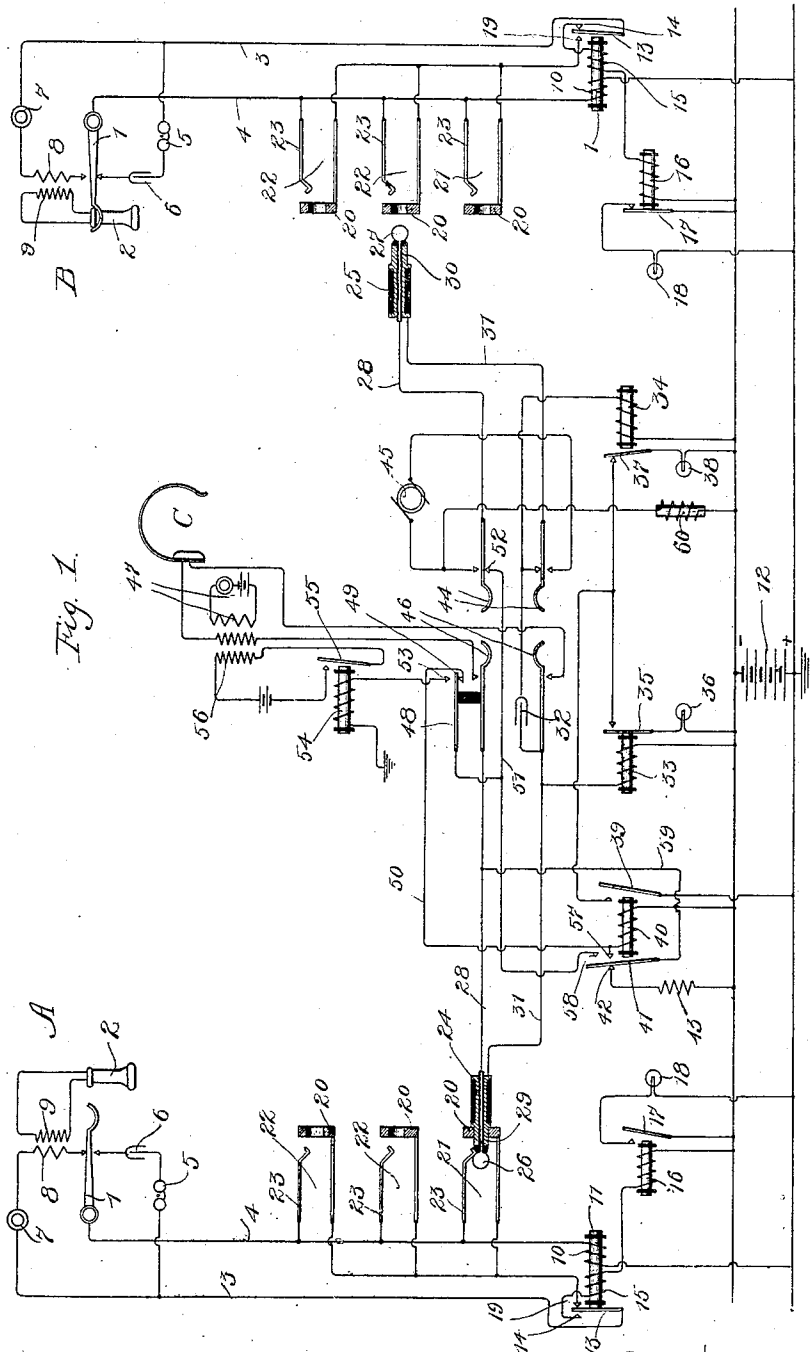


H. G. WEBSTER.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED MAY 7, 1903.

921,187.

Patented May 11, 1909.

