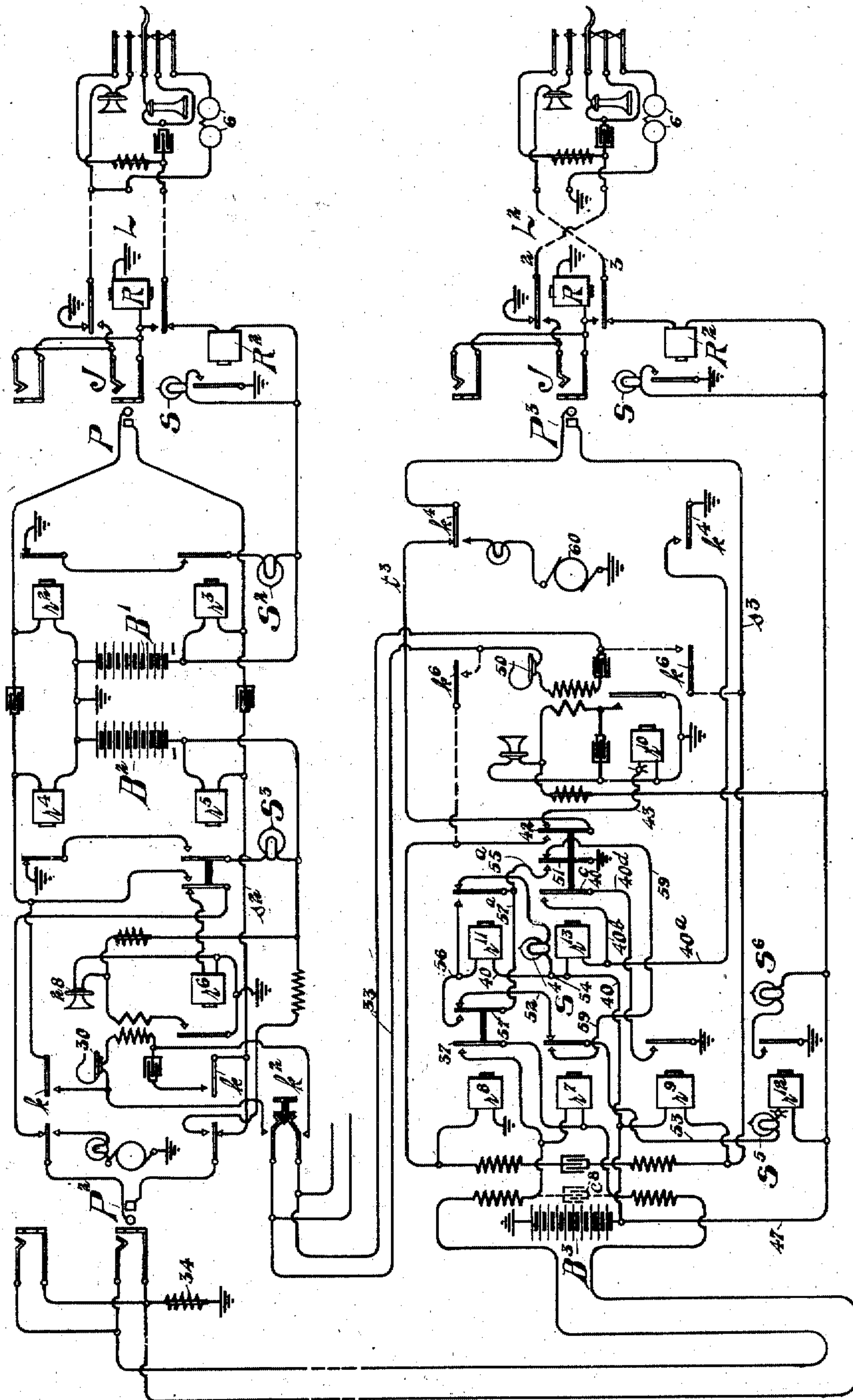


No. 842,178.

PATENTED JAN. 29, 1907.

W. W. DEAN.  
TELEPHONE TRUNKING SYSTEM.

APPLICATION FILED JAN. 22, 1903.



Witnesses.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE TRUNKING SYSTEM.

No. 842,178.

Specification of Letters Patent.

