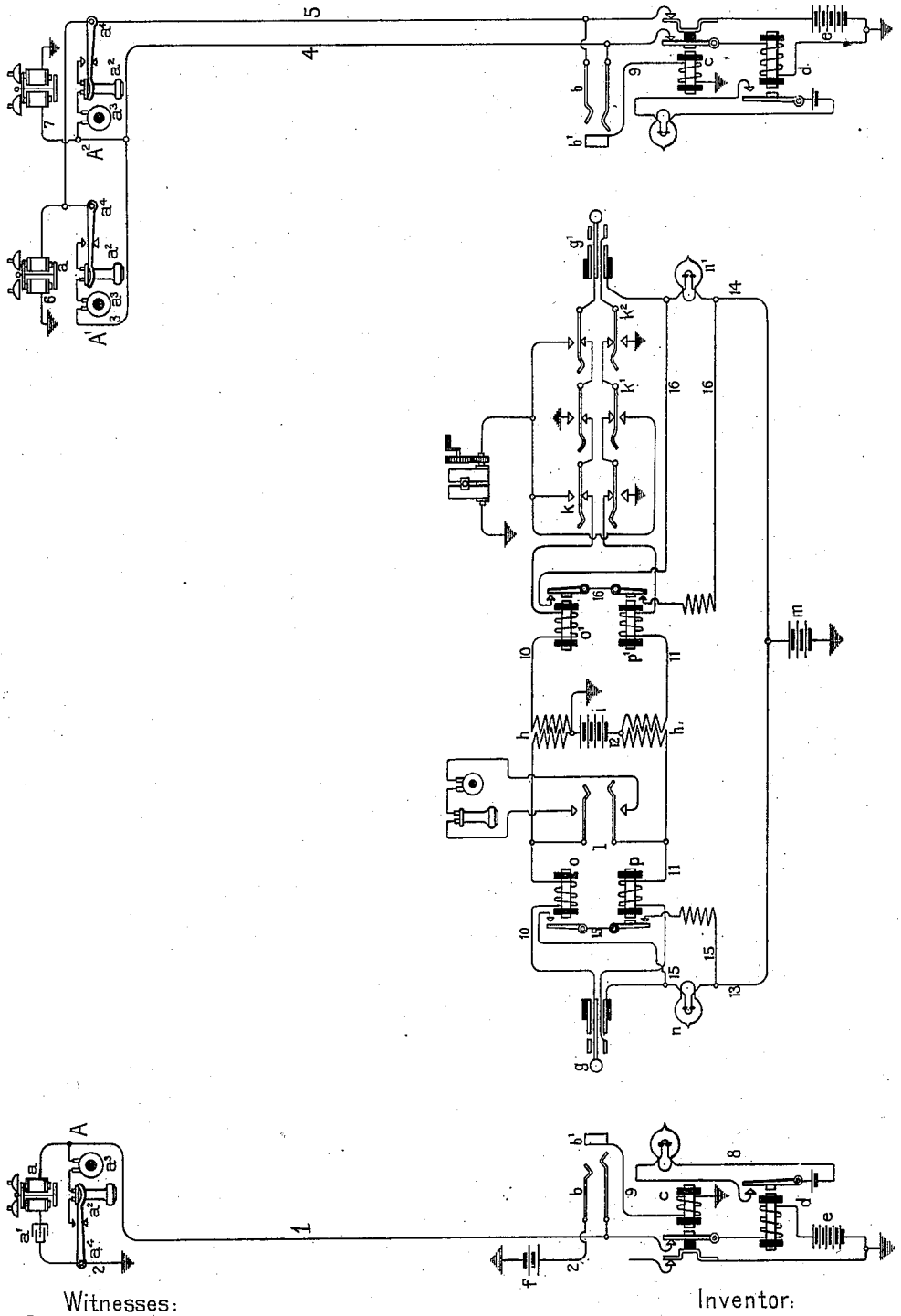
No. 649,076. Patented May 8, 1900.

C. E. SCRIBNER.

SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS.

(Application filed Apr. 23, 1898.)

(No Model.)



