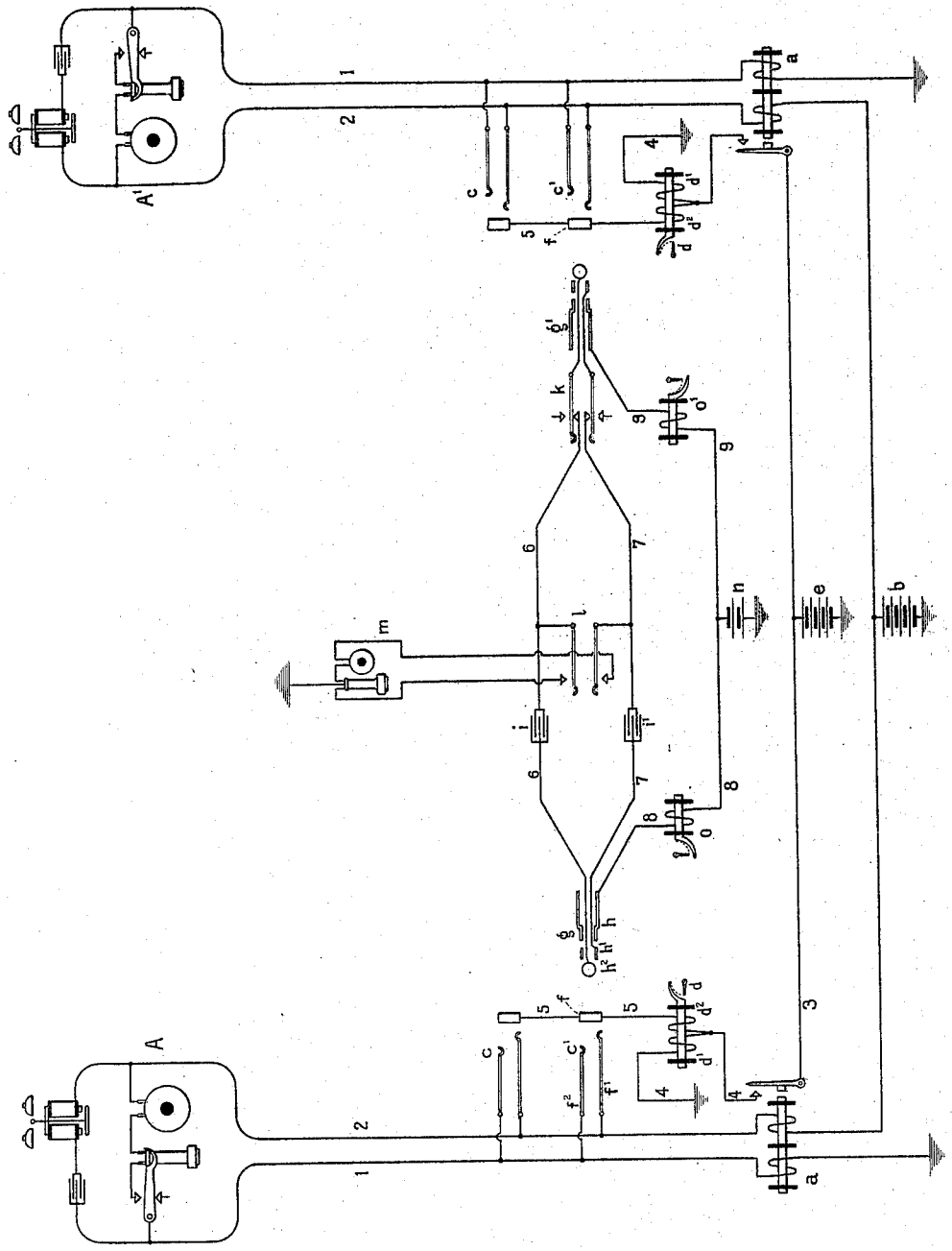
No. 638,425. Patented Dec. 5, 1899.

C. E. SCRIBNER.

SIGNAL FOR TELEPHONE SWITCHBOARDS.

(Application filed Apr. 23, 1897.)

(No Model.)



Witnesses:
John W. Sinclair
L. M. C. Barnes

Inventor:
Charles E. Scribner.
by Baxter & Brown his Attys.

UNITED STATES PATENT OFFICE.

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

SIGNAL FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 638,425, dated December 5, 1899.

Application filed April 23, 1897. Serial No. 633,447. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, 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 Signals for Telephone-Switchboards, (Case No. 449,) 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.

