a charging source of electricity and an impedance element included in a bridge separate from the repeating-coil and between the limbs of each end of the cord-circuit, substantially as described.

28. The combination with a cord connector terminating in connecting-plugs, of a repeating-coil interposed between said plugs, a pair of signal-controlling electromagnets, one in parallel with each winding of said repeating-coil, means for sending charging-currents through the windings of said electromagnets during conversation, a plug-seat switch for each of said plugs, and a pair of supervisory signals for the cord connector, one signal controlled by one of said electromagnets and corresponding plug-seat switch, and the other signal controlled by the other electromagnet and the corresponding plug-seat switch, said plug-seat switches being arranged when the plugs are placed therein to prevent the display of the signals, substantially as described.

29. The combination with a pair of telephone-lines, of a cord-circuit to unite said lines for conversation, the ends of said cord-circuit being inductively united, a source of current and an electromagnet bridged across each end of the cord-circuit independent of the inductive device whereby current is supplied from the central office to the substation-lines for conversation, and supervisory signals controlled by the said magnets during conversation, substantially as described.

30. The combination with a pair of telephone-lines, of a cord-circuit to unite said lines for conversation, the ends of said circuit being inductively united, an electromagnet connected across each end of the cord-circuit and having divided windings, a source of current interposed between the windings of each magnet to furnish current over the corresponding telephone-line for conversational purposes, and supervisory signals for the cord-circuit controlled by said magnets during conversation, substantially as described.

31. The combination with a pair of telephone-lines, of a cord-circuit to unite said lines for conversation, the ends of the cord-circuit being inductively united, a separate source of current and an electromagnet

bridged across each end of the cord-circuit whereby current is supplied from central office to each of the substations of the lines for talking, a supervisory signal for each end of the cord-circuit controlled by the corresponding electromagnet to render the same inoperative during conversation, and operative during a connection and when the subscriber's telephone is off its hook, substantially as described.

32. The combination with a pair of telephone-lines, of a cord-circuit to unite said lines for conversation, the ends of the cord-circuit being inductively united, a source of current and an electromagnet bridged across each end of the cord-circuit whereby current is supplied from the central office to the substation of the lines for talking, a supervisory signal for each end of the cord-circuit, the circuit of said signals being provided with current by auxiliary means when connection is established and the subscribers' telephones are not in use and deprived of operating-current during conversation by the said magnets, substantially as described.

33. The combination with a pair of telephone-lines, of a cord-circuit to unite said lines for conversation, the ends of the cord-circuit being inductively united, a source of current and an electromagnet bridged across each end of the cord-circuit whereby current is supplied from the central office to the substation of the lines talking, a supervisory signal for each end of the cord-circuit, the circuits of said signals being controlled at one point by the said magnets and at another point by auxiliary means, substantially as described.

34. The combination with a pair of telephone-lines, of a cord-circuit to unite said lines for conversation, the ends of the cord-circuit being inductively united, a source of current and an electromagnet bridged across each end of the cord-circuit whereby current is supplied from the central office to the substation of the lines for talking, a supervisory signal for each end of the cord-circuit, each said signal having an independent operating-circuit controlled at one point by the corresponding relay and at another point by auxiliary means so that the said circuits are completed during connections and opened under normal conditions, substantially as described.

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

KEMPSTER B. MILLER.

Witnesses:

M. R. ROCKFORD,

M. R. NYMAN.