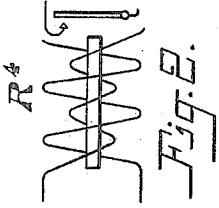
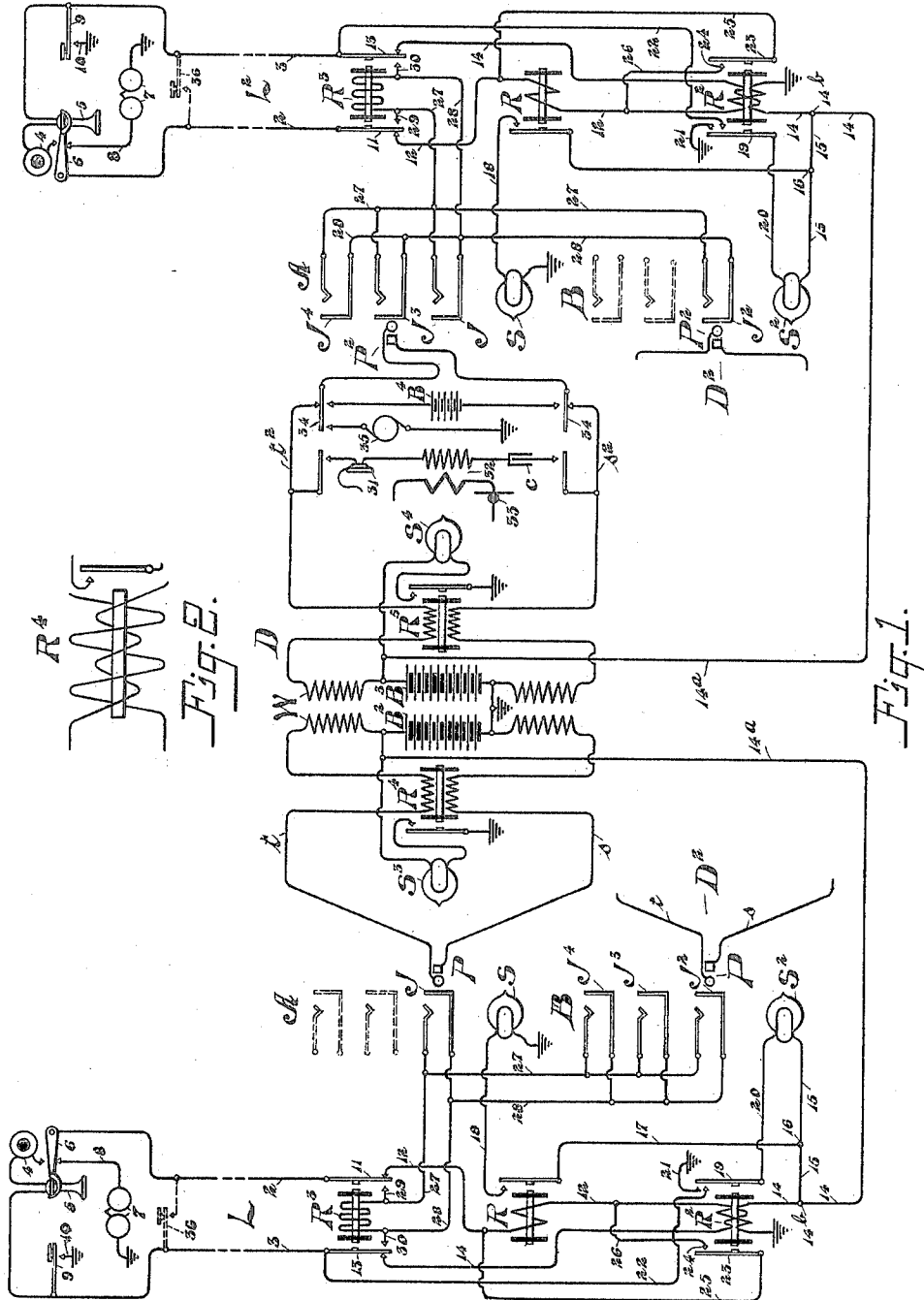


J. H. LENDI.

TWO DIVISION TELEPHONE SYSTEM.