2 SHEETS—SHEET 1.



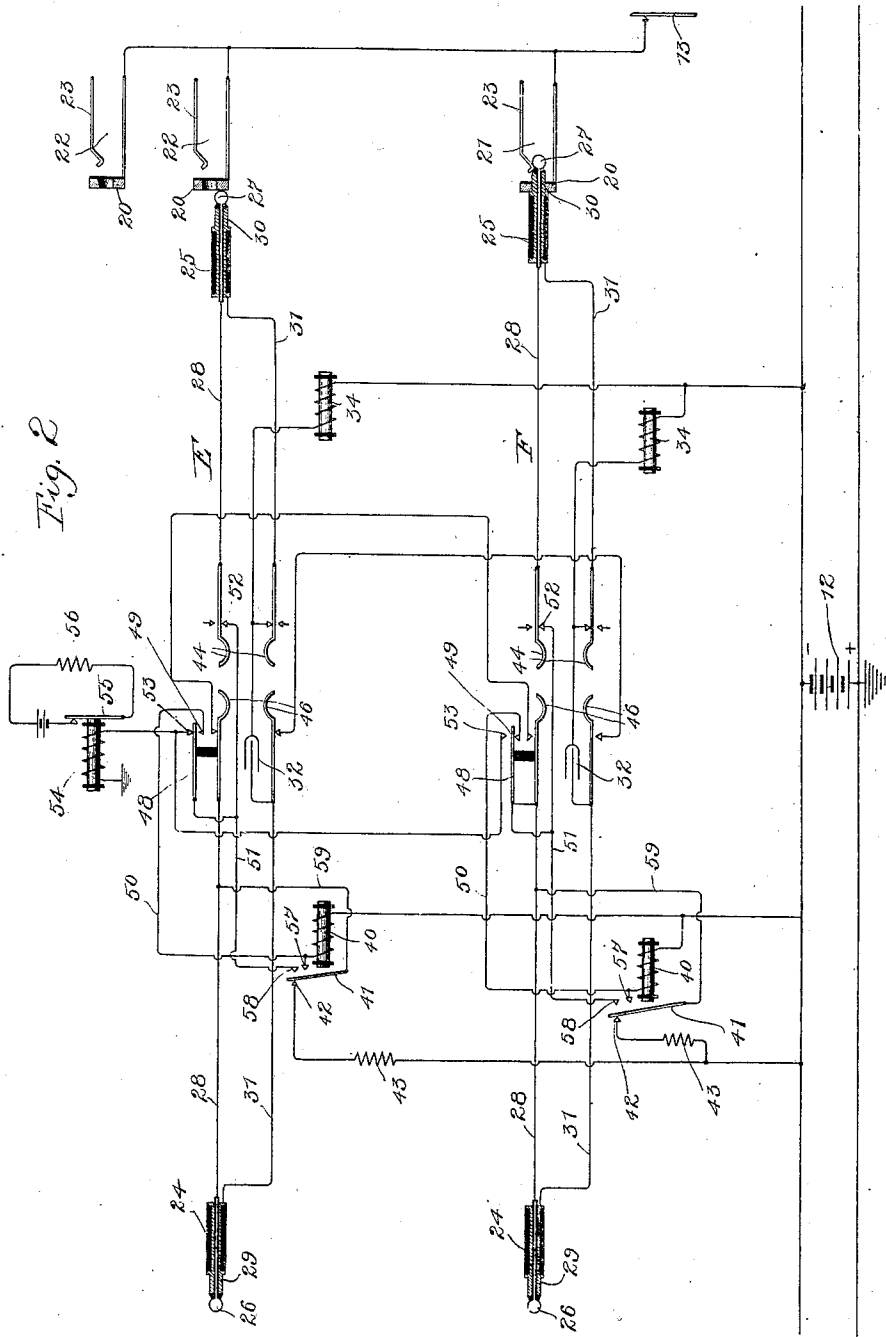
Witnesses
Leonard W. Novander.
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2 SHEETS—SHEET 2,



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UNITED STATES PATENT OFFICE.

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

TELEPHONE-EXCHANGE SYSTEM.

No. 921,187.

Specification of Letters Patent.

Patented May 11, 1909.

Application filed May 7, 1903. Serial No. 156,069.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, 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 part of this specification.

My invention relates to telephone exchange systems and more particularly to telephone exchange systems employing a multiple switchboard at the central station and is particularly well adapted for use in connection with such multiple switchboard systems in which a common source of current located at the central exchange may be employed for supplying the telephone lines leading thereto with both signaling and talking currents.