Witnesses:

Inventor:
Charles E. Scribner,

by Barton & Brown his Attys

UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

SUPERVISORY SIGNAL FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 649,076, dated May 8, 1900.

Application filed April 23, 1898. Serial No. 678,646. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Supervisory Signals for Telephone-Switchboards, (Case No. 465,) of which the following is a full, clear, concise, and exact description.

This invention concerns the automatic operation of supervisory signals in association with devices for uniting lines of different character, comprising metallic and grounded circuit-lines and metallic lines with permanent ground branches, the object of the invention being to attain a uniform operation of the signals independent of the character of the lines with which they are associated.

It is common in telephone-exchange practice to provide a pair of signals brought into temporary connection with two united lines, referring to the respective lines, each responsive to current in the line determined in the use of the telephone at the corresponding station. The device consists in a source of current in a bridge of the line-circuit, an electromagnet in the path of current to either station, a signal controlled by the magnet, and a telephone-switch at each substation arranged to close the circuit of the line as respects unvarying current in the line during the use of the telephone. The signal and source of current form portions of the link conductors for uniting lines in the switchboard. One terminal of the source is grounded. Hence this apparatus may be used indifferently in uniting metallic or grounded circuits. However, it frequently becomes desirable to employ permanent ground connections with both line conductors of a metallic circuit—as, for example, for the purpose of placing selective call-bells or other similar appliances in branches from the line to an earth or other common return-conductor. The before-mentioned supervisory signals cannot be operatively used with such lines in view of the existence of permanently-closed circuits for the source of current and signaling apparatus independent of the telephone-switches at the stations of the lines.

The present invention applies to the operation of supervisory signals in connection with metallic circuits having permanent ground branches, with metallic circuits free from such ground connections, and with grounded circuits, indifferently. It consists in the combination, with the two conductors forming a plug circuit or link for uniting telephone-lines, of a source of current in a bridge of the plug-circuit, an electromagnet in each of the link conductors, and a signal controlled by these magnets jointly, the signal being preferably concealed when both magnets are excited, and as respects the use of these appliances with grounded lines it further consists in a normal partial return-conductor for the grounded circuit and a source of current in this conductor to excite one of the signal-controlling magnets during connection with the line.

The features of the invention are shown diagrammatically in the attached drawing.

The drawing represents the apparatus of three substations, with a grounded line extending from a central office to one of the stations and a metallic-circuit party-line extending from the same office to the remaining stations, together with plugs and a plug-circuit and other apparatus in accordance with this invention for uniting the lines and supervising the use of the circuit thus established in the central office.

Each substation is furnished with transmitting and receiving telephones, a call-bell, and a telephone-switch for closing the line-circuit through the telephones during the use of these instruments. At the station of the grounded line the line conductor 1 is provided with two paths to the grounded return-conductor 2, one of which includes the polarized call-bell a, together with a condenser a', and the other of which traverses the telephones a^2 and a^3 and is controlled by the telephone-switch a^4. The rising of the switch, when relieved from the weight of the receiving-telephone, thus closes the line-circuit as respects continuous or unvarying current.

The apparatus at the stations A' and A^2 of the party-line are of like character, but are somewhat differently arranged in the circuit. At each station a bridge 3 of the line-circuit 4 5 exists, controlled by the telephone-switch a^4, which includes the transmitting and re-

ceiving telephones; but at the station A′ the bell *a* is located in a ground branch 6 from the line conductor 5, no condenser being interposed in this circuit, while at the station A^2 the bell *a* is similarly located in a ground branch 7 from the line conductor 4. This arrangement of the bells is to permit the selective operation of the bells at the different stations, it being obviously possible to send a calling current over one line conductor and the ground-return to ring the bell at station A′ or over the other line conductor with the ground-return to ring the bell at station A^2.

The line-circuits of whatever nature are led to the line-contacts of spring-jacks *b* in a telephone-switchboard. Thence normal extensions are led through the switch-contacts of a cut-off relay *c* to sources of current and individual or line signals of special arrangement, in accordance with the nature of the line. Thus the extension of line conductor 1 is led through the magnet-winding of a relay *d* to the pole of a battery *e* or other source of current. It is customary to provide also the wire 2, which forms within the switchboard the return-circuit for the line. This wire is connected with one contact-piece of the spring-jack *b*, and is then grounded, usually at a point outside of the switchboard. In converting such a grounded line into a metallic circuit the portions of wire 2 at the substations and at the central office are disconnected from earth and united by an insulated wire, and the wire 2 is extended to the contact-anvil of cut-off relay *c*. In carrying out the present invention, however, I interpose a battery *f* of small voltage in a grounded conductor 2 at the central office for a purpose which will be explained hereinafter. The relay *d* controls a local circuit 8, which includes a secondary line-signal, which may be a small incandescent lamp placed near the spring-jack of the line in the switchboard. The cut-off relay, following the usual practice, is located in a conductor 9, grounded at one end and terminating in a normally-open contact-ring *b′* of the spring-jack of the line. The party-line is similarly provided with a secondary line-signal controlled by the relay and is connected with a source of current *e;* but in this instance the normal ground extension of line conductor 4 includes the magnet-winding of the relay *d*, while the source of current *e* is interposed in the grounded extension of the other line conductor 5. The purpose of this arrangement is to permit the excitement of the relay only when a connection is completed between the line conductors at one of the substations.

The apparatus for uniting lines in the switchboard comprises plugs *g* and *g′*, each with three contacts designed to register with the three contact parts of a spring-jack, circuits uniting the line-contacts of the plugs to form the plug-circuit, and other local conductors terminating in the local contacts of the plugs to bring about the operation of certain appliances in the switchboard. Thus the spherical tips of the plugs are united by conductor 10, while the short rings constructed to register with the longer springs of the spring-jacks are united by a conductor 11. The conductors 10 and 11 of the plug-circuit traverse the windings of a repeating-coil *h*, two serially-connected windings of the coil being interposed in each conductor. The points of junction of these windings are united by a bridge 12 of the plug-circuit, which includes a source *i* of current. The pole of this source of current adjacent to conductor 10 is grounded. The plug-circuit traverses the switch-contacts of the usual calling keys *k*, *k′*, and k^2 for looping a generator of signaling-current into circuit with plug *g′* to send calling current over either or both of two line-wires. It is connected with an operator's listening-key *l* for bringing a telephone into the plug-circuit.

The sleeve-contacts of the plugs, which register with the ring-contacts of the spring-jacks, form the terminals of conductors 13 and 14, respectively, which lead to the free pole of a grounded battery *m* and which include signals *n* and *n′*. The different signals *n* and *n′* refer to the corresponding plugs *g* and *g′*, being associated with them in the switchboard. Their display is determined by the application or withdrawal of shunts which are controlled by relays in the plug-circuit. The disposition of these relays in the plug-circuit and the arrangement of circuits by which they control the supervisory signal-lamps *n* and *n′* to produce a uniform operation of the signals when the plug-circuits are used in uniting lines of diverse types constitute the essential features of this invention.

The controlling-relays for the signal *n* are designated *o* and *p*. The former is included in the portion of conductor 10 between the bridge 12 and the plug *g* and the latter in the like portion of conductor 11. The relays *o′* and *p′* in a like manner control the signal *n′*, referring to the plug *g′*, the former relay being in the portion of conductor 10 leading from the bridge to the plug *g′* and the latter relay being in a like part of conductor 11. The shunt through the agency of which the relays *o* and *p* control the signal *n* consists in the wire 15, which traverses in series the switch-contacts of the two relays *o* and *p*. This wire may include a coil of low resistance, the diversion of the full current from the signal-lamp being unnecessary. A like shunt for the lamp *n′* exists in the wire 16, whose continuity is controlled at two points by the relays *o′* and *p′*.

The act of calling for connection from a substation is the same in all stations. It consists merely in taking the telephone from its switch for use. The mode in which this act causes the display of the line or calling signal, however, varies in the case of grounded lines and party-lines. Thus the removal of a telephone from its switch at the station A produces a

closed circuit through the telephones at that station which permits current to flow from battery *e* through the magnet-winding of relay *d* over the line conductor 1 to the substation, and thence by the way of the return-conductor 2 to earth, whereby the local circuit, including the secondary signal, is closed and the signal-lamp is lighted. In calling from a station A′ or A² the closure of the circuit through the telephones by the telephone-switch permits current to flow from the battery *e* of the party-line through the conductor 5, and thence through the bridge, including the telephones, returning to the central office through conductor 4 of the line and traversing the magnet-winding of relay *d*. It will be noted that the battery has normally no circuit through the relay, notwithstanding the existence of the permanent ground connections with the lines.

In response to the display of a line-signal of any line the attendant will insert the plug *g* into the spring-jack associated with the signal and will bring her telephone into connection with the plug-circuit to learn from the calling subscriber the order for the line with which connection is required. After receiving the information she will insert the plug *g′* into the spring-jack of the line called for, as that of the lines to station A′ or A², after which she will ring the bell at the required station by means of a key *k*, if the line be a single-station line, or through the instrumentality of the proper key *k′* or *k²*, if the line be a party-line, in accordance with the well-known methods.

The insertion of plug *g* into the spring-jack *b* of any line closes a local circuit made up of conductors 13 9, in which current is thus permitted to flow from battery *m* to excite the supervrisory lamp-signal *n* and the cut-off aelay *c*. The cut-off relay severs the normal ground connections of the line and leaves the line in closed circuit with the plug-circuit, and through the medium of this circuit with the line to the required station. The presence of plug *g′* in the spring-jack of the line called for similarly closes the local circuit 14 9 of the line called for, whereby the signal lamp *n′* is excited and the cut-off relay of the answering line is energized and severs the ground connections of the latter line. The functions of the parts thus far described are performed in this way in the case of any connections, whether they be with grounded or metallic circuits or with metallic party-lines. The behavior of the relays *o p* and *o′ p′* is dependent on the nature of the lines with which they become associated, however, and must be traced in different cases.

When the calling line is, as has been described, a grounded line, the act of answering a call brings the battery *i* into circuit with the line 1 2, which is closed at the station, whereby current is permitted to flow through the conductor 11, traversing the winding of relay *p*, to the line-wire 1, and thence to grounded return-conductor 2 at the substation. At the same time current is produced by the battery in the grounded conductor 2 at the central office to the conductor 10 of the plug-circuit, and thus to earth through the magnet-winding of relay *o*. Magnet *o* is thus excited by the current, which will remain constant while the connection exists, while magnet *p* becomes excited with a current dependent on the position of the telephone-switch at the calling station. Relay *o* closes the break in the shunt-wire 15, which it controls and maintains the continuity of this wire during the existence of the connection. Magnet *p* similarly closes the break which it controls, while the telephone-switch is in its alternate position, the telephone being in use. The shunt-wire is thus effective in diverting current from the lamp *n*, so that this lamp remains dark while the telephone at the calling station is in use, but becomes lighted whenever the telephone is replaced on its switch.

Turning now to the operation of the relays *o′* and *p′*, the insertion of plug *g′* into the spring-jack of the party-line provides a circuit from battery *i* through portions of conductors 10 and 11 of the plug-circuit to the wires 5 and 4 of the line-circuit. Current will flow from conductors 11 and 4 through the ground branch 7 at the substation, including the bell, which may excite the relay *p′* and may cause this relay to close the break which it controls in the shunt-wire 16; but no current will exist in the portion of conductor 10, which includes the winding of relay *o′*, since no source of current is found connected with the portions of the plug-circuit and line-circuit which are directly connected with this instrument. Hence the shunt-wire 16 will remain broken at the switch-contacts of relay *o′*, and the lamp *n′*, being not shunted, will remain lighted. Its illuminated condition constitutes an indication to the operator that the subscriber at the station called has as yet made no response. When the telephone is taken for use at either station A′ or A², a bridge of the line-circuit is closed at that point, as already mentioned, so that a complete circuit is formed from battery *i* through a portion of conductor 11, line-wire 4, line-wire 5, and a portion of conductor 10, returning thence to battery *i*. The current in this circuit excites the magnet of relay *o′*, which closes the second break in the shunt 16, and thus brings about the extinction of lamp *n′*. This signifies to the attendant a response to the call at the station called.

It will be apparent that if the called line were a grounded circuit the relays *o′* and *p′* would be operated in the way traced for the relays *o* and *p* in making connection with the calling line. If the called line were a metallic circuit, the operation would be similar to this just described for the party-line, the two relays being excited by current passing out over one line-wire, finding circuit through the

bridge closed in the telephones and returning through the other line-wire to excite the second relay in the plug-circuit. In general each signal n and n' will be caused to indicate by its lighted or dark condition the position of the switch at the station of any line with which it may be connected irrespective of the nature of the line-circuit.

The invention is defined in the following claims:

1. The combination with a telephone-line and a switch at the station thereof for changing the resistance of the line, of a source of current in a bridge of the line in a central office, an electromagnet in the path of current from said source to each line conductor, and a signal controlled by said magnets jointly, substantially as described.

2. The combination with a telephone-line having a switch at its station for completing the line-circuit in the use of the telephone, a spring-jack for the line, a plug and plug-circuit for making connection with the line through the agency of the spring-jack, of a source of current in a bridge of the plug-circuit, an electromagnet connected with each conductor of the plug-circuit to be in the path of current from said source to the corresponding line conductor, a signal or other mechanism, and means for operating the said signal or mechanism through the agency of either magnet; whereby the plug-circuit may be operated when associated with grounded lines, or metallic circuits, or grounded metallic circuits, as described.

3. The combination with grounded-circuit lines and grounded-metallic-circuit lines, with switches at the stations thereof for changing the resistance of the lines in the use of the telephones, spring-jacks for the lines, a plug and plug-circuit for making connection with any line by means of the spring-jack, of a source of current in a bridge of the plug-circuit, an electromagnet in the path of current from said source to each line conductor of a line, switch-contacts controlled by each magnet, a supervisory signal, and a circuit thereof including said switch-contacts, made operative in the simultaneous actuation of the switch-contacts, as described.

4. The combination with grounded-circuit lines and grounded-metallic-circuit lines, each with a switch at its substation for closing the line-circuit in the use of the telephone, a spring-jack for each line, a plug and plug-circuit for making connection with the line by means of the spring-jack, of a bridge of the plug-circuit and a source of current therein, a relay in each conductor of the plug-circuit the winding of each relay being in a path of current from said source, a supervisory signal in a local circuit, and a shunt of the signal controlled by the switch-contacts of both said relays, to be closed when both relays are excited, substantially as described.

5. The combination with a wholly-metallic circuit and partially-metallic circuit telephone-lines, a switch at each station for closing the line-circuit in the use of the telephone, a spring-jack for each line, a plug and plug-circuit for making connection with any line by means of the spring-jack, of a bridge of the plug-circuit and a grounded source of current therein, an electromagnet in each conductor of the plug-circuit, a supervisory signal controlled by the said electromagnets when simultaneously excited, and a source of current in the grounded portion of each partially-metallic line; substantially as described.

6. The combination with plugs and a plug-circuit for uniting grounded circuits, metallic circuits, and grounded metallic circuits, in a switchboard, of a bridge of the plug-circuit and a source of current therein, an electromagnet in each conductor of the plug-circuit between the said bridge and one of the plugs, and a supervisory signal controlled jointly by the magnets adjacent to the same plug, substantially as described.

7. The combination with telephone lines and switches at the stations thereof for changing the resistance of the lines in the use of the telephones, spring-jacks for the lines, a plug and plug-circuit for making connection with any line by means of the spring-jack, of a source of current connected with both conductors of the plug-circuit, an electromagnet in the path of current therefrom to each conductor of the plug-circuit, and a signal controlled jointly by said magnets, as described.

8. The combination with a telephone line, of a spring-jack therefor, a plug and plug-circuit for making connection with the jack, a source of current and an electromagnet in the plug-circuit, a local circuit adapted to be closed continuously in registering contact-pieces of said jack and plug during connection with the line, a source of current and an electromagnet in said local circuit, and a supervisory signal controlled by said electromagnets, as described.

In witness whereof I hereunto subscribe my name this 8th day of March, A. D. 1898.

CHARLES E. SCRIBNER.

Witnesses:
ELLA EDLER,
DUNCAN E. WILLETT.