Patented Jan. 29, 1907.

Application filed January 22, 1903. Serial No. 140,166.

*To all whom it may concern:*

Be it known that I, WILLIAM W. DEAN, 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 Telephone Trunking Systems, of which the following is a specification.

In an application filed by me June 28, 1902, Serial No. 113,581, I have shown and described a telephone trunking system in which a relay that is actuated over a portion of the talking-circuit when the incoming end of the trunk is connected with the called line serves to disconnect the test-relay and place the tip trunk-cord in condition for conversation, to suitably control the circuits through the ringing-signal and locking-relay, and to open and close the local circuit of the calling and disconnecting signal. In the present application the relay that is actuated over the talking-circuit in the manner above explained serves to control a locking-circuit of an auxiliary relay which takes the place of the first-named relay in the system above described and which is initially operated over a local circuit controlled by the ringing-key.

My invention is illustrated in the accompanying drawing, in which the figure represents a diagram of a trunk-circuit extending between two central offices, together with radiating lines from each of the offices.

L indicates one of the radiating telephone-lines from the outgoing central office or A office, which lines are preferably of the two-wire or Dunbar type. At the central office of the A exchange a cord-circuit is shown of the usual type suitable for connecting the subscribers' lines together for conversation, while a trunk-line is shown extending from the A office to the B office, where it terminates in the usual flexible cord and plug. At the incoming or B office telephone-lines, such as L<sup>2</sup>, and which are also of the two-wire type center and are provided with suitable connection-terminals or spring-jacks to enable the subscribers to be connected together for conversation. The trunk-circuits terminating at this office are provided with ringing-signals to indicate that the called subscriber has not yet responded and with disconnecting-signals which show when the cord-circuit at the A office has been disconnected from the trunk. Suitable means are provided at

this end of the trunk to ring the wanted subscriber and to test the condition of his line to determine its idle or busy condition.

The subscriber located upon the line L desiring a connection with another subscriber whose line terminates at the B office takes up his receiver and thereby closes a path for current over the telephone-line from the battery B', thus operating the line-relay R<sup>2</sup> of the line and lighting the line-lamp S. Upon observing this signal the A operator inserts the answering-plug P of her cord-circuit in the answering-jack J of the calling-line, thereby operating the cut-off relay R of the line L to render the line-signal inoperative and to connect the spring-jack with the external line-circuit.

By means of the listening-key *k* the operator is enabled to connect her head-telephone with the opposite end of the cord-circuit to receive the order from the calling subscriber, her transmitter 28 being at this time energized by current from the central battery B<sup>2</sup>. The presence of current in the battery B' over both sides of the cord-circuit and the telephone-lines operates both supervisory relays *r*<sup>2</sup> and *r*<sup>3</sup>, and the supervisory signal remains inert.

Upon learning that a subscriber in the exchange B is wanted the order-key *k*<sup>2</sup> is depressed to connect her head-set with the order wire or circuit 33, extending to the other exchange, where it is joined to the B operator's instrument. In response to the order for connection the B operator nominates the trunk to be used and immediately proceeds to test the condition of the wanted line by means of the trunk-plug P<sup>3</sup>, while simultaneously the A operator completes the connection at her office by inserting the calling-plug P<sup>2</sup> of her cord-circuit in one of the jacks of the trunk. If the tested line is busy, a path for testing current is provided over the tip-strand *t*<sup>3</sup> of the trunk-cord and through the spring 42 of the auxiliary relay *r*<sup>13</sup>, its normal contact, and the conductor 43, leading to the test-relay of high resistance and high impedance and thence to ground. The operation of this relay causes a click in the operator's receiver. Upon finding the line idle the trunk-plug P<sup>3</sup> is inserted and the ringing-key *k*<sup>4</sup> operated to call the wanted subscriber. It will be noted that the call-bell 6 at the sub-



