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SIGNALING APPARATUS FOR TELEPHONE SWITCHBOARDS.

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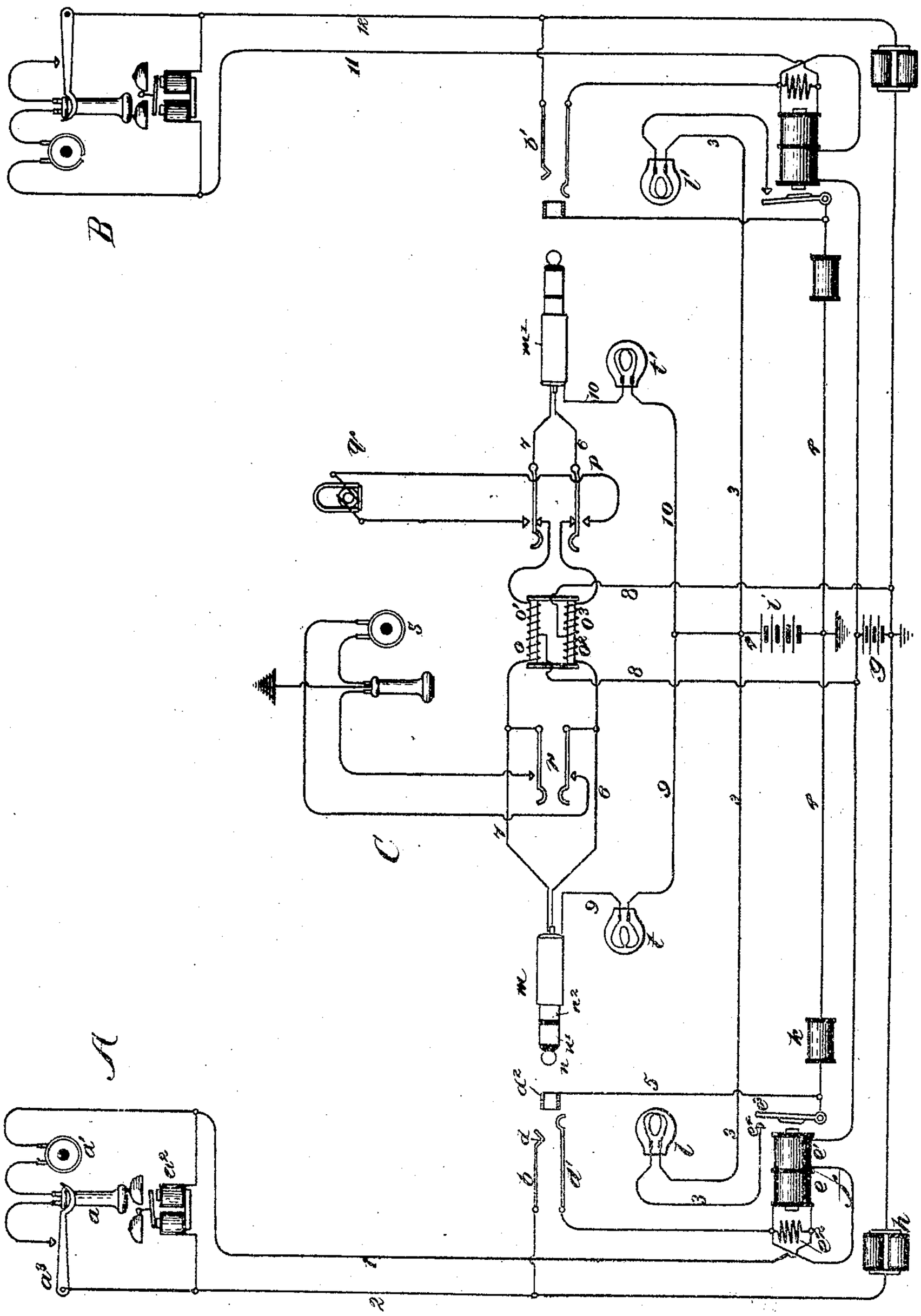
NO MODEL.



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UNITED STATES PATENT OFFICE.

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SIGNALING APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 774,332, dated November 8, 1904.

Application filed December 26, 1899. Serial No. 741,575. (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 Signaling Apparatus for Telephone-Switchboards, of which the following is a full, clear, concise, and exact description.

My invention relates to the signaling apparatus of telephone-switchboards for indicating at the switchboard signals transmitted from the substations of the different telephone-lines terminating in the switchboard.

In a former patent, No. 680,879, dated August 20, 1901, I have described a system of signals in which a subsidiary line-signal permanently associated with each telephone-line and a subsidiary clearing-out or supervisory signal temporarily associated with the line during connection are controlled by a single relay included in the line-circuit and responding to currents existing in it during the use of the telephone-line.

My present invention is a modification of the invention in the before-mentioned prior patent, and has for its object to adapt the signal-controlling relay for use in telephone-exchange systems in which current for exciting or operating the substation telephone-transmitters is supplied through the telephone-lines from a common source at the central station during the use of the lines, the temporary connection of the source of current-supply being made through impedance-coils or repeating-coils of comparatively low resistance. With such a system if a high-resistance signal-controlling magnet were merely included in a bridge of the line with the spring-jack between such bridge and the substation, as shown in my Patent No. 680,879, for example, the connection of the battery with the line at the spring-jack through the low-resistance repeating-coil in the plug-circuit would shunt the current from the signal-magnet and impair the working of the system.