My present invention provides an improved busy test circuit and apparatus for use in conjunction with the central station operator's cord connecting apparatus for testing the condition of the called subscriber's line to ascertain whether or not such line is in use before establishing a connection therewith.

It has heretofore been the common practice to provide the multiple spring jacks of multiple switchboards each with a special testing contact, the potential of which is altered upon the connection with the associated line of an operator's cord circuit. As distinguished from such systems, my invention provides for the use of one of the line contacts of the spring jack for test purposes thereby avoiding the use of the additional contact heretofore found necessary.

In accordance with my invention, I find it desirable to use a test relay, preferably of high resistance and high impedance, through which the test circuit is established in making a test of a busy line. The provision of such a high wound test relay prevents a disagreeable click which might otherwise be produced in a subscriber's telephone receiver due to the establishment of a test circuit at the central station. The closure of a circuit through the high wound test relay does not undesirably affect the current flowing through the subscriber's substation apparatus for the reason that the current flowing through the test relay is very small

on account of the high resistance thereof and this small current is but gradually built up to its full strength due to the high impedance of the test relay winding. As distinguished from other test circuits which have heretofore been proposed and which employ such a high wound relay, the test circuit being controlled by a relay, my invention provides for the control of the test circuit by means of the usual operator's listening key which, if found desirable, may be provided with special contacts. It has been found desirable in practice to disconnect the testing tip of a calling plug from all parts of the operator's cord circuit with the exception of the test circuit proper. Thus upon a manipulation of the operator's listening key to establish a connection between the testing tip contact and the busy test circuit, the conductive continuity of one of the cord strands is interrupted. In accordance with my invention, I provide means whereby a circuit in shunt of the break in the cord strand due to a manipulation of the listening key may be closed upon the insertion of the calling plug within a jack of a line leading to a substation at which the telephone receiver has been removed from its hook.

The features of my invention will be readily understood by reference to the accompanying drawing which illustrates my improved test circuit applied to an operator's cord circuit adapted to be used in conjunction with the line circuit described in my Patent No. 688,452 of December 10th, 1901.

Figure 1, diagrammatically illustrates an operator's cord circuit with my invention applied thereto and a line circuit with which the cord circuit is well adapted for use. Fig. 2, illustrates two cord connecting apparatus, one of which is shown in the condition of making a busy test.

In Fig. 1, I have diagrammatically illustrated at each of the substations A and B the usual substation apparatus comprising in each instance a switch hook 1, which when in its normal depressed condition due to the weight of the receiver 2 connects between the line limbs 3 and 4 a call bell 5 and a serially connected condenser 6. When relieved of the weight of the receiver 2 the switch hook closes a conductive circuit between the line limbs 3 and 4, this circuit being traced through the battery transmitter 7 and the primary 8 of the induction coil

whose secondary 9 is connected with the receiver 2. The line limbs 3 and 4 lead to the central station C, the line limb 4 being connected through a winding 10 of the differential relay 11, and with the positive grounded pole of the common battery 12. The line limb 3 is permanently connected with the armature 13 of the differential relay 11, this armature when in its normal unattracted condition serving in conjunction with the back contact 13 to close a circuit from the line limb 3 through the winding 15 of the differential cut-off relay 11 and the winding of the line relay 16 to the negative pole of the common battery 12. The armature 17 of the line relay 16 controls a local circuit through the line signaling lamp 18. It will be noted that the windings 10 and 15 of the relay 11 are differentially connected so that the closure of a conductive circuit between the line limbs 3 and 4 at the substation A will cause no net energization of the relay to cause the attraction of the armature 13. The armature 13 is provided with a front contact 19, connected with the sleeve contacts 20 20 of the answering jack 21 and the multiple line jacks 22 22, the tip contacts 23 of these jacks being permanently connected with the line limb 4, as shown. The sleeve contacts 20 20 also serve as the testing thimbles of the spring jacks.

The operator's cord connecting apparatus comprises the answering plug 24 and the calling plug 25, the tip contacts 26 and 27 of these plugs being connected by means of the tip cord strand 28, while the sleeve contacts 29 and 30 of the plugs are connected by means of the sleeve strand 31. The conductive continuity of the sleeve strand 31 is interrupted by means of the serially connected condenser 32, the condenser, however, being shunted by a circuit through the supervisory relays 33 and 34, these relays being each connected between the sleeve strand 31 of the cord circuit and the negative pole of the common battery 12, one relay being connected on either side of the condenser 32. The supervisory relay 33 is provided with an armature 35 which controls a local illuminating circuit through the supervisory signaling lamp 36. The supervisory relay 34 is provided with an armature 37 which in the same manner controls the continuity of a local illuminating circuit through the supervisory signaling lamp 38. The connection of the positive grounded pole of the common battery 12 with the local circuits through the supervisory signaling lamps 36 and 38 is also controlled by the armature 39 of the supervisory controlling relay 40. The supervisory controlling relay is provided with an auxiliary armature 41 which normally closes a circuit through its back contact 42 and the resistance 43 between the negative pole of

the common battery 12 and the tip strand 28 of the operator's cord circuit. There is provided the usual operator's ringing key 44 which, when manipulated, serves to connect the terminals of the ringing generator 45 in bridge of the cord strands leading to a calling plug 25. There is also provided the operator's listening key 46 which when manipulated serves to connect the operator's telephone set 47 in bridge of the cord strands. There is operatively associated with the upper spring of the listening key an auxiliary contact spring 48 which, when in its normal position, in connection with the front contact 49 serves to close a circuit from the negative pole of the common battery 12 through the winding of the supervisory controlling relay 40, the conductor 50, the front contact 49, the spring 48, and the conductor 51 to the contact 52 normally connected with the tip strand 38 leading to the calling plug 25. When in its alternate position in connection with the back contact 53, the contact spring 48 closes a circuit from the tip contact of the calling plug 25, through the contact 52 and the conductor 51, through spring 48 and contact 53 and through the winding of the test relay 54 to the ground, to which the positive pole of the common battery 12 is tied, as shown. The test relay 54 is preferably wound to a high resistance and high impedance for a purpose which will more fully appear hereafter. The test relay may if found desirable be common to a number of cord circuits; for instance, all of the cord circuits for any one operator's position. The armature 55 of the test relay 54 controls a local circuit through a test winding 56 inductively related to the induction coil of the operator's telephone set, as shown.

The armature 41 is provided with front contacts 57 and 58, the connection with the armature and the contact 57 serving to close a circuit between the contact 49 and the tip strand 28 of the cord circuit leading to the tip contact 26 of the answering plug. The connection of the armature 41 with the contact 57 also serves to close a direct circuit between the negative pole of the battery 12 and the tip strand leading to the answering plug. A connection between the armature 41 and the front contact 58 serves to more directly close by means of the conductors 50 and 59 a conductively continuous circuit between the tip contacts of the calling and the answering plugs.

The operation of my invention and the system to which it is applied may be described as follows: The removal of the receiver 2 from the switch hook at substation A causes the closure of a conductive circuit between the line limbs 3 and 4 whereby current may be traced through the following circuit: from the negative pole of the com-

mon battery 10 through the line relay 16, the winding 15, of the differential cut-off relay of contact 14, the armature 13, line limb 3, transmitter 7, primary coil 8, switch hook 1, line limb 4, winding 10 back to the positive pole of the battery 12. On account of the differential winding of the two coils of the cut-off relay 11, there will be no consequent attraction of the armature 13. The line relay 16, however, will be energized to cause the attraction of its armature 17 whereupon a local circuit will be closed through the line signaling lamp 18 to cause the illumination thereof. In response to the line signal, the operator thereupon inserts the plug 24 within the answering jack 21, causing the closure of a circuit which may be traced as follows: from the negative pole of the battery 12 through the resistance 43, contact 42, armature 41, conductor 59, tip strand 28, tip contact 26, tip spring 23, winding 10 of the differential relay 11, to the positive pole of the battery 12. The closure of this circuit permits an increased flow of current through the winding 10 of the differential relay whereby the energization due to the current flowing through the winding 15 is overpowered, thereby causing an attraction of the cut-off relay armature 13. The attraction of this armature at once breaks the circuit previously traced through the winding 15, the current flowing through the winding 10 serving to retain the armature 13 in its forward attracted position, as shown. The break in the connection between the armature 13 and the contact 14 also serves to cause the deenergization of the line relay 16, whereupon the armature 17 is retracted to cause the extinguishment of the line signaling lamp 18. Talking current is now fed to the substation as follows: from the positive side of battery 12, through winding 10 to line limb 4, through substation apparatus to line limb 3, through armature 13 and contact 19 to the sleeve contact, through the sleeve of plug 24 to conductor 31 and through relay 33 to the negative side of the battery. The energization of the supervisory relay 33 causes the attraction of the armature 35, whereby the circuit through the supervisory signaling lamp 36 is opened. As yet no circuit will have been closed through the supervisory controlling relay 40 to cause the attraction of the armature 39 to connect the positive pole of the battery with the local illuminating circuit of the lamps 36 and 38. It will be apparent that the resistance 43 may or may not be employed, as found desirable, and the resistance may or may not have impedance. Having thus established a connection between the line circuit and the cord circuit, the operator manipulates her listening key 46 to connect her telephone set 47 in bridge of the cord strands leading to the answering jack 21. By tele-

phonic communication with the subscriber at substation A she ascertains the number of the substation with which connection is desired. Learning that the subscriber at substation B is wanted, the operator proceeds to test the condition of the line leading to substation B to learn whether or not the same is in use. In making such a busy test, the operator throws her listening key into its abnormal position to break the connection between contacts 48 and 49 and to establish connection between the contact spring 48 and the contact 53 connected with the test relay 54. The operator then applies the testing tip contact 27 of her calling plug to a test thimble 20 of one of the line jacks 22 associated with the line to substation B. If the line to substation B is already in use, an operator at some other section of the multiple switch board will have inserted a plug of her cord connecting apparatus within one of the jacks associated with the line to substation B. Upon the application, therefore, of the testing contact 27 to a sleeve contact 20, of a jack 22 the following circuit will be closed: from the positive pole of the battery 12 through test relay 54, contact 53, contact spring 48, conductor 51, contact 52, tip strand 28, tip contact 27, sleeve contact 20, thence through a sleeve contact of a plug of some other cord connecting apparatus and through the corresponding supervisory relay to the negative pole of the battery 12. The closure of this circuit through test relay 54 will cause its energization and the attraction of the armature 55, thereby closing the local circuit through the test winding 56, thereby producing a click in the receiver of the operator's telephone set, thereby indicating to her that the tested line is already in use.

If at the time the plug of some cord circuit is inserted within a jack associated with the line to substation B the receiver at substation B is removed from its switch hook, the application of the testing tip contact 27 to a sleeve contact 20 will also effect the closure of a circuit from the testing tip contact through the sleeve contact 20, front contact 19, armature 13, line limb 3, transmitter 7, primary winding 8, switch hook 1, line limb 4, tip spring 23, the tip contact of some other cord connecting plug, tip strand of the associated cord circuit, and thence through the conductor 59 and the armature 41, and through either the resistance winding 43 or the supervisory controlling relay 40 of the other cord circuit to the negative pole of the common battery 12. The closure of this circuit through the substation apparatus does not produce a disagreeable click or disturbance of the substation receiver for the reason that the high resistance of the test relay 54 permits the flow of only a small current through this circuit

