

No. 772,899.

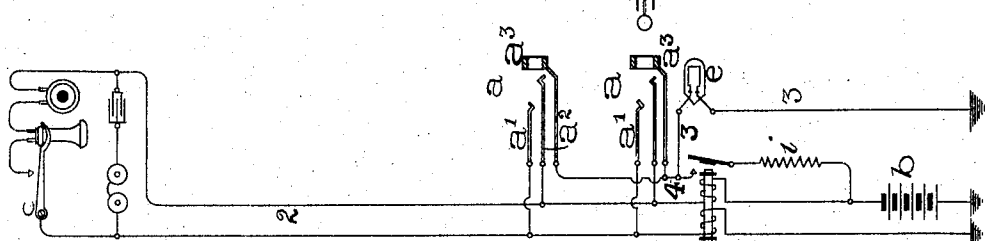
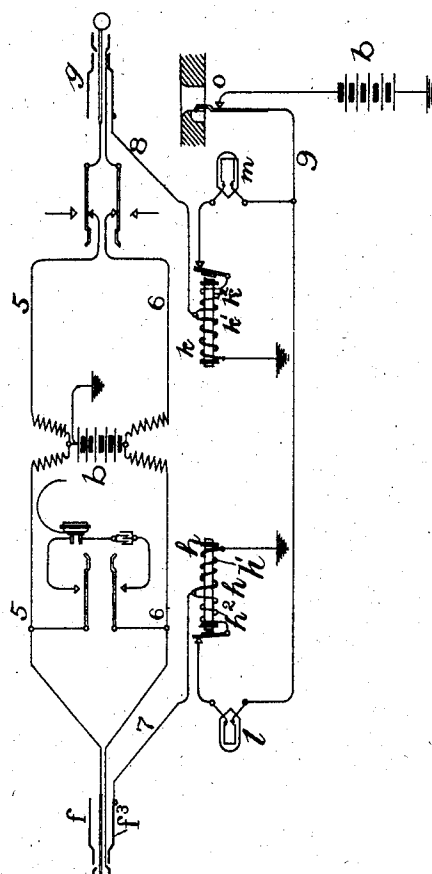
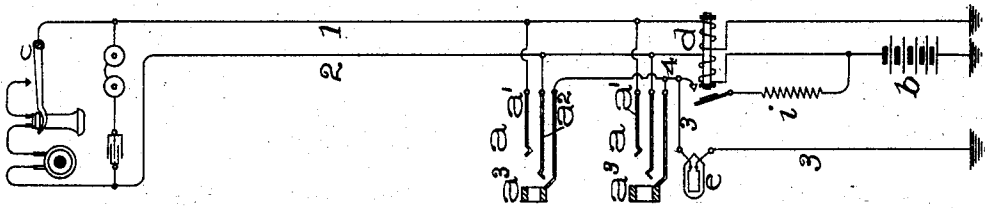
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F. R. McBERTY.

SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS.

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NO MODEL.



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# UNITED STATES PATENT OFFICE.

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## SUPERVISORY SIGNAL FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 772,899, dated October 18, 1904.

Application filed February 12, 1902. Serial No. 93,777. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Supervisory Signals for Telephone-Switchboards, of which the following is a full, clear, concise, and exact description.

My invention relates to a supervisory signaling apparatus for telephone-switchboards, and has for its object to provide improved and simplified apparatus whereby a call-signal may be automatically displayed at the central office of a telephone-exchange by the operation of a switch at the substation, which signal is automatically effaced when the central-office operator responds to the call, a second signal being simultaneously brought under the control of the substation-switch to be automatically actuated upon a reverse movement of said switch.

Another object is to provide a busy-test circuit controlled by the signaling mechanism and so organized as to insure the presence of a test-potential on the multiple spring-jack terminals of a line during the continuance of a connection therewith.

