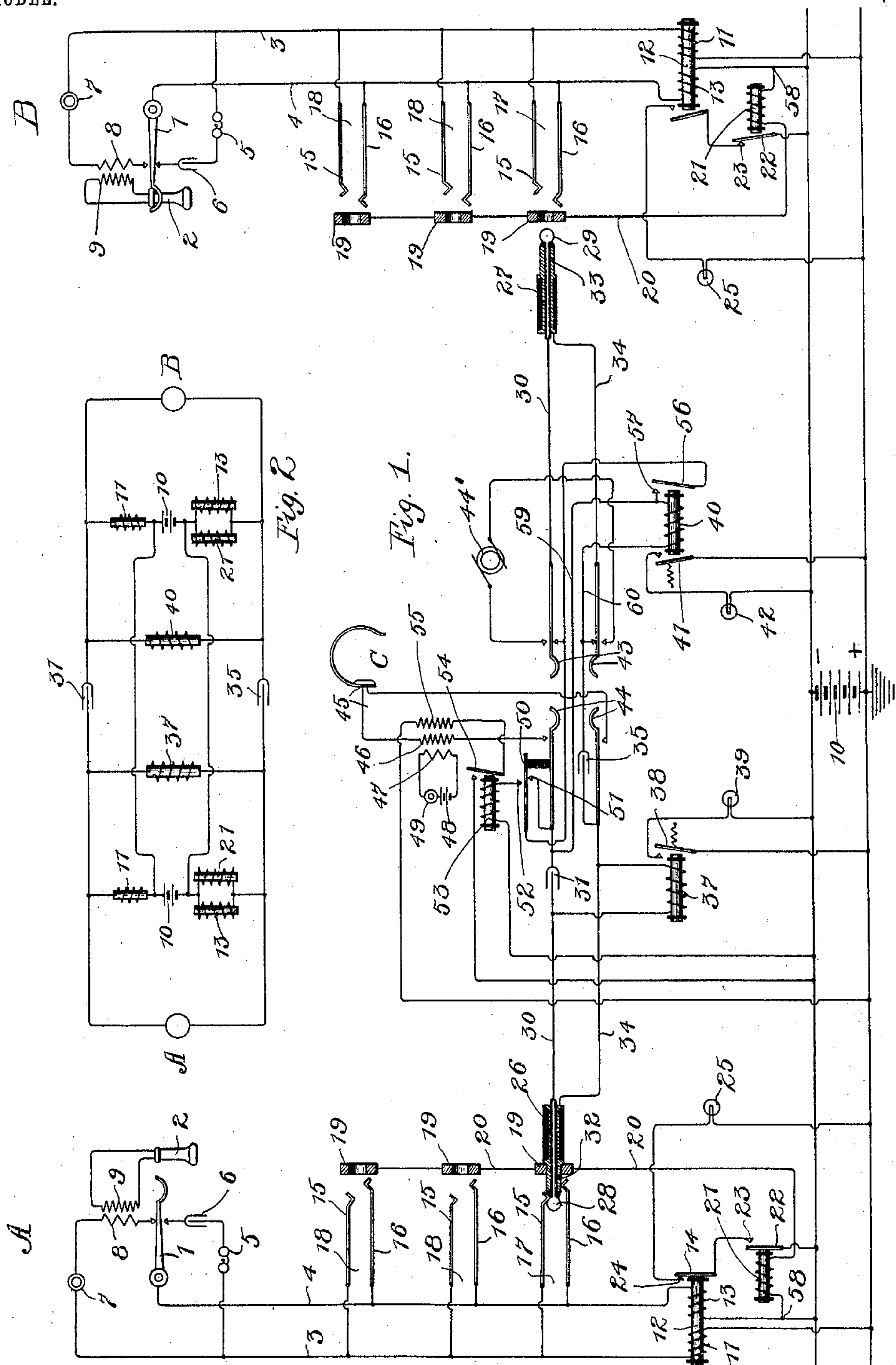


PATENTED SEPT. 20, 1904.

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NO MODEL.



Witnesses,

Witnesses,  
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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 770,269, dated September 20, 1904.

Application filed May 20, 1903. Serial No. 158,012. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM M. DAVIS, 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 drawings, forming a part of this specification.

My invention relates to telephone systems, and is particularly well adapted for use in conjunction with systems in which a common source of current at the central station is employed for the purpose of supplying signaling and talking currents to the substations associated therewith.

Central energy systems of the prior art have been more or less unsatisfactory in their operation, one of the principal objections to such systems being the clicks produced in the receiver at a substation during the connecting and switching operations at the central station. This clicking may be attributed largely to the momentary opening of the line-circuit during the manipulation of cord connecting apparatus employed for the purpose of connecting one line with another for conversation.

One of the principal objects of my present invention is to provide a system in which the supply of current to the substation apparatus whose receiver has been removed from its switch-hook shall not be interrupted or interfered with by switching operations taking place during the connection of one line with another.

My present invention provides a novel line-circuit adapted for use in conjunction with a cord-circuit whose features are particularly described and claimed in my copending application, Serial No. 158,013, filed May 20, 1903.

My invention will be best understood by reference to the accompanying drawings, in which—

Figure 1 is a diagrammatic view illustrating the features of my invention and a busy-test circuit adapted for use in conjunction therewith, and Fig. 2 is a diagrammatic view illus-

trating the talking-circuit between two connected substations.

