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H. G. WEBSTER.
TELEPHONE TRUNKING SYSTEM.

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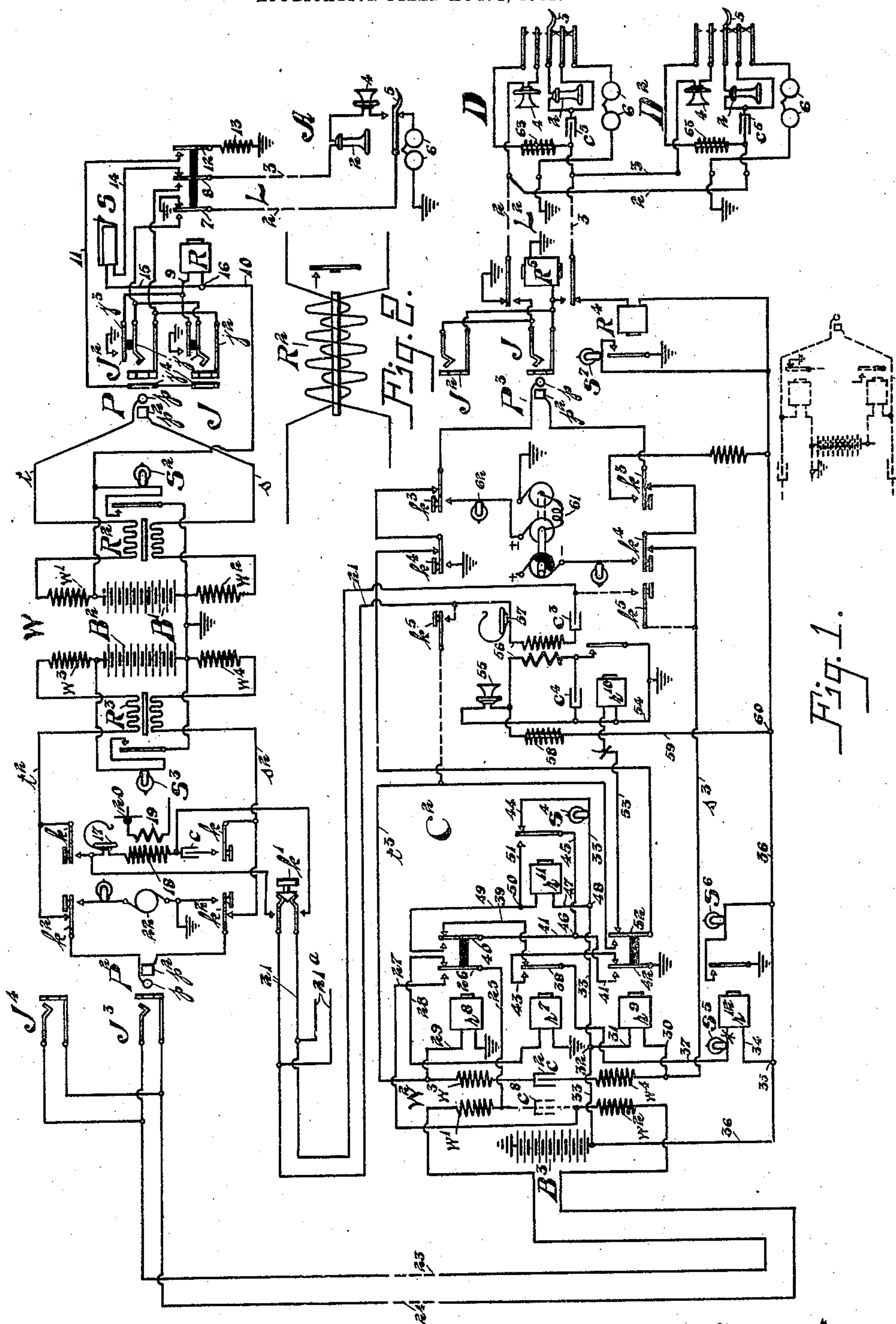


Fig. 1.

Witnesses.
R. H. Burfield
Gazelle Beder.

Inventor:-
Harry G. Webster,
by Robert Lewis Ames,
Attorney.

UNITED STATES PATENT OFFICE.

HARRY G. WEBSTER, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE TRUNKING SYSTEM.

No. 847,385.

Specification of Letters Patent.

Patented March 19, 1907.

Application filed August 1, 1902. Serial No. 117,920.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented a certain new and useful Improvement in Telephone Trunking Systems, of which the following is a specification.

My invention relates to improvements in telephone trunking systems, my object being to provide a system of the kind specified in which the operations of connecting and disconnecting telephone-lines which terminate at different switchboards or switchboard-sections may be conveniently and expeditiously performed.

In an application filed by Francis W. Dunbar August 25, 1902, Serial No. 120,878, a trunking system is shown and described in which the subscribers' lines terminating at the A office are of the "three" or "four" wire type and those terminating at the B office are of the "Dunbar" or "two-wire" type. The operator's connecting apparatus at the A office is provided with a repeating-coil, the middle point of the windings of which is connected through a supervisory relay and battery to ground. The trunk-circuit is provided at the incoming end with a trunk-relay legged to ground through the normal contacts of a second relay responsive to current in the line when a called subscriber responds, said trunk-relay being actuated by current from the battery associated with the connecting or calling ends of the A cord-circuit.

This invention relates to a similar trunking system in which lines of the three or four wire type terminate at the A office and lines of the Dunbar or two-wire type terminate at the incoming office. The A cord-circuit, however, is provided with batteries bridged across each end, one pole of which is grounded, and the trunk-relay at the incoming end of the trunk is normally legged to ground from the tip side of the trunk, the metallic circuit of the trunk being at the same time open and a relay responsive to current in the line when the called subscriber answers to disconnect said trunk-relay during conversation and to complete the metallic circuit of the outgoing end of the trunk.

The invention further comprises other features of novelty, hereinafter described, and

particularly pointed out in the appended claims, reference being had to the accompanying drawing, in which the same reference characters designate like parts throughout the several views, and in which—

Figure 1 is a diagram showing the types of lines terminating at both offices, the operator's connective circuits at the A office, and the trunk-circuit extending between the two offices; and Fig. 2 represents a detail of the winding of the supervisory relays used in the A cord-circuit.

The subscriber's line L, terminating at the A office, is provided at the substation with the usual common-battery talking instruments, including a receiver 2 and a transmitter 4 in series between the limbs of the telephone-line when the receiver is removed from the hook-switch 5, the latter serving when the receiver is placed thereon to connect the tip side of the line with the grounded signaling-bell 6. The line extends in two limbs 2 and 3 to the central office, where it is provided with multiple connecting-jacks J and J², with a cut-off relay R, and with a line signaling device S. The jacks each have tip and sleeve springs *j* and *j*², connected together and to the forward contacts of springs 7 and 8 of the cut-off relay R. A third contact *j*³ of each of the jacks is adapted when a plug is inserted in the jack to ground the conductor 9, leading to one side of the cut-off relay R, the other side of which is connected by conductor 10 with the live pole of battery B', associated with the cord-circuit. The jacks are also provided with test-terminals *j*⁴, insulated from the line conductors at all times, even during conversation, which are connected by a conductor 11 with the forward contact of spring 12 of the cut-off relay R, the said spring being grounded through a resistance 13. The normal contact and spring 8 of the cut-off relay R leads by way of conductor 14 to one terminal of the line-signal S, which may be in the form of a drop, the other terminal of which is connected by wire 15 with the point 16 upon the conductor 10, leading to the live pole of the battery B'.

The cord-circuit at the A office is provided with an answering-plug P, provided with tip and sleeve contacts *p* and *p*², the former of which is connected with the tip-strand *t* of