APPLICATION FILED OCT. 27, 1902.



Witnesses:  
*R. L. Bradford*  
*Gayelle Beder*

Inventor:-  
*J. Henry Lendi,*  
 by *Robert Lewis Ames,*  
 Attorney.

# UNITED STATES PATENT OFFICE.

JOHN HENRY LENDI, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## TWO-DIVISION TELEPHONE SYSTEM.

No. 820,803.

Specification of Letters Patent.

Patented May 15, 1906.

Application filed October 27, 1902. Serial No. 128,854.

*To all whom it may concern:*

Be it known that I, JOHN HENRY LENDI, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Two-Division Telephone Systems, of which the following is a specification.

My invention relates to a two-division multiple-switchboard telephone system, my object being to provide a system of the kind described in which the source of current for the actuation of all substation and central-office apparatus is located at the central office and in which the apparatus both at the substation and at the central office for accomplishing the desired operations and results are of simple character.

In systems of the two-division type the switch-board is divided into two divisions and the subscribers' lines are provided with an answering-jack upon each of the divisions and with multiple jacks or connection-terminals upon one of said divisions. The subscriber is provided with means at his substation for actuating his calling-signal associated with either of the answering-jacks, whereby he is enabled to attract the attention of an answering operator upon either division of the switchboard. By thus being able to indicate a call upon either half of a switchboard the multiple sections thereof, as is evident, may be reduced one-half from the usual number with only an increase of a single answering-jack and the associated signal for each line, which results in a considerable saving in the aggregate.

In carrying out my invention I locate the operating-batteries or sources of current at the central office and provide each subscriber's line with two line-relays and a cut-off relay. The subscriber is enabled by suitable switches or keys to actuate either of the line-relays to selectively operate the desired signal, and when the subscriber answers to his call the cut-off relay is actuated to render the signaling devices inoperative. The operator's apparatus is provided with the usual supervisory signals, whereby she is informed of the condition of the connected lines at all times.

My invention is illustrated in the accompanying drawings, in which the same refer-

ence characters indicate like parts throughout both views, and in which—

Figure 1 is a diagram of the system, and Fig. 2 is a detailed view of the differential supervisory relays in the cord-circuit.

Referring to Fig. 1, L and L<sup>2</sup> indicate two subscribers' lines extending in two limbs 2 and 3 to the central office. At the substation the usual transmitter 4 and receiver 5 are included in a bridge of the line during conversation, which bridge is normally open at the switch-hook 6, permanently connected with the tip-conductor 2 of the line. An ordinary call-bell 7 is in a ground branch 8 from the normal contact of the switch-hook 6, whereby when the receiver is upon the hook the tip side 2 of the line will be grounded through the branch 8, and when the receiver is removed therefrom the metallic circuit of the line free from grounds will be completed. A push-button 9 is permanently connected with the sleeve-conductor 3 of the telephone-line and is adapted when depressed to ground said conductor through the grounded branch 10.

At the central office the line is provided with the line-relay R, controlling a line-signal S upon one division of the switchboard, and with a second line-relay R<sup>2</sup>, controlling the operation of a lamp or signal S<sup>2</sup>. An answering-jack J is associated with the signal S upon one division, and a similar jack J<sup>2</sup> is associated with the line-signal S<sup>2</sup> upon the other division. Multiple jacks J<sup>3</sup> and J<sup>4</sup> are provided for the line upon one of the two divisions of the switchboard. In the case of line L the said jacks are located upon the same division as the answering-jack J<sup>2</sup> and in the case of line L<sup>2</sup> upon the same division with answering-jack J, this arrangement being adopted merely to indicate the location of the several multiple jacks in the two divisions of the switchboard. Each line is also provided with a cut-off relay R<sup>3</sup>, which is adapted to be operated from any of the jacks when a connection is established therewith. The line conductor 2 is permanently connected with the movable contact 11 of the cut-off relay R<sup>3</sup>, the normal contact of which is connected with the extension-conductor 12 of said conductor 2 and includes the winding of the line-relay R and also one winding of the differential line-relay R<sup>2</sup> and continues thence to

ground. The other line conductor 3 is permanently connected with the spring 13 of the cut-off relay  $R^3$ , the normal contact of which is connected with the extension 14 of said line conductor, which includes the other winding of the differential relay  $R^2$  and leads thence by battery-lead or common bus-bar  $14^a$  to the live pole of the battery  $B^2$ . The line-relay  $R$  serves when actuated to close a local circuit from battery  $B^2$ , containing the line-signal  $S$ , said local circuit including the conductors  $14^a$  and  $14$  to  $14^b$ , conductor 15 to point 16, and thence by conductor 17, the spring of the line-relay  $R$ , its forward contact, and the conductor 18 to the lamp  $S$ , the opposite terminal of which is grounded. The line-relay  $R^2$  when actuated closes, through its spring 19, the local circuit of lamp  $S^2$ , said circuit including the conductors  $14^a$ ,  $14$ , and 15 from the live pole of the battery  $B^2$  to one terminal of the lamp and thence by conductor 20 from its other terminal to the spring 19 of said relay and thence by its forward contact and the branch 21 to ground. When this relay  $R^2$  is actuated, its spring-contact 19 also closes, through one of its two forward contacts, a locking-circuit for itself, said circuit including the branch conductor 22, leading from the second forward contact of the spring 19 to the line conductor 3, whereby as soon as said relay is operated a path for current from the live pole of the battery  $B^2$  is established over the extension 14 of the line conductor through one winding of said relay, the spring 13 of the cut-off relay  $R^3$ , the said branch 22, the two forward contacts, and the spring 19 of the relay  $R^2$  and thence by conductor 21 to ground, whereby the relay is locked when once actuated until the operator inserts the plug of her cord-circuit to answer the call. The line-relay  $R^2$  has an additional set of normally open contacts 23 and 24, which are closed when the relay is actuated to thereby complete a short circuit by branches 25 and 26 of the line-relay  $R$ , whereby the line-relay  $R$  is cut out of the metallic circuit and cannot thereafter be actuated when the subscriber takes his telephone off the hook. The cut-off relay  $R^3$  is bridged between the conductors 27 and 28, connected with the tip and sleeve contacts of the several jacks, and the forward contacts of springs 11 and 13 of the said cut-off relay when the said relay is actuated are disconnected from the extensions 12 and 14 of the line conductors and are connected with said switchboard-conductors 27 and 28 by the short conductors 29 and 30.

The operator's circuits and apparatus are diagrammatically typified at one division of the switchboard by the cord-circuit  $D$  and associated apparatus and at the other division of the board by means of a cord-circuit  $D^2$ , which for appearance's sake is only par-

tially indicated. The cord-circuits are each provided with an answering-plug  $P$  and with a calling-plug  $P^2$ , each having tip and sleeve contacts, the tip-contact of the answering-plug  $P$  being joined by the flexible strand  $t$  with the live pole of the battery  $B^2$  and including one winding of the differential supervisory relay  $R^4$  and also one winding of the repeating-coil  $W$ . The corresponding sleeve-strand  $s$ , connected with the sleeve-contact of the plug, includes likewise the other winding of the relay  $R^4$  and a winding of the repeating-coil  $W$  and is connected with the grounded pole of said battery. The supervisory signal  $S^3$  is associated with the answering-plug  $P$  and has its circuit controlled through the normally open contacts of said supervisory relay  $R^4$ . The tip-strand  $t^2$ , connected with the calling-plug  $P^2$ , includes one winding of the differential supervisory relay  $R^5$  and one winding of the said repeating-coil  $W$  and is connected with the live pole of a second battery  $B^3$ , while the sleeve-strand  $s^2$  from said plug includes like parts. The relay  $R^5$  controls the normally open circuit of the supervisory signal  $S^4$ , associated with the calling-plug. By means of a suitable listening-key the operator's receiver 31, the secondary winding of her induction-coil 32, and the condenser  $c$  may be bridged across between the two strands  $t^2$  and  $s^2$  of the cord-circuit to enable her to communicate with the subscriber and to receive the busy-test. Her transmitter 33 and the primary of the induction-coil 32 are in a local circuit preferably charged from the battery  $B^3$ , although a separate battery may be employed, if desired. The contacts 34 of a suitable ringing-key are included in the strands  $t^2$  and  $s^2$ , leading to the calling-plug, and serve when the key is actuated to connect the grounded ringing-generator 35 with the tip-strand thereof. When the key is actuated, an auxiliary battery  $B^4$  is connected between the springs 34 and serves during such actuation of the key to maintain the cut-off relay  $R^3$  of the called line actuated.

It will be understood that all the subscribers will be listed in the telephone-directory as of the division upon which their multiple jacks are located. In order to call a wanted subscriber, therefore it is necessary for the calling party to actuate one or the other of his calling-signals corresponding to the listed division of the wanted party, so that his answering operator may connect his answering-jack with the adjacent multiple jack of the wanted party through the intermediation of her cord-circuit. Assuming, for instance, that he wishes a party located upon division  $B$ , he depresses the push-button 9, and a path for current is provided from ground at the substation over the conductor 3 of the telephone-line, the spring 13 of the cut-off relay  $R^3$ , extension 14 through one winding

of the differential line-relay  $R^2$ , and conductor 14<sup>a</sup> to the live pole of the battery  $B^2$ . This actuates the line-relay  $R^2$ , which closes the local circuit of the corresponding lamp  $S^2$ , causing it to glow. At the same time the locking-circuit for the relay  $R^2$  is completed, as heretofore described, whereby it cannot be deenergized when the subscriber releases the button 9, and a short-circuit of the line-relay  $R$  is also completed, thus preventing its possible operation. As soon as the subscriber has depressed the button he takes up his receiver. On account of the short circuit of the line-relay  $R$  it does not at this time operate.

In case it is desired to actuate the signal at division A the receiver 5 is taken up in the ordinary manner, which completes a path for current over the metallic circuit of the line from the battery  $B^2$ . This current flows equally through the differential coils of the line-relay  $R^2$ , causing it to remain inactive, and also through the line-relay  $R$ , which is actuated. This latter relay completes the circuit of the signal-lamp  $S$ , but is not required to be locked, for the reason that current continues to flow therethrough until the operator answers the call. For the purpose of making the calls uniform the key 36 (shown in dotted lines) at the substation may be employed in place of the hook-switch 6; but the same results will be accomplished, for upon depressing the key 36 to actuate the signal  $S$  the subscriber would immediately take up his telephone, so that the line-relay  $R$  would be continuously actuated.

The operator, observing the lighting of the signal  $S$ , inserts the answering-plug  $P$  of her cord-circuit into the answering-jack of the calling-line, which completes a circuit from the battery  $B^2$  over the tip-strand  $t$ , the tip-conductor 27 of the jacks, the winding of the cut-off relay  $R^3$ , sleeve-conductor 28 of the jacks, and the sleeve-strand  $s$  of the cord-circuit to the opposite pole of said battery. The cut-off relay  $R^3$  is therefore actuated and disconnects the springs 11 and 13 from extensions 12 and 14, thereby cutting off both line-relays and rendering both line-signals  $S$  and  $S^2$  inoperative. The supervisory signal  $S^3$ , associated with the answering-plug  $P$ , remains inactive at this time, for the reason that an equal amount of current flows through its differential coils, there being no ground present upon either side of the circuit. Upon learning that a subscriber located upon the line  $L^2$  is desired the calling-plug  $P^2$  is inserted in one of the multiple jacks in that division of the switchboard and belonging to that line and the ringing-key 34 is actuated. Current from the battery  $B^4$  is now directed, through the cut-off relay  $R^3$  of the line  $L^2$ , to maintain the same actuated during ringing, while ringing-current flows from ground at the central office over the tip side of the cord-circuit and line to the substation and thence