station upon the line  $L^2$  is connected with the tip-conductor 2 thereof when a receiver is upon the hook-switch and since the calling-generator 60 is connected between ground and the tip side of the trunk ringing-current is suitably sent out over the tip side of the line to actuate said call-bell. At the same time the cut-off relay R of the line is actuated by current over the sleeve-cord  $s^3$  of the trunk by current from the battery  $B^3$ , and since this circuit is not open during ringing the cut-off relay remains actuated. The depression of the sleeve-spring of the ringing-key  $k^4$  completes in the first instance the circuit of the auxiliary relay  $r^{13}$  from the battery  $B^3$ , conductor 40, through the said relay, and thence by conductor  $40^a$ , to the said spring  $k^4$  and to ground. As soon as this relay is operated it completes a locking-circuit for itself through the branch conductor  $40^b$ , the forward contact and spring  $40^c$  of said relay, conductor  $40^d$ , the forward contact and spring of sleeve-relay  $r^9$ , and thence to ground. This relay  $r^{13}$  therefore remains actuated as long as said sleeve-relay  $r^9$  is energized.

Upon the connection of the cord-circuit at the A office with the outgoing end of the trunk a path for current from the battery  $B^2$  is provided over the sleeve-strand  $s^2$  of the cord-circuit through the supervisory relay  $r^5$  and thence over the sleeve strand or conductor of the trunk-circuit, through the high-resistance trunk-relay  $r^7$  at the incoming office, and thence back to the A office over the tip side of the trunk and through the tip-strand of the cord-circuit to the other side of the battery  $B^2$ . It will be understood that the initial operation of the supervisory relay  $r^5$ , which accomplishes the completion of the tip-cord strand, is secured through the grounded retardation-coil 34. The high resistance of the trunk-relay  $r^7$  prevents the operation of the tip supervisory relay  $r^4$  in the A cord-circuit, so that the supervisory lamp  $S^3$  is lighted to indicate to the A operator that the called subscriber has not yet responded. Likewise at the incoming end of the trunk the ringing-lamp  $S^4$  is now lighted by current from the battery  $B^3$  over conductor 40, point 54, through the lamp  $S^4$ , the normal contact and spring of locking-relay  $r^{11}$ , conductor  $55^a$  forward contact and spring 51 of relay  $r^{13}$  to ground.

When the subscriber answers his call, current from the battery  $B^3$  flows over the metallic line to the substation and back to the central office through the tip-relay  $r^8$ , which is actuated to close the short-circuit through the spring 37 and forward contact of the said high-resistance trunk-relay  $r^7$ . The said resistance being removed from the path for current over the trunk permits the tip supervisory relay  $r^4$  in the A cord-circuit to operate and opens the circuit of the supervisory lamp  $S^3$ , which is rendered inert to indicate to the A

operator that the called subscriber has responded. Similarly, the spring 57 closes upon its forward contact the circuit of the locking-relay  $r^{11}$ , which is completed from the battery-lead 40 through the said relay, conductor 56, forward contact, and spring 57, conductor  $57^a$ , conductor  $55^a$ , and spring 51 to ground. The locking-relay is therefore actuated and opens the circuit of the ringing-lamp  $S^4$  and thereby extinguishing the same and indicating to the B operator also that the called subscriber has responded. The path for current through relay  $r^{11}$  is now also completed through its spring and forward contact, whereby although the tip-relay  $r^8$  is de-energized when the called subscriber hangs up his telephone the said locking-relay remains actuated and the ringing-lamp is prevented from operation during the connection.

During conversation the battery  $B'$  at the A office is furnishing current to the line L for transmission, while the battery  $B^3$  at the other office is furnishing current for the line  $L^2$  for transmission. At the termination of the conversation the subscribers return their receivers to the hooks, with the result that the supervisory signal  $S^2$  is directly operated at the A office, and the tip-relay  $r^8$  at the B office is deenergized and the resistance of relay  $r^7$  again introduced into the trunk-circuit, thereby deenergizing tip-relay  $r^4$  in the A cord and lighting the supervisory signal  $S^3$ . The A operator seeing the supervisory signals associated with her cord exposed takes down the connection and restores the parts at her office to normal position. The withdrawing of the cord-circuit at the outgoing end of the trunk deenergizes the trunk-relay at the incoming end, and since the tip-relay  $r^8$  has been already deenergized a path for current from the battery-lead 47 is provided through the disconnect-pilot relay  $r^{12}$  and signal  $S^5$  over conductor 53, spring, and back contact of trunk-relay  $r^7$ , conductor 52, back contact, and spring 57 of relay  $r^8$ , conductor  $57^a$ , conductor  $55^a$ , and spring 51 to ground. This disconnect-signal, as well as the pilot-signal  $S^6$ , is lighted, thus indicating to the B operator that the conversation has terminated, whereupon she withdraws the trunk-plug and restores all parts to normal condition.