and the high impedance of the test winding 54 causes this small current to rise very slowly to its maximum value. If the line to substation B is not in use, there will be no circuit established upon the application of the testing tip contact to the test thimble of the tested line for the reason that the test thimbles are normally insulated and disconnected from any portion of the line circuit. Upon finding that the line to substation B is not in use the operator inserts her calling plug within a calling jack 22. The subsequent restoration of the listening key 46 to its normal position causes a break in the connection between the contact spring 48 and the contact 53 and closes a connection between the contacts 48 and 49. A circuit may now be traced as follows: from the negative pole of the common battery 12 through the supervisory controlling relay 40, the conductor 50, contact 49 contact spring 48, conductor 51, contact 52, tip strand 28, tip contact 27, tip spring 23, winding 10 of the differential cut-off relay 11 to the positive pole of the battery 12. Current flowing through this circuit causes the attraction of the armature 13 of the differential cut-off relay thereby connecting the sleeve contacts 20 of the multiple jacks directly with the line limb 3 to substation B and at once breaking the connection through the line signaling relay 16 and the winding 15 of the cut-off relay to the line limb 3 leading to substation B. Furthermore, the energization of the supervisory controlling relay 40 due to the passage of current there-through causes the attraction of the armatures 39 and 41. The attraction of the armature 39 causes the connection of the positive pole of the common battery 12 with the local illuminating circuit for the supervisory signaling lamps 36 and 38. The lamp 36, however, will not be illuminated for the reason that the armature 35 has already been attracted into its forward position, as heretofore explained. The armature 37, however, being in its normal position in connection with its back contact, the supervisory signaling lamp 38 will be caused to glow, thereby indicating that the subscriber at substation B has not removed his telephone from the switch hook. The attraction of the armature 41 into its forward position momentarily breaks the circuit through the resistance 43 to the tip strand of the cord circuit, but the connection between the negative pole of the battery and the tip strand is immediately closed by the connection through the supervisory controlling relay 40, the front contact 57, armature 41, and conductor 59. The flow of current through the winding 10 of the differential relay 11 may now be traced through the supervisory controlling relay 40 rather than through the resistance 43, the flow of current through this circuit serving

to maintain the armatures 39 and 41 in their forward attracted positions regardless of the ensuing manipulations of the listening key 46 with the auxiliary spring 48, or of the calling plug 25.

It will be noted that before the attraction of the armatures 39 and 41 the tip cord strand has not been conductively continuous between the answering and the calling plugs. The connection between the armature 41 and the front contact 58, however, establishes a conductively continuous circuit through the tip strand of the cord circuit, this circuit being traced from the tip contact 26, through the conductor 59, armature 41, contact 58, conductor 51, and contact 52 to the tip contact 27 of the calling plug. It will be understood that the conductive continuity of the tip cord strand is necessary in order to carry the voice current between the telephone lines to substations A and B. It is desirable, however, that at the time of making the busy test the operation of the cord connecting apparatus which has been connected with the line to substation A be entirely disconnected from the test circuit. It will be seen that the test circuit is entirely free from the operation of the cord connecting apparatus which is connected with the answering plug 24 until after the calling plug 25 has been inserted within a line jack associated with the called line. After having inserted her calling plug within a line jack, thereby causing the actuation of the supervisory controlling relay 40, the operator manipulates her ringing key 44 to connect the terminals of the generator 45 in bridge of the cord strands connected with the calling plug 25, thereby sending an alternating current over the line limbs 3 and 4 to the signal bell at substation B, the actuation of which calls the subscriber to his phone. In order that the armature 13 of the differential cut-off relay 11 shall not be retracted due to the break in the circuit previously traced through the winding 10, due to the manipulation of the ringing key, I have found it desirable to provide a connection between the upper tip contact of the ringing key and the negative pole of the common battery 12, this connection desirably including an impedance coil 60. Upon removing the receiver at substation B from the switch hook a circuit is closed through the supervisory relay 34 whereby the armature 37 is attracted to cause an extinguishment of the supervisory signaling lamp 38. Upon completing the conversation either subscriber upon replacing his receiver upon the switch hook causes a break in the circuit previously established through the corresponding supervisory relay. The consequent deenergization of the corresponding supervisory relay causes the illumination of its associated signaling lamp to notify the operator

that the connected subscribers have finished their conversation. She thereupon removes the plugs of her cord connecting apparatus from the line jacks, whereupon all of the
5 relays are deenergized to cause the retraction of their armatures into their normal positions.

