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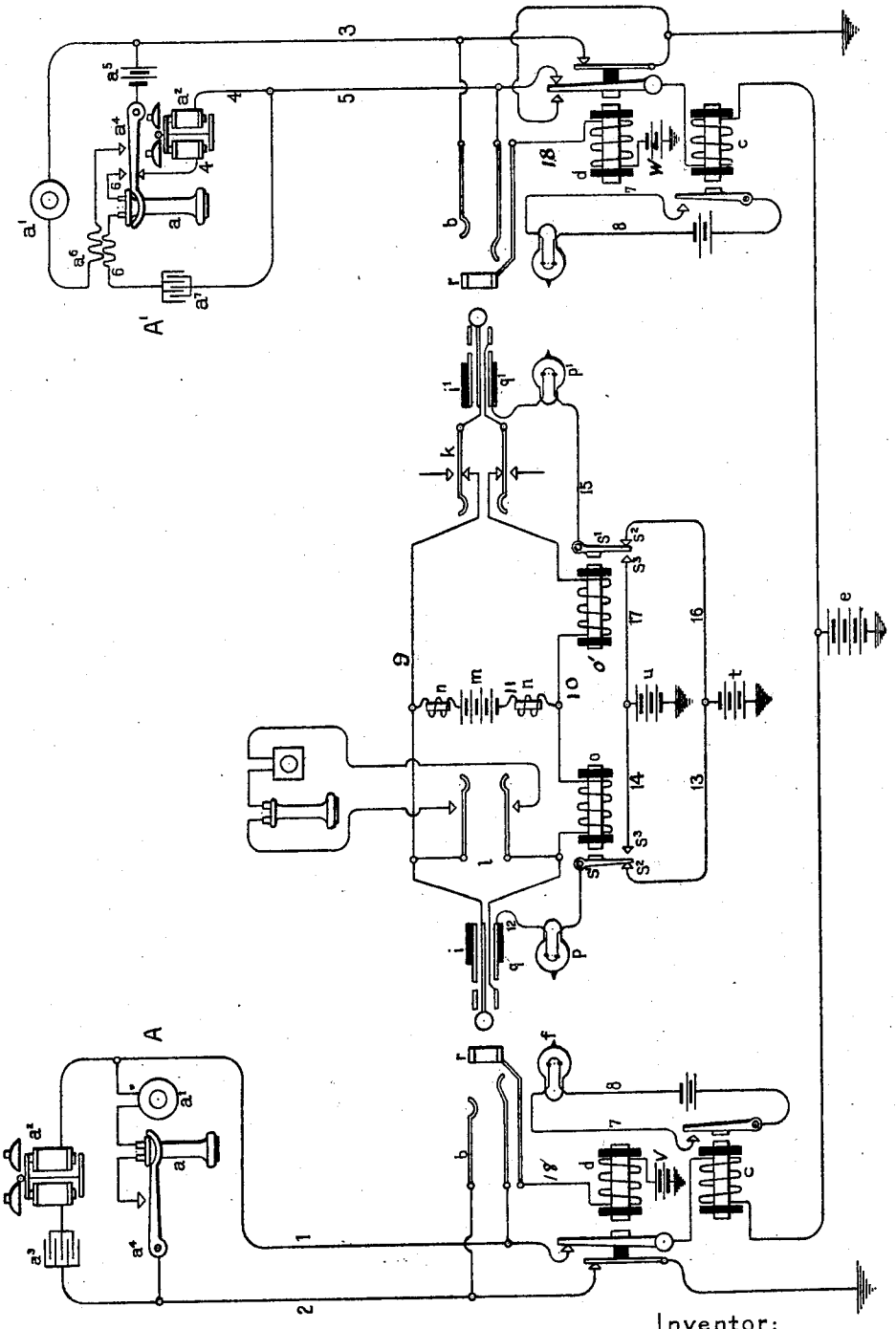
F. R. McBERTY.

SUPERVISORY SIGNAL FOR TELEPHONE SYSTEMS.

(Application filed Nov. 13, 1897.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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SUPERVISORY SIGNAL FOR TELEPHONE SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 682,732, dated September 17, 1901.

Application filed November 13, 1897. Serial No. 658,400. (No model.)