through the hook-switch 6, grounded branch 8, and the bell 7 to ground. After the closing of the ringing-key 34 and before the subscriber responds current flows from the battery  $B^3$  over the tip side of the cord-circuit, the tip-conductor of the line, and through the signaling-bell 7 to ground. This current serves to unbalance the magnetic effects of the coils of the supervisory relay  $R^5$ , which attracts its armature and closes the circuit of the supervisory signal  $S^4$ . When the subscriber responds, the ground at the substation is removed, thus permitting an equal division of the current through the two coils of the supervisory relay  $R^5$ , which becoming neutral releases its armature and renders the supervisory signal  $S^4$  inert. The operator is thus apprised of the response of the called subscriber and knows by the extinguishing of both supervisory lamps that the parties are in communication. The cut-off relays  $R^3$  for the lines are actuated from the respective batteries  $B^2$  and  $B^3$ , while the transmitters at the substations are likewise energized from said batteries. Upon the termination of the conversation the subscribers return their receivers to their hooks, with the result that the metallic circuits of the lines are opened at the substations and the tip-conductors thereof are connected to ground. This results in unbalancing the magnetic effects of the currents flowing through the coils of the supervisory relays  $R^4$  and  $R^5$ , thus causing them to close the local circuits of the corresponding supervisory signals, which are ignited to indicate to the operator the fact of the termination of the conversation. The cut-off relays for the lines receive sufficient current of course during the time that the subscribers' lines are open to maintain them in actuated condition.

The busy-test is received in the usual way from the tip-strand of the calling-plug through the battery  $B^3$  to ground, it being understood that normally the test-rings of the jacks are insulated from ground, but that during a conversation or an established connection they are connected with ground through the sleeve-strand of the cord-circuit used to establish such connection. The completion of the busy-testing circuit causes a change of potential in the condenser  $c$ , thereby causing a flow of current through the operator's bridge and causing a click in her receiver.

The multiple jacks (shown in dotted lines) upon the two divisions of the switchboard are intended merely to illustrate that other lines are represented by multiple jacks upon the several sections of the two divisions of the board.

Fig. 2 shows diagrammatically that the windings of the supervisory relays are superposed in such manner that the voice-currents in the metallic line are directly neutralized, and therefore suffer no impedance.

The several grounds combined at the substation may be one and the same or a common office return. The batteries are understood to be employed for the apparatus in both divisions of the exchange, although, of course, separate sets may be employed for the different divisions. The ringing and listening keys shown are understood to typify any of the usual or desired kinds of keys used for such purposes, and the subscriber's apparatus is intended to indicate merely any desired type of common battery-substation apparatus.

One advantage of the system herein shown is that but two wires extending throughout the switchboard are required for each line, whereby a great reduction in the cost of copper and installation results. I do not wish to be limited in all respects to the method herein shown and described, as the invention is capable of modification without departing from its scope or principle.

Having thus described my invention, what I claim is—

1. The combination with a telephone-line, of two line-signal-controlling electromagnets in series in the metallic line, one only of said electromagnets being responsive to current over the metallic circuit and a separate signal for each electromagnet, substantially as described.

2. The combination with a telephone-line, of two line-signal-controlling electromagnets in series in the metallic line, one of said electromagnets being differentially wound and unresponsive to current over both conductors of the line and a separate signal controlled by each magnet, substantially as described.

3. The combination with a telephone-line, of two signal-controlling electromagnets and a source of current in series in the metallic circuit of said line, one of said magnets being differential and therefore unresponsive to current from said source flowing over both sides of the line, and means operated from the substation for directing an actuating-current through either of said electromagnets, substantially as described.

4. The combination with a telephone-line, of two signal-controlling electromagnets and a source of current in series in the line at the central office, one of said signal-controlling electromagnets having two differential windings, one winding in each line conductor, means at the substation for completing the metallic circuit of the telephone-line over which current flows from said source and to which current said differential electromagnet is unresponsive and said other electromagnet is responsive, and further means at the substation for completing a circuit from said source through one winding only of said differential electromagnet to operate it, substantially as described.