the cord-circuit and the latter with the sleeve-strand s , these strands each including a winding of the differential supervisory relay R^2 and being connected together through the windings w' and w^2 of the repeating-coil W and the common battery B' . The calling-plug P^2 of the cord-circuit is likewise provided with tip and sleeve contacts connected, respectively, with the tip and sleeve contacts t^2 and s^2 of the cord-circuit, which likewise include the differential windings of the supervisory relay R^3 and are connected together by the windings w^3 and w^4 of the repeating-coil W and the battery B^2 . The windings w' and w^3 of the repeating-coil W , as well as windings w^2 and w^4 , are in inductive relation to each other and serve to transmit voice-currents from one path of the cord-circuit to the other. The supervisory relay R^2 controls, as shown, the supervisory signal S^2 in the form of an incandescent lamp, a similar supervisory signal S^3 being provided for the other half of the cord-circuit and controlled by the relay R^3 . The operator's receiver 17, the secondary 18 of her induction-coil, and the condenser c are arranged to be bridged between the strands t^2 and s^2 of the cord-circuit by means of the listening-key k . The primary 19 and the transmitter 20 of her apparatus may be charged in any desired manner, as by a local battery or from one of the main batteries B' or B^2 . She is also provided with a key k' , by means of which her instrument may be connected with the order wire or circuit 21, leading to the B office. A calling-generator 22 may be connected between ground and the tip-strand of the cord-circuit and by means of the tip-contact of the ringing-key k^2 the sleeve-contact of said key serving to connect the sleeve-strand of the cord-circuit to ground.

The trunk-circuit extending between the two offices is provided at the outgoing end with jacks J^3 and J^4 , each having tip and sleeve contacts in the usual manner. This circuit extends in two limbs 23 and 24 to the central office C^2 , where they terminate in windings w' and w^2 of the repeating-coil W^2 . The tip-conductor 23 is connected through the medium of a conductor 25 with the spring 26 of the tip-relay r^8 , associated with the incoming end of the trunk, the forward contact of which is joined by a conductor 27 with the sleeve-limb 24 of the trunk-line. The normal contact of the spring 26 of relay r^8 is connected by a conductor 28 to one terminal of the trunk-relay r^7 , the other terminal of which is grounded. The tip and sleeve strands t^3 and s^3 of the trunk-cord terminate in contact-surfaces p and p^2 of the plug P^3 and are connected together by the windings w^3 and w^4 of the repeating-coil W^2 and an interposed condenser c^2 . The relay r^8 is legged to ground from the tip-strand t^3 of the trunk-cord by means of a conductor 29. A sleeve-

relay r^9 is connected on one side by wire 30 with the sleeve-strand of the trunk-cord and on the other side by wire 31, leading to point 32 upon the battery-lead 33, connected with the live pole of the battery B^3 . The disconnect or guard signal S^5 is connected in series with the pilot-relay r^{12} , which is connected on one side by conductor 35 to point 34 upon the battery-lead 36. The other terminal of the said signal is connected by way of conductor 35 with the armature 38 of the trunk-relay r^7 , the back contact of which is connected by conductor 39 to the back contact of spring 40 of the tip-relay r^8 , said spring being joined by conductor 41 with the forward contact of grounded spring 42 of sleeve-relay r^9 . The forward contact of the trunk-relay is joined by wire 43 with the back contact of spring 42 of relay r^9 .

A ringing-lamp S^4 is provided for the incoming end of the trunk, said lamp being connected on one side by conductor 33 from the live pole of the battery B^3 and on the other side by conductor 44 with the back contact of the armature of a locking-relay r^{11} and thence by way of conductor 45 with the point 46 upon the conductor 41. The locking-relay r^{11} is connected on one side by conductor 47, leading to point 48 upon the battery-lead 33, and upon the other side by conductor 49 with the forward contact of spring 40 of tip-relay r^8 . The locking-circuit for the said relay extends between point 50 upon the conductor 49 by way of conductor 51 to the forward contact of the said relay.

In order to suitably test a subscriber's line the test-terminals of which are directly connected with one side of the talking-circuit, the forward portion of the tip-strand of the trunk-cord is connected with the spring 52 of the sleeve-relay r^9 , which serves when the said relay is actuated to complete the strand for talking purposes, but normally to complete a testing-circuit from said spring 52 over conductor 53 to the test-relay r^{10} , the other pole of which is grounded by conductor 54. The armature of said test-relay closes upon its forward contact a shunt of the operator's transmitter 55, which causes a flow of current through the primary of her induction-coil 56 to thereby cause a click in her receiver 57, the latter being connected together with the secondary of her induction-coil and the condenser c^3 in series in the order-circuit 21. A condenser c^4 is included in the operator's transmitter-circuit, as well as the retardation-coil 58, which is connected by a conductor 59 with the point 60 upon the battery-lead 36. The trunk-cord is provided with means for selectively calling the subscribers, said means including a generator 61, adapted to be connected by the tip-contact of key k^3 through resistance-lamp 62 with the tip-strand of the cord-circuit and the tip side of the line, the sleeve-contact of said key k^3