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Downers Grove, in the county of Dupage and State of Illinois, have invented a certain new and useful Improvement in Supervisory Signals for Telephone Systems, (Case No. 59,) 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 supervising-signals in telephone-switchboards for use in temporary association with lines variously equipped at their substations with devices for opening or closing the line-circuits during the use of the telephones, the object of the invention being to provide means for insuring the uniform operation of the supervisory signals under these varying conditions.

Two modes of supplying substation transmitting-telephones with current from a central source are commonly practiced in telephone-exchanges—namely, the transmitting-telephone may be serially in the line-circuit, current being transmitted to it from the central source over the line-wires during the use of the telephone, or a local storage battery may be placed at the substation in a normally closed circuit with the line to be charged by current from the central source during the idleness of the line, means being provided for connecting the local storage battery in circuit with the transmitting-telephone and an induction-coil during the use of the telephone. In associating automatically-operated signals with such lines the former plan commonly involves a telephone-switch for closing the line-circuit during the use of the telephone, while the latter plan employs mechanism for opening the line-circuit or the special circuit containing the signal to be operated while the telephone is in use. It is frequently desirable to employ both modes of current-supply on lines centering in the same telephone-switchboard, inasmuch as the system of direct supply is applicable to greatest advantage to short lines, while the local storage system is especially adapted for use on long lines of high resistance. Heretofore it has been impracticable to employ lines with such diverse arrangements in the same switchboard, because of the necessity of using the same link conductors or plugs and plug-circuits for uniting any two lines in the switchboard, whether these be lines equipped for direct supply or be provided with local storage batteries, or one be provided with a local storage battery and the other be adapted for direct supply. The supervisory signals associated with the terminal plugs of a plug-circuit and serving for the operator's guidance during the existence of a connection have been adapted for operation through the breaking of line-circuits at the stations, and in other cases through the completion of the circuit at the station; but in no instance have they been adapted for uniform operation, permitting uniform supervision of connections, in uniting lines involving both modes of controlling the signals.

Stated generally, in accordance with my invention a signal-receiving device, such as an electromagnet, is connected or adapted to be connected with each telephone-line at the central office. This signal-receiving device may be a magnet included in a plug-circuit or link conductor for uniting any two lines. The lines of the exchange being of different types different means for signaling from the substation of each line are provided, the magnet being responsive in some way to the means of signaling provided for any of said lines. A supervisory signal, such as an incandescent lamp, is under the control of the electromagnet or signal-receiving device, and an intermediate translating device or agent is provided through which the magnet acts to effect the supervisory signal, said intermediate device being adapted operatively to connect the magnet with the supervisory signal in a distinctive manner according to the type of line, whereby the signals received by said magnet will be transferred to the supervisory signal in a given way, according to the condition or character of the intermediate device. This intermediate device may be, for example, an electric circuit established in making connection with any line, each line having a portion of such circuit associated with a terminal in the spring-jack of that line, the character of the circuit or of the apparatus in-

cluded therein being different for the different classes of lines. When connection is made with any line, the intermediate device, which is associated in part with the line, is brought into action to operatively connect the magnet with the supervisory signal in a definite way, according to the mode of signaling which is provided for the line in question. When connection is made with lines of one type, a certain condition of the electromagnet will be caused to effect the supervisory signal in one way, while when connection is made with another line the same condition of the magnet will be caused to effect the supervisory signal in a different way, the control of the magnet over the supervisory signal being dependent upon the intermediate translating device or agent peculiar to each line which operatively connects the magnet with the supervisory signal when connection is made with the line.

I have chosen to apply my invention to that type of switchboard known as the "relay-switchboard," wherein each line-circuit is normally connected with a line-relay controlling a line-signal and is temporarily connected with a supervisory relay controlling a supervisory signal during connection with the line and has a relay for severing the normal line connections excited through the agency of a local circuit completed in the act of making connection with the line. This switching system is represented in the attached drawing.

Station A is equipped for direct supply of current for exciting the substation transmitting-telephone. The appliances at the station comprise a receiving-telephone a, a transmitting-telephone a', a polarized signal-bell a^2, and a condenser a^3 in circuit therewith, and a telephone-switch a^4 for closing the normally open line-circuit through the telephone in shunt of the bell and condenser when the switch is relieved of the weight of the receiving-telephone. From these appliances conductors 1 and 2 extend to a spring-jack b in a telephone-switchboard in a central office, whence they are led through the separable switch-contacts of a cut-off relay d and the magnet-winding of a line-relay c to the free pole of a grounded battery e, which is common to the different lines of the exchange, and to earth, respectively.

