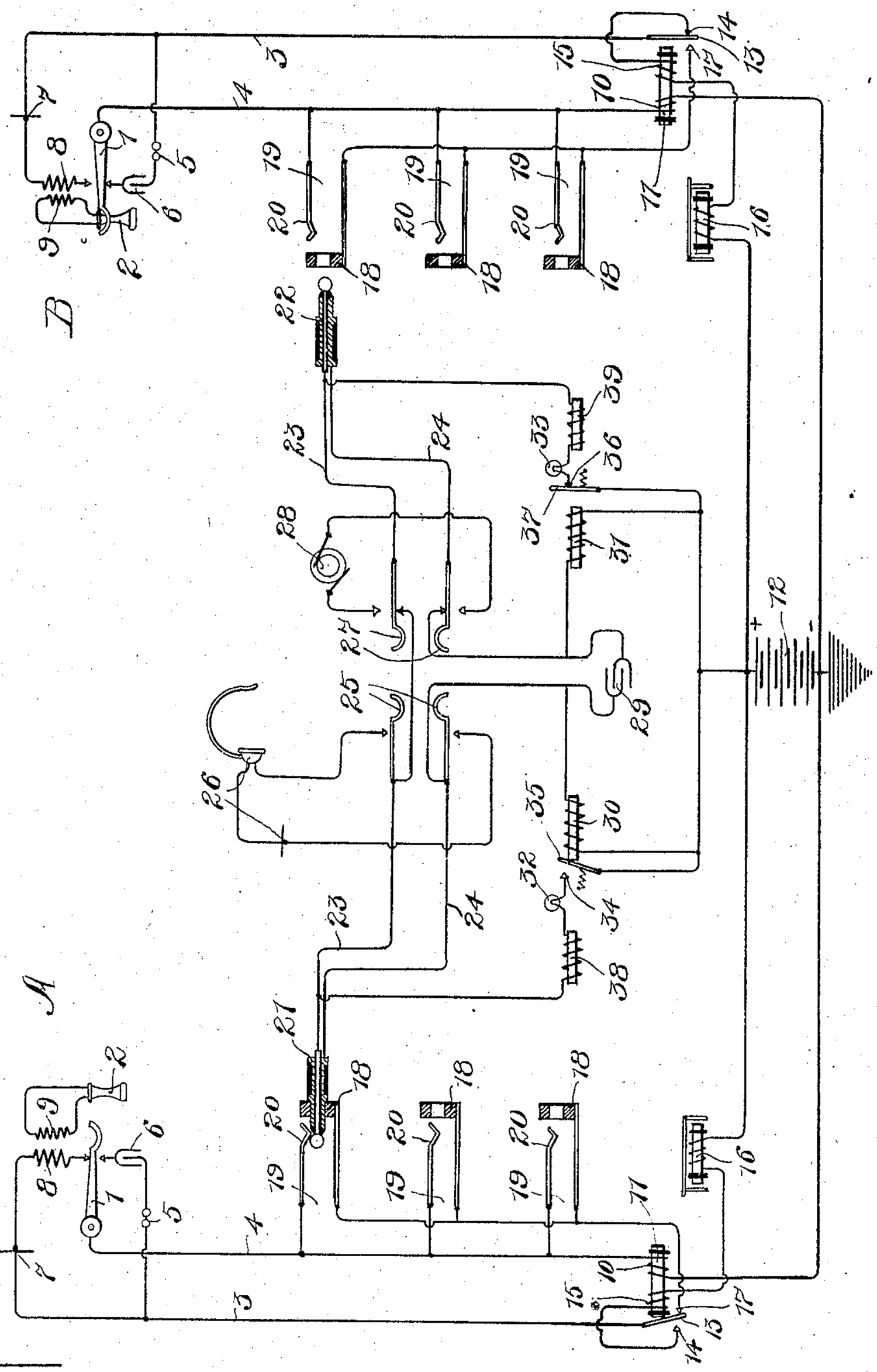
No. 816,052. PATENTED MAR. 27, 1906.