serving at the same time to close battery upon the sleeve-strand of the trunk-cord. By means of the sleeve-contact k^4 of the ringing-key the generator is connected between the ground and the sleeve-strand of the cord-circuit to direct pulsating current over the sleeve side of the line, the corresponding tip-spring serving at the same time to ground the tip side of the line. The line-circuit shown at this office is of the Dunbar or two-wire party-line type and is furnished at the central office with the line-signal S^7 actuated by line-relay R^4 and a cut-off relay R^5 , legged to ground from the sleeve side of the talking-circuit, the multiple jacks J and J^2 being normally disconnected from the line by said cut-off relay. The line-limbs 2 and 3 extend to the substations and are connected together when the receiver 2 is off the hook-switch 5 through the transmitter 4 and a retardation-coil 63, the bell 6 and a condenser c^5 being connected to ground from the proper side of the line when the receiver is placed upon the hook.

The subscriber upon the line L takes up his receiver to call the central office, and thereby closes a circuit from the battery B' through the line-signal S , actuating the same and attracting the operator's attention, who inserts the answering-plug P of her cord-circuit in a jack of the line. The insertion of the plug actuates the cut-off relay R , causing it to disconnect the limb 2 from the ground and the limb 3 from the signaling device S and to connect, through their forward contacts, with the tip and sleeve contacts, respectively, of the jacks. At the same time the test-rings j^4 of the jacks are connected through ground to the spring 12 of the cut-off relay. Current now flows over the metallic circuit of the connecting end of the cord and the subscriber's line and through both coils of the differential supervisory relay R^2 , which is so arranged as to not actuate its armature under these conditions, whereby the supervisory signal S^2 remains inert. The supervisory signal is wound as shown more clearly in Fig. 2, in which the windings are shown superposed, whereby the effects of the rapidly-alternating voice-currents are completely neutralized and transmission thereof is not affected. The operator after connecting her telephone to the cord-circuit and ascertaining the number of the wanted subscriber depresses the key k' and communicates with the operator at the B exchange, who nominates the trunk to be used and at the same time tests the condition of the wanted line and if found idle inserts the plug of the trunk.

In case the subscriber's line has been connected with at some other section, as by means of a trunk-cord of the type shown, it will be seen that the sleeve side of the line is connected by means of the live pole of the

battery. The cord-circuit intended to be used with lines of this type is arranged as shown in dotted lines, in which the live pole of a battery is connected with the sleeve-strand, so that under all conditions of use the sleeve side of the line-circuit is connected with live battery. When, therefore, the line is tested by means of the trunk-plug, a complete circuit is established over the forward portion of the tip-strand and through the test-relay r^{10} to ground. This relay being of high resistance and impedance, current upon the line is not varied to such an extent as to disturb the connected subscribers.

In case the line is found idle the plug is inserted, which actuates the sleeve-relay r^9 by current from battery B^3 over conductor 33 to point 32, thence by conductor 31 through the relay r^9 , conductor 30, and over the sleeve-strand s^3 of the trunk-cord and through the cut-off relay r^5 of the subscriber's line to ground. The cut-off relay is thus actuated to render the signaling device inoperative and to connect the jacks with the limbs of the line. At the same time the sleeve-relay r^9 is energized and closes a circuit of the ringing-lamp S^4 from the live pole of the battery B^3 over conductor 33 through the lamp S^4 , conductor 44, back contact and armature of locking-relay r^{11} , conductor 45 and 46, and thence over conductor 41 and spring 42 of relay r^9 to ground. This lamp is therefore lighted and indicates to the B operator that the called subscriber has not responded. As soon as the A operator is notified as to the trunk to be used she inserts the plug P^2 of her cord-circuit in the jack of the trunk at her section, this occurring at substantially the same time that the trunk-plug P^3 is connected with the called line. A path for current is provided from the battery B^2 of the A cord over the tip-strand of the cord-circuit through one winding of the supervisory relay R^3 , tip-conductor 23 of the trunk, through winding w' of the repeating-coil W^2 , and over conductor 25, spring 26 of relay r^8 , and conductor 28 to the trunk-relay r^7 and ground. The supervisory relay R^3 is therefore actuated and closes the circuit of supervisory signal S^3 to indicate to the A operator that the called subscriber has not yet responded. A trunk-relay at the same time opens the circuit of the disconnecting-lamp S^5 , and thereby prevents its operation.

In calling the wanted subscriber the B operator depresses the contacts $k^3 k^3$ of the ringing key or contacts $k^4 k^4$ thereof to connect the generator 61 with the proper line conductor, to thereby actuate the grounded call-bell. When the called subscriber removes his receiver from the hook in answer to his call, a path for current from the battery B^3 is provided over the metallic circuit of the line and through the tip-relay r^8 , thus actu-

ating the relay and causing it to disconnect the trunk-relay r^7 and at the same time completing a circuit between the tip and sleeve conductors of the outgoing end of the trunk, whereby current from the battery B^2 of the A cord-circuit flows over the metallic circuit of the outgoing end of the trunk and through both windings of the differential supervisory relay R^3 , to thereby render the supervisory signal S^3 inert and to indicate to the operator that the called subscriber has responded. Spring 40 of tip-relay r^8 at the incoming office initially closes the circuit of the locking-relay r^{11} from the live pole of battery B^3 over conductor 33 to point 48, conductor 47, relay r^{11} , conductor 49, forward contact and spring 40 of tip-relay r^8 , conductor 41, forward contact and spring 42 of the sleeve-relay r^9 to ground. This actuates the locking-relay r^{11} to open the circuit of the ringing-lamp S^4 and to close this latter path from point 50 upon the conductor 49, over conductor 51, the forward contact and armature of the relay, and thence over conductors 45 and 41 to the grounded spring 42 of relay r^9 . This lamp is therefore prevented from operation during the remainder of the connection or until the plug P is taken down and the sleeve-relay r^9 deenergized.

The subscribers are now in communication, the battery B' furnishing current to the line L for talking purposes as well as for the operation of the several relays, and the battery B^3 sending current to the called line for talking and for the operation of the relays associated with the incoming end of the trunk. At the termination of the conversation the subscriber upon line L returns his receiver to the hook, and thereby completes a path from the live pole of the battery B' over the tip-strand of the trunk-cord, through one winding only of the differential supervisory relay R^3 , and over the tip-conductor of the subscriber's line to ground. The supervisory signal S^3 is therefore operated. The called subscriber in hanging up his receiver breaks a path for current over the metallic circuit and through the tip-relay r^8 , thereby opening the metallic circuit of the outgoing end of the trunk and completing a path to ground over the tip side and through the trunk-relay r^7 , whereby the supervisory relay R^3 is actuated to operate the signal S^3 . The A operator upon observing both signals lighted withdraws the cord-plugs and takes down the connection, with the result that the trunk-relay r^7 is deenergized, thus closing the circuit of the disconnect-lamps S^5 and the pilot-relay r^{12} , the latter serving to operate the pilot-signal S^6 . This circuit may be traced from the live pole of the battery B^3 over conductors 36 and 34, pilot-relay r^{12} , disconnect-signal S^5 , conductor 37, spring 38 and back contact of trunk-relay r^7 , conductor 39, back contact and spring 40 of tip-relay r^8 , conductor 41,

the forward contact and grounded spring 42 of sleeve-relay r^9 . The disconnect-signal indicates to the B operator the termination of the conversation, when the trunk-plug is taken down and all parts restored to normal position. The signal S^5 serves also as a guard-signal in case connection is established at the outgoing end with the wrong trunk, the path for current through the signal S^5 being in such case over conductor 36 to point 35, conductor 34, pilot-relay r^{12} , guard-signal S^5 , conductor 37, spring 38, and forward contact of trunk-relay r^7 , conductor 43, back contact and grounded spring 42 of the relay r^9 . The order-circuit 21, as is indicated by the branching lines 21^a, connects the B operator with several A operators either at the same or at different exchanges. The A operator is also provided with a plurality of keys k^2 to connect herself with the different B operators. The test-relay and the pilot-relay are of course common to a plurality of circuits.