In accordance with my invention the signal-controlling magnet or relay has a winding included serially in the line-circuit between the spring-jack of the line and the substation. The signaling-battery is connected in a bridge of the line between the spring-jack and the winding of the relay, above referred to. This bridge is of high impedance to prevent the shunting of telephone-currents. I preferably provide a second winding of high impedance for the line-signal magnet before referred to and include this winding in the bridge with the signaling-battery. The battery or other source of current which is designed to supply the substation-transmitters may in accordance with the usual practice be the same battery as that used for operating the line-relay before referred to and may be connected in a bridge of the plug-circuit between the windings of a repeating-coil. The magnet in the line-circuit may serve to control signals in accordance with the plan described in Patent No. 669,708, granted March 12, 1901, to Charles E. Scribner—that is to say, a line-signal may be included in a local circuit with a battery and a resistance, said circuit being controlled by switch-contacts operated by the line-signal magnet or relay, and a supervisory signal associated with the plug by which connection is made with the line may be included in a shunt of the line-signal closed in registering contacts of the plug and spring-jack. The substation apparatus will be provided with the usual telephone-switch to determine the flow of current in the line. When the substation-telephone is removed from its switch-hook, the circuit of the signaling-battery is closed and current therefrom flows through the coils of the line-relay, exciting the relay and causing the same to close the local circuit containing the subsidiary line-signal. When in response to the signal connection is made with the line by the insertion of a plug in the spring-jack thereof, the battery is applied to the line through the low-resistance windings of the repeating-coil in the plug-circuit and flows out to the substation to excite the transmitter. This current traverses the low-resistance winding of the line-relay

and maintains the excitation of said relay, although the high-resistance winding thereof, which may have been included in the permanent bridge with the signaling-battery, is shunted by the low-resistance repeating-coil during the connection. While the line-relay remains excited, both the parallel circuits containing the subsidiary signals are closed and neither signal receives sufficient current for its excitation; but when at the end of the conversation the subscriber replaces his telephone on its hook the branch containing the line-signal will be opened, so that increased current will flow through the other branch containing the supervisory signal, causing the latter to be displayed.

I have diagrammatically illustrated a form of my invention in the accompanying drawing, which represents two substations connected by metallic circuit-lines with spring-jacks upon a telephone-switchboard and with relays controlling signal-lamps, together with a pair of connecting-plugs and their accessory appliances in the switchboard.

The substations—for example, substation A—are each equipped with a telephone-receiver a and a transmitter a', a signal-bell a^2, and a telephone-switch a^3, which is adapted to close the circuit through the telephone. The bell a^2 should be of high resistance—say of five thousand ohms—for the purpose of practically severing the connection between the line-wires in respect to currents adapted to operate the central-station relay. The substation apparatus is connected by line-wires 1 and 2 with a terminal spring-jack b in the switchboard at the central station C, the different conductors extending to the contact-springs d' and d, respectively, of the spring-jack. One helix, e, of the line-relay f is included in conductor 1 before the latter is connected with the spring-jack b. The other helix, e', of the relay is included in an extension from conductor 1 to one pole of a battery g, which is common to the different telephone-lines of the exchange and serves to supply them with current both for operating the relays and for operating the substation-transmitters. Conductor 2 of the line is connected with the other pole of the same battery, an impedance-coil h being interposed in the conductor for the purpose of balancing the line-circuit and preventing the conduction of telephonic or voice currents between the different lines. The coil e of the relay is shunted by a resistance-coil e^2, wound non-inductively. The contacts e^3 e^4 of the relay control a local circuit 3 4, including a line-lamp l, resistance-coil k, and a battery i. The line-lamp is placed near the spring-jack b, so as to be permanently associated therewith. Each spring-jack is furnished with a contact-ring d in addition to its line-contacts d and d'. The ring d^2 of the jack b constitutes one terminal of a conductor 5, extending to the portion 4 of the local circuit 3 4 and connected therewith between the resistance-coil and the contacts e^3 e^4 of the line-relay.

The usual pairs of connecting-plugs m and m' are provided for the operator for use in connecting different lines together by means of their spring-jacks. Each plug is constructed with three contact-surfaces insulated from each other, n, n', and n^2, respectively, which are adapted to come into connection with the spring-jack contacts d, d', and d^2. The pieces n n of the two plugs m m' are connected together through a conductor 6 and the pieces n' n' are united through another conductor 7. In each of these conductors 6 and 7 two helices o o' and o^2 o^3, in inductive relation to each other, are included in series. The conductors of the plug-circuit are united at points intermediate of the two helices by a bridge-wire 8, which extends to and includes the battery q, which constitutes the source of current-supply for signaling and for exciting the telephone-transmitters. The helices o o' o^2 o^3 of the repeating-coils should be of low resistance—as, for example, of twenty ohms each. A battery q of moderate size is thus enabled to produce in the line-circuits with which the plugs are connected sufficient current to operate the substation-transmitters properly.

To repeat briefly, the telephone-line 1 2 extends from the substation A to the central-office switchboard, where it terminates in the two line-springs of an ordinary three-part spring-jack. One winding e of the line-relay f is included in series in the limb 1 of the telephone-line before it reaches the line-spring d' of the spring-jack to which it is connected. A battery g, common to all the lines of the exchange, is connected in a permanently-closed bridge of the line, said bