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W. M. DAVIS.

TELEPHONE EXCHANGE SYSTEM.

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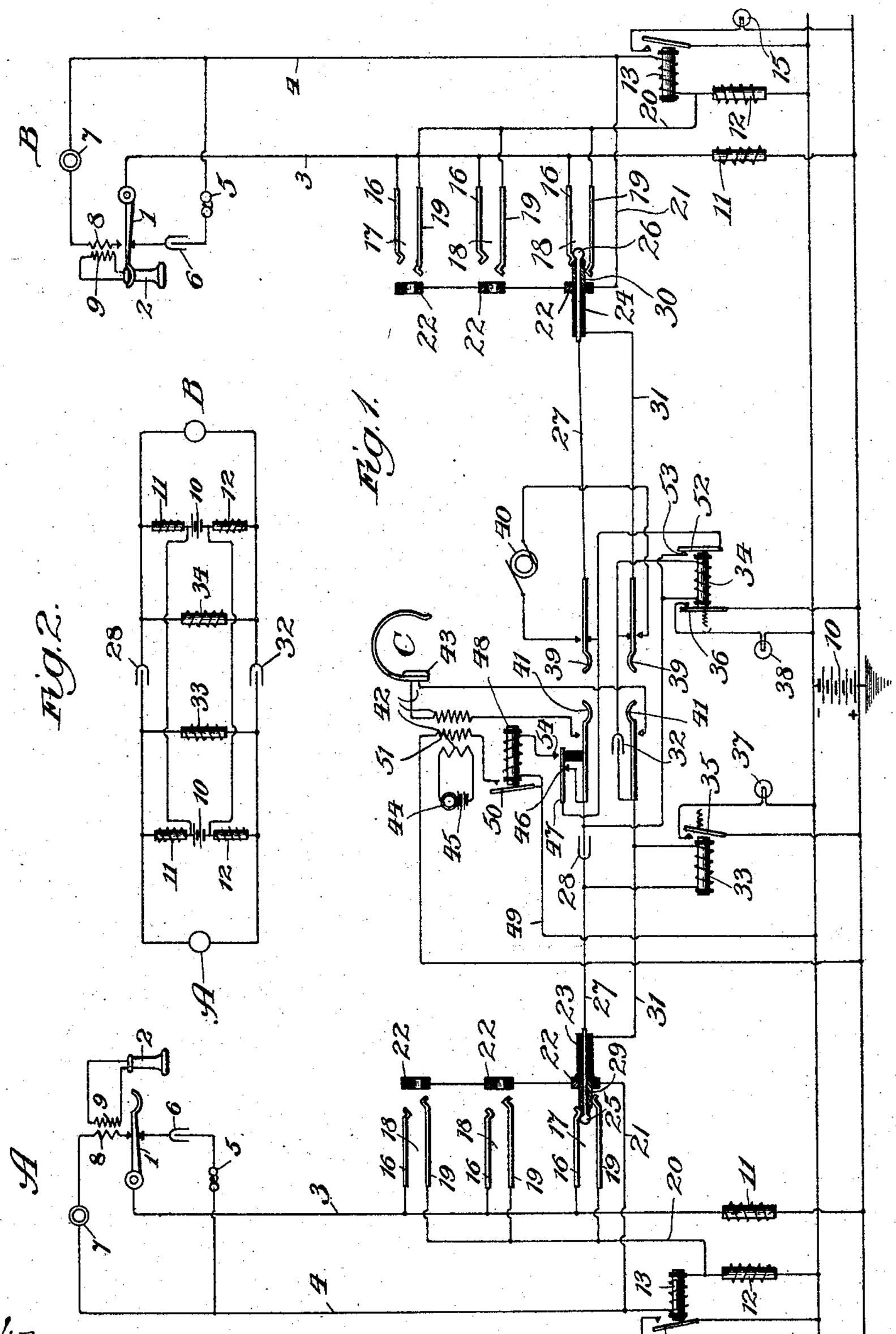


Fig. 1.

Fig. 2.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 782,382, dated February 14, 1905.

Application filed May 20, 1903. Serial No. 158,013.

*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-exchange systems, and particularly to a so-called "busy-test" which a central-station operator employs for the purpose of ascertaining whether or not a subscriber's line is in use.

While the invention herein shown and described may be applied to many telephone systems, it is particularly well adapted for use in connection with a so-called "central-energy" system, in which a source of current located at the central exchange is utilized for the purpose of supplying both talking and signaling currents to the telephone-lines.

Many central-energy telephone systems of the prior art have been objectionable due to the disagreeable clicks produced in the telephone-receivers during the operation of connecting one subscriber with another for conversation. My present invention, in conjunction with the telephone system with which it is herein shown to be incorporated, prevents such disagreeable clicks, for the reason that the supply of current to the substation telephone instruments is entirely controlled by the substation hook-switch. As distinguished from many systems of the prior art, no part of the talking-current is supplied to the substations through the operator's cord-circuit. My improved busy-test provides means whereby the testing tip-contact when making a busy test is entirely freed from connection with any part of the cord-circuit and is connected only with and through a special test-relay. A manipulation of the operator's listening-key to connect the test-relay in circuit with the testing-tip of the calling-plug breaks the conductive continuity of the tip-cord strand. As it is frequently found desirable for the operator to manipulate her listening-key to connect her telephone set in bridge of the cord-circuit over which two connected subscribers are talking, I provide means whereby the conductive continuity of the tip-cord strand may be maintained regardless of the manipulation of the operator's listening-key at all times when the subscriber on the called line has removed his telephone-receiver from its switch-hook. A preferable means for maintaining this continuity of the tip-cord strand consists in the provision of an auxiliary armature for the supervisory relay controlled from the called substation.

A preferred embodiment of my invention and a line and cord circuit with which it is well adapted for use are illustrated in the accompanying drawings, in which—

Figure 1 is a diagrammatic view illustrating the features of a telephone system to which my improved busy-test circuit has been adapted. Fig. 2 is a diagrammatic view illustrating the telephonic talking-circuit between two connected substations.

Referring more particularly to Fig. 1, I have illustrated at each of the substations A and B a telephone switch-hook 1, which when in its depressed condition, due to the weight of the receiver 2, connects the line-limbs 3 and 4 through a circuit including the signal-bell 5 and a serially-connected condenser 6. When relieved of the weight of the receiver 2, the switch-hook 1 closes a conductive circuit between the line-limbs 3 and 4, this circuit including 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 each lead to the central station C, where they are permanently connected with the terminals of a common battrery 10, whose positive pole may be connected with the ground, as shown. The line-limb 3 includes in its circuit an impedance-coil 11. The line-limb 4 includes in its circuit from the common battery 10 an impedance-coil 12 and a line-relay 13, adapted upon energization by the passage of a suitable current from the battery 10 to attract its armature 14, thereupon

closing a local circuit through the line signal-lamp 15. The line-limb 3 is permanently and directly connected with the tip-springs 16 16 of the answering-jack 17 and the multiple calling-jacks 18 18, as shown. The sleeve-springs 19 19 of these jacks are connected, through a conductor 20, with a point in the line-circuit intermediate between the impedance-coil 12 and the line-relay 13. A conductor 21 leads from the line side of the relay 13 to the jack-thimbles 22 22. It will be seen that an electrical connection between a sleeve-spring 19 and a thimble 22 will close a circuit in shunt of the line-relay 13. The adjustment of the line-relay 13 is desirably made such that the closure of a low-resistance circuit between the conductors 20 and 21, as between the sleeve-spring 19 and a thimble 22, will cause a sufficient deënergization of the line-relay to permit the retraction of the armature 14, thereby causing the extinguishment of the lamp 15.

The operator's cord connecting apparatus may desirably comprise an answering-plug 23 and a calling-plug 24, the tip-contacts 25 and 26 being connected through a tip-cord strand 27, there being a condenser 28 serially included in this strand. The sleeve-contacts 29 and 30 are connected by a sleeve-strand 31, whose conductive continuity is interrupted by the serially-connected condenser 32. Connected in bridge of the cord-strands leading from the condensers 28 and 32 to the answering-plug 23 is a supervisory relay 33. Similarly, between the cord-strands leading from the condensers 28 and 32 to the calling-plug 24 there is connected in bridge the supervisory relay 34. The supervisory relays 33 and 34, respectively, control armatures 35 and 36, each serving upon its attraction due to the suitable energization of its associated relay-magnet to close a circuit through a supervisory signaling-lamp 37 or 38, as the case may be.