In case it be desired to dispense with the order-circuit the A operator may test the condition of the trunks before her upon receiving an order for a connection and upon finding an idle one insert the calling-plug  $P^2$ . This operates the trunk-relay  $r^7$ , which closed through its forward contact, conductor 59, and spring 51 of relay  $r^{13}$  the local circuit of lamp  $S^5$ , which now serves as a calling-signal. In response to this signal the B operator connects her telephone with a cord-circuit by the listening-key  $k^6$  and receives the order from the A operator. The subsequent steps



of establishing and clearing out the connection is the same as previously stated and is unnecessary to be repeated here. It should be mentioned, however, that the insertion of the trunk-plug into the jack of the called line and the operation of the ringing-key serves to operate the auxiliary relay  $r^{13}$ , to thereby open the circuit of said calling-signal through its spring 51 and back contact; also, that the condenser  $c^8$  (shown in dotted lines) permits conversation between the operators without hindrance from the trunk-relay  $r^7$ .

Although the call-bell at the substation upon line  $L^2$  is legged to ground from the tip side, it will be understood that the plug may be used for metallic calling or that a party-line may be provided in which the call-bells are legged to ground from the opposite line conductors. This system is shown in my application, Serial No. 142,292, filed February 7, 1903, in which an auxiliary relay is shown in connection with a cord-circuit adapted for directly connecting lines together for conversation. This calling-signal of course operates as a guard-signal when the order-circuit is used for communicating between the operators in making connections, for the reason that should the order be misunderstood by the A operator and the cord-circuit connected by her with an idle trunk the said signal will be operated to notify the B operator that an error had been made. Likewise inserting the plug of the wrong trunk in the jack of the called subscriber by the B operator results in operating said guard-signal to again notify the B operator that a mistake has been made. The said signal  $S^5$  therefore acts as a guard-signal under this method of establishing connections between subscribers at the different exchanges.

I claim—

1. The combination with a trunk-line, of a cord-circuit to connect with its outgoing end and a called-subscriber's line to connect with its incoming end, a retardation-coil legged to ground from one side of the talking-circuit established by the connection of the cord with the trunk, a supervisory signal associated with the cord-circuit and placed in operative condition when the cord is connected with the trunk, a trunk-relay at the other end of the trunk actuated when the cord is first connected with the trunk by current over one side of the same with suitable return, a trunk-signal actuated by the energization of said relay, a second relay associated with the incoming end of the trunk, said relay being actuated by current flowing over a local circuit closed by the ringing-key when the operator is calling the wanted subscriber, said second relay when operated being adapted to extinguish said trunk-signal, a locking-circuit for said latter relay, and a third relay energized during connection of the trunk and line to control said locking-circuit, and

means under the control of the called subscriber for extinguishing said supervisory signal, substantially as described.

2. The combination with a trunk-line, of a cord-circuit to connect with its outgoing end and a called-subscriber's line with which its incoming end is connected, a ringing-signal for the incoming end of the trunk, a source of current at said end to actuate said signal and to energize the transmitter of the called-subscriber's line, a relay actuated over a local circuit closed by the actuation of the ringing-key when the operator is calling the wanted subscriber, said relay serving to direct current through said signal to operate the same when the subscriber has been called but before his response, a second relay adapted to deprive said relay of operating-current when the subscriber responds, and a locking-relay for locking out said signal during the remainder of the connection, substantially as described.

3. The combination with a trunk-line, of a cord-circuit to connect with its outgoing end and a called-subscribers's line with which its incoming end is connected, a disconnect-signal for said incoming end, a source of current for said signal and adapted to energize the transmitter of the called-subscriber's line, means operated by current flowing over a local circuit closed by the ringing-key when the operator is calling the wanted subscriber, to place said signal in condition to operate, and further means controlled by the connection of said cord-circuit with the trunk for rendering said signal inoperative, substantially as described.