In Fig. 2, I have diagrammatically illustrated parts of two cord circuits as connected with multiple line jacks in making
10 a busy test. The calling plug 25 of cord circuit F is shown inserted in answering jack 21 of a telephone line. The listening key of the cord circuit E is shown in its
15 abnormal position, whereby the common test relay is connected to the calling tip contact of cord circuit E. This testing tip contact is shown applied to the test thimble 20
20 of a line jack 22, whereby a circuit may be traced through the test relay as follows: from the positive grounded pole of the common battery 12 through the test relay 54,
25 contact 53, contact spring 48, conductor 51, contact 52, tip strand 28, and tip contact 27, all of cord circuit E, test thimble 20 of line jack 22, test thimble 20 of answering
30 jack 21, sleeve contact 30 of cord circuit F, the corresponding sleeve strand 31, supervisory relay 34 to the negative pole of the battery 12. As hereinbefore described, the
35 passage of current through this circuit causes the energization of the test relay to attract its armature 55, thereby effecting an actuation of the signaling device controlled
by the test relay to indicate to the operator the busy condition of the tested line.

While I have herein described one preferred embodiment of my invention, it will be apparent to those skilled in the art that
40 many modifications may be employed without departing from the spirit thereof. I do not, therefore, wish to limit myself to the precise disclosure herein set forth, but

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

1. In a telephone system, the combination with a telephone line having testing terminals, of a cord circuit having an answering
50 and a calling plug, a test relay normally disconnected from the tip of said plugs, an operator's listening key, actuation of said key causing the tip strand of only the calling plug to be connected with said test relay,
55 and means upon connection of the calling plug with the line for causing the tips of both plugs to be connected with said test relay.

2. In a telephone exchange system, the
60 combination with a telephone line extending by its limbs from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling
65 current to said line, a plurality of line jacks at the exchange each having a test thimble

connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve
strands connecting tip and sleeve contacts of said plugs, said tip strand being normally
discontinuous, an operator's telephone set, a
70 listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby
75 the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a supervisory controlling relay controlling the break in the continuity of the tip cord strand, said
80 relay being primarily controlled when said listening key is in its normal position by the insertion of the calling plug within a line jack to close the break in the continuity
85 of the tip cord strand, an actuation of said relay serving to provide a secondary control thereof dependent upon the insertion of the answering plug within a line jack.

3. In a telephone exchange system, the
90 combination with a telephone line extending by its limbs from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling
95 current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve
100 strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone
105 set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves
110 to connect said test relay with the tip contact of said calling plug, and a relay controlling the break in the continuity of the tip cord strand, said relay being primarily
115 controlled when said listening key is in its normal position by the insertion of the calling plug within a line jack to close the break in the continuity of the tip cord strand, an actuation of said relay serving to provide a
secondary control thereof dependent upon the insertion of the answering plug within a line jack.

4. In a telephone exchange system, the
120 combination with a telephone line extending by its limbs from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling
125 current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve
130 strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone

set, a listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a supervisory controlling relay controlling the break in the continuity of the tip cord strand, said relay being primarily controlled by the insertion of the calling plug within a line jack to close the break in the continuity of the tip cord strand, an actuation of said relay serving to provide a secondary control thereof dependent upon the insertion of the answering plug within a line jack.

5. 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 for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a relay controlling the break in the continuity of the tip cord strand, said relay being primarily controlled by the insertion of the calling plug within a line jack to close the break in the continuity of the tip cord strand, said relay serving to provide a secondary control thereof dependent upon the insertion of the answering plug within a line jack.

6. 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 for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a supervisory controlling relay controlling the break in the

continuity of the tip cord strand, said relay being primarily controlled when said listening key is in its normal position by the insertion of the calling plug within a line jack to close the break in the continuity of the tip cord strand, an actuation of said relay serving to close an auxiliary energizing circuit therethrough, said auxiliary circuit including the tip contact of the answering plug.

7. 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 for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a relay controlling the break in the continuity of the tip cord strand, said relay being primarily controlled when said listening key is in its normal position by the insertion of the calling plug within a line jack to close the break in the continuity of the tip cord strand, an actuation of said relay serving to close an auxiliary energizing circuit therethrough, said auxiliary circuit including the tip contact of the answering plug.

8. 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 for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a supervisory controlling relay controlling the break in the continuity of the tip cord strand, said relay being primarily controlled by the insertion of the calling plug within a line jack to close the

break in the continuity of the tip cord strand, an actuation of said relay serving to close an auxiliary energizing circuit therethrough, said auxiliary circuit including the tip contact of the answering plug.

