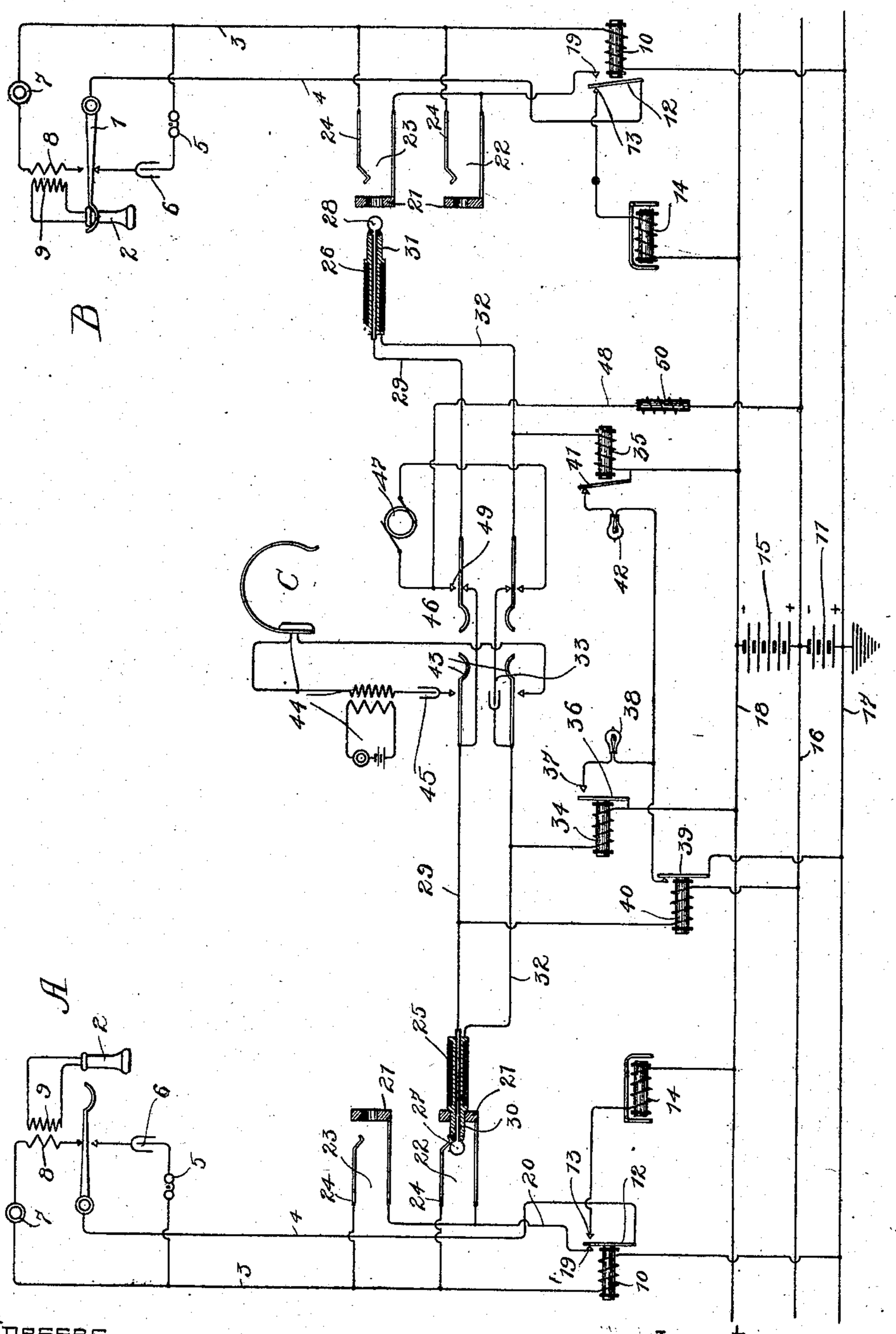
No. 840,726. PATENTED JAN. 8, 1907.

H. G. WEBSTER.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED MAY 28, 1903.



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TELEPHONE-EXCHANGE SYSTEM.

No. 840,726. Specification of Letters Patent. Patented Jan. 8, 1907.

Application filed May 28, 1903. Serial No. 159,118.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to telephone-exchange systems, and more particularly to telephone systems in which a central source of current is employed for the purpose of supplying both signaling and talking currents to the subscriber's telephone-lines.

My invention provides for the normal inclusion at the central station, in series with a subscriber's line, of two electromagnetic devices, one of which may be known as the "cut-off relay" and the other as an "electromagnetic signal-controlling device." The resistances and adjustments of these electromagnetic devices are preferably made such that the closure of a conductively-continuous circuit through the line at the substation associated therewith will not permit the passage of sufficient current to cause the actuation of the cut-off relay, while sufficient current will pass to cause the actuation of the electromagnetic signal-controlling device.

A cord-circuit is employed for interconnecting telephone-lines for conversation, and means are provided whereby the connection of an operator's cord connecting apparatus with a telephone-line causes the closure of a circuit of decreased resistance through the cut-off relay, whereby the same is sufficiently energized to attract its armature, thereby destroying the control of the electromagnetic line-signal-controlling device by the subscriber's substation apparatus.

My invention will be readily understood by reference to the accompanying drawing, in which at each of the substations A and B is shown the usual subscriber's substation apparatus, comprising a switch-hook 1, which when in its normal depressed condition, due to the weight of the receiver 2, serves to connect between the line-limbs 3 and 4 a signal-bell 5 and the serially-connected condenser 6. When relieved of the weight of the receiver 2, the switch-hook 1 assumes its alternate position, thereby connecting in a conductively-continuous circuit with the line-limbs 3 and 4 the battery-transmitter 7 and the primary 8 of an induction-coil whose secondary 9 is connected with the receiver 2. The line-limbs 3 and 4 lead to the exchange, the line-limb 3 being serially connected through the winding of a cut-off relay 10 with the positive grounded pole of the section 11 of the common battery thereat.

The line-limb 4 leads to the armature 12 of the cut-off relay 10. This armature when in its normally unattracted position in connection with the back contact 13 serves to connect the line-limb 4 through an electromagnetic signal-controlling device or line-signal 14 with the negative pole of the section 15 of the common battery. I have also illustrated a form of electromagnetic signal-controlling device commonly known as a "visual" line-signal, in which a mechanical shutter is attached to the electromagnet-armature. It will be at once understood by those skilled in the art that any other form of electromagnetically-controlled signal may be employed.

As illustrated in the drawing, the sections 11 and 15 of the common battery are connected in series, and the total voltage between the extreme terminals of this common battery may desirably be made approximately forty volts. The section 11 may be of approximately four-volts pressure, while the section 15 will therefore be of approximately thirty-six volts in pressure. While I have found these particular voltages to be well adapted for practical operation, it will be apparent to those skilled in the art that these voltages may be subject to wide variations without departing from the spirit of my invention, and, indeed, it is possible to devise a circuit incorporating my invention in which no intermediate terminal or bus bar 16 is required. The extreme terminals of the battery are desirably connected with the bus-bars 17 and 18, as shown. The cut-off relay is provided with a front contact 19 for the armature 12, whereby the attraction of this armature serves to connect the line-limb 4, through the conductor 20, directly with the sleeve-contacts 21 21 of the answering-jack 22 and the multiple-line jack 23. These sleeve-contacts 21 also serve as the test-thimbles for the line-jacks. The tip springs or contacts of these line-jacks are connected directly with the line-limb 3. The operator's cord connecting apparatus which I have illustrated comprises an answering-plug 25 and a calling-plug 26, the tip-contacts 27 and

28 of these plugs being connected through the conductively-continuous cord-strand 29. The sleeve-contacts 30 and 31 are connected through a sleeve-strand 32, the conductive continuity of this sleeve-strand being preferably interrupted by the serial inclusion of the condenser 33, this condenser being shunted by the windings of the supervisory relays 34 and 35, the relay 34 being connected between the sleeve-strand 32 leading to the answering-plug 25 and the bus-bar 18 and the winding of the supervisory relay 35 being connected between the bus-bar 18 and the section of the sleeve-strand 32 leading to the calling-plug 26. The supervisory relay 34 is provided with an armature 36, which when in its normal unattracted position, in connection with the back contact 37, closes a circuit through the supervisory signaling-lamp 38, the circuit through this lamp, however, being further controlled by the armature 39 of a supervisory controlling-relay 40. The armature 41 of the supervisory relay 35 similarly controls the local circuit for the supervisory signaling-lamp 42. The supervisory controlling-relay 40 is desirably connected between the bus-bar 16 and the tip-strand of the cord-circuit. The usual operator's listening-key 43 serves when manipulated to connect the operator's telephone set 44 in bridge of the cord-strands, the condenser 45 being desirably included in the operator's telephone-circuit. A ringing-key 46 serves when in its alternate position to connect the terminals of a ringing-generator 47 with the sleeve-strands leading to the calling-plug 26. As will hereinafter be more fully explained, the actuation of the cut-off relay is controlled by a circuit traced through the tip cord-strand, and in order that the manipulation of the ringing-key may not interrupt the circuit through the cut-off relay I find it desirable to provide a conductor 48, running from the contact 49 to the bus-bar 16. This conductor may desirably serially include an impedance-coil 50.

The operation of a telephone system constructed in accordance with my invention may be described as follows: A subscriber at substation A in initiating a telephone-call removes his receiver 2 from the switch-hook 1, thereby closing a conductively-continuous circuit between the line-limbs 3 and 4. Current flowing over this circuit may be traced as follows: from the negative pole of the common battery, through the bus-bar 18, the line-signal 14, contact 13, armature 12, line-limb 4, switch-hook 1, primary coil 8, transmitter 7, line-limb 3, cut-off relay 10, and thence through the bus-bar 17, to the positive grounded pole of the common battery. The line-signal 14 may desirably be made of very high resistance, the resistance of the cut-off relay 10 being desirably quite low. Furthermore, the adjustment of these relays is made such that the high resistance of the line-relay will not permit sufficient current to flow through the circuit last traced to cause an actuation of the cut-off relay 10. Sufficient current does flow over this circuit, however, to cause the actuation of the line-signal 14, thereby indicating to the central-station operator that a connection is desired. The operator answers this signal by inserting the answering-plug 25 of her cord-connecting apparatus within the answering-jack 22. The insertion of this plug causes the closure of a circuit which may be traced as follows: from the bus-bar 16, through the supervisory controlling-relay 40, which may desirably be of comparatively low resistance, the tip-strand 29, tip-contact 27, tip-spring 24, cut-off relay 10, and the bus-bar 17. While the potential which forces current through this circuit is of but four-volts pressure, the resistances of the relays 40 and 10 are such as to permit the passage of sufficient current to cause the attraction of the armature 12 of the cut-off relay 10. The attraction of the armature 12 into its front position in connection with the contact 19 serves at once to connect the line-limb 4 directly with the sleeve-contacts 21 of the associated line-jacks and also to interrupt the circuit previously traced through the line-signal 14, thereby destroying the substation control of this signal. A circuit may now be traced as follows: from the bus-bar 18, connected with the extreme negative pole of the common battery, through the supervisory relay 34, the sleeve-strand 32, sleeve-contact 30, sleeve-contact 21, conductor 20, front contact 19, armature 12, line-limb 4, switch-hook 1, primary coil 8, transmitter 7, line-limb 3, cut-off relay 10, and thence through the bus-bar 17 to the extreme positive pole of the common battery. Current flowing through this circuit causes an increased energization of the cut-off relay 10 and also a sufficient energization of the supervisory relay 34 to cause the attraction of its armature 36, thereby preventing the illumination of the supervisory signaling-lamp 38.

The operator manipulates her listening-key to connect her telephone set in bridge of the cord-circuit and by telephonic communication with the subscriber at substation A ascertains the number of the substation with which the calling subscriber desires connection. Learning that substation B is desired, the operator first applies the tip-contact 28 of her calling-plug to a testing-thimble 21 of the line-jack associated with the line to substation B to ascertain whether or not this line is in use. Under normal conditions when the line to substation B is idle the test-thimbles 21 are insulated from other parts of the telephone-circuit, whereby the application of the testing tip-contact to the insulated thimble produces no click or

disturbance in the operator's telephone-receiver, thus indicating that the line is idle. If, however, an operator at some other position on a multiple switchboard has inserted a plug of her cord connecting apparatus within one of the line-jacks associated with the line to substation B, the application of the testing tip-contact 29 to the test-thimble 21 will cause the closure of a circuit, which may be traced as follows: from the bus-bar 16, through the supervisory controlling-relay 40, the tip-strand 29, tip-contact 28, testing-contact 21, the sleeve-contact of some other cord connecting-plug, through the sleeve-strand 32 of this other cord-circuit, and a supervisory-relay, to the bus-bar 18. The closure of this circuit produces a click in the operator's telephone-receiver to indicate to her that the line with which connection is desired is already in use.

It will of course be apparent to those skilled in the art that many other test-circuits and arrangements may be used in place of that herein described, and I do not wish to limit myself to the use of this particular means of testing the condition of telephone-lines.

If the operator finds that the line to substation B is idle, she inserts the calling-plug 26 within a line-jack 23, thereby causing the closure of the following circuit: from bus-bar 16, through the supervisory controlling-relay 40, the conductively-continuous tip cord-strand 29, tip-contact 28, tip-spring 24, the winding of the cut-off relay 10, to the bus-bar 17. The closure of this circuit causes the energization of the cut-off relay 10, whereby its armature 12 is attracted to connect the line-limb 4 directly with the sleeve-contacts 21, associated with the called line. At the same time the line-circuit through the line-signal 14 is broken to destroy the substation control of this signal.

It will be remembered that the energization of the supervisory controlling-relay 40 will have caused the closure of the local illuminating-circuit through the supervisory signaling-lamp 42. The operator after having inserted the calling-plug within the jack 23 manipulates her ringing-key to connect the terminals of the generator 47 with the line-limbs leading to substation B. She thereby actuates the call-bell 5 to signal the subscriber. The subscriber in answering the call removes the receiver from the switch-hook, thereby interrupting the circuit through the call-bell 5 and closing a conductively-continuous circuit between the line-limbs 3 and 4, thus connecting his telephone set with the line. The removal of the receiver from the switch-hook causes the closure of a circuit through the supervisory relay 35, whereupon the armature 41 is attracted to break the local illuminating-circuit through the supervisory signaling-lamp 42, thereby causing its extinguishment to indicate to the central-station operator that the calling-signal has been answered by the subscriber at substation B. The subscribers are now properly connected for conversation, upon the completion of which either subscriber upon replacing his receiver upon the switch-hook causes the interruption of the circuit traced through the corresponding supervisory relay, whereby this relay is deënergized, thereby permitting the retraction of its armature to cause the closure of a local illuminating-circuit through the associated supervisory signaling-lamp. The operator upon noting the illumination of the supervisory signaling lamp or lamps removes the plugs of the cord connecting apparatus from the line-jacks, thereby causing the deënergization of all the relays through which circuits have been traced, thus causing a restoration of the apparatus to its normal condition.

The high resistance of the line-signal may be obtained by winding the line-signal coils with German silver or other high-resistance wire. It is of course immaterial whether the entire resistance of the line-signal or electromagnetic signal-controlling device be wound entirely upon the line-signal or whether a part of this resistance be included in the circuit through the line-signal between the contact 13 and the bus-bar 18.

It will be seen that with the arrangement of the potentials of the source of current as herein described the operation of the cut-off relay is effected by a current of four-volts pressure, while the pressure utilized in setting up the telephonic voice-currents over the telephone-line circuit is of very nearly forty-volts intensity.

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, therefore, wish to limit myself to the precise disclosure herein set forth; but,

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

1. In a telephone-exchange system, the combination with a subscriber's line-circuit, of a low-resistance cut-off relay, a high-resistance line-signal and a souce of current all normally in the line-circuit, test-terminals normally disengaged from the line, and means for operating said cut-off relay to disconnect the line-signal and connect said test-terminals to the line when a connection is established therewith at central.

2. In a telephone-exchange system, a subscriber's line-circuit, a marginally-adjusted relay, a line-signal and a source of current all connected in the line and so arranged that a flow of current may be determined in the line by the subscriber to energize the signal but not to actuate said relay, test-terminals

for said line normally disconnected therefrom, and means controlled by an operator in making connection with the line to energize said relay and thereby connect the line to the test-terminals.

3. In a telephone-exchange system, the combination with a subscriber's line-circuit, of a low-resistance non-polarized cut-off relay, a high-resistance line-signal, and a source of current all normally in the line-circuit, test-terminals normally disengaged from the line, and means for operating said cut-off relay to disconnect the line-signal and connect said test-terminals to the line when a connection is established therewith at central.

4. In a telephone-exchange system, a subscriber's bimetallic line-circuit normally including a source of current, test-terminals normally disconnected therefrom, a controlling-relay therefor having a single winding permanently connected to the line, and means to supply energizing-current to said relay in making connection with the line.

5. In a telephone-exchange system, a subscriber's line-circuit normally including a source of current, test-terminals normally disconnected therefrom, a non-polarized controlling-relay therefor, having a single winding permanently connected to the line, and means to supply energizing-current to said relay in making connection with the line.

6. In a telephone-exchange system, a subscriber's line-circuit adapted for use as a talking-circuit for carrying telephonic voice-currents, said line-circuit being normally closed through a source of current at the central station, test-terminals normally disconnected from the line, a controlling-relay therefor having a single winding permanently connected to the line, and means to supply energizing-current to said relay in making connection with the line.

7. In a telephone-exchange system, a subscriber's line-circuit normally closed through a source of current at the central station, test-terminals normally disconnected therefrom, a non-polarized controlling-relay therefor, having a single winding permanently connected to the line, and means to supply energizing-current to said relay in making connection with the line.

8. In a telephone-exchange system, a subscriber's line-circuit normally closed at the central station through a common source of current, test-terminals normally disconnected therefrom, a controlling-relay therefor, having a single winding permanently connected to the line, and means to supply energizing-current to said relay in making connection with the line.

9. In a telephone-exchange system, a subscriber's line-circuit normally closed at the central station through a common source of current, test-terminals normally disconnected therefrom, a non-polarized controlling-relay therefor, having a single winding permanently connected to the line, and means to supply energizing-current to said relay in making connection with the line.

In witness whereof I hereunto subscribe my name this 26th day of May, A. D. 1903.

HARRY G. WEBSTER.

Witnesses:
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