H. G. WEBSTER.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED DEC. 3, 1903.



Witnesses

Arthur H. Boettcher.

Lynn A. Williams

Inventor

Harry G. Webster.

By Charles A. Brown

Attorney.

UNITED STATES PATENT OFFICE.

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

TELEPHONE-EXCHANGE SYSTEM.

No. 816,052. Specification of Letters Patent. Patented March 27, 1906.

Application filed December 3, 1903. Serial No. 183,655.

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 drawings, forming a part of this specification.

My invention relates to telephone-exchange systems, and more particularly to the supervisory signaling system employed in connection with the means for interconnecting subscribers' lines, this supervisory signaling system serving to notify the central-station operator of the operative condition of connected lines.

The invention is particularly applicable to multiple-switchboard-exchange systems in which operator's cord connecting apparatus is employed for the purpose of connecting two telephone-lines for conversational purposes. Such a cord connecting apparatus may consist of two cord-strands connecting plugs adapted for insertion in spring-jacks connected with telephone-lines. In its preferred embodiment the invention is applied to so-called "common-battery" telephone-exchange systems in which a central source of current located at the exchange is employed for the purpose of supplying talking and signaling currents to all the lines terminating at that exchange. A supervisory signal may desirably take the form of a small electric lamp, the illumination of which may indicate to the central-station operator that the connected line is no longer desired for conversational purposes, whereupon it may be disconnected. A preferable form of supervisory signaling system is one in which a lamp is employed for each plug of the cord-circuit, whereby the operative condition of both of two connected lines may be ascertained. Such a signaling system is known as a "double" supervisory system.

The control of the lamp or other signal employed is desirably jointly effected from two points in the lamp-circuit. One of the contact-points controlling the actuation of the supervisory signal is controlled by the operator. The other contact which controls the supervisory signaling-circuit is desirably controlled by the subscriber. It has been found desirable in supervisory signaling arrangements of this class to, if possible, avoid the necessity of third contacts of the spring-jacks and corresponding third contacts of the cord connecting-plugs.

A supervisory system for use in connection with a two-wire-jack system has been proposed, in which the local illuminating-circuit has been jointly controlled by two relays, one of the relays being connected with one strand of the cord-circuit and the other relay being connected with the other strand of the cord-circuit. The circuit through one of these relays has been controlled by the insertion of the associated cord connecting-plug within a line-jack, while the other relay has been controlled by the operative condition of the subscriber's substation apparatus. Such a supervisory signaling arrangement is more or less complicated and requires for each supervisory lamp or signal two relays, or at least three relays for two supervisory lamps. These relays are expensive to install and are liable to get out of order and adjustment. They do, however, introduce the advantage of providing an inductively-balanced circuit, there being in such an installation an impedance between the terminals of the common battery and either side of the telephone-circuit which transmits voice-currents.

It is the purpose of my present invention to provide a double supervisory signaling system employing small electric lamps as signals in which there need be but one relay for each lamp and in which, furthermore, the telephonic circuit is inductively balanced, due to the presence of impedance in the connection to both sides of the line-circuit. In this respect of providing an inductively-balanced circuit my present invention shows an improvement over the supervisory signaling system disclosed in Patent No. 688,452, issued to me December 10, 1901. In my present system each supervisory lamp is jointly controlled, first, directly by the insertion of the associated plug in a line-jack, and, secondly, by a relay connected between a terminal of the common battery and one of the cord-strands, the energization of the relay being controlled by the operative condition

of the substation apparatus associated with the line within which the plug has been inserted.