The usual operator's ringing-key 39 is provided, an actuation of this key serving to connect the ringing-generator 40 in bridge of the cord-strands 27 and 31, leading to the calling-plug 24. The operator's listening-key 41 serves when actuated to connect the operator's telephone set 42 in bridge of the cord-circuit, the operator's telephone set in this case being shown as comprising an induction-coil whose secondary is connected with the receiver 43 and whose primary is connected by a local circuit through the transmitter 44 and the local battery 45. The conductive continuity of the tip-cord strand from the condenser 28 to the calling-plug 24 includes a contact-point 46 and a contact-spring 47, which is operated in unison with the upper spring of the operator's listening-key 41, a manipulaton of the operator's listening-key to connect her telephone set in bridge of the cord-circuit thus serving to interrupt the continuity of the tip-cord strand between the contact 46 and the spring 47. A manipulation of the listening-key 41 serves to connect one terminal of the high-resistance test-relay 48 with the tip-strand 27, leading to the tip-contact 26 of the calling-plug 24, the other terminal of the test-relay being connected, through a conductor 49, with the negative pole of the common battery 10. The test-relay 48 controls, by means of its armature 50, a local circuit through the test-winding 51, inductively associated with the windings of the induction-coil of the operator's telephone set, an attraction of the armature 50 serving to close a circuit through the test-winding 51, thereby producing a click in the operator's telephone in the manner well understood by those skilled in the art.

The supervisory relay 34 is provided with an auxiliary armature 52. The relay 34 and its armatures 36 and 52 are so adjusted that the armature 52 is very much more easily attracted than the armature 36, whereby a current which is insufficient to maintain the armature 36 in its forward attracted position is amply sufficient to maintain the armature 52 in its attracted position. The purpose of this adjustment of these armatures will hereinafter more fully appear. The armature 52 serves upon its attraction to close a circuit in shunt of the contacts 46 and 47. Thus when the supervisory relay 34 is so energized as to attract the armature 52 the manipulation of the listening-key 41 to disconnect the contacts 46 and 47 does not conductively interrupt the continuity of the tip-cord strand 27 between condenser 28 and the tip-contact 26, the circuit being in this case traced from the condenser 28 through the front contact 53 and the armature 52 to the cord-strand 27, leading to the tip-contact 26.

The operation of my improved telephone system may be described as follows: The removal of the receiver from the switch-hook at substation A causes the closure of a circuit which may be traced from the positive pole of the common battery 10 through the impedance-coil 11, the line-limb 3, the switch-hook 1, the primary coil 8, the transmitter 7, the line-limb 4, the line-relay 13, and the impedance-coil 12 to the negative pole of the battery 10. The passage of current over this circuit causes the attraction of the armature 14, thereby closing a local circuit through the lamp 15. The central operator answers the signal given by the illumination of the lamp 15 by inserting the answering-plug 23 of her cord connecting apparatus in the answering-jack 17, as shown. The sleeve 29 of the answering-plug produces a short-circuit connection between the sleeve-spring 19 and the thimble 22 of the jack 17, thereby closing a short-circuited path in shunt of the line-relay 13. The line-relay 13 is thus deprived of current to such an extent that it is deënergized to permit the retraction of the armature 14, whereupon the line-signal lamp 15 is extinguished to indicate that the subscriber's call has been an-

swered. There are now provided from the battery 10 through the impedance-coils 11 and 12 two parallel circuits, one which has already been traced through the transmitter at substation A and the other which may be traced as follows: from the positive pole of the battery 10 through the impedance-coil 11, the tip-spring 16 of the answering-jack 17, the tip-contact 25, the tip-strand 27, the supervisory relay 33, the sleeve-strand 31, the sleeve-contact 29, the sleeve-spring 19, the conductor 20, and the impedance-coil 12 back to the negative pole of the battery 10. The winding of the supervisory relay 33 is desirably made of such resistance and the adjustment of the relay-armature 35 is desirably made such that the comparatively low-resistance path through the substation-transmitter 7 deprives the supervisory relay 33 of current to such an extent that the armature 35 will not be attracted from its normal position shown. The operator after inserting the plug 23 within the answering-jack 17 manipulates her listening-key 41 to connect her telephone set 42 in bridge of the cord-circuit and thereafter communicates with the subscriber at substation A to ascertain the number of the substation with which he desires telephonic communication. Learning that this is substation B, the central operator first applies the tip 26 of her calling-plug to a thimble 22 of a calling-jack 18 to ascertain if the line to substation B is in use. If the tested line to substation B is not already in use, the application of the test-contact 26 to a thimble 22 will not close a circuit through the test-relay 48; but if the plug of some other cord connecting apparatus has been inserted within one of the jacks associated with the line to substation B a test-circuit may be traced as follows: from the negative pole of the common battery 10 through conductor 49, test-relay 48, contact 54, contact-spring 47, tip-strand 27, tip-contact 26, test-thimble 22, (and if the plug of another cord-circuit is inserted within a connected line-jack,) through a sleeve-strand corresponding with the sleeve-strand 31 here shown, through a supervisory relay corresponding with relay 34, through a tip-cord strand corresponding with strand 27, through a tip-contact corresponding with tip-contact 26, through a tip-spring 16 of a line-jack, and through the impedance-coil 11 to the positive pole of the battery 10. The closure of this circuit through the test-relay 48 causes the attraction of its armature 50, thereupon closing a local circuit through the test-winding 51 and causing a consequent click in the operator's telephone-receiver, thus notifying her of the busy condition of the tested line. If a plug of some other cord-circuit has not been inserted in a jack associated with the line to substation B, but the subscriber at substation B has removed his receiver from the switch-hook, as in the act of signaling the central station, a test-circuit may be traced as follows: from the negative pole of the common battery 10, through the test-relay 48, contact 54 and contact-spring 47, tip-strand 27, tip-contact 26, test-thimble 22, line-limb 4, transmitter 7, primary coil 8, switch-hook 1, line-limb 3, to the positive pole of the common battery 10. As in the case where the circuit was traced through a supervisory relay associated with a plug inserted in some other jack, the closure of a circuit through the test-relay 48 causes an actuation of its armature 50 to close a local circuit through the test-winding 51, whereupon a click is produced in the operator's receiver notifying her of the busy condition of the tested line. Assuming, however, that the tested line to substation B is not in use, the application of the test-contact 26 to a test-thimble 22 will cause no click in the operator's telephone-receiver. She therefore inserts the plug 24 within a jack 18, thereby closing a low-resistance circuit in shunt of the line-relay 13 and at the same time closing a circuit through the supervisory relay 34, which circuit may be traced as follows: from the positive pole of the battery 10 through the impedance-coil 11, the tip-spring 16, the tip-contact 26, tip-strand 27, supervisory relay 34, sleeve-strand 31, sleeve-contact 30, sleeve-spring 19, and the impedance-coil 12 back to the negative pole of the battery 10. The current flowing through this circuit will cause an energization of the supervisory relay 34 sufficiently powerful to cause the attraction of both the armatures 36 and 52. The attraction of the armature 36 causes the closure of a local circuit through the supervisory signaling-lamp 38, thereby causing this lamp to glow, giving the operator a signal that the subscriber at substation B has not answered the signal-call by a removal of his receiver from its switch-hook. The attraction of the armature 52 to make electrical connection with the front contact 53 causes the closure of a circuit about the contacts 46 and 47, whereupon the listening-key 41 may be manipulated to connect the operator's telephone set in bridge of the cord-strands without conductively interrupting the continuity of the tip-strand 27 from the condenser 28 to the calling-plug 24. After inserting the calling-plug 24 within the jack 18 the operator manipulates her ringing-key 39 to connect the generator 40 in bridge of the cord-strands leading to the line-limbs 3 and 4 of the line to substation B, thereupon causing the actuation of the call-bell 5 to notify the subscriber at substation B that another subscriber desires communication with him. The removal of the receiver from its switch-hook at substation B causes the closure of a comparatively low-resistance circuit in multiple arc with the circuit already traced through the supervisory relay 34, the circuit in both instances including the impedance-coils 11 and 12. The current through the supervisory relay 34 is thus