In each of the figures like reference characters are applied to similar parts.

Referring, first, more particularly to Fig. 1, I have illustrated at each of the substations A and B the usual substation instruments comprising a switch-hook 1, adapted when in its normal depressed position, due to the weight of receiver 2, to connect between the telephone line-limbs 3 and 4, a call-bell 5, adapted to be actuated by alternating currents from the central station, and a serially-connected condenser 6. When in its upper alternate position, due to the removal of the receiver 2, the switch-hook causes the closure of a conductively-continuous circuit through the battery-transmitter 7 and the primary 8 of an induction-coil whose secondary 9 is serially connected with the receiver 2. The line-limbs 3 and 4 extend in each instance to the central station, where they are preferably permanently connected with the terminals of a common battery 10, the circuit to the line-limb 3 being traced from the positive grounded pole of the battery 10 through the winding 11 of the line-relay 12. The circuit to line-limb 4 may be traced from the negative pole of the battery 10 through a winding 13 of the line-relay 12, the windings 11 and 13 being in cumulative relation one to the other, whereby the closure of a circuit through the transmitter 7 at the substation causes the energization of the line-relay 12 to attract its armature 14. The cumulative winding of the two coils of the line-relay 12 is in contradistinction with those systems in which a so-called "differential-wound" relay is employed the two windings of which are under certain conditions so connected as to cause no net energization of the relay-magnet core.

Permanently connected with the line-limbs 3 and 4 are the tip-springs 15 and the sleeve-springs 16 of the answering-jack 17 and the calling-jacks 18 18. Each of the jacks is provided with a thimble 19, which, in addition to its other functions, may serve as a test-thimble, the test-thimbles 19 of all the line-



jacks associated with any one line being connected together by a conductor 20, which leads through a cut-off relay 21 to the negative pole of the battery 10. The relay 21 is provided with an armature 22, which when in connection with its normal back contact 23 causes, in conjunction with the armature 14 when in connection with its front contact 24, the closure of a local circuit through the line signal-lamp 25.

At the central exchange C is provided an operator's cord connecting apparatus comprising an answering-plug 26 and a calling-plug 27, the tip-contacts 28 and 29 of these plugs being connected by a tip cord-strand 30, whose conductive continuity is interrupted by the serial inclusion of a condenser 31. In the same manner the sleeve-contacts 32 and 33 of the plugs 26 and 27 are connected through the sleeve cord-strand 34, whose conductive continuity between the plugs is interrupted by the serial inclusion of a condenser 35. The purpose of the condensers 31 and 35 on this connection is to divide the cord-circuit into two conductively-insulated portions and at the same time to inductively relate the portions of the cord-circuit in such a manner as to provide for the ready transmission of telephonic voice-currents therethrough. There is connected in bridge of the cord-strands 30 and 34, leading to the answering-plug 26, a supervisory relay 37, preferably of comparatively high resistance—for instance, eight hundred ohms. This supervisory relay controls by its armature 38 a local circuit through the supervisory signal-lamp 39. A second supervisory relay 40 is similarly connected in bridge of the cord-strands 30 and 34, leading to the calling-plug 27, this relay being provided with an armature 41, which when attracted into its front position causes the closure of a local circuit through the supervisory signal-lamp 42. The usual operator's ringing-key 43 is provided, which when manipulated serves to connect the terminals of the alternating-current generator 44 in bridge of the cord-strands leading to the calling-plug 27, the manipulation of this key serving at the same time to disconnect the cord-strands leading from the generator-contacts to the calling-plug 27 from the other parts of the cord-circuit. There is also provided the usual operator's listening-key 44, which when actuated serves to connect in bridge of the cord-strands the operator's telephone-receiver 45 and the secondary 46 of an induction-coil whose primary 47 may be connected by a local circuit through a battery 48 and a transmitter 49.

While it forms no part of my present invention, I have herein shown a busy-test circuit adapted for use in conjunction with my invention for testing the condition of a subscriber's line to ascertain whether or not such line is in use before making a connection therewith. This busy-test circuit comprises a con-

tact-spring 50, operated by a mechanical connection with the upper spring of the operator's listening-key 44. The contact-spring 50 is provided with a normal back contact 51, connected with the upper spring of the listening-key 44, and with a front contact 52, connected, through the winding of a test-relay 53, with the negative pole of the common battery 10. The test-relay is provided with an armature 54, which when in its forward-attracted position serves to close a circuit from the battery 10 through the test-winding 55, inductively associated with the secondary winding 46 of the operator's telephone set.

It will be seen that under normal conditions a manipulation of the listening-key 44 to connect the operator's telephone set in bridge of the cord-strands breaks the electrical connection between the contact 51 and the contact-spring 50. The continuity of the tip cord-strand 30 is traced through an electrical connection between the contacts 50 and 51. Thus while the listening-key is manipulated the continuity of the tip cord-strand is broken. As is well-known to those skilled in the art, it is frequently desirable where two subscribers have been connected for conversation for the operator to manipulate her listening-key to connect her telephone set in bridge of the cord-circuit to ascertain whether or not the telephone-lines are in use and in some cases to communicate with the connected subscribers. In order that such a manipulation of the listening-key where two subscribers are connected for conversation may not break the continuity of the cord-circuit, and thereby interfere with the conversation between the connected substations, the supervisory relay 40 is provided with an auxiliary armature 56, this armature serving when attracted into its forward position, in connection with the front contact 57, to close a circuit about the contacts 51 and 50, as will hereinafter be more fully explained. The adjustment of the armature 56 is made such that whenever two subscribers are connected for conversation this armature will remain in its forward-attracted position in connection with the contact 57, thereby maintaining the conductive continuity or tip cord-strand, whereby the operator may manipulate her listening-key to connect her telephone set in bridge of the cord-circuit without interfering with the conversation between the two connected substations.

The operation of my improved telephone system may be described as follows: A subscriber at substation A desiring to communicate with a subscriber at substation B removes his receiver from the switch-hook 1, thereby closing a conductively-continuous circuit between the line-limbs 3 and 4, whereby current may be traced from the common battery 10 through the following circuit: from the positive grounded pole of the common battery 10 through the winding 11 of the



line-relay 12, the line-limb 3, the transmitter 7, the primary coil 8, the switch-hook 1, the line-limb 4, the winding 13 of the line-relay 12, and back to the negative pole of the battery 10. The passage of current through the cumulative windings 11 and 13 of the line-relay 12 causes the energization thereof to attract the armature 14 into its forward position in electrical connection with the front contact 24, whereby a circuit may be traced through the line signaling-lamp 25, as follows: from the positive pole of the battery 10, through the line-lamp 25, the front contact 24, the armature 14, the back contact 23, the armature 22, to the negative pole of the battery 10. The operator responds to the signal produced by the consequent illumination of the lamp 25 by the insertion of the answering-plug 26 of her cord connecting apparatus within the answering-jack 17, associated with the line to substation A. It will be seen that the connection of the test-thimble 10 through the sleeve 32 of the plug 26, with the sleeve jack-spring 16 causes the closure of a circuit through the cut-off relay 21 in parallel with the circuit through the winding 13 of the line-relay 12. Thus between the point of the juncture 58 and the line-limb 4, extending to the substation A, may be traced the two following circuits: first, from the point of juncture 58, through the winding 13, to the line-limb 4. The other circuit may be traced from the juncture-point 58, through the cut-off relay 21, the conductor 20, the test-thimble 19, the sleeve-contact 32, the jack-spring 16, to the line-limb 4. The energization of the cut-off relay 21, due to the passage of current therethrough, causes the attraction of the armature 22, thereby interrupting the flow of current through the line-lamp 25, thereby indicating by its consequent extinguishment that the signal has been answered.

In the telephone system disclosed in my present invention it is desirable that the current be fed from the battery 10 to the transmitter at the substation A through a circuit containing more or less impedance, whereby the voice-currents impressed upon the line may not be short-circuited through the battery 10, but may be transmitted through the cord connecting apparatus to a line leading to another substation. This impedance is provided for the line-limb 3 by the winding 11 of the line-relay 12. The impedance between the line-limb 4 and the negative pole of the battery 10 is introduced by the parallel winding 13 of the line-relay and the winding of the cut-off relay 21. In order that the impedance shall be balanced so that each line-limb shall be connected for conversation through substantially the same impedance as the other line-limb, the winding 11 may be made approximately two hundred ohms resistance, while the winding 13 and the winding of the

cut-off relay 21 may be made each of approximately four hundred ohms resistance. When these two windings are connected in parallel by the insertion of a plug within a line-jack, the resultant resistance interposed between the line-limb 4 and the negative pole of the battery is approximately two hundred ohms. Thus when connected with a plug of the cord connecting apparatus battery-current is supplied to the substation-transmitter through line-limbs in each of which there is included an impedance coil or coils of approximately two hundred ohms resistance. It will be seen that after the insertion of the plug 26 within the jack 17 there is provided, in addition to the path to substation A, a parallel electrical path through the winding of the supervisory relay 37. This parallel shunt-circuit may be traced as follows: from the positive pole of the battery 10, through the winding 11 of the line-relay 12, the tip-spring 15, the tip-contact 28, the tip-strand 30, the supervisory relay 37, the sleeve-strand 34, the sleeve-contact 32, and thence through two paths—one through the winding 13 of the line-relay 12 and the other through the winding of the cut-off relay 21—to the point 58, and thence to the negative pole of the battery 10.

It will be seen that the current flowing through the windings of the line-relay 12 and the cut-off relay 21 divides, part flowing through the battery-transmitter at substation A and part through the supervisory relay 37. The resistance of the supervisory relay 37 is desirably made comparatively high—for instance, eight hundred ohms—and the adjustment of its armature 38 and the customary reacting-spring are made such that the comparatively small amount of current flowing through the winding of the supervisory relay will not cause a sufficient energization thereof to attract the armature 38 to close the local circuit through the supervisory signal-lamp 39. After having answered the signal produced by the illumination of the line-lamp 25 by the insertion of the answering-plug 26 in the jack 17 the operator manipulates her listening-key 44 to connect her telephone set in bridge of the cord-strands and thereafter communicates with the subscriber at substation A to ascertain the number of the line with which he desires connection. Learning that a connection is desired with line leading to substation B, the operator first tests this line to ascertain whether or not it is in use. To make this busy-test, she manipulates her listening-key 44, thereby causing a break in the electrical connection between the contacts 50 and 51, whereby the tip-strand 30, leading to the tip-contact 26 of the plug 27, is disconnected from the remainder of the cord-circuit and connected through the winding of the test-relay 53 with the negative pole of the battery 10. The application of the test-contact 29 to the test-thimble 19 of an idle line cannot cause



the closure of an electrical circuit through the test-relay 53. If, however, the tested line is busy, there will be a closure of either one or both of the following circuits through the test-relay 53: Supposing that the subscriber whose substation is connected with the tested line has removed his telephone-receiver from its hook, but that his line-signal has not as yet been answered at the central station, there may be traced through the test-relay 53 the following circuit: from the negative pole of the common battery 10, through the test-relay 53, the contact 52, the spring 50, the tip-strand 30, the tip-contact 29, the test-thimble 19, the cut-off relay 21, the winding 13 of the line-relay 12, the line-limb 4, the primary coil 8, the transmitter 7, the line-limb 3, the winding 11 of the line-relay 12, to the positive pole of the battery 10. The closure of this circuit will cause an energization of the test-relay 53, whereupon its armature 54 will be attracted to close a local circuit through the test-winding 55, the closure of a circuit through the test-winding serving to produce a click in the operator's telephone-receiver, thereby giving her a characteristic busy-test signal. If an operator at some other section of a multiple switchboard has inserted a plug of her cord connecting apparatus within a line-jack associated with the tested line, the following circuit through the test-winding 53 may be traced whether or not the subscriber at the associated substation has removed his receiver from the switch-hook: from the negative pole of the common battery 10, through the test-relay 53, contact 52, spring 50, tip-strand 30, test-contact 29, test-thimble 19, the sleeve-contact of the plug of some other operator's cord connecting apparatus which has been inserted within an associated line-jack, through the sleeve-strand 34 of this other cord-circuit, through the associated supervisory relay 40 or 37, as the case may be, through the tip-strand 30 of this other cord-circuit, the associated tip-contact 29, a tip-spring 15, the winding 11 of the line-relay 12, to the positive pole of the common battery 10. As in the case of the circuit previously traced, the closure of this circuit will cause an energization of the test-relay 53, whereupon its armature 54 will be attracted to cause the closure of a local circuit through the test-winding 55, which produces a click in the operator's telephone-receiver. After having tested the line leading to substation B and ascertaining that this line is not in use the operator inserts the plug 27 within the jack 18 and thereupon manipulates her ringing-key 43 to connect the terminals of the generator 44 with the cord-strands 30 and 34, leading to the calling-plug 27, whereby an alternating current is caused to traverse a circuit through the call-bell 5, thereby calling the subscriber at substation B to his telephone.

Insertion of the calling-plug 27 within the jack 18 causes, as in the case of the line apparatus associated with the calling-line, the closure of a circuit through the cut-off relay 21 between the point 58 and the line-limb 4. The insertion of the plug 27 within the jack 17 also causes the closure of the following circuit through the supervisory relay 40: from the positive pole of the battery 10, through the winding 11 of the line-relay 12, the tip-spring 15, the tip-contact 29, the tip-strand 30, the contact-spring 50, contact 51, conductor 59, supervisory relay 40, conductor 60, sleeve-strand 34, sleeve-contact 33, and thence through two parallel paths, one through the winding 13 of the line-relay 12 and the other through the winding of the cut-off relay 21 to the negative pole of the battery 10. The passage of current through this circuit at once causes the energization of the relays 12 and 21, whereupon their armatures are attracted, the attraction of the armature 22 of the cut-off relay 21 serving at once to open the circuit through the line-lamp 25, thereby preventing its illumination due to the attraction of the armature 14. Until the subscriber at substation B answers the calling-signal by the removal of his receiver from the switch-hook 1 there is but this one electrical path through the supervisory relay 40 for the current flowing through the line and cut-off relays. The current through the supervisory relay 40 is therefore of sufficient strength to cause its energization to attract the armatures 41 and 56. The adjustment of the armatures 41 and 56 is made such that a very feeble current flowing through the winding of the supervisory relay 40 will attract and maintain in its attracted position the armature 56, while the attraction and retention of the armature 41 requires the passage through the winding of the relay 40 of a very much larger current. Upon the removal of the receiver at the substation B from its switch-hook a path of comparatively low resistance is closed in shunt of the path through the supervisory relay 40, whereby the relay 40 is deprived of current to such an extent that the partial deenergization of the relay permits the retracting of the armature 41, thereby causing the extinguishment of the lamp 42, which will have been illuminated during the interval between the insertion of the plug 27 within the jack 18 and the removal of the receiver from its switch-hook at substation B. There will be, however, a slight current flowing through the supervisory relay 40 even after the removal of the receiver from its switch-hook at substation B, this current being of sufficient strength to cause an energization of the relay 40 capable of maintaining the armature 56 in its forward attracted position.

As hereinbefore pointed out, the armature 56 in its forward position serves to close a circuit in shunt of the contacts 50 and 51, where-



by the subsequent manipulation of the listening-key 44 to connect the operator's telephone set in bridge of the cord-strands does not interfere with the conductive continuity of the cord-circuit which is necessary for the transmission of voice-currents between the lines to substations A and B. Upon the completion of the conversation the subscriber at either of the connected substations A and B upon replacing his receiver upon the switch-hook causes a break in the conductive continuity of the circuit between the line-limbs 3 and 4. Thus the electrical path of low resistance in parallel relation with the corresponding supervisory relay is opened, whereupon the entire current passing through the line and cut-off relays is permitted to flow through the supervisory relay, thereby causing a sufficiently strong energization thereof to cause the attraction of the main armature which controls the local circuit through the supervisory signaling-lamp. The illumination of a supervisory signaling-lamp upon the replacement of the receiver at the connected substation upon its hook gives the operator a disconnect-signal, whereupon she removes the plug of her cord-circuit from the jack, thereby restoring the line and cut-off relays to their normal condition and depriving the supervisory relay of current, whereupon it is restored to its normal condition. Thus upon the removal of both of the cord-connecting plugs from their jacks all of the apparatus is restored to its normal condition.

I have indicated in Fig. 2 the transmission-circuit which carries the voice-currents between the substations A and B.

It will be seen that in bridge of the conductors, each of which serially includes a condenser 31 or 35, are the windings of the supervisory relays 37 and 40. Battery-current is supplied to each of the substations from the battery 10 through impedance-coils comprising the winding 11 of the line-relay 12 and on the other side the winding 13 of the line-relay and the winding of cut-off relay 21, connected in parallel therewith.

It will be seen that the inclusion of the impedance-coils in the current-feeding circuits prevents the short-circuiting of voice-currents. The conductive insulation of the two sides of the cord-circuit permits the control of the supervisory relays by their associated substation apparatus, and the condensers provide for the inductive relation of the two conductively-insulated portions of the cord-circuit necessary for the proper transmission of telephonic voice-currents.

While I have herein shown and described one preferred embodiment of my invention, it will be apparent to those skilled in the art that many modifications may be introduced without departing from the spirit thereof. I do

not wish, therefore, 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 a source of current at the exchange adapted to supply talking and signaling currents to said line, a line-relay having two cumulative windings, one of said windings being serially included in one of said line-limbs, and the other of said windings being serially included in the other of said line-limbs, a cut-off relay, a line-signal included in a local circuit bridged across said source of current and adapted to include the armatures of said line-relay and said cut-off relay, actuation of said line-relay causing attraction of its armature to close said local circuit, whereby the signal is displayed, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of one of the windings of said line-relay, whereby said cut-off-relay armature is attracted to open said local circuit to extinguish said signal, substantially as described.

2. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a source of current at the exchange adapted to supply talking and signaling currents to said line, a line-relay having two cumulative windings, one of said windings being serially included in one of said line-limbs and the other of said windings being serially included in the other of said line-limbs, a line-signal normally controlled by said line-relay, a 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 serves to connect said cut-off relay in shunt of one of the windings of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

3. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a source of current at the exchange adapted to supply talking and signaling currents to said line, a line-relay having two cumulative windings, one of said windings being serially included in one of said line-limbs and the other of said windings being serially included in the other of said line-limbs, a line-signal normally controlled by said line-relay, a cut-off relay, cord connecting apparatus for connecting said line with another for conversation, the connection of said cord connecting apparatus with said line serving to close a conductive path between said line-limbs, and means whereby the connection of said cord



connecting apparatus with said line serves to connect said cut-off relay in shunt of one of the windings of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

4. In a telephone-exchange system, the combination with a source of current located at an exchange, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having one part of its winding normally included in one limb and the other part of the winding normally included in the other limb, a cut-off relay, cord connecting apparatus at the exchange for telephonically connecting said line with another for conversation, and means whereby connection of said cord connecting apparatus with said line serves to connect the cut-off-relay winding in parallel with one of said relay-windings independently of the cord circuit-conductors.

5. In a telephone-exchange system, the combination with a source of current located at an exchange, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having one part of its winding normally included in one limb and the other part of the winding normally included in the other limb, a cut-off relay, cord connecting apparatus at the exchange for telephonically connecting said line with another for conversation, and means whereby connection of said cord connecting apparatus with said line serves to connect the cut-off-relay winding in parallel with one of said relay-windings, the resistance of the other relay-winding being substantially equal to the joint resistance of the two windings adapted for connection in parallel.

6. In a telephone-exchange system, the combination with a source of current located at an exchange, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having one part of its winding normally included in one limb and the other part of the winding normally included in the other limb, a cut-off relay, cord connecting apparatus at the exchange for telephonically connecting said line with another for conversation, and means whereby connection of said cord connecting apparatus with said line serves to connect the cut-off-relay winding in parallel with one of said relay-windings, the impedance of the other relay-winding being substantially equal to the joint impedance of the two windings adapted for connection in parallel.

7. In a telephone-exchange system, the combination with a source of current located at an exchange, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having one part of its winding normally included in one limb and the other part of the winding

normally included in the other limb, said winding parts acting cumulatively, a cut-off relay, cord connecting apparatus at the exchange for telephonically connecting said line with another for conversation, and means whereby connection of said cord connecting apparatus with said line serves to connect the cut-off-relay winding in parallel with one of said relay-windings independently of the cord circuit-conductors.

8. In a telephone-exchange system, the combination with a source of current located at an exchange, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having one part of its winding permanently serially included in one limb and the other part of the winding permanently serially included in the other limb, a cut-off relay, cord connecting apparatus at the exchange for telephonically connecting said line with another for conversation, and means whereby connection of said cord connecting apparatus with said line serves to connect the cut-off relay winding in parallel with one of said relay-windings, the resistance of the other relay-winding being substantially equal to the joint resistance of the two windings adapted for connection in parallel.

9. In a telephone-exchange system, the combination with a source of current located at an exchange, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having one part of its winding permanently serially included in one limb and the other part of the winding permanently serially included in the other limb, a cut-off relay, cord connecting apparatus at the exchange for telephonically connecting said line with another for conversation, and means whereby connection of said cord connecting apparatus with said line serves to connect the cut-off-relay winding in parallel with one of said relay-windings, the impedance of the other relay-winding being substantially equal to the joint impedance of the two windings adapted for connection in parallel.

10. In a telephone-exchange system, the combination with a source of current located at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the second line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off



relay in shunt of said line-relay, whereby the current-supply to the substation apparatus through said second line-limb divides itself between the line-relay and the cut-off relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay.

11. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the other line-limb, a line signaling-lamp whose local circuit is normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, said cord connecting apparatus serving to close a conductive electrical path between said line-limbs, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of the local circuit for said line signaling-lamp by said line-relay.

12. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to said substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the other line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to close a conductive electrical path between said line-limbs and to connect said cut-off relay in shunt of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

13. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the other line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of

said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay, the joint resistance of said line-relay and the cut-off relay when connected in parallel therewith, being approximately equal to the resistance of said impedance-winding.

14. In a telephone-exchange system, the combination with a source of current located at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the second line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, whereby the current-supply to the substation apparatus through said second line-limb divides itself between the line-relay and the cut-off relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay.

15. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the other line-limb, a line signaling-lamp whose local circuit is normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, said cord connecting apparatus serving to close a conductive electrical path between said line-limbs, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of the local circuit for said line signaling-lamp by said line-relay.

16. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to said substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the other line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another



for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to close a conductive electrical path between said line-limbs and to connect said cut-off relay in shunt of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

17. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding permanently serially included in the other line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay, the joint resistance of said line-relay and the cut-off relay when connected in parallel therewith, being approximately equal to the resistance of said impedance-winding.

18. In a telephone-exchange system, the combination with a source of current located at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding serially included in the second line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, whereby the current-supply to the substation apparatus through said second line-limb divides itself between the line-relay and the cut-off relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay.

19. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding serially included in the other line-limb, a line signaling-lamp whose local circuit is normally controlled by

said line-relay, cord connecting apparatus for connecting said line with another for conversation, said cord connecting apparatus serving to close a conductive electrical path between said line-limbs, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of the local circuit for said line signaling-lamp by said line-relay.

20. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to said substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding serially included in the other line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to close a conductive electrical path between said line-limbs and to connect said cut-off relay in shunt of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

21. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding permanently serially included in one of said line-limbs, a line-relay having a winding serially included in the other line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay, the joint resistance of said line-relay and the cut-off relay when connected in parallel therewith, being approximately equal to the resistance of said impedance-winding.

22. In a telephone-exchange system, the combination with a source of current located at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding serially included in the second line-limb, a line-signal normally controlled by



trolled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, whereby the current-supply to the substation apparatus through said second line-limb divides itself between the line-relay and the cut-off relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay.

23. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding serially included in the other line-limb, a line signaling-lamp whose local circuit is normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, said cord connecting apparatus serving to close a conductive electrical path between said line-limbs, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of the local circuit for said line signaling-lamp by said line-relay.

24. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to said substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding serially included in the other line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to close a conductive electrical path between said line-limbs and to connect said cut-off relay in shunt of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

25. In a telephone-exchange system, the combination with a source of current located at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, an impedance-winding serially included in one of said line-limbs, a line-relay having a winding serially included in the other line-limb, a line-signal normally controlled by

said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said line-relay, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay, the joint resistance of said line-relay and the cut-off relay when connected in parallel therewith, being approximately equal to the resistance of said impedance winding.

26. In a telephone-exchange system, the combination with a source of current located at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having a winding permanently serially included in one of said line-limbs, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in direct shunt of said line-relay independent of cord-circuit conductors, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay.

27. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having a winding permanently serially included in one of said line-limbs, a line signaling-lamp whose local circuit is normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, said cord connecting apparatus serving to close a conductive electrical path between said line-limbs, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in direct shunt of said line-relay independent of cord-circuit conductors, thereby causing an actuation of said cut-off relay to destroy the control of the local circuit for said line signaling-lamp by said line-relay.

28. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to said substation, a line-relay having a winding permanently serially included in one of said line-limbs, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conver-



sation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to close a conductive electrical path between said line-limbs and to connect said cut-off relay in direct shunt of said line-relay independent of cord-circuit conductors, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

29. In a telephone-exchange system, the combination with a source of current located at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having a winding serially included in one line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in direct shunt of said line-relay independent of cord-circuit conductors, thereby causing an actuation of said cut-off relay to destroy the control of said line-signal by said line-relay.

30. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to a substation, a line-relay having a winding serially included in one line-limb, a line signaling-lamp whose local circuit is normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, said cord connecting apparatus serving to close a conductive electrical path between said line-limbs, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in direct shunt of said line-relay independent of cord-circuit conductors, thereby causing an actuation of said cut-off relay to destroy the control of the local circuit for said line signaling-lamp by said line-relay.