The features of my invention will be more clearly understood by reference to the accompanying drawing, wherein I have shown at each of the subscriber's substations A and B the usual substation apparatus for common-battery systems, which comprises in each instance a hook-switch 1, which when in its normal depressed condition, due to the weight of the receiver 2, serves to connect the line-limbs 3 and 4 through a call-bell 5 and the condenser 6. When in its upper position, due to the removal of the receiver 2, the hook-switch closes a circuit through the battery-transmitter 7 and the primary 8 of an induction-coil whose secondary 9 is serially connected with the receiver 2. The line-circuit arrangement herein shown is similar to that disclosed in my above-mentioned patent. It will be apparent, however, to those skilled in the art that any other line-circuit may be employed.

The line-limb 4 leads through the winding 10 of a differential cut-off relay 11, and thence to the negative grounded pole of the common battery 12. The line-limb 3 leads to the armature 13 of the relay 11, this armature normally making connection with its back contact 14, which is connected through the other winding 15 of the differential cut-off relay, and thence through the line-signal 16 to the positive pole of the common battery 12. The armature 13 is provided with a front contact 17, which leads to the sleeve-contacts 18 18 of the line-jacks 19 19. The tip-contacts 20 20 of the line-jacks are connected directly with the line-limb 4, as shown. The windings 10 and 15 of the cut-off relay are differentially wound in order that the passage of equal currents through both windings at the same time will cause no net energization of the relay-core.

The operator's cord-connecting apparatus comprises the answering-plug 21 and the calling-plug 22. The tip-contacts of these plugs are connected by the tip-strand 23, while the sleeve-contacts are connected by means of the sleeve-strand 24. The usual operator's listening-key 25 is provided, an actuation of which serves to connect the operator's telephone set 26 in bridge of the cord-strand. A ringing-key 27 is also provided, an actuation of this key serving to connect the terminals of the ringing-generator 28 in bridge of the cord-strands leading to the calling-plug and to break the connection to the answering-plug. The conductive continuity of the sleeve-strand is interrupted by the serial inclusion of a condenser 29, this condenser, however, readily permitting the passage of telephonic voice-currents. There are permanently connected between the positive pole of the common battery 12 and the conductively-insulated portions of the sleeve-strand 24 supervisory relays 30 and 31. The supervisory lamps or signals 32 and 33 are connected, one between the tip-strand leading to the answering-plug and the back contact 34 of the armature 35 of the relay 30 and the other between the tip-cord strand leading to the calling-plug 22 and the back contact 36 of the armature 37 of the relay 31. There is included in each of the lamp-circuits an impedance-coil, that associated with the lamp 32 being designated as 38 and that associated with the lamp 33 as 39.

The operation of such a system may be described as follows: A subscriber at substation A desiring connection with some other subscriber removes the receiver 2 from the telephone-switch hook, thereby closing a conductive circuit between the line-limbs 3 and 4, leading to substation A. The circuit thus closed may be traced as follows: from the positive pole of the common battery 12, through the line-signal 16, the winding 15 of the differential cut-off relay, contact 14, armature 13, line-limb 3, transmitter 7, primary winding 8, switch-hook 1, line-limb 4, winding 10 of the differential cut-off relay, and thence to the negative pole of the common battery 12. The closure of this circuit causes an actuation of the line-signal 16 to indicate to the central-station operator that a connection is desired. The cut-off relay 11, however, is not actuated, for the reason that its two windings are differentially connected and no net energization is produced by the closure of a circuit through these two windings. The operator answers the signal produced by inserting the answering-plug 21 within the answering-jack of the calling-line. A circuit is thereupon closed through the supervisory signaling-lamp as follows: from the positive pole of the battery 12, through the armature 35, its back contact 34, the lamp 32, impedance-coil 38, the tip-contact of the plug 21, the tip-spring 20, winding 10 of the cut-off relay 11, and thence to the negative pole of the common battery. The closure of this circuit would cause an illumination of the lamp 32, except for the fact that the relay 30 is at the same time energized. This relay 30 is energized over the following circuit: from the positive pole of the battery 12, through the winding of the relay 30, the sleeve-strand 24, leading to the sleeve-contact of the plug 21, sleeve-contact 18 of the jack 19, contact 17, armature 13, line-limb 3, transmitter 7, primary 8, switch-hook 1, line-limb 4, winding 10 of the differential relay, and thus to the grounded negative pole of the common battery 12. The energization of the relay 30 due to the flow of current over this circuit causes an attraction of the armature 35, whereupon the circuit through the lamp 32 is broken. A momentary circuit, however, does flow through the lamp 32, this cir-

cuit being traced, as previously stated, through the winding 10 of the differential cut-off relay. The path of increased resistance through the winding 10 of the differential cut-off relay afforded by the circuit through the supervisory lamp 32 causes an unbalancing of the energization of the differential relay due to the two windings, and the magnetization due to the current flowing through winding 10 overcomes that due to the current flowing through winding 15, and a net energization of the cut-off relay is produced to attract the armature 13, thereby cutting off the line-signal 16. The operator now converses with the calling-subscriber to ascertain the number of the subscriber to be called. Upon learning the number of the called subscriber the operator inserts the calling-plug 22 within a jack 19, associated with the line leading to substation B—that is, assuming that substation B is the station desired by the calling-subscriber. It will be seen that after the calling-subscriber's call has been answered by the insertion of the answering-plug 21 into an answering-jack there will be an unbalanced condition of the circuit, which would cause induction disturbances, and therefore noise in the receiver of the calling-subscriber, due to the path afforded from the positive pole of the common battery 12 through the armature 37, the contact 36, lamp 33, and thence to the tip-strand 23 of the operator's cord-connecting apparatus, and from the tip-strand to the tip-spring 20, which is associated with line-limb 4, leading to substation A. This direct connection of a pole of the battery with a line-limb leading to substation A would cause noise, due to inductive disturbances. In order to prevent this noise, due to inductive disturbances and unbalancing of the line, the impedance 39 is included in circuit with the lamp 33. This impedance maintains the balance of the circuit, whereby noise due to inductive unbalancing is prevented. After inserting the calling-plug 22 within a calling-jack 19, the operator manipulates her ringing-key 27 to connect the terminals of the ringing-generator 28 with the cord-strands connected with the called line. The insertion of the calling-plug 22 within the jack 19 causes the closure of a circuit from the tip-strand through the line-limb 4 of the called line and winding 10 of the differential cut-off relay associated with the line to substation B to the negative pole of the common battery 12. The flow of current over this circuit causes an energization of the relay 11, whereby the armature 13 is attracted to at once cut off the line-signal 16. The subscriber at substation B answers the call by removing his receiver from the switch-hook, whereby a conductive circuit is closed through the substation apparatus at B. The closure of this circuit causes, as in the case of the calling-line, the closure of a circuit through the relay 31, whereby its armature 37 is attracted to break the circuit through the supervisory signaling-lamp 33. It will be seen that each subscriber controls one of the supervisory relays 30 or 31 and that each subscriber in this manner has complete control and supervision of one of the supervisory signaling-lamps. It will of course be understood that when both of the supervisory relays 30 and 31 are energized, and the circuits through both of the supervisory lamps 32 and 33 are thereby broken, there will be no need for the impedances 38 and 39 to balance the telephonic circuit inductively; but these impedances serve to prevent noise due to inductive disturbances whenever a single plug of the cord-connecting apparatus is inserted in a jack. Upon the completion of the conversation the subscribers replace their receivers upon the switch-hooks, thereby breaking the conductive line-circuit, whereupon the supervisory relays 30 and 31 are deënergized to permit the retraction of their armatures. The armatures when in their retracted normal position close circuits through the supervisory lamps and impedances 38 and 39 to cause the illumination of the supervisory lamps, thereby notifying the operator of the desired disconnection. The operator upon receiving the disconnect signal from either one or both of the substations removes the associated plug or plugs, thereby breaking the circuit through the differential cut-off relays. Upon the deënergization of the cut-off relays the armatures 13 are retracted to restore the line-circuits to their normal condition.

