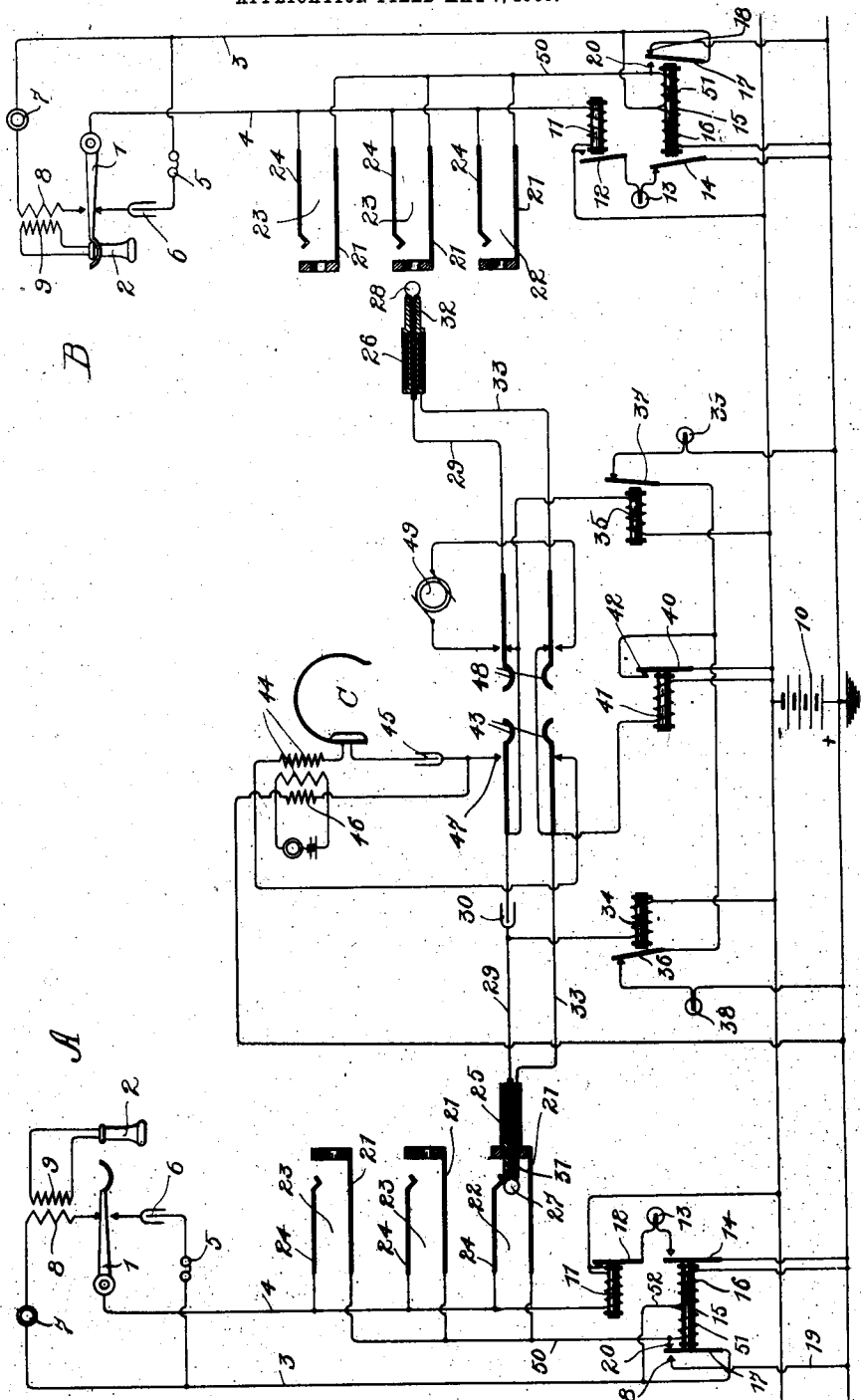


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H. G. WEBSTER.
TELEPHONE EXCHANGE SYSTEM.

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Witnesses,

Samuel W. Alexander
Harvey L. Hanson.

Inventor

Harry G. Webster.

By

Charles A. Brown
Attorney

UNITED STATES PATENT OFFICE.

HARRY G. WEBSTER, OF CHICAGO, ILLINOIS, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

No. 835,047.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, 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-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to telephone-exchange systems, and is particularly well adapted for use in conjunction with systems employing a multiple switchboard at the central exchange and a common source of current located at the central exchange adapted to supply both signaling and talking currents to the telephone-lines leading to subscribers' substations.

The principal objects of my invention are to provide a system employing what may be known as a "two-wire multiple circuit"—that is, a switchboard-circuit in which there are but two jack-contacts and but two wires or conductors led to each line-jack; to provide a system in which both of the jack-contacts are permanently connected with the telephone-line limbs, but in which the actuation of the cut-off relay is prevented by a normal short circuit of a cut-off-relay winding which is normally and preferably permanently connected in circuit with a telephone-line limb; and to provide a system in which the testing-contacts of the line-jacks are normally directly connected with the ground, whereby any inductive or static disturbances may not interfere with the proper operation the busy-test circuit employed.

Other objects of my invention will be at once apparent to those skilled in the art.

In general, my invention provides a system in which the telephone-line limbs are each connected with opposite terminals of the common source of current located at the central exchange. One of the line-limbs includes in its circuit the winding of a line-signal or line-relay. The other line-limb normally includes one winding of a cut-off relay, this winding, however, being normally short-circuited through a low-resistance shunt, this shunt being closed by the normal back contact of an armature of the cut-off relay. The insertion of the plug of an operator's

cord connecting circuit within a line-jack serves to close a circuit through a second cumulatively-wound winding of the cut-off relay, whereby the cut-off relay is actuated to cause the attraction of its armatures, the attraction of one of the armatures serving to destroy the control of the line-signal by the switching apparatus installed at the subscriber's substation, and the attraction of the other armature serving to break the continuity of the low-resistance circuit in shunt of the first winding of said cut-off-relay, and upon reaching its front contact to close a low-resistance shunt-circuit about the second winding of the cut-off relay, whereby the contacts of the line-jacks are both connected directly with the telephone-line limbs through circuits which are entirely non-inductive. Thus an entirely non-inductive path is afforded between the telephone-line jacks and the subscriber's substation. The necessary impedance to prevent the short-circuiting of voice-currents through the source of current or common battery at the central station is provided for one line-limb by the permanent inclusion of the line-signal, which may desirably take the form of a line-relay adapted to control a local circuit through a line-signal lamp, and for the other line-limb through the said first winding of the cut-off relay, it being remembered that upon the establishment of a connection between the cord connecting apparatus and the telephone-line the low-resistance and non-inductive circuit in shunt of this winding is opened, whereupon the battery-current must be supplied to the substation apparatus through a winding of the cut-off relay. Any suitable cord connecting apparatus may be employed, and any desirable busy-test circuit may be applied thereto. In connection with the test-circuit employed it may be noted that one terminal of the common battery at the central exchange is connected with the ground. One of the contacts of the line-jacks, which may also serve as the test-thimble for testing the condition of a line, is normally connected through a winding of the cut-off relay with the grounded terminal of the common battery. The grounded connection of the test-thimble prevents variations in the potential thereof, due to inductive or static disturbances, which in many systems of the prior art fre-

quently cause the false operation of the busy-test circuits employed.

My invention will be readily understood by reference to the accompanying drawing, diagrammatically illustrating a system constructed in accordance therewith.

At each of the substations A and B, I have illustrated the usual subscriber's substation apparatus, comprising a switch-hook 1, which when in its normal depressed condition, due to the weight of the receiver 2, serves to connect between the line-limbs 3 and 4 the call-bell 5 and the serially-connected condenser 6. When the receiver 2 is removed from the switch-hook 1, a conductively continuous circuit between the line-limbs is closed through the transmitter 7 and the primary 8 of an induction-coil whose secondary 9 is connected with the receiver 2. The line-limbs 3 and 4 lead to the central station, where they are connected each with a terminal of the common battery 10. The line-limb 4 permanently serially includes in its circuit the winding of a line-signal or line-relay 11, whose armature 12 when in its forward attracted position normally closes a local circuit through the line signaling-lamp 13, the continuity of this local circuit, however, being further controlled by the armature 14 of a cut-off relay 15, a winding 16 of which is normally included in the circuit between the line-limb 3 and the positive grounded terminal of the common battery 10. A second armature 17 of the cut-off relay 15 serves when in its normal retracted position to close a low-resistance shunt-circuit about the winding 16, whereby the line-limb 3 is normally directly connected with the positive grounded pole of the common battery 10 through a circuit including the armature 17, its back contact 18, and the conductor 19. When in its forward attracted position, the armature 17 and its front contact 20 serve to directly connect the line-limb 3 with the sleeve-contacts 21 21 of the answering-jack 22 and the line-calling jacks 23 23, the tip-contacts 24 24 of these jacks being preferably permanently connected with the line-limb 4, as shown.

The operators cord connecting apparatus for connecting one substation with another for conversation comprises an answering-plug 25 and a calling-plug 26, whose tip-contacts 27 and 28 may be connected by the tip-strand 29, whose conductive continuity is interrupted by the serially-connected condenser 30. The sleeve-contacts 31 and 32 are connected by means of a sleeve-strand 33. The supervisory relays 34 and 35 are each connected between the negative pole of the common battery 10 and the tip-strand 29, one on either side of the condenser 30. The armatures 36 and 37 of these supervisory relays serve when in their normal unattracted positions to respectively close a local illumi-

nating-circuit through the supervisory signaling-lamps 38 and 39, the circuit through these lamps, however, being further controlled by the armature 40 of a controlling-relay 41, which is connected between the negative pole of the battery 10 and the sleeve-strand 33. When in its forward attracted position, the armature 40, in conjunction with its front contact 42, serves to connect the negative pole of the common battery 10 with the armatures 36 and 37.

The usual listening-key 43 is provided, by means of a manipulation of which the operator may connect her telephone set 44, through a serially-connected condenser 45, into a bridged relation with the cord-circuit. A test-winding 46, inductively related to the induction-coil of the operator's telephone set, is connected between the contact 47 and the positive grounded pole of the common battery 10. The ringing-key 48 when manipulated in the manner well understood by those skilled in the art serves to connect the terminals of the alternating-current generator 49 with the cord-strands leading to the calling-plug 26.

The operation of my improved system may be described as follows: A subscriber at substation A, desiring a telephonic connection with some other subscriber, such as the subscriber located at substation B, removes his receiver 2 from its switch-hook 1, whereupon the switch-hook assumes the position shown in the drawing, thereby closing a conductively continuous circuit, which may be traced as follows: from the negative pole of the common battery 10 through the line-relay 11, the line-limb 4, switch-hook 1, primary winding 8, transmitter 7, line-limb 3, armature 17, contact 18, and conductor 19 to the positive grounded pole of the common battery 10. Current flowing through this circuit causes an actuation of the line-signal 11, whereby the attraction of the armature 12 serves to close a local circuit through the line-signaling lamp 13, thereby causing the illumination thereof to notify the operator that a connection with some other telephone-line is desired. In addition to the circuit traced from the line-limb 3 through the armature 17 and its back contact 18 to the positive pole of the battery there is also a circuit through the winding 16 of the cut-off relay 15; but this circuit is of comparatively high resistance, and sufficient current cannot be forced through this winding to cause the attraction of the cut-off-relay armatures 14 and 17. The operator at the central exchange answers the signal caused by the illumination of the lamp 13 by inserting the answering-plug 25 of her cord-circuit within the answering-jack 22. This causes the closure of a circuit which may be traced as follows: from the negative pole of the common battery 10 through the winding of the

supervisory controlling-relay 41, the sleeve-strand 33, the sleeve-contact 31, the sleeve-contact 21 of the jack 22, the conductor 50, the winding 51 of the cut-off relay, and
 5 thence through the conductor 52 and the armature 17 to back contact 18, and the conductor 19 to the positive pole of the battery 10. The consequent energization of the cut-off relay causes the attraction
 10 of the armatures 14 and 17. The attraction of the armature 17, however, from its back contact 18 serves to break the circuit just traced through the winding 51. However, the flow of current through this winding is maintained for a short interval through
 15 a circuit which may be traced through the winding 51, the winding 16, and thence to the positive pole of the battery 10. The armature 17 upon reaching its front contact 20 serves to close a low-resistance circuit in
 20 shunt of the winding 15, this low-resistance circuit being traced from the jack-contact 21 through the conductor 50, the contact 20, the armature 17, the conductor 52, and
 25 thence, as before, through the cut-off-relay winding 16 to the positive pole of the battery 10. This actuation of the cut-off relay serves, first, by the attraction of its armature
 30 14 to destroy the control of the line-signal by the hook-switch at the subscriber's substation; second, to break the continuity of the low-resistance circuit in shunt of the cut-off-relay winding 16, and, third, to connect
 35 a low-resistance circuit in shunt of the cut-off-relay winding 51, whereby the jack-contact 21 is connected through a non-inductive circuit directly with the line-limb 3. It will
 40 be seen that under normal conditions with the armature 17 in connection with its back contact 18 there is a grounded connection through the windings of the cut-off relay with the sleeve-contacts of the line-jacks.
 45 These contacts are thus normally maintained at the zero potential of the earth and are therefore free from inductive and static disturbances likely to affect the operation of the busy-test apparatus employed. The
 50 closure of the hereinbefore-traced circuits through the supervisory controlling-relay 41 causes the attraction of its armature 42, whereupon the illuminating-circuit for the
 55 supervisory signaling-lamps 38 and 39 is closed. The armature 37 is for the present not attracted by its relay-magnet, whereupon a circuit is closed through the supervisory signaling-lamp 39 to cause its illumination. The armature 36 of the supervisory
 60 relay 34, however, is attracted by the energization of the relay 34, the circuit through this relay being traced as follows: from the negative pole of the common battery 10 through the relay 34, the tip-strand 29, the
 65 tip-contact 27 of the answering-plug 25, the tip-contact 24, the line-limb 4, the switch-hook 1, the primary coil 8, the transmitter 7, the line-limb 3, and after the insertion of
 the plug 25 within the jack 22 through the conductor 52, the cut-off-relay winding 16, and thence back to the positive grounded pole of the common battery 10. The consequent attraction of the armature 36 prevents
 70 the illumination of the supervisory signaling-lamp 38. After thus establishing connection between her cord-circuit and the telephone-line to substation A the operator
 75 manipulates her listening-key 43 to connect her telephone set in bridge of the cord-circuit and by communication with the subscriber at substation A ascertains the number of the subscriber's substation with which
 80 communication is desired. Learning this to be substation B, the operator applies the tip-contact 28 of her calling-plug 26 to the sleeve-contact 21 of a line-jack 23, associated with the line to substation B. If
 85 this line is already in use and some other operator at some other position on the multiple switchboard has inserted the plug of a similar cord-circuit within any one of the line-jacks, the application of the test-contact 28
 90 to the sleeve-contact 21 of such a busy line will cause the closure of a circuit, which may be traced as follows: from the positive grounded pole of the battery 10 through the
 95 test-winding 46, the contact 47, the upper spring of the listening-key 43, the sleeve-strand 29, leading to the contact 28, the sleeve-contact 21, the sleeve-contact 32 of some other cord-circuit, the sleeve-strand 33 of the corresponding cord-circuit, and the
 100 corresponding supervisory controlling-relay 41 to the negative pole of the common battery 10. The momentary closure of such a circuit through the test-winding 46 causes a click in the operator's telephone-receiver,
 105 thereby indicating to her that the tested line is in use. If at the time of making the busy test the subscriber at substation B has removed his telephone-receiver from the switch-hook, but his line-signal has not as yet been
 110 answered by the insertion of a plug within the answering-jack, the test-circuit may be traced from the testing-tip contact 28 through the conductor 50, the winding 51 of the cut-off relay, line-limb 3, transmitter 7,
 115 primary coil 8, switch-hook 1, line-limb 4, and line-relay 11 to the negative pole of the common battery 10. This circuit, as well as that previously traced, will produce a click in the operator's telephone-receiver to give her
 120 the characteristic busy-test signal. If the line to substation B is not in use, no current will be caused to flow through the test-winding 46, for the reason that the test-contacts 21 of the line-jacks are normally connected with
 125 the grounded terminal of the common battery 10, with which the test-winding 46 is also connected. The fact that the test-contacts 21 of the line-jacks are thus provided with this normal ground connection prevents
 130

the false operation of the busy-test circuit due to inductive or static disturbances of the potential of the test-contacts of the line-jacks. The operator finding that the line to
 5 substation B is not in use inserts her calling-plug within a calling-jack 23 and manipulates her ringing-key 48 to connect the terminals of the generator 49 with the line-limbs lead-
 10 ing to the call-bell at substation B. The subscriber at substation B in answering the signal removes his receiver from the switch-hook 1, whereupon a conductively continuous circuit is closed between the line-limbs 3
 15 and 4, thereby causing the closure of a circuit through the supervisory relay 35, whereupon the armature 37 is attracted to cause the extinguishment of the lamp 39. The removal of the receiver at substation B from
 20 its switch-hook will not cause the illumination of the corresponding line signaling-lamp 13, due to the armature 12 of the line-relay 11, for the reason that the insertion of the calling-plug 26 within the line-jack 23 will
 25 have caused the actuation of the cut-off relay 15 by a circuit which may be traced through the relay-winding as follows: from the negative pole of the battery 10 through the supervisory controlling-relay 41, the sleeve-strand 33, leading to the sleeve-contact 32, the
 30 sleeve-contact 21 of the jack 23, the conductor 50, the winding 51 of the cut-off relay, and the winding 16 thereof to the positive pole of the battery 10. The flow of current through this circuit will cause the energization of the
 35 cut-off relay 15, whereupon its armatures 14 and 17 will be attracted, the attraction of the armature 14, as previously described, serving to destroy the substation control of the line-signal, and the attraction of the armature 17
 40 serving to break the continuity of the low-resistance shunt about the winding 16 and to close a low-resistance circuit in shunt of the winding 51 of the cut-off relay. The telephonic connection between the lines leading to
 45 substations A and B being thus established, the subscribers may converse with one another over a circuit containing but the single relay-contact between the armature 17 and the contact 20. Upon having finished the conversation
 50 either subscriber upon replacing his receiver upon the switch-hook breaks the continuity of the conductive circuit previously traced through the associated supervisory relay, whereupon the supervisory-relay arma-
 55 ture is retracted into its normal position, thus closing a circuit through the associated supervisory signaling-lamp to notify the central-station operator of the desired disconnection. The operator thereupon removes the cord-circuit plugs from the jacks, whereupon the
 60 cut-off-relay armatures are retracted into their normal position, thus restoring the apparatus to its normal condition

While I have herein shown and described
 65 one preferred embodiment of my invention,

it will be apparent to those skilled in the art that many modifications may be employed without departing from the spirit thereof. I do not, therefore, wish to limit myself to the precise disclosure herein set forth; but,

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

1. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with one of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

2. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy

the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

3. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

4. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

5. In a telephone-exchange system, the

combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay free from current-flow when the cord connecting apparatus is disconnected from the line, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

6. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

7. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an ex-

change, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

8. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay free from current-flow when the cord connecting apparatus is disconnected from the line, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

9. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said

line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

10. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

11. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially

included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay free from current-flow when the cord connecting apparatus is disconnected from the line, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

12. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

13. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently

serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay and to afford a non-inductive electrical path between said jack-contacts and the line-limbs.

14. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for affording a non-inductive electrical path between said jack-contacts and the line-limbs.

15. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the sec-

ond line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and to afford a non-inductive electrical path between said jack-contacts and the line-limbs.

16. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for affording a non-inductive electrical path between said jack-contacts and the line-limbs.

17. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance

path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for affording a non-inductive electrical path between said jack-contacts and the line-limbs.

18. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof, to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for affording a non-inductive electrical path between said jack-contacts and the line-limbs.

19. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-re-

sistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof, to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for affording a non-inductive electrical path between said jack-contacts and the line-limbs.

20. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof, to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for affording a non-inductive electrical path between said jack-contacts and the line-limbs.

21. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path

in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electric circuit through said second winding of the cut-off relay to cause an actuation thereof, to destroy the substation control of said line-signal and to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for affording a non-inductive electrical path between said jack-contacts and the line-limbs.

22. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding included in the second line-limb, a low-resistance path in shunt of said winding of said cut-off relay, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay free from current-flow when the cord connecting apparatus is disconnected from the line, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electrical circuit through the second winding of said cut-off relay to cause an actuation thereof to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

23. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding included in the second line-limb, a path in shunt of said winding of said cut-off relay, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay normally free from current-flow upon closure of the line at the substation, and means

whereby the connection of said cord connecting apparatus with said line causes the closure of an electrical circuit through the second winding of said cut-off relay to cause an actuation thereof to break the continuity of the path in shunt of said first winding of said cut-off relay.

24. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding included in the second line-limb, a path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay normally free from current-flow upon closure of the line at the substation, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electrical circuit through the second winding of said cut-off relay to cause an actuation thereof to break the continuity of the path in shunt of said first winding of said cut-off relay.

25. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding included in the second line-limb, a path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay free from current-flow when the cord connecting apparatus is disconnected from the line, and means whereby the connection of said cord connecting apparatus with said line causes the closure of an electrical circuit through the second winding of said cut-off relay to cause an actuation thereof to break the continuity of the path in shunt of said first winding of said cut-off relay.

26. In a telephone-exchange system, the

combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding included in the second line-limb, a path in shunt of said winding of said cut-off relay, a line-jack having a contact permanently connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electrical circuit through the second winding of said cut-off relay to cause an actuation thereof to break the continuity of the path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for closing a low-resistance non-inductive electrical path between said jack-contact and the second line-limb.

27. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding included in the second line-limb, a path in shunt of said winding of said cut-off relay, a line-jack having a contact connected with each of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, a second cumulative winding for said cut-off relay, means whereby the connection of said cord connecting apparatus with said line causes the closure of an electrical circuit through the second winding of said cut-off relay to cause an actuation thereof to break the continuity of the path in shunt of said first winding of said cut-off relay, and means upon actuation of said cut-off relay for closing a low-resistance non-inductive electrical path between said jack-contact and the second line-limb.

28. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the sub-

station adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact permanently directly connected to one of said line-limbs and a second contact permanently connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said line-signal and to open the circuit through the path in shunt of said first winding of said cut-off relay.

29. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact directly connected to one of said line-limbs and a second contact connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said line-signal and to open the circuit through the path in shunt of said first winding of said cut-off relay.

30. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an ex-

change, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact permanently directly connected to the line-limb including said line-relay and a second contact permanently connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said signal and to open the circuit through the path in shunt of said first winding of said cut-off relay.

31. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact directly connected to the line-limb including said line-relay and a second contact connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said line-signal and to open the circuit through the path in shunt of said first winding of said cut-off relay.

32. In a telephone-exchange system, the combination with a telephone-line extending

by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a relay having a winding permanently serially included in the first line-limb, a signal-circuit controlled by said relay, a normally closed low-resistance path in shunt of said winding of said relay to prevent actuation thereof upon actuation of switching apparatus at the substation, a line-jack having one contact permanently directly connected to the second of said line-limbs and a second contact permanently connected through a second cumulative winding of said relay with the first of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said relay to cause an actuation of said relay to open the circuit through the path in shunt of said first winding of said relay whereby said relay becomes actuated to change the condition of said signal-circuit.

33. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a relay having a winding serially included in the first line-limb, a signal-circuit controlled by said relay, a normally closed low-resistance path in shunt of said winding of said relay to thereby prevent actuation of said relay upon actuation of substation apparatus, a line-jack having one contact directly connected to the second of said line-limbs and a second contact connected through a second cumulative winding of said relay with the first of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said relay to cause an actuation of said relay to open the circuit through the path in shunt of said first winding of said relay whereby said relay becomes actuated to change the condition of the signal-circuit.

34. In a telephone-exchange system, the combination with a telephone-line extending

by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact permanently directly connected to one of said line-limbs and a second contact permanently connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, means whereby the insertion of a plug within said jack closes a circuit through said second jack-contact and the said second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said line-signal and to open the circuit through the path in shunt of said first winding of said cut-off relay, and means upon actuation of said relay for closing a low-resistance non-inductive electrical path between said second contact of said jack and said second line-limb.

35. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact directly connected to one of said line-limbs and a second contact connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said line-signal, to open the circuit through the path in shunt of said first winding of said cut-off relay, and to close a low-re-

sistance non-inductive electrical path between said second contact of said jack and said second line-limb.

36. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay permanently serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding permanently serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact permanently directly connected to said line-limb including said line-relay and a second contact permanently connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said line-signal and to open the circuit through the path in shunt of said first winding of said cut-off relay, and means upon actuation of said relay for closing a low-resistance non-inductive electrical path between said second contact of said jack and said second line-limb.

37. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a line-signal controlled by said line-relay, a cut-off relay having a winding serially included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, a line-jack having one contact directly connected to the line-limb including said line-relay and a second contact connected through a second cumulative winding of said cut-off relay with the other of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, and means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said

second winding of said cut-off relay to cause an actuation of said cut-off relay to destroy the substation control of said line-signal, to open the circuit through the path in shunt of said first winding of said cut-off relay, and to close a low-resistance non-inductive electrical path between said second contact of said jack and said second line-limb.

38. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a relay having a winding permanently serially included in the first line-limb, a normally closed low-resistance path in shunt of said winding of said relay, a line-jack having one contact permanently directly connected to the second of said line-limbs and a second contact permanently connected through a second cumulative winding of said relay with the first of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said relay to cause an actuation of said relay to open the circuit through the path in shunt of said first winding of said relay, and means upon actuation of said relay adapted to close a low-resistance non-inductive electrical path between said second contact of said jack and said first line-limb.

39. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to an opposite terminal of said source of current, a relay having a winding serially included in the first line-limb, a normally closed low-resistance path in shunt of said winding of said relay, a line-jack having one contact directly connected to the second of said line-limbs and a second contact connected through a second cumulative winding of said relay with the first of said line-limbs, cord connecting apparatus for connecting said line with another for conversation, means whereby the insertion of a plug of said cord connecting apparatus within said jack closes a circuit through said second jack-contact and the said second winding of said relay to cause an actuation of said cut-off relay to

open the circuit through the path in shunt of first winding of said relay, and means upon actuation of said relay adapted to close a low-resistance non-inductive electrical path between said second contact of said jack and said first line-limb.

40. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to a terminal of said source of current, a spring jack-contact normally connected indirectly with one line-limb, a relay having a winding included in one line-limb, a low-resistance path in shunt of said winding of said relay, cord connecting apparatus for connecting said line with another for conversation, and means whereby the connection of said cord connecting apparatus with said line causes an actuation of said relay to break the continuity of the low-resistance path in shunt of said winding of said relay and to directly connect said jack-contact with the line-limb.

41. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay serially included in one of said line-limbs, a cut-off relay having a winding included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, cord connecting apparatus for connecting said line with another for conversation, means whereby the connection of said cord connecting apparatus with said line causes an actuation of said cut-off relay to destroy the substation control of said line-signal, and means adapted upon actuation of said cut-off relay to break the continuity of the low-resistance path in shunt of said first winding of said cut-off relay.

42. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of an electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being permanently connected each to an opposite terminal of said source of current, a line-relay

serially included in one of said line-limbs, a cut-off relay having a winding included in the second line-limb, a normally closed low-resistance path in shunt of said winding of said cut-off relay, cord connecting apparatus for connecting said line with another for conversation, and means whereby the connection of said cord connecting apparatus with said line causes an actuation of said cut-off relay to destroy the substation control of said line-signal.

43. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of switching apparatus at the substation adapted to control the conductive continuity of electrical path between said line-limbs, a source of current at the exchange for supplying talking and signaling currents to said line, said line-limbs being connected each to a terminal of said source of current, a spring jack-contact normally connected indirectly with one line-limb, a relay having a winding included in said line-limb, a low-resistance path in shunt of said winding, cord connecting apparatus for connecting said line with another for conversation, and means upon the connection of said cord connecting apparatus with said line for causing actuation of said relay to break the continuity of the low-resistance path in shunt of said winding and to directly connect said jack-contact with the line-limb.