9. 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 for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a supervisory controlling relay controlling the break in the continuity of the tip cord strand, said relay being primarily controlled by the insertion of the calling plug within a line jack to close the break in the continuity of the tip cord strand, an actuation of said relay serving to close an auxiliary energizing circuit therethrough, said auxiliary circuit including the tip contact of the answering plug.

10. 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 for supplying talking and signaling current to the line, a plurality of line jacks at the exchange each having a test thimble connected to one of said limbs, a normally discontinuous cord circuit for connecting said line with another for conversation, an operator's telephone set, an operator's listening key for connecting said telephone set with said cord circuit, a normally open test circuit adapted upon actuation of said key to include said test contact, a test signal included in said circuit, means upon connection of said cord circuit with said line for establishing the continuity of the cord circuit, means upon actuation of said listening key when said cord circuit is connected with the line tending to break the continuity of said cord circuit, and additional means for maintaining the continuity of the cord circuit independent of the listening key.

11. In a telephone exchange system, the combination with a central exchange, of telephone lines leading therefrom and terminating in substations, a normally discontinuous cord circuit for connecting telephone lines for conversation, a calling plug and an operator's

listening key associated with said cord circuit, and a relay normally connected with the calling plug through the listening key, connection of the calling plug with a telephone line causing the completion of a circuit through said relay whereby said relay is energized to close a path therefrom to said calling plug independently of the listening key, said relay upon energization also serving to establish the continuity of the cord circuit.

12. In a telephone exchange system, the combination with a central exchange, of telephone lines leading therefrom and terminating in substations, a cord circuit at the central exchange provided with an answering and a calling plug, an operator's listening key for said cord circuit, the tip strand of said cord circuit being normally discontinuous, a relay having its winding normally connected with the tip of the calling plug, through the listening key and through part of the discontinuous tip strand, connection of the calling plug with a line closing a circuit through said relay winding, whereby said winding is directly connected with the calling plug tip independently of the listening key, actuation of said relay also causing the continuity of the tip strand to be established.

13. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith for conversation, an operator's listening key for the cord circuit, a supervisory relay having its coil normally connected with a talking strand of the cord circuit through contacts of said listening key and adapted to be disconnected from said strand when the listening key is actuated, and a locking circuit for said relay adapted to close a circuit in shunt of the contacts of said listening key, substantially as described.

14. In a telephone system, the combination with a cord circuit, of a listening key associated with the cord circuit, a testing strand associated with the cord circuit, a relay for the cord circuit controlling contacts of said testing strand, the circuit of said relay being controlled by contacts of the listening key, whereby when the listening key is actuated the circuit of said relay is maintained broken, substantially as described.

15. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a testing conductor for the cord circuit, a relay controlling contacts of said testing conductor, an operator's listening key having series contacts in the circuit of said relay, whereby when the listening key is actuated the circuit of said relay is open, said relay having contacts in shunt of the series contacts of said key,

whereby when the relay is actuated the actuating of the key will not open the circuit of the relay, substantially as described.

5 16. In a telephone system, the combination with a cord circuit, of a source of current, a supervisory relay connected between a talking strand of said cord circuit and said source, a listening key for the cord circuit
10 having contacts normally in the circuit between the coil of said relay and said strand of the cord circuit, the actuating of said relay being adapted to close contacts in shunt of the contacts of said listening key, whereby a locking circuit is completed for
15 said relay, and whereby the listening key may be again actuated without severing the circuit of said supervisory relay, substantially as described.

17. In a telephone system, the combina-

tion with a cord circuit, of a source of current therefor, a listening key, a supervisory relay for the cord circuit, said relay being normally connected with a contact of the calling plug of said cord circuit through the normal contacts of said listening key, 25 contacts of said relay adapted to close a shunt about normal contacts of said listening key when the relay is actuated, whereby the listening key may thereafter be actuated without severing the circuit of said supervisory relay, substantially as described. 30

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

HARRY G. WEBSTER.

Witnesses:

LYNN A. WILLIAMS,
HARVEY L. HANSON.