While I have shown my improved supervisory signaling system in connection with a certain line-circuit, it will be apparent to those skilled in the art that many other line-circuits may be employed with equal advantage, and in the same way the cord-circuit may be modified in a great many ways. I do not wish, therefore, to limit myself to the precise construction and circuit arrangements herein set forth; but,

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

1. In a telephone-exchange system, the combination with a telephone-line extending from a substation to an exchange, of cord connecting apparatus for connecting said line with another for conversation, a common source of current at the central exchange for supplying talking and signaling current to the cord-circuit and telephone-lines, a circuit extending between one pole of said source of current and one cord-strand and including a supervisory lamp and an impedance-coil, a second circuit extending from the same pole of said source to the other cord-strand and including only the winding of a supervisory relay, connection of said cord-circuit with a telephone-line causing the circuit through

said supervisory lamp to be completed, and actuation of substation apparatus upon connection of the cord-circuit with the line causing the circuit through the supervisory relay to be completed and the circuit through the supervisory lamp opened.

2. In a telephone-exchange system, the combination with a telephone-line extending by its limbs from a substation to an exchange, of cord connecting apparatus for connecting said line with another for conversation, a common source of current at the central exchange for supplying talking and signaling current to the cord-circuit and to the telephone-lines, a line-signal normally included in circuit with a telephone-line and said source of current upon actuation of substation apparatus, a circuit at the central exchange extending from one pole of said source of current to one cord-strand and including a switch, a supervisory lamp and a coil of high impedance, connection of said cord connecting apparatus with the line causing the line-signal to become inactive and causing said circuit to become closed, whereby the supervisory lamp becomes illuminated, and a second circuit at the exchange connected between the same pole of said source and the other cord-strand, said circuit containing only the winding of a supervisory relay controlling said switch, actuation of substation apparatus upon connection of the cord-circuit with the line causing closure of said circuit through said supervisory relay, whereby said switch is actuated to open the supervisory-lamp-containing circuit.

3. In a telephone-exchange system, the combination with a telephone-line extending from a central exchange to a substation, of cord connecting apparatus at the central exchange for connecting telephone-lines together, a common source of current at the exchange for supplying talking and signaling current to the cord-circuit apparatus and to the telephone-line, each line-limb being normally connected with one pole of said source and each including one of the differential windings of a cut-off relay, a line-signal included in one of said line-limbs and normally connected with the line-limb through the armature of said cut-off relay, spring-jacks having one contact permanently connected with one line-limb and another contact normally disconnected from the other line-limb, a circuit extending from one pole of said source to one cord-strand and including a switch, supervisory lamp, and a coil of high impedance, connection of said cord-circuit with a spring-jack causing closure of the supervisory-lamp circuit and energization of the cut-off relay, whereby the line-signal is removed from circuit and the normally disconnected spring-jack contacts connected with the line-limb, a second circuit extending from the same pole of said source to the other cord-strand, and a supervisory relay in said second circuit and controlling said switch, actuation of substation apparatus upon connection of the cord-circuit with the line causing closure of said second circuit whereby the supervisory relay becomes energized to actuate said switch to open the supervisory lamp-circuit.

4. In a telephone-exchange system, the combination with a telephone-line extending from a substation to the exchange, of a cord-circuit for connecting said line with another for conversation, a common source of current at the exchange for supplying talking and signaling currents to the cord-circuit and telephone-line, a supervisory lamp-circuit extending between one pole of said source and one cord-strand, and a winding of high impedance included in said supervisory circuit, said impedance being included in circuit only when the substation apparatus is inactive but disconnected from any circuit upon actuation of the substation apparatus.

In witness whereof I hereunto subscribe my name this 25th day of August, A. D. 1903.

HARRY G. WEBSTER.

Witnesses:

HARVEY L. HANSON,

JOHN STAHR.