Station A' is adapted for local current-supply to the transmitting-telephone from a local storage battery. The instruments at a station comprise a receiving-telephone a and transmitting-telephone a', a polarized bell a^2, a telephone-switch a^4, a local storage battery a^5, and an induction-coil a^6. Conductor 3 of the line-circuit is connected with the lever of switch a^4, the local storage battery a^5 being interposed in the circuit. The normal resting-anvil of the switch a^4 is led through wire 4 to conductor 5 of the line-circuit. One of the alternate contact-points constitutes the terminal of a wire 6, leading to line conductor 5 and including the receiving-telephone a, together with the secondary winding of the induction-coil a^6, while the other of the alternate contact-points is connected with a wire 7, traversing the primary winding of the induction-coil a^6 and the transmitting-telephone a', being adapted to come into a closed local circuit of the storage battery a^5 when the switch is permitted to rise. It will be understood that the switch at this station is normally closed through the conductors 3 and 5, being broken at the condenser a^7 as respects continuous current while the telephone is in use. Line-conductors 3 and 5 lead to a spring-jack b in the switchboard, thence through the switch-contacts of cut-off relay d, and thence respectively through the magnet-winding of the line-relay c to battery e and to earth.

The line-relay c of line to station A controls a local circuit 7 8, which includes a source of current and a line signal-lamp f, the latter being associated with the spring-jack b of the corresponding line in the switchboard. The relay is adapted to close the local circuit when its magnet becomes excited. The line-relay c of line to station A' similarly controls a local circuit 7 8, including, likewise, a source of current and a line-lamp f; but in this case the relay is adapted to close the circuit of the secondary line-signal when the magnet of the relay becomes inert through the opening of the line-circuit. Pairs of plugs i and i' and their plug-circuit 9 10, uniting them, are provided in the switchboard for bringing the circuits of lines into connection with each other. This plug-circuit is furnished with the usual operator's calling-key k for connecting a generator of calling-current with plug i' and with an operator's listening-key l for bringing her telephone into a bridge of the plug-circuit. A permanently-closed bridge of the circuit is formed by a wire 11, which includes a battery m or other source of current, together with the windings of impedance-coils n, designed to prevent the shunting of telephonic current through the cross connection. Conductor 10 of the plug-circuit traverses the windings of two relays o and o', one between each plug and the bridge 11 of the plug-circuit, which control supervisory signals p and p', respectively, associated with plugs i and i'. These supervisory signals are included in local circuits which become closed in the act of making connection between lines, the flow of current through the signals being determined by the relays o and o'. Each plug carries a contact-piece q in addition to its usual line-contacts, which is designed to register with the contact-ring r of a spring-jack, into which it may be inserted. Contact-piece q of plug i forms the terminal of a conductor 12, leading to the lever s' of relay o. This switch-lever oscillates between two contact-pieces s^2 and s^3. The former of these, the resting-contact of the lever, is connected by wire 13 with the free pole of a battery t. The alternate

contact s^3 is connected by wire 14 with the free pole of a grounded battery u. Similarly contact-piece q of plug i' is connected by wire 15 with switch-lever s' of relay o', whose resting and alternate contacts are connected by wire 16 with battery t and by wire 17 with battery u, respectively. The magnet of cut-off relay d of each line is located in a conductor 18, leading from contact-ring r of the spring-jack of the same line to earth. A battery v is interposed in this conductor 18 of line to station A and a battery w in wire 18 of line to station A'.

The special mode of operation which forms the object of this invention is attained through the agency of batteries t, u, v, and w, with their associated switches and local circuits. The polarity of the battery v or w is adapted to the normal condition of the line with which it is associated, being of one direction in case of a line normally closed, but open during the use of the telephone, and in another direction in case of a line normally open, but closed during the use of the telephone. These batteries are designed to cooperate with the batteries t and u, temporarily associated with the lines during connection, to insure the illumination of supervisory signals p and p' at the proper times without respect to the special character of the line with which the signal happens to be associated.

Referring again to the figure, the positive pole of battery t is connected to ground, while the negative pole of the equal battery u is grounded. The negative pole of battery v is connected to earth, and the positive pole of battery w is similarly connected. The batteries u and t should be of sufficient strength to excite the cut-off relay d, whether opposed by battery v or w or not; but when thus opposed one of them should have an electromotive force insufficient to light the signal-lamp p or p'. Batteries t and u may be of six volts electromotive force and batteries v and w of four volts. Then the lamps p and p' should require ten volts in the circuit through them for their full illumination, the potential available at the lamp-terminals being determined by the relation between the resistance of the lamps and that of the magnet of cut-off relay d.