In a well-known signaling system of this character when the subscriber takes his telephone in initiating a call the circuit of the line is automatically closed through a line-relay, which in drawing up its armature completes a local circuit containing an incandescent-lamp signal. When the operator in response to the call inserts her answering-plug in the spring-jack of the line, a local shunt of the line-lamp is automatically established in registering contacts of the plug and spring-jack, this shunt containing a second or supervisory signal-lamp, which is thus temporarily associated with the line while the plug remains in the spring-jack. A resistance is included in the undivided portion of the signal-circuit. As long as the telephone at the substation is in use the line-relay remains excited, both local circuits containing the sig-

nal-lamps being closed, so that each lamp is shunted by the other and neither receives sufficient current to light it; but when the subscriber is through talking and hangs up his telephone upon its automatic switch-hook the circuit of the line is broken and the branch which contains the line-lamp broken, so that the supervisory lamp receives increased current and is lighted to indicate a signal for disconnection.

In the system above described the resistance of the two shunts must be accurately proportioned to one another in order that each lamp may be effectively extinguished when both shunts are closed, and some difficulty has been experienced in the practical application of the system for this reason. It is hard to obtain a number of signal-lamps which will all have the same resistance, and lamps are found to vary in resistance after being some time in service.

My invention contemplates a system somewhat similar in character to the one outlined, but in which the line-signal is effectively shunted by a low-resistance magnet-winding instead of by a signal-lamp, and the supervisory signal is controlled by the magnet and positively cut out or otherwise effaced instead of being merely shunted by the line-signal while the circuit is closed at the line-relay.

In order that the thimbles of all the multiple line-jacks of a line which has a connection at one of the multiple jacks may have an electric potential, whether the contacts of the line-relay be open or closed, so that the busy test will not be impaired, I provide means made operative in completing connection with the line for applying the test-potential through a second path when the normal path controlled by the switch-contacts of the line-relay is interrupted. I preferably provide a high-resistance shunt of these switch-contacts, including a differential winding for the magnet which controls the supervisory signal. While a connection is made with the line at one of the spring-jacks thereof, the line-signal is

shunted by the low-resistance winding of the magnet, and if the contacts of the line-relay are open current flows through the shunt containing the differential winding, from whence the greater portion flows through the low-resistance magnet-winding and a small part through the line-signal in shunt thereof. The two differential windings are so proportioned that when thus connected in series their effects balance one another and the magnet leaves its armature unattracted, in which position the supervisory signal controlled thereby is displayed. The connection of the plug-contact with battery through the shunt containing the high-resistance differential winding leaves the contact-thimble of the multiple spring-jacks electrified to establish a busy test irrespective of whether the line-relay contacts be open or closed. When said contacts are closed, an increased current flows through the low-resistance winding, whereby the balance of the differential magnet is destroyed, its armature is attracted, and the controlled supervisory signal is positively effaced.

I will describe my invention more particularly by reference to the accompanying drawing, which is a diagram illustrating two telephone-lines extending from substations to a central-office switchboard, together with the operator's switching and accessory apparatus for uniting lines, the system being organized and equipped for my improved system of automatic signaling.

The features which I regard as novel will be pointed out in the appended claims.

Each of the lines illustrated extends in two limbs 1 2 from a substation to multiple spring-jacks  $a$   $a$  and through the windings of the usual line-relay  $d$  to the poles of a central battery  $b$ . At the substation the usual telephone apparatus is included in a bridge of the line, with an ordinary gravity telephone-switch  $e$  normally maintaining the bridge open, but adapted to close the same and permit the flow of current in the line when the telephone-receiver is removed from the hook for use. A second bridge is also provided at each station, containing a condenser and a high-impedance call-bell for receiving incoming signals. The operator is provided with the usual pairs of plugs  $f$   $g$  for uniting lines by plugging into the spring-jacks thereof, the plugs of each pair being united by the link conductors of a flexible cord-circuit. Each plug has the usual tip, ring, and sleeve contacts adapted to register with the short and long line-springs  $a'$   $a''$  and the test-thimble  $a^3$ , respectively, of any spring-jack into which it may be inserted. The line-springs  $a'$   $a''$  of each of the several multiple spring-jacks of each line are connected, respectively, with the conductors 1 2 of each line, and the tip and ring contacts of each plug are connected by link conductors 5 6 with the corresponding contacts of its

mate plug, so that any two lines may be united by inserting the plugs of pair into the respective spring-jacks of such lines. The link conductors 5 6 each contains two windings of the usual repeating-coil, and the central battery  $b$  is connected, as usual, in a bridge of said link conductors between the windings of the repeating-coil for supplying current to the substation-transmitters. In the drawing several batteries (marked  $b$ ) are shown at different places; but it should be understood that this is merely for convenience of illustration and that in accordance with the usual practice a single battery may be employed, which may be connected as indicated. The positive pole of the battery, which is connected to the limbs 1 of the several telephone-lines, is grounded. Each plug-circuit is furnished with the usual listening and ringing keys, whereby the operator may connect her telephone in circuit and may transmit call-signals. A line-signal  $c$ , which may be an incandescent lamp, is provided for each line in a local circuit 3, controlled at the switch-contacts of the line-relay  $d$ . This local circuit is normally open, but is closed when the line-relay is excited—that is, when the telephone-receiver at the substation is off the hook. A resistance  $i$  is included in each local circuit between the battery and the switch-contacts of the relay. A conductor 4 extends from the local circuit 3 at a point between the line-lamp  $c$  and the switch-contact of the line-relay to the test-thimbles  $a^3$  of all the multiple spring-jacks of the line. The third contact or shank  $f^3$  of the answering-plug of each pair, which registers with the test-thimble of the jack into which such plug may be inserted, forms the terminal of a conductor 7, which extends to the grounded pole of the battery  $b$  and includes the low-resistance winding  $h'$  of a signal-controlling electromagnet  $h$ . When the answering-plug is inserted in the spring-jack of any line therefore, a low-resistance shunt 7 4 about the line-signal is thus established in registering contacts of the plug and jack, so that the line signal-lamp, which may have been lighted by the closure of the local circuit 3 at the contacts of the line-relay, as in the initiating of a call, will be shunted out by the low-resistance path 7 4 established when the operator makes connections with the lines. A shunt conductor 8, corresponding to the conductor 7 of the answering-plug, connects the shank of the calling-plug  $g$  with the grounded pole of the battery and contains the low-resistance winding  $h'$  of a controlling-magnet  $h$ , similar to the magnet  $h$ .

The magnet  $h$  has in addition to the low-resistance winding  $h'$  a high-resistance differential winding  $h^2$ , connected between the armature switch-lever of such magnet and the shank of the plug  $f$ . Similarly, the magnet  $h$  has a

high-resistance differential winding  $k^2$ , which is connected between the armature switch-lever and the shank of plug  $g$ . The back contacts, against which the armature-levers of the magnets  $h$  and  $k$  normally rest, are connected through supervisory signals  $l$  and  $m$ , respectively, with a conductor 9, leading to the free pole of battery  $b$ . The circuit of conductor 9 is controlled by a plug-seat switch  $o$ , which is kept normally open by the calling-plug resting therein, but which is automatically closed when the calling-plug is lifted preparatory to being inserted in a spring-jack.

The operation of the system may be briefly outlined as follows: A subscriber who desires an exchange connection transmits a call-signal in the usual way by removing his telephone-receiver from its hook. The circuit of the line is thus closed, and current flows through the line-relay  $d$ , which draws up its armature, closes the local circuit 3, and so brings about the excitement of the line-signal  $e$ . The closure of the line-relay contact also connects the thimbles  $a^3$  of the spring-jacks of the line with battery  $b$  by way of conductor 4, thus establishing a test-potential at said spring-jacks. In response to the call the operator inserts the answering-plug  $f$  of a pair in the answering spring-jack of the line and bringing her telephone into circuit by means of her listening-key inquires the number of the subscriber with whom communication is desired. The insertion of the answering-plug establishes the shunt 7 4 about the line signal-lamp, whereby the latter is deprived of the current necessary to its illumination. The magnet  $h$  is excited by current flowing in the winding  $h'$  and draws up its armature, cutting out the supervisory signal  $l$ . When the operator has learned the number of the subscriber wanted, she makes the usual preliminary test and finding the line free inserts the calling-plug  $g$  of the pair and transmits a call-signal by means of her ringing-key. When the calling-plug  $g$  is lifted from its socket, the plug-seat switch  $o$  automatically closes, applying battery to the conductor 9; and when said plug is inserted in the spring-jack of the called line the circuit 8 4 3 is established. Until the called party answers the contacts of his line-relay are open. Current flows from conductor 9 through the supervisory lamp  $m$  and by way of the armature and back contact of magnet  $k$  through both windings  $k'$   $k^2$  thereof in series. The windings being differentially connected and proportioned to balance one another, the armature of this magnet is not drawn up. A portion of the current from conductor 9 after passing through winding  $k^2$  finds its way through the line-lamp  $e$  of the called line; but this is not sufficient to light the lamp, since the winding  $k'$  forms a low-resistance shunt for the same. This current serves to apply a test-potential to

the thimbles  $a^3$  of the spring-jacks of the called line. The supervisory lamp  $m$  remains lighted until the called party answers. When the telephone is taken for use at the called station, the circuit of the line is closed, and the line-relay  $d$ , receiving current, closes its switch-contacts and shunts the high-resistance winding  $k^2$  of the magnet  $k$  by the resistance  $i$ . An increased current is thus caused to flow through winding  $k'$ , and the magnet  $k$  is unbalanced and attracts its armature, cutting off the supervisory signal  $m$ . This current also creates a test-potential at the thimbles of the spring-jacks of the called line. The line-lamp  $e$  of the closed line is still shunted by the low-resistance magnet-winding  $k$ . When at the termination of the conversation either of the subscribers hangs up his telephone, his line-relay will be rendered inert and by allowing its armature to fall back will open the shunt about the high-resistance winding of the differential magnet which is associated with the line in question. Both windings of said magnet will thus be temporarily deprived of current, and the armature thereof will drop back and close the connection to battery through the corresponding supervisory lamp and the plug-seat switch. The two windings of the magnet being connected in series will balance one another, and the armature will stay in its unattracted position, causing the continued illumination of the corresponding supervisory lamp. The lighting of both lamps will constitute a signal to the operator to take down the connection.

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

1. The combination in a telephone-switchboard apparatus with a circuit containing a resistance and a signal device and leading through relay-contacts controlling its continuity, of a shunt of said signal device containing one winding of a differential magnet and a switch for closing said shunt, a branch circuit or second shunt including both windings of said differential magnet and shunting the said resistance and relay contacts, and an independent signal device connected in the said second shunt, and controlled by the said differential magnet.

2. The combination with a telephone-line extending from a substation to a central office, of a central battery and a line-relay in the circuit of the line at the central office, a switch at the substation for controlling the flow of current in the line, a local circuit including a resistance and a line-signal at the central office, controlled by the line-relay, a spring-jack for the line, a plug and plug-circuit for making connection therewith, a shunt of the line-signal established in registering contacts of the plug and spring-jack, a supervisory magnet having two differential windings, one

of which is included in said shunt, a shunt of the line-relay switch-contacts, containing the other winding of said differential magnet, and a supervisory signal controlled by said differential magnet.

3. The combination with a telephone-switchboard having multiple spring-jacks for the telephone-lines centered thereat, and automatic line-switches *d* controlled from the substations of said lines, of a local circuit for each line including a battery and a line-signal, controlled by the switch *d* of such line, a plug and plug-circuit for making connection with the line, a conductor associated with the plug, adapted to shunt the line-signal of the line whose spring-jack may be plugged into, a supervisory magnet associated with the plug, having differential windings one of which is included in the aforesaid shunt-conductor, and a shunt of the contacts of said line-switch *d* including a supervisory signal and the other differential winding of said magnet, and normally closed-in switch-contacts operated by said magnet, said switch-contacts being opened when the magnet is excited.

4. The combination with a telephone-line having a telephone-switch at a substation, of a source of current and a line-relay permanently connected with the line at a central office, multiple spring-jacks for the line, each spring-jack having a test contact-piece, a normally open conductor closed by the line-relay when excited, leading from the several test-pieces of the line to a source of test-potential, a plug and plug-circuit for making connection with the line, and a switch brought under the control of said line-relay by the insertion of the plug in a spring-jack, and closed through the agency of said relay when inert, adapted to establish another connection of said test-pieces to a source of test-potential; whereby the line is made to test busy before connection when the telephone-switch is closed and during connection whether the telephone-switch is open or closed.

5. The combination with a telephone-line and a telephone-switch for determining the flow of current in the line during the use of the telephone, and multiple spring-jack terminals for the line in different sections of the multiple switchboard, said multiple spring-jacks each having a test-contact, of an electromagnet directly responsive to current in said line, and a test-circuit of the said contacts controlled by said magnet to be completed while the telephone is in use, a second electromagnet controlled by current in the line, and switch-contacts thereof also controlling the test-circuit to complete it when the current in said line is interrupted, said second-mentioned magnet being made operative when connection is made with the line at a spring-jack.

6. The combination with a telephone-line

and a telephone-switch for determining the operation of signals in the line at a switchboard, of a magnet controlling a line-signal to display the signal while the telephone is in use, a magnet controlling a supervisory signal to display the same when the telephone is replaced on its switch, said magnets being controlled by said telephone-switch, multiple spring-jack terminals for the line, a test-contact in each spring-jack, and a test-circuit leading to said test-contacts closed by either of said magnets in displaying its signal, as described.

7. The combination with a telephone-line and a telephone-switch for determining the flow of current in the line during the use of the telephone, of a magnet controlled by said telephone-switch, a multiple spring-jack for the line and a connecting-plug therefor, a signal-circuit closed by said magnet, divided into multiple branches, a high-resistance line-signal in one of said branches, a low-resistance magnet controlling the other of said branches, said last-mentioned branch being closed in registering contacts of the spring-jack and plug, and a supervisory signal controlled by said low-resistance magnet; whereby the line-signal is shunted and the supervisory signal is brought under the control of the line-relay when connection is made with the line, as described.

8. The combination with a telephone-line and a telephone-switch thereof for controlling signals at the central office, multiple spring-jack terminals of the line in the multiple switchboard, and plugs and plug-circuits for making connection therewith, a signal-controlling magnet in the line at the central office, a local circuit controlled thereby, divided into multiple branches, a high-resistance line-signal in one of said branches, a low-resistance signal-controlling magnet in the other of said branches adapted to shunt said high-resistance line-signal; said last-mentioned branch being closed during the connection of a plug-circuit with a spring-jack of the line; a test-contact for each spring-jack, a test-circuit thereof connected with said branches, and switch-contacts controlled by said low-resistance magnet to close the test-circuit when the magnet is inert, the corresponding plug being in a spring-jack of the line as described.

9. The combination with a telephone-line having a switch at the substation and a relay at the central office responsive to said switch, of multiple spring-jacks for the line each having a test-thimble, a source of current, a connection from said source of current to the multiple test-thimbles controlled by said line-relay, a plug and plug-circuit for making connection with the line, a conductor associated with the plug adapted to complete the circuit from the test-thimble of the jack to

the other pole of said source of current, said  
conductor including one winding  $k'$  of a dif-  
ferential magnet, a conductor including a sec-  
ond winding  $k''$  of said differential magnet in  
5 shunt of the switch-contacts of the line-relay,  
whereby a test-potential is applied to the  
multiple test-thimbles when the contacts of  
the line-relay are open, and a supervisory sig-

nal arranged to be displayed by the differen-  
tial magnet when the same is neutral. 10

In witness whereof I hereunto subscribe my  
name this 8th day of February, A. D. 1902.

FRANK R. McBERTY.

Witnesses:

DUNCAN E. WILLETT,  
FREDERICK A. WATKINS.