This invention concerns signals associated with telephone-lines in telephone-switchboards designed to be controlled automatically in the use of the substation-telephones and serving to continuously inform the attendant at the switchboard of the condition of the substation appliances. It is a system of secondary electromagnetic signals and an electromagnetic controlling device therefor associated with the line and responsive to changes in the electrical condition of the line determined in the use of the substation-telephone, this device serving to control both the line-signal and the supervisory signal at different times, the purpose of the invention being to avoid as far as possible closed bridges of the line-circuit or magnets interposed in the telephonic circuit. The signals comprise a line-signal permanently associated with the line and representing it in the switchboard and a supervisory signal adapted for temporary association with the line during connection with it.

The invention involves a mode of effecting the concealment of the line-signal when connection is made with the line in response to a call, a new arrangement of circuit connections whereby the display of the line-signal of a called line during the use of the latter is prevented, and means whereby the supervisory signals associated with the usual connecting-plugs in the switchboard are brought temporarily under the control of the electromagnetic signal-controlling appliances of the united lines.

In constructing a commercial form of this invention I provide a relay which constitutes the signal-controlling appliance connected in a permanently-closed bridge of the line-circuit, including also a source of current, together with a switch at the substation automatically operated in the use of the telephone to change the circuits at the substation and thereby to affect the relay, a local-battery circuit in the switchboard for the relay and an electromagnetic visible line-signal having a winding in the local circuit and adapted to display its indicator when excited, a differential and equal winding on the magnet of the line-signal, a circuit including this winding and means for closing the circuit in the act of making connection with the line to render the line-signal inert, an extension of the local circuit controlled by the relay temporarily completed in registering contact-pieces of the terminal spring-jack of the line and of the plug therein during connection with the line, and a supervisory signal in this temporarily-extended circuit adapted to display its indicator when deprived of current.

The invention involves also certain specific arrangements of circuits for securing a test-signal when the system is applied to multiple switchboards, which will be fully set forth in the specification and claims.

The invention is illustrated in the diagram hereto attached, which represents two substations connected by telephone-lines with spring-jacks and signal-controlling relays in a telephone-switchboard, together with a pair of plugs for uniting the lines and signals associated with the plugs after the plan of this invention.

The usual call-bell, transmitting-telephone, receiving-telephone, and telephone-switch are provided at the substation, the bell being in a closed bridge of the line, together with a condenser, and the telephones being in the bridge of the line, which is normally open at the contacts of the switch. This arrangement of circuits permits the closure of the line only while the telephone is in use. The line conductors 1 and 2 extend from these appliances to the switchboard, where they traverse the windings of a relay *a*, whose magnet should be characterized by suitably-high impedance. After traversing the windings of this relay the line conductor 1 is led to earth, while conductor 2 is connected with the free pole of a grounded battery *b* or other source of current. The usual spring-jacks *c* and *c'* form normally open terminals of the

line in the switchboard, the spring-jacks being located, if desired, upon different sections of a multiple board.

The relay a controls a local circuit 3 4, which includes a winding d' of the secondary line-signal d. The wire 3 leads from one pole of a grounded battery e to the movable contact-piece of the relay, while the wire 4 is an earth branch from the fixed contact-point of the relay. From the latter wire 4 a conductor 5 is led to the ring or thimble contacts f of spring-jacks c and c'. The signal d is of well-known type, consisting of a magnet with an extended curved pole-piece acting upon a pivoted iron shutter, the action of the magnet when excited being to draw the shutter or indicator into a vertical position, in which it is displayed.

The usual connecting-plugs g and g' are furnished for the use of the operator in the switchboard. Each plug comprises three contact-sections h, h', and h^2, which are designed to register with the thimble f and with the two line-springs f' and f^2 of a spring-jack into which the plug may be inserted. The contact-pieces h' and h^2 of the two plugs are united by conductors 6 and 7, which constitute the plug-circuit. Condensers i and i' are interposed in the conductors 6 and 7 to break the continuity of these conductors as to continuous currents, while permitting the flow of telephonic currents through the plug-circuit for the purpose of maintaining independence of operation for the signal-controlling relays a of two united lines. The usual calling-key k is included in the plug-circuit, and a listening-key l is furnished to enable the operator to connect her telephone m in a bridge of the plug-circuit.

The contact-pieces h of plugs g and g' form the terminals of wires 8 and 9, respectively, which lead to the free pole of a grounded battery n. The conductor 8 traverses the magnet-winding of a visible signal o, which is associated in the switchboard with the plug g. Conductor 9 includes the winding of a similar signal o', which refers to plug g' in the switchboard. These signals are substantially like the line-signals d, but differ in that their pole-pieces are arranged below the pivoted shutters in such a way that the shutters normally displayed are drawn into horizontal positions, where they are concealed, through the action of the pole-pieces when the magnets are excited.

Inasmuch as the successful operation of this system depends to some extent on the proper adjustment of the resistances of the different parts, the following statement of electrical dimensions may be taken as specifying a typical arrangement. Each of the windings of the relay a may be of three hundred ohms. The battery b may have an electromotive force of twenty volts. The battery e may have an electromotive force of six volts and the battery n two volts. The resistance of each of the windings d' and d^2 of the signal d may be one hundred ohms and that of each of the signals o and o' may be forty ohms. A general statement of the essential relations between the resistances and electromotive forces in the local circuits may be more clearly made in connection with the description of the coöperative functions of those parts.

The removal of the receiving-telephone from its switch at a substation permits current to flow from battery b in the line-circuit, which excites the magnet of relay a and causes the latter to close the local circuit which it controls. This action of the relay permits current to flow in the circuit 3 4, which, traversing the winding d' of signal d, excites this secondary signal and brings the shutter of the signal into its vertical position, in which it is displayed to the operator. The presentation of this indicator signifies to the attendant that the user of the line with which the signal is associated is awaiting attention. She accordingly inserts plug g into the spring-jack c' of the line and connects her telephone with the plug-circuit 6 7 by means of listening-key l, whereby she is brought into telephonic communication with the calling party. The insertion of the plug into the spring-jack causes a rearrangement of the circuits, as follows: A path is completed from battery e through wire 3, thence through the contact-pieces of the relay to wire 5, including the winding d^2 of the signal d, and thence through the contact-pieces f of the spring-jack and h of the plug, conductor 8, including signal o, and battery n to earth.

The current through the winding d^2 should be of such strength as to neutralize the magnetizing effect of winding d', rendering the magnet inert and permitting the indicator of the signal to return to its normal concealed position. The current through the magnet of signal o should excite this magnet and cause the withdrawal of its indicator from view.

Having learned from the person calling the order for the connection required, the operator may test the line called for—as, for instance, that to station A'—in the usual way—that is, by applying the tip of plug g' to the thimble f of a spring-jack of the line. It will be observed that in the ordinary condition of the apparatus no battery is connected with the rings f of the spring-jacks of the line, and hence at such a time no test-signal would be produced in the operator's telephone by the contact of the plug with the ring. When, however, the line-relay a of the line has become excited and closed its local circuit, the battery e is connected with the test-rings, or when a connection has been made by means of a plug with the line the battery n is connected with the rings, in either of which cases the application of the tip of plug g' to the test-ring will permit current to flow therefrom through the telephone m to earth, producing the usual characteristic sound in the telephone. Having found the line called for free for use, the operator in-

serts plug g' into the spring-jack c' and transmits a signaling-current by means of key k to ring the bell at station A'. The uniting of wires 5 and 9 changes the electrical condition of the test-rings in readiness for a subsequent test, while it also completes a circuit through winding d^2, differential to winding d', so that the magnet of signal d of the called line remains inert. The current through signal o' from battery n should be insufficient to excite that signal and effect the concealment of its indicator, so that the indicator will remain in view. Its presence indicates to the attendant that the telephone at the called station still remains on its switch. When the telephone at that station is removed for use, the relay a becomes excited, as before traced with reference to the calling-line, and connects the battery e with the conductors 4 and 5. Sufficient current is thus produced through the magnet of signal o' to conceal the indicator of that signal, signalizing to the operator the response of the called party. Inasmuch as the current divides between windings d' and d^2 of the line-signal d, however, the latter signal remains inert.

When the receiving-telephones at the stations are replaced on their supports, the line-relays a are deprived of current and permit their armatures to break the connection of battery e with the conductors 5 8 and 5 9 associated with the respective lines, whereby the indicators of supervisory signals o and o' become displayed. Their simultaneous indications may be accepted as a call for disconnection and may be followed by the removal of plugs g and g' from the spring-jacks of the line.

I claim as the invention—

1. The combination with a telephone-line extending from a subscriber's station to a central office, of a signal associated with the line at the central office, said signal having two differential windings, a continuously-active source of current and means at the subscriber's station, actuated during the use of the telephone, for effecting the connection of said source of current with one of the windings to operate the signal, a circuit including a second winding of the said signal differential with respect to the first-mentioned winding, a source of current in the latter circuit, and switch-contacts closed in the act of making connection with the line to complete the last-mentioned circuit, whereby the magnet of the signal is rendered inert when connection is made with the line, as described.

2. The combination with a telephone-line extending from a subscriber's station to a central office, of an indicator associated with the line at the central office, a continuously-active source of current and a circuit including the same with a winding of said indicator, means at the subscriber's station for effecting the completion of said circuit during the use of the telephone, whereby current is supplied to said winding as long as the telephone remains in use, a spring-jack for the line, and plugs and a plug-circuit for making connection therewith, a local circuit with a source of current therein including a second winding of the signal differential in its effect thereon with respect to the current controlled from the substation, said local circuit being controlled in registering contact-pieces of the spring-jack and plug during connection, substantially as and for the purpose specified.

3. The combination with a telephone-line, a source of current and a relay therein, and means at the substation of the line for determining the flow of current in the line during the use of the telephone, of a local circuit controlled by the relay, a source of current therein, an electromagnetic signal associated with the line having a winding included in the said local circuit, a second local circuit including a winding differential with respect to said first-mentioned winding, a spring-jack and a plug for making connection with the line, and registering switch-contacts in the spring-jack and plug adapted to complete the said second-mentioned local circuit, substantially as described.

4. The combination with a telephone-line having means at its station for determining the flow of current in the line automatically in the use of the telephone, of a relay responsive to such current connected with the line, a spring-jack for the line and a plug and plug-circuit for making connection therewith, a local circuit controlled by the relay including a source of current, and an electromagnetic signal having a winding in the said local circuit, a second local circuit also controlled by the relay including a second winding of the said signal differential with respect to the first, registering contact-pieces of the plug and spring-jack adapted to complete said second-mentioned local circuit, and a supervisory signal included in the second-mentioned local circuit associated with the plug, substantially as described.

5. The combination with a telephone-line having at its substation means for determining the flow of current in the line, a spring-jack for the line and a plug and plug-circuit for making connection therewith, and a signal controlled by such current in the line through the agency of a winding thereon, of a local circuit completed in registering switch-contacts of the spring-jack and plug, a second winding on the signal-controlling device differential with respect to the first, both said windings being included serially in the said local circuit, and a supervisory signal associated with the plug and interposed in the said local circuit, said supervisory signal being also controlled by curent in the telephone-line; whereby connection may be made with the line and the supervisory signal may be controlled without causing the display of the line-signal, as described.

6. The combination with a telephone-line having means for determining the flow of cur-

rent in the line in the use of the telephone, a spring-jack for the line and a plug and plug-circuit for making connection therewith, an electromagnetic line-signal associated with the line, said line-signal having two windings, and a supervisory signal associated with the plug, a relay responsive to current in the line, a local circuit controlled by the relay divided into two parallel branches, a winding of said line-signal in each of said branches, said windings being differential with respect to each other, said supervisory signal being included in one of said branches, and switch-contacts of the spring-jack and plug completing said last-mentioned branch; whereby the line-signal is rendered inert and the supervisory signal is brought under the control of the relay when connection is made with the line, as described.

7. The combination with a telephone-line having means at its station for determining the flow of current in the line in the use of the telephone, a spring-jack of the line and a plug and plug-circuit for making connection therewith, a line-signal associated with the spring-jack, said line-signal having two windings, a supervisory signal associated with the plug, a relay for the line responsive to current therein, a local circuit including a battery controlled by the said relay, said local circuit being divided into two parallel branches, a winding of the line-signal being included in each of the branches, said windings being differential with respect to each other, switch-contacts of the spring-jack and plug completing one of said branches, the supervisory signal being included in said last-mentioned branch, a source of test-current insufficient to operate the said signals included in the same branch, and means for testing the spring-jacks to determine the electrical condition of the contact-pieces in the local circuit, substantially as described.

8. The combination with a telephone-line extending from a subscriber's station to a central office, of an indicator associated with the line at the central office, a continuously-active source of current, a circuit connecting the same with a winding of said indicator, and means at the subscriber's station for effecting the completion of such circuit during the use of the telephone, whereby said winding is continuously supplied with current while the telephone remains in use, a branch circuit connected in parallel with said first-mentioned circuit and including a second winding of said indicator differential with respect to said first-mentioned winding, a spring-jack for the telephone-line and a plug for making connection therewith, said branch circuit being closed in registering contacts of the plug and spring-jack, and a supervisory signal connected with said branch circuit, substantially as set forth.

In witness whereof I hereunto subscribe my name this 2d day of March, A. D. 1897.

CHARLES E. SCRIBNER.

Witnesses:

ELLA EDLER,

JAMES L. MCQUARRIE.