4. The combination with a trunk-line, of a cord-circuit to connect with its outgoing end and a called-subscriber's line with which its incoming end is adapted to connect, a signal associated with said incoming end, a source of current for said signal and adapted to energize the transmitter of the called-subscriber's line, a relay also at the incoming end adapted to be operated by current sent over the trunk-circuit, a second relay at said incoming end operated by current flowing over a local circuit independent of the connecting-plug and closed by the operation of the ringing-key in calling the wanted subscriber, said relays jointly controlling said signal so as to operate the same to give a guard indication when the cord-circuit is connected with the trunk-circuit and the trunk-circuit is disconnected from said line, or to place said signal in condition to operate so as to give a disconnect indication when the cord-circuit is disconnected from the trunk and the trunk is connected with said line, substantially as described.

5. The combination with a trunk-line, of a cord-circuit to connect with its outgoing end and a called-subscriber's line with which its incoming end is adapted to connect, a guard-



signal for the incoming end of the trunk, means to actuate said signal by current sent over the trunk when the cord-circuit is connected with the trunk, and further means  
5 actuated by current over a local circuit independent of the connecting-plug and closed when a called subscriber is rung for rendering said signal inert, substantially as described.

6. The combination with a trunk-line and  
10 a called-subscriber's line, of a relay associated with said trunk-line and adapted to be operated over a local circuit independent of the connecting-plug and closed by the operator in ringing the called subscriber, a second relay adapted to open said local circuit, a testing-circuit completed over one strand of the trunk cord-circuit and including the normal contacts of said relay, an operator's telephone-circuit connected with said testing-circuit and provided with order-wire leads  
20 whereby the operator may receive a test-signal without the use of a manual switch, and whereby the testing-circuit is disconnected by the ringing of the called subscriber, substantially as described.

7. The combination with a trunk-line, of a cord-circuit to connect with its outgoing end and a called-subscriber's line with which its incoming end is to connect, of signaling apparatus associated with the incoming end of the trunk, a relay actuated over a local circuit independent of the connecting-plug and closed in ringing the wanted subscriber, a second relay adapted to open said local circuit, a testing-circuit completed through the normal contacts of said relay, and means for placing said signaling apparatus in condition to operate and for disconnecting the testing-circuit when the said relay is actuated, substantially as described.

8. The combination with a telephone trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of two signals associated with the incoming end of said trunk-circuit and adapted by their condition to impart information to facilitate the utility of the trunk-circuit, a source of direct current associated with the  
50 trunk-circuit, a relay associated with said source and controlling contacts in the circuit of each of said signals, the circuit of said relay

being first controlled by means independent of the talking-circuit and thereafter by current flowing over a portion of the talking-circuit, substantially as described. 55

9. The combination with a trunk-circuit, of a cord-circuit adapted to be connected therewith at its outgoing end, and a telephone-line with which the incoming end is adapted to connect, a signal associated with the incoming end of the trunk, a relay to control the circuit of said signal energized by the actuation of the ringing-key in calling the wanted subscriber, a second relay actuated  
60 when the connection is established with the called telephone-line to place said first relay in condition to actuate, a third relay actuated upon the response of the calling subscriber to efface said signal, locking-circuits for said first and third relays, and contacts of said second relay controlling said locking-circuits, whereby the relays will all be deenergized when the trunk is removed from its connection with the line, substantially as described. 75

10. In a telephone system, the combination with a trunk-line, of a cord-circuit adapted to be connected with said line at its outgoing end, and a telephone-line with which the incoming end of said trunk may be connected, a signal for the incoming end of the trunk, a relay actuated over a local circuit including contacts of the ringing-key to display said signal, and a relay actuated over  
80 a portion of the talking-circuit when the connection is established with the called line to place said first relay in condition to operate, a third relay actuated when the called subscriber answers his call to efface said signal, a locking-circuit for said first and third relays, the locking-circuit of the third relay being controlled by contacts of said first relay, and the locking-circuit of said first relay being controlled by contacts of said second relay, substantially as described. 95

Signed by me at Chicago, county of Cook, State of Illinois, this 17th day of January, 1903.

WILLIAM W. DEAN.

Witnesses:

ROBERT LEWIS AMES,  
GAZELLE BEDER.