44. In a telephone-exchange system, the combination with a telephone-line extending from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling currents to the line, the line-limbs being connected each to a terminal of said source of current, a spring jack-contact normally connected indirectly with one line-limb, a relay having a winding permanently included in said line-limb, a low-resistance path in shunt of said winding, cord connecting apparatus at the central exchange, means whereby the connection of said cord connecting apparatus with said line causes actuation of said relay to break the continuity of the low-resistance path in shunt of said winding, and means upon actuation of said relay for causing said jack-contact to be connected directly with the line-limb.

45. In a telephone-exchange system, the combination with a telephone-line extending from a substation to an exchange, of a source of current at the exchange, the line-limbs being connected each to a terminal of said source, a relay having a winding included in one line-limb, a spring jack-contact connected indirectly with said line-limb through another winding of said relay, a second spring jack-contact directly connected with the other line-limb, a low-resistance path in shunt of the first relay-winding, cord connecting apparatus at the central exchange, means

whereby the connection of said cord connecting apparatus with said line causes actuation of said relay, means upon such actuation for causing the continuity of the low-resistance path in shunt of the first winding to be broken, and additional means upon actuation of said relay for causing said first spring jack-contact to be connected directly with the first line-limb.

46. In a telephone-exchange system the combination with a telephone-line extending from a central exchange to a substation, of a source of current at the central exchange to the terminals of which the line-limbs are normally connected, a relay having two windings, one of said windings only being normally included in circuit upon actuation of substation apparatus, a signal-circuit controlled by said relay, a short circuit normally about said winding to prevent actuation of said relay, cord connecting apparatus at the central exchange, and means adapted upon connection of said cord connecting apparatus with the line to cause said other winding to be included in circuit whereby said relay is actuated and the condition of the signal-circuit changed.

47. In a telephone-exchange system the combination with a telephone-line leading from a substation to a central exchange, of a source of current at the central exchange to the terminals of which the line-limbs are connected, cord connecting apparatus at the central exchange normally disconnected from the line, a relay at the central exchange having two windings, a signal-circuit controlled by said relay, means adapted upon actuation of substation apparatus for causing the inclusion in circuit of only one of said windings, means for normally maintaining a short-circuit path about said winding to prevent actuation of said relay, means adapted upon connection of the cord-circuit with the line to primarily cause current to flow through the second winding whereby said relay is actuated and the condition of the signal-circuit changed, and means adapted upon actuation of said relay for opening the short-circuit path through the first winding.

48. In a telephone-exchange system the combination with a telephone-line leading from a substation to a central exchange, of a source of current at the central exchange to

the terminals of which the line-limbs are connected, cord connecting apparatus at the central exchange normally disconnected from the line, a relay at the central exchange having two windings, means adapted upon actuation of substation apparatus for causing one of said windings only to be connected in circuit, a signal-circuit controlled by said relay, switching apparatus controlled by said relay and normally adapted to close a short-circuit path about said winding whereby said relay remains inactive and the signal-circuit unchanged, and means adapted upon connection of the cord-circuit with the line for causing current-flow through the second winding of the relay to cause actuation of the relay and of the switching mechanism whereby said short-circuit path about the first winding is opened and the condition of the signal-circuit changed.

49. In a telephone-exchange system, the combination with a telephone-line leading from a central exchange to a substation, of a source of current at the central exchange, to the terminals of which the line-limbs are connected, a cord-circuit at the central exchange normally disconnected from the line, a relay at the central exchange having two windings, means upon actuation of substation apparatus for causing the completion of a circuit through but one of said windings, means for normally closing a short-circuit path about said winding to render the relay inactive, a spring jack-contact normally indirectly connected with a line-limb through the other relay-winding, means upon connection of the cord-circuit with the line for causing current-flow through said second winding, whereby said relay becomes actuated, means upon actuation of said relay for opening the short-circuit path about the first winding, and means upon actuation of said relay for there-after closing a short-circuit path about the second winding whereby said spring jack-contact is directly connected with the line-limb.

In witness whereof I hereunto subscribe my name this 5th day of May, A. D. 1903.

HARRY G. WEBSTER.

Witnesses:

LYNN A. WILLIAMS,
HARVEY L. HANSON.