5. The combination with a telephone-line terminating in a two-division switchboard at the central office, of a signal for said line upon each of the divisions, a signal-controlling electromagnet for each signal, said electromagnets being included together with a source of current in series in the line, one of said electromagnets having differential windings disposed in the opposite sides of the circuit and means operated from the substation for completing the circuit for current over the metallic line to which current the differential relay is unresponsive and for closing the circuit over one side of the line and through one winding only of the differential electromagnet to operate the same, substantially as described.

6. The combination with a telephone-line, of a line-signal-controlling electromagnet in one conductor thereof, a differential signal-controlling electromagnet having its windings in both conductors thereof, and a source of current included between said conductors, means at the substation for operating either of said relays singly from said source, and means whereby when the differential relay has been operated the other electromagnet is thereafter rendered inoperative, substantially as described.

7. The combination with a telephone-line, of a line-signal-controlling electromagnet in one conductor thereof, a differential signal-controlling electromagnet having its windings in both conductors thereof, a source of current included between both of said conductors, means at the substation for operating either of said relays singly from said source, and means whereby when the differential electromagnet has been operated the other electromagnet is thereafter short-circuited, substantially as described.

8. The combination with a telephone-line, of two signal-controlling electromagnets therefor, one of said electromagnets being differentially wound and unresponsive to current in the metallic line, and means for rendering said electromagnets inoperative when the operator establishes a connection with the line for conversation, substantially as described.

9. The combination with a telephone-line, of two signal-controlling electromagnets therefor, one of said electromagnets being differentially wound and unresponsive to current in the metallic line, and a cut-off relay for the line adapted when actuated to render said signal-controlling electromagnets inoperative, substantially as described.

10. The combination with a telephone-line, of a line-signal therefor in different divisions of a divided multiple switchboard, a line-relay for each signal and a source of current in series in the line, one of said relays being differential and having its windings disposed in the opposite sides of the line, a cut-off relay

for the line adapted when operated to render said signals inoperative, and means for closing a circuit through said cut-off relay over a portion of the talking-circuit when connection is established by the operator with the line, substantially as described.

11. The combination with a telephone-line, of a line-signal therefor in different divisions of a divided multiple switchboard, a line-relay for each signal and a source of current in series in the line, one of said relays being differential and having its windings disposed in the opposite sides of the line, a cut-off relay for the line adapted when operated to render said signals inoperative, a cord-circuit, a supervisory signal associated therewith, and means for operating said cut-off relay and to place said supervisory signal in condition to operate by current over a portion of the talking-circuit when a connection is established with the line, substantially as described.

12. The combination with a telephone-line, of two signals therefor located upon different divisions of a divided multiple switchboard at the central office, of two line-relays therefor controlling said signals, one of said relays being differential and having its windings connected in the line so as to be unresponsive to current in the metallic line, said relays being capable of selective operation from the substation, and means to render the signals inoperative when a connection is established with the line at either of the divisions of the switchboard for conversation, substantially as described.

13. The combination with a telephone-line, of two signal-controlling electromagnets therefor, a signal for each magnet placed in the different divisions of a switchboard at the central office, one of said electromagnets being differentially wound and connected in the line so as to be unresponsive to current in the metallic line, said electromagnets being capable of selective operation from the substation, and means for rendering said signals inoperative when the operator establishes a connection with the line for conversation, substantially as described.

14. The combination with a telephone-line, of two signal-controlling electromagnets therefor, a signal for each electromagnet placed in different divisions of the switchboard, one of said electromagnets being differentially wound and connected in the line so as to be unresponsive to the current in the metallic telephone-line, means at the substation to cause the operation of said electromagnets singly, and a cut-off relay for the line adapted to be actuated when a connection is established with the line for conversation to render said signals inoperative, substantially as described.

15. The combination with a telephone-line, of a signal-controlling electromagnet in one conductor thereof, a differential signal-con-

trolling electromagnet having its windings in both conductors of the line, a signal for each electromagnet placed in different divisions of the switchboard, a source of current included between said conductors, means at the substation for operating either of said electromagnets singly from said source, means whereby when the differential relay is operated the other relay is prevented from operation, and means for rendering said signals inoperative when a connection is established with the line at either division of the switchboard, substantially as described.