In the normal condition of the appliances described the telephone at station A is on its switch, the line-circuit is broken at the substation, so that the relay c is inert, and the circuit of the secondary line-signal is open. At station A', on the contrary, the line-circuit is closed, being complete from battery e over line conductor 5 through bell a^2 and the local storage battery a^5 to line-wire 3, and thence to earth at the central office. The local storage battery a^5 is thus subject to a continuous charging-current from the central battery e. The line-relay c of line to station A' is constantly excited and holds its armature away from the normal resting-stop, maintaining a break in the circuit of the secondary line-signal.

In order to trace the operation of the system, assume that subscriber at station A wishes to communicate with subscriber at station A'. The call-initiating subscriber removes his telephone from its switch for use. This act permits current to flow from battery e through the line-circuit and to earth at the central office, whereby relay c is excited and lights the secondary-line signal f to indicate the call. Responding to the call an operator inserts plug i into spring-jack b of the calling-line, at the same time bringing her telephone into connection with the plug-circuit. The insertion of the plug into the spring-jack brings about an extension of the line conductors 1 and 2 to the conductors 9 and 10 of the plug-circuit, whereby the battery m is brought into a bridge of the line. Since the line-circuit is closed at the substation, this battery produces a flow of current in the line which excites the supervisory relay o and causes it to attract its armature s'. The act of inserting plug i into the spring-jack b, together with the change of position of armature-lever s', completes a local circuit made up of conductors 18, 12, and 14, which includes batteries u and v, together with the supervisory signal p and the cut-off relay d. The resultant electromotive force in this circuit is sufficient to excite the cut-off relay d and cause it to sever the normal extensions of the line conductors to the relay c and battery and to earth, respectively, but is insufficient to light the lamp p. Hence the act of making connection with the calling-line effaces the signal of the line-lamp and at the same time renders the supervisory lamp inert. Having learned the order of the calling subscriber for connection with line to station A the operator inserts plug i' into spring-jack b of that line and rings the bell a^2 at the station by means of calling-key g. The insertion of plug i' into spring-jack b brings the two line-circuits into complete metallic connection through the agency of plug-circuit 9 and 10. While the line-circuit remains completed by the telephone-switch at the substation, current from battery m flows to the line and excites the supervisory relay o', whereby its armature is attracted against the contact s^3. A local circuit associated with the line to station A' is thus completed, comprising conductors 18, 15, and 17, and containing the cut-off relay d of the called line, the supervisory signal-lamp p', and the two batteries u and w. It will be noted that the polarity of these two batteries is in the same direction in the circuit, so that the resultant electromotive force is ten volts. This is sufficient to operate the cut-off relay d, severing the normal earth connections of the called line, and also to light the lamp p'. The severence of the earth connections by the cut-off relay is attended with the closing of a local circuit of battery e through relay c of

the called line, whereby the interruption of the circuit 7 8 is maintained and the display of the line-signal is prevented. The removal of the telephone from its switch at the called station in response to the call breaks the normally complete circuit of the line and leaves it open at the condenser a' as to currents from constant sources of electromotive force. This deprives the supervisory relay o' of current, and the relay releases its armature, breaking the connection of wire 15 with wire 17 and closing it to wire 16. The battery t is thus introduced into the local circuit in the opposite direction to battery u, so that the resultant electromotive force in the local circuit is now but two volts, which maintains the excitement of cut-off relay d, but is insufficient to light the supervisory lamp p'. The extinction of lamp p' therefore indicates to the operator the taking of the telephone for use at the called station. If during the existence of the connection the subscriber at station A should replace his telephone on its switch, thereby breaking the telephone-line, relay o would be deprived of current and would break the connection between wires 12 and 14, completing it between wires 12 and 13, and thus introducing the battery t into the local circuit 13 12 18 in proper direction to light the supervisory lamp p. A similar act on the part of subscriber at station A' would cause the illumination of lamp p' in the mode already traced in considering the establishment of connection with the called line. Hence the replacement of the telephone on its switch at either station lights the supervisory lamp temporarily associated with the line to that station, while the taking of the telephone for use extinguishes the lamp. The replacement of both telephones resulting in the lighting of both lamps p and p' may be considered a call for disconnection to be followed by the removal of the plugs from the spring-jacks of the united lines. Obviously plugs i and i' might be used in making connection between two stations equipped like station A for direct-current supply to the transmitting-telephones or between two stations equipped like station A' for local supply to the telephones. In the former case both supervisory signals p and p' would be operative in the way traced for signal p, which was in connection with such a line. In the latter case both supervisory signals would operate in the way described for signal p' in connection with line to station A'. In short the operation of the supervisory signals which come into temporary association with both normally closed and normally open lines is the same for both cases and is uniform throughout the switchboard, the different modes of controlling the signals in the different cases being compensated for by special appliances, each adapted for the particular line with which it is connected.