materially reduced by the closure of the circuit at substation B, causing a partial deënergization of the relay-magnet. The armature 36 is so adjusted that this partial deënergization of the relay-magnet permits the retraction of the armature 36, thereby causing the extinction of the lamp 38 to indicate that the subscriber at substation B has answered the call. The armature 52, however, is so adjusted that the slight current flowing through the winding of the relay 34 is sufficient to maintain this armature in its attracted position. Therefore if at any time the calling-plug 24 is inserted within a line-jack sufficient current will flow through the winding of the supervisory relay 34 to cause the attraction of the armature 52, whereupon the continuity of the tip-cord strand from the condenser 28 to the calling-plug is maintained. This is desirable for the reason that the operator frequently finds it convenient to manipulate her listening-key to connect her telephone set in bridge of the cord-circuit, whereupon she may ascertain whether or not the subscribers are in conversation and whereby she may put herself in telephonic communication with either one or both of the subscribers connected with the cord-circuit. If it were not for the continuity of the tip-strand circuit maintained by the attraction of the armature 52, the manipulation of the listening-key 41 would interrupt the continuity of the tip-cord strand between the contacts 46 and 47, thereby interrupting the circuit over which the connected subscribers might be conversing. The contacts 46 and 47 provide means whereby the testing tip-contact at the time of making a busy-test is freed from an electrical connection with everything from the testing-relay 48. At the same time the provision of the auxiliary armature 52 for the supervisory relay 34 provides means whereby the continuity of the cord-circuit is maintained whenever two substations have been connected for communication notwithstanding the manipulation of the key 41 and the consequent break in electrical connection between the contacts 46 and 47. Either of the connected subscribers at substations A and B upon finishing the conversation replaces his receiver upon the switch-hook 1, thereby causing a break in the continuous electrical circuit between the line-limbs 3 and 4. Thus the continuity of the electrical path in shunt of the corresponding supervisory relay is broken, whereupon the current flowing through the supervisory relay is increased to cause an attraction of the main armature 35 or 36, as the case may be. The attraction of the main armature of a supervisory relay causes the closure of a local circuit through the corresponding supervisory signaling-lamp, the illumination of which gives the operator a positive signal that the connected subscriber has finished the conversation and that the cord connecting-plug may be removed, thus restoring the apparatus to its normal condition.

In Fig. 2 I have diagrammatically illustrated the talking-circuit between substations A and B. The reference characters applied in this figure will indicate that the connection between the substations includes the serially-connected condensers 28 and 32. In bridge of the conductors connecting the substations are the supervisory relays 33 and 34 and two similarly-connected impedance-coils 11 11 and two similarly-connected impedance-coils 12 12, there being interposed between each impedance-coil 11 and the corresponding impedance-coil 12 the common battery 10.

The resistance of the impedance-coils and the relays employed in connection with my invention may be varied to meet the special conditions of a given case. In ordinary practice, however, I have found it desirable to make the resistance of each of the impedance-coils 11 and 12 approximately two hundred ohms and the resistance of the line-relay 13 approximately two hundred ohms, while the supervisory relays are desirably wound to a comparatively high resistance—for instance, eight hundred ohms each. It is desirable that the resistance of the test-relay 48 and the adjustment of its armature be made such that slightly more current will be required to actuate the test-relay than is required to actuate the line-relays. This is for the purpose of preventing a false busy-test signal due to leakage on the telephone-line. It will be seen that the line-limbs 3 are normally and permanently connected with the grounded side of common battery 10. The line-limbs 4 are connected with the other side of the common battery each through a line-relay. If the line-limb 4 becomes grounded or partially grounded, a circuit is closed through the line-relay 13. If the resistance of this leakage-path is sufficiently low, enough current may be forced through the line-relay 13 to cause an actuation thereof, thereby producing an illumination of the line-signaling lamp 15. The operator in attempting to answer the line-signal thus produced will learn that the actuation thereof has been due to a grounded line rather than to a call initiated from a subscriber's substation. She may therefore notify the proper parties, who may put the line in proper repair. If the test-relay were operable upon a less quantity of current than the line-relay, the application of a testing tip-contact to a test-thimble of a line whose line-limb 4 was partially grounded might cause an actuation of the test-relay, thereby indicating to the central-station operator that the line was in use. The resistance of the leakage-path from the line-limb 4 to ground being in this case of too high resistance to permit the actuation of the line-relay the operators would have no reliable means of knowing that

the apparent busy condition of the line, as indicated by the test-relay, was due rather to the leakage-path between the line-limb 4 and the ground than to the removal of the receiver from the switch-hook at the associated substation. The fact that more current is required for the operation of the test-relay than for the operation of the line-relay insures the operators against mistakes due to false busy-test signals due to leakage on the telephone-lines.