16. The combination with a telephone-line, of a line-signal-controlling electromagnet in one conductor thereof, a differential signal-controlling electromagnet having its windings in both conductors of the line, a source of current included between said conductors, signals for the line one for each magnet and one in each division of the switchboard, means controlled by the differential relay to prevent the operation of the other signal-controlling electromagnet when the differential magnet is operated, said magnets being operated from said source at the will of the subscriber, and means for retiring the signals when connection is established with the line, substantially as described.

17. The combination with a telephone-line, of a signal-controlling electromagnet in one conductor thereof, a differential signal-controlling electromagnet having its windings in both conductors of the line, a signal for each electromagnet, a source of current included between said conductors, only said first-named electromagnet being responsive to current from said source when the metallic line is closed at the substation, a switch at the substation for closing circuit from said source over one line conductor only to operate said differential electromagnet, a locking-circuit for said differential electromagnet, a short circuit of said first-named relay controlled by said differential electromagnet, and a cut-off relay for the line to render said signals inoperative and to open said locking-circuit, substantially as described.

18. The combination with a telephone-line, of a relay in one line conductor thereof, a differential relay having its windings in both line conductors, a signal for each electromagnet upon different divisions of a switchboard at the central office, a source of current included between said line conductors, only said first-named relay being responsive to current from said source when the metallic line is closed at the substation, a switch at the substation for closing circuit from said source over the other line conductor to operate said differential relay, a locking-circuit for said differential relay, a short circuit of said first-named relay controlled by said differential relay, a cut-off relay for the line to render said signals inoperative, a cord-circuit

to establish connections with the line for conversation, and means for including said source and said cut-off relay in a local circuit including a portion of the talking-circuit when  
 5 the cord-circuit is connected with the line, said source being included in the metallic talking-circuit during connections to furnish current to the substation for talking, substantially as described.

10 19. The combination with a telephone-line, of two signals therefor placed upon the different divisions of a switchboard at the central office, two relays for the line one for each of  
 15 said signals, one of said relays being placed in one line conductor and the other relay being differentially wound and connected in both line conductors, a central common source of  
 20 current at the central office between the line conductors, means at the substation for completing circuit from said source over the metallic line to operate the first-named relay,  
 the second relay being unresponsive to such current in the metallic line, means at the sub-  
 25 station for completing circuit over one of the line conductors through said differential relay only to operate the same without operating  
 the other relay, a cord-circuit to establish connections with the line for conversation,  
 30 and means whereby when the connection is established said signals are rendered inoperative and the source of current is connected in the metallic circuit to furnish current to the substation for talking, substantially as described.

35 20. The combination with a telephone-line, of a line-signal therefor in different divisions of a divided multiple switchboard, a line-relay for each signal and a source of current in series in the line, one of said relays being dif-  
 40 ferential and unresponsive to current in the line when the subscriber completes the me-

tallic line at his station, a switch at the substation to complete the circuit from said source over one line conductor and through  
 45 one winding of the differential relay to actuate the same without actuating said first-named relay, a cut-off relay for the line adapted when operated to render said signals inoperative, a cord-circuit, and means for closing  
 50 a circuit from said source through said cut-off relay over a portion of the talking-circuit to operate the cut-off relay when connection is established by the cord-circuit with the line, said source being at the same time included in the metallic talking-circuit to furnish  
 55 current to the substation for talking, substantially as described.

21. In a divided central system, the combination with a telephone-line, of a plurality of signals therefor located upon the different  
 60 divisions of the switchboard, a plurality of relays associated with the line, and controlled from a substation to cause the desired operation of said signals, a common source of current to which the line is connected at the  
 65 central office, one of said relays being differential and having a winding in each side of the telephone-line, and another of said relays connected in one line conductor only, said relays being both operated from said source,  
 70 and means to render said signals inoperative when a connection is established with the line for conversation at any of the divisions of the switchboard, substantially as described.

Signed by me at Chicago, county of Cook, 75 State of Illinois, this 24th day of October, 1902.

J. HENRY LENDI.

Witnesses:

ROBERT LEWIS AMES,  
 GAZELLE BEDER.