This invention in its broader aspects may of course be applied to switchboards of other types than that with which it has been herein associated and is obviously capable of great modification as respects details of arrrangement and mechanism.

The invention is defined in the following claims:

1. The combination with telephone-lines of different types centering in the same switchboard, of a signal-receiving electromagnet o for each line and means at the substation of each line for transmitting signals to which said magnet is responsive, said means being different for the different lines, whereby said magnet is affected in different ways, a supervisory signal controlled by the magnet, and an intermediate device or agent through which the magnet acts to affect the supervisory signal, the effect of a given condition of the magnet upon its supervisory signal being dependent upon the intermediate device, the intermediate device of each magnet being associated with the corresponding line and adapted to transfer the signals received by the magnet to the supervisory signal in a manner distinctive to that class of lines, substantially as set forth.

2. The combination with differently-equipped telephone-lines centering in the same switchboard, spring-jacks for the lines and a pair of plugs and their plug-circuit for connecting any two lines together, of a signal-receiving electromagnet in the plug-circuit and means at the substation of each line for determining the flow of current in that line to transmit signals to the central office, the magnet in the plug-circuit being responsive to all such signals, a supervisory signal associated with the magnet, an intermediate translating device or agent adapted operatively to connect the magnet with the supervisory signal, and means controlled by connection of the plug-circuit with any line, for adapting the intermediate device to the particular means of signaling of that line, whereby uniform action of the supervisory signal is obtained in connecting the plug with all of said lines, as set forth.

3. The combination with telephone-lines having switches at their substations for closing different circuits for signaling, of a link conductor for making connection with any line, and a signal-receiving device responsive to the calling-current from any line, a secondary signal associated with the link conductor, and an intermediate controlling device between said signal-receiving device and said secondary signal and operatively connecting them when said link conductor is connected with the line, said intermediate device consisting in part of a circuit permanently associated with the line and adapted to modify the control of said signal-receiving appliance over said signal, as described.

4. In combination, normally open telephone-lines with switches for closing them in the use of the telephones, and normally closed

lines with switches for opening them in the use of the telephones, said lines centering in a switchboard, of plugs and a plug-circuit for uniting the lines, a supervisory signal associated with each plug, a controlling device for each signal in the plug-circuit, and means for producing current in the said device when the circuit is closed at the substation with which the controlling device is connected; local circuits forming the medium of control between said controlling device and said supervisory signal, each such local circuit being formed in part of a conductor permanently associated with a telephone-line, and a device in the said circuit connections of each line adapted to determine the operation of the signals, the said devices of the normally open and of the normally closed lines being adapted to affect the signal in opposite ways; whereby the response of the signals to changes of position of the switches at the substations is the same whether they are associated with normally open or normally closed lines, as described.

5. The combination with a telephone-line having a switch for opening the line in the use of the telephone, a relay connected with the line to be excited by current therein, a line-signal controlled by the relay to be lighted when the relay is inert, of a switch actuated in making connection with the line to sever the normal-line connection with the said relay, and auxiliary contacts of the said switch adapted to complete a local circuit of the relay, whereby the line-signal is effaced in making connection with the line, as described.

6. The combination with a telephone-line, a relay associated therewith to respond to current in the line, a supervisory signal controlled by the relay, a cut-off relay for severing normal circuits during connection with the line, a local circuit including said cut-off relay and said supervisory signal, a switch-lever for said supervisory controlling-relay, and circuit connections controlled thereby adapted to apply a small electromotive force for exciting the cut-off relay or an increased electromotive force for exciting the supervisory signal, according to the position of said relay, as described.

In witness whereof I hereunto subscribe my name this 29th day of September, A. D. 1897.

FRANK R. McBERTY.

Witnesses:

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