Although I have described the method of making connections through the medium of the order-circuit, I do not wish to so confine the invention for it is apparent that the A operator is able to test the condition of the several trunks before her until an idle trunk is found, and upon so finding a trunk she may insert the calling-plug P^2 of her cord-circuit in a jack of the trunk, with the result that the trunk-relay r^7 operates and lights the lamp S^5 , which in this method of connection constitutes a call-lamp. The B operator upon seeing the calling-lamp lighted depresses her listening-key k^5 k^5 , to connect her receiver-circuit with the trunk-cord, whereby she is enabled to communicate with the A operator. The presence of the condenser c^8 , (shown in dotted lines between the windings w' and w^2 of the repeating-coil W^2), permits conversation between the operators at this time. Upon learning the desired connection the B operator completes the same, as before described. It will also be understood that had the subscriber A called for a connection with another subscriber in the same exchange the line of that subscriber would have been tested in the ordinary manner by means of the cord-plug P^2 and the subscriber would have been called by the ringing-generator g .

The ground connections at each central office heretofore referred to, it will be understood, may be and in practice usually are, one and the same, or they may be the common office return.

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

1. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end of the trunk

placed in condition to operate by current over the tip side only of the trunk when connection is established at said end, and a relay at the incoming end of the trunk responsive to current in the line when the called party answers, said relay adapted when actuated to disconnect the trunk-relay from the trunk and to permit a flow of current over both sides of the trunk to thereby render said signal inoperative, substantially as described.

2. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end of the trunk placed in condition to operate by current over the tip side of the trunk and ground, the metallic circuit of the trunk being open, and a relay at the incoming end of the trunk responsive to current in the line when the called subscriber answers, said relay serving to disconnect the ground from the trunk and to complete the metallic circuit thereof and thereby permit a flow of current over both sides of the trunk to render said supervisory signal inoperative, substantially as described.

3. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signaling device associated with the outgoing end of the trunk having two differential windings placed in opposite sides of the talking-circuit, means for including one of said windings and the source of current in a circuit over the tip side of the trunk and ground when a connection exists at the outgoing end, and a relay at the incoming end responsive to current in the line when the called party answers to disconnect the ground at said end and complete the metallic circuit of the trunk to permit a flow of current over both sides of the trunk and through the other winding also of the differential supervisory signaling device whereby the signal is rendered inert, substantially as described.

4. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a relay at the incoming end actuated over a portion of the talking-circuit when a connection is established with the called line, a trunk-relay at said end actuated by current over the tip side only of the outgoing end of the trunk when the connection is established at the outgoing end, a relay at the incoming end responsive to current in the line when the called subscriber responds, said relay being adapted when ac-

tuated to disconnect the trunk-relay, and a signal at said end whose actuation depends upon said relays, substantially as described.

5. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a guard-signal at the incoming end of the trunk, a relay actuated over the tip side only of the outgoing end of the trunk-circuit when a connection is established at said end to place said signal in condition to operate, and a second relay at the incoming end actuated by current over a portion of the talking-circuit when a connection is established at the called line to render said signal inoperative, substantially as described. 60

6. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a signal at the incoming end, a relay actuated over a portion of the talking-circuit when connection is established with the called line and a trunk-relay actuated over the tip side only of said end of the trunk when connection is established at the outgoing end and when the called subscriber's telephone is not in use, said relay serving to control said signal so that a guard indication is given when the trunk-relay is energized and the first-named relay is deenergized and a disconnect indication is given when the first-named relay is energized and the other relay is deenergized and the called subscriber has returned his receiver to its hook, substantially as described. 75

7. The combination with a trunk-circuit extending between different switchboard-sections, of a signal at the incoming end thereof displayed when connection is made with a called line, of a trunk-relay at said incoming end operated by current over one limb only of the trunk when a connection is established at the outgoing end of said trunk to render said signal inoperative, a supervisory signal associated with the outgoing end thereof placed in condition to operate by current over the tip side of the trunk and through said trunk-relay, and means operated when the called subscriber responds to disconnect said trunk-relay from the trunk and to render the latter signal inoperative, substantially as described. 80 95 100 105

Signed by me at Chicago, county of Cook, State of Illinois, this 28th day of July, 1902.

HARRY G. WEBSTER.

Witnesses:

ROBERT LEWIS AMES.

F. W. DUNBAR.