31. In a telephone-exchange system, the combination with a source of current at the exchange for supplying talking and signaling currents to the substation apparatus, of a telephone-line extending by its limbs each from a terminal of said source of current to said substation, a line-relay having a winding serially included in one line-limb, a line-signal normally controlled by said line-relay, cord connecting apparatus for connecting said line with another for conversation, a cut-off relay, and means whereby the connection of said cord connecting apparatus with said line serves to close a conductive electrical path between said line-limbs and to connect said cut-

off relay in direct shunt of said line-relay independent of cord-circuit conductors, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

32. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding permanently serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon energization, to destroy the control of said line-signal by said line-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 serves to connect said cut-off relay in direct shunt of said winding of said line-relay independent of cord-circuit conductors.

33. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange and terminating at the exchange in a source of current for supplying talking and signaling current to the substation apparatus, of a line-relay having its winding permanently serially included in one of said line-limbs, a line-signal normally controlled by said line-relay, a cut-off relay adapted upon actuation to destroy the control of said line-signal by said line-relay, a line-jack, contacts for said line-jack, one of said contacts connecting with said line-limb at one side of the line-relay winding, the other jack-contact having connection through said cut-off relay winding with said line-limb at the other side of the line-relay winding, and cord connecting apparatus having a plug adapted for insertion in said line-jack, said plug upon insertion into the jack causing said jack-contacts to be short-circuited, whereby a parallel path is closed about said line-relay winding and whereby said cut-off relay is actuated.

34. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding permanently serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a line-jack having contacts permanently connected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting said line with another for conversation and for closing a conductive electrical path between said line-limbs, and means whereby the connection of



said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said winding of said line-relay.

35. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding permanently serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a line-jack having contacts permanently connected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting said line with another for conversation and for closing a conductive electrical path between said line-limbs, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said winding of said line-relay, independently of the cord-circuit conductors.

36. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a high-resistance supervisory relay connected in bridge of the cord-strands, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

37. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-circuit, comprising two conductively-insulated portions inductively related for the transmission of voice-currents, a high-resistance supervisory relay connected in bridge of the cord-strands of each of said conductively-insulated portions, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

38. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to the substation through said windings, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon energization to destroy the control of said line-signal by said line-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 serves to connect said cut-off relay in shunt, of said line-relay winding whereby the current-supply to the substation through the line-relay limb divides itself between the line-relay winding and the cut-off-relay winding, whereby said cut-off relay is energized.

39. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange and terminating at the central exchange in a source of current for supplying talking and signaling current to the substation apparatus, of a line-relay having a winding permanently serially included in the first line-limb, an impedance-winding serially included in the second line-limb, a line-signal normally controlled by said line-relay, a cut-off relay adapted upon actuation to destroy the control of said line-signal by said line-relay, a line-jack, contacts for said line-jack, one of said contacts connecting with the first line-limb at one side of the line-relay winding, the other contact being connected through said cut-off-relay winding to the first line-limb at the other side of the line-relay winding, a cord connecting apparatus having a plug adapted for insertion in said line-jack, said plug upon insertion causing short-circuiting of said jack-contacts whereby the circuit through said cut-off-relay winding is connected in parallel about said line-relay winding, thereby causing actuation of said cut-off relay.

40. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding permanently serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a line-jack having contacts permanently connected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting



said line with another for conversation and for closing a conductive electrical path between said line-limbs, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said winding of said line-relay.

41. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding permanently serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a line-jack having contacts permanently connected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting said line with another for conversation and for closing a conductive electrical path between said line-limbs, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said winding of said line-relay, independently of the cord-circuit conductors.

42. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a high-resistance supervisory relay connected in bridge of the cord-strands, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

43. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-circuit, comprising two conductively-insulated portions inductively related for the transmission of voice-currents, a high-resistance supervisory relay connected in bridge of the cord-strands of

each of said conductively-insulated portions, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

44. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon energization, to destroy the control of said line-signal by said line-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 serves to connect said cut-off relay in direct shunt of said winding of said line-relay independent of cord-circuit conductors.

45. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange and terminating at the exchange in a source of current for supplying talking and signaling current to the substation apparatus, of a line-relay having its winding serially included in one of said line-limbs, a line-signal normally controlled by said line-relay, a cut-off relay adapted upon actuation to destroy the control of said line-signal by said line-relay, a line-jack, contacts for said line-jack, one of said contacts connecting with said line-limb at one side of the line-relay winding, the other jack-contact having connection through said cut-off-relay winding with said line-limb at the other side of the line-relay winding, and cord connecting apparatus having a plug adapted for insertion in said line-jack, said plug upon insertion into the jack causing said jack-contacts to be short-circuited, whereby a parallel path is closed about said line-relay winding and whereby said cut-off relay is actuated.

46. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding permanently included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a line-jack having contacts permanently connected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting said line with another for conversation and for closing a conductive electrical path between said line-



limbs, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

5 47. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding serially included in one of said line-limbs, a source of  
10 current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actua-  
15 tion, to destroy the control of said line-signal by said line-relay, a line-jack having contacts permanently connected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting said line with another for con-  
20 versation and for closing a conductive electrical path between said line-limbs, and means whereby the connection of said cord connect- ing apparatus with said line serves to connect  
25 said cut-off relay in shunt of said winding of said line-relay, whereby said cut-off relay is actuated.

48. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange,  
30 of a line-relay, having a winding serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said  
35 line-relay, a cut-off relay adapted, upon actua- tion, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a high-resist-  
40 ance supervisory relay connected in bridge of the cord-strands, and means whereby the con- nection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

45 49. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding serially in-  
50 cluded in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-  
55 circuit, comprising two conductively-insu- lated portions inductively related for the transmission of voice-currents, a high-resist-  
60 ance supervisory relay connected in bridge of the cord-strands of each of said conductively- insulated portions, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

65 50. In a telephone-exchange system, the

combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding serially in-  
cluded in one of said line-limbs, an impedance-  
winding serially included in the other line- 70 limb, a source of current at the central ex- change adapted to supply talking and signal- ing currents to the substation through said windings, a line-signal normally controlled by  
75 said line-relay, a cut-off relay adapted, upon energization, to destroy the control of said line-signal by said line-relay, cord connecting apparatus for connecting said line with an-  
80 other for conversation, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt, of said line-relay winding whereby the current-supply to the substation  
85 through the line-relay limb divides itself be- tween the line-relay winding and the cut-off- relay winding, thereby causing actuation of said cut-off relay.

51. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange 90 and terminating at the central exchange in a source of current for supplying talking and signaling current to the substation apparatus, of a line-relay having a winding serially in-  
95 cluded in the first line-limb, an impedance- winding serially included in the second line- limb, a line-signal normally controlled by said line-relay, a cut-off relay adapted upon actua-  
100 tion to destroy the control of said line-signal by said line-relay, a line-jack, contacts for said line-jack, one of said contacts connecting with the first line-limb at one side of the line-relay winding, the other contact being connected  
105 through said cut-off-relay winding to the first line-limb at the other side of the line-relay winding, and cord connecting apparatus hav- ing a plug adapted for insertion in said line-  
110 jack, said plug upon insertion causing short- circuiting of said jack-contacts whereby the circuit through said cut-off-relay winding is connected in parallel about said line-relay winding, thereby causing actuation of said cut-off relay.

52. In a telephone-exchange system, the combination with a telephone-line extending 115 by its limbs from a substation to an exchange, of a line-relay having a winding permanently included in one of said line-limbs, an impe-  
dance-winding serially included in the other line-limb, a source of current at the central 120 exchange adapted to supply talking and sig- naling currents to said line, a line-signal nor-  
mally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, 125  
a line-jack having contacts permanently con- nected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting  
130 said line with another for conversation and



for closing a conductive electrical path between said line-limbs, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

53. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay having a winding serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a line-jack having contacts permanently connected one to each of said line-limbs, cord connecting apparatus having a plug adapted for insertion in said line-jack for connecting said line with another for conversation and for closing a conductive electrical path between said line-limbs, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in shunt of said winding of said line-relay, whereby said cut-off relay is actuated.

54. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a high-resistance supervisory relay connected in bridge of the cord-strands, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

55. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-circuit, comprising two conductively-insulated portions inductively related for the transmission of voice-currents, a high-resistance supervisory relay connected in bridge of the cord-strands of each of said conductively-insulated portions, and

means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

56. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a supervisory relay connected in bridge of the cord-strands, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

57. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-circuit, comprising two conductively-insulated portions inductively related for the transmission of voice-currents, a supervisory relay connected in bridge of the cord-strands of each of said conductively-insulated portions, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

58. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a supervisory relay connected in bridge of the cord-strands, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

59. In a telephone-exchange system, the



combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding permanently serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-circuit, comprising two conductively-insulated portions inductively related for the transmission of voice-currents, a supervisory relay connected in bridge of the cord-strands of each of said conductively-insulated portions, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

60. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a supervisory relay connected in bridge of the cord-strands, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

61. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding serially included in one of said line-limbs, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-circuit, comprising two conductively-insulated portions inductively related for the transmission of voice-currents, a supervisory relay connected in bridge of the cord-strands of each of said conductively-insulated portions, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

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

by its limbs from a substation to an exchange, of a line-relay, having a winding serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted, upon actuation, to destroy the control of said line-signal by said line-relay, a two-strand cord-circuit adapted to connect, telephonically, said line with another for conversation, a supervisory relay connected in bridge of the cord-strands, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay.

63. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, having a winding serially included in one of said line-limbs, an impedance-winding serially included in the other line-limb, a source of current at the central exchange adapted to supply talking and signaling currents to said line, a line-signal normally controlled by said line-relay, a cut-off relay, a two-strand cord-circuit, comprising two conductively-insulated portions inductively related for the transmission of voice-currents, a supervisory relay connected in bridge of the cord-strands of each of said conductively-insulated portions, and means whereby the connection of said cord-circuit with said line serves to connect said cut-off relay in shunt of said winding, of said line-relay, whereby said cut-off relay is actuated to destroy the control of said line-signal by said line-relay.

64. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of a line-relay, a source of current at the exchange connected with the limbs of said line, a line-signal normally controlled by said line-relay, a cut-off relay adapted upon energization to destroy the control of said line-signal by said line-relay, cord connecting apparatus at the exchange, and means whereby the connection of said cord connecting apparatus with said line serves to connect said cut-off relay in direct shunt of said line-relay, thereby causing energization of said cut-off relay independently of cord-circuit conductors.

In witness whereof I hereunto subscribe my name this 18th day of May, A. D. 1903.

WILLIAM M. DAVIS.

Witnesses:

LYNN A. WILLIAMS,  
JOHN STAHR.