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 employed without departing from the spirit thereof. I do not wish to limit myself, therefore, 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 an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

2. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

3. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

4. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

5. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

6. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

7. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

8. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

9. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the con-

ductive continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

10. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the conductive continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

11. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the conductive continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

12. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the conductive continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

13. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

14. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

15. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test- contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

16. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

17. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

18. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

19. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-

contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

20. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

21. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of said break in the continuity of said cord-circuit.

22. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of said break in the continuity of said cord-circuit.

23. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of said break in the continuity of said cord-circuit.

24. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of said break in the continuity of said cord-circuit.

25. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes a connection of said test-contact, independent of said switching means, with the remainder of the cord-circuit.

26. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes a connection of said test-contact, independent of said switching means, with the remainder of the cord-circuit.

27. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes a connection of said test-contact, independent of said switching means, with the remainder of the cord-circuit.

28. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, switching means to connect

said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes a con nection of said test-contact, independent of said switching means, with the remainder of the cord-circuit.

29. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the conductive continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

30. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the conductive continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

31. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the conductive continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

32. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the conductive continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

33. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

34. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching-means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

35. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

36. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of a path in shunt of said switching means.

37. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a normally continuous cord-circuit, of a high-resistance and high-impedance test-relay, a test-contact, associated with the calling-plug of said cord connecting apparatus and normally disconnected from the test-relay, switching means to connect said test-relay with said test-con-

tact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of said break in the continuity of the cord-circuit.

38. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a normally continuous cord-circuit, of a test-relay, a test-contact, associated with the calling-plug of said cord connecting apparatus and normally disconnected from the test-relay, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of said break in the continuity of the cord-circuit.

39. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a normally continuous cord-circuit, of a high-resistance and high-impedance test-relay, a test-contact normally disconnected from said relay, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of said break in the continuity of the cord-circuit.

40. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a normally continuous cord-circuit, of a test-relay, a test-contact normally disconnected from said relay, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of said break in the continuity of the cord-circuit.

41. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of a path in shunt of said switching means.

42. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of a path in shunt of said switching means.

43. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of a path in shunt of said switching means.

44. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of a path in shunt of said switching means.

45. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a normally continuous cord-circuit, of a test-relay, a test-contact, associated with a calling-plug and normally disconnected from said relay, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line to cause the closure of said break in the continuity of said cord-circuit.

46. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with a calling-plug, switching means to connect said test-

relay with said test-contact, means whereby an actuation of said switching means causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line to cause the closure of a path in shunt of said switching means.

47. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and an auxiliary armature controlled by said supervisory relay, the actuation of said auxiliary armature being controlled by the insertion of said calling-plug within a telephone-line jack, said armature controlling the continuity of a path in shunt of said switching means.

48. In combination, an operator's cord-circuit for connecting telephone-lines for conversation, an operator's listening-key associated with said circuit, means upon actuation of said listening-key for causing a break in the telephonic continuity of said cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of the break in the continuity of said cord-circuit independently of said listening-key.

49. In combination, an operator's cord-circuit for connecting telephone-lines for conversation, an operator's listening-key associated with said circuit, means upon actuation of said listening-key for causing a break in the continuity of said cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of the break in the continuity of said cord-circuit independently of said listening-key.

50. In combination, an operator's cord-circuit for connecting telephone-lines for conversation, an operator's listening-key associated with said circuit, means upon actuation of said key for causing a break in the telephonic continuity of said cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of the break in the continuity of said cord-circuit independently of said listening-key.

51. In combination, an operator's cord-circuit for connecting telephone-lines for conversation, an operator's listening-key associated with said circuit, means upon actuation of said key for causing a break in the continuity of said cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of the break in the continuity of said cord-circuit independently of said listening-key.

52. In combination, an operator's cord-circuit for connecting telephone-lines for conversation, an operator's listening-key associated with said circuit, means upon actuation of said listening-key for causing a break in the telephonic continuity of said cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of the calling-plug with a telephone-line to cause the closure of said break in the continuity of said cord-circuit independently of said listening-key.

53. In combination, an operator's cord-circuit for connecting telephone-lines for conversation, an operator's listening-key associated with said circuit, means upon actuation of said listening-key for causing a break in the continuity of said cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of the calling-plug with the telephone-line to cause the closure of said break in the continuity of said cord-circuit independently of said listening-key.

54. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, a test-contact, associated with the calling-plug, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

55. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, a test-contact, associated with the calling-plug, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, asso-

ciated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of a path in shunt of said switching means.

56. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a test-relay normally disconnected from the cord-circuit, a test-contact, associated with the calling-plug, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

57. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, a test-contact, associated with the calling-plug, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

58. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a test-relay normally disconnected from the cord-circuit, a test-contact, associated with the calling-plug, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

59. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a high-resistance and high-impedance test-relay, a test-contact, associated with the calling-plug, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

60. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a test-relay, a test-contact, associated with the calling-plug, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

61. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a normally continuous cord-circuit, a high-resistance and high-impedance

test-relay, a test-contact, associated with the calling-plug and normally disconnected from said relay, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

62. In combination, a source of current at a central exchange, telephone-lines leading from substations to said exchange and adapted to be supplied with talking and signaling currents from said source, an operator's cord connecting apparatus for connecting two of said lines for conversation, a normally continuous cord-circuit, a test-relay, a test-contact, associated with the calling-plug and normally disconnected from said relay, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means to connect said test-relay with said test-contact causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line, to cause the closure of said break in the continuity of said cord-circuit.

63. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

64. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay normally disconnected from the cord-circuit, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

65. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

66. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay normally disconnected from the cord-circuit, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit and means independent of said switching means for restoring the continuity upon breaking thereof.

67. In an operator's cord connecting apparatus for connecting telephone-lines for conversation, the combination with a normally telephonically continuous cord-circuit, of a test-relay normally disconnected from the cord-circuit, a test-contact associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of said cord-circuit, and means independent of said switching means and said test-relay for restoring the continuity upon breaking thereof.

68. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, of a test-contact, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

69. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, of a test-contact, switching means to connect said test-relay with said test-contact, means whereby

an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and means independent of said switching means for causing a substitute connection of said test-contact with said cord-circuit immediately upon disconnection thereof.

70. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, of a test-contact, associated with the calling-plug of said cord connecting apparatus, an operator's listening-key for connecting her telephone set with the cord-circuit, switching means, associated with said listening-key to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the telephonic continuity of the cord-circuit, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of said break in the continuity of said cord-circuit.

71. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a high-resistance and high-impedance test-relay normally disconnected from the cord-circuit, of a test-contact, associated with the calling-plug of said cord connecting apparatus, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a disconnection of said test-contact from the remainder of the cord-circuit and a break in the continuity of the cord-circuit, a supervisory relay, and means whereby an actuation of said supervisory relay causes the closure of said break in the continuity of the cord-circuit.

72. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay normally disconnected from the cord-circuit, of a test-contact, associated with a calling-plug, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line to cause the closure of said break in the continuity of said cord-circuit.

73. In an operator's cord connecting apparatus, for connecting telephone-lines for conversation, the combination with a test-relay normally disconnected from the cord-circuit, of a test-contact, associated with a calling-plug, switching means to connect said test-relay with said test-contact, means whereby an actuation of said switching means causes a break in the continuity of the cord-circuit and a disconnection of said test-contact from the remainder of the cord-circuit, a supervisory relay, and means whereby said supervisory relay is actuated during the connection of said calling-plug with a telephone-line to cause the closure of a path in shunt of said switching means.

74. In combination, an operator's cord-circuit, for connecting telephone-lines for conversation, there being a break in the telephonic continuity of said cord-circuit, a test-relay normally disconnected from the cord-circuit, a test-contact, switching means to connect said relay with said test-contact, and means whereby the connection of said cord connecting apparatus with a called line causes the closure of the break in the continuity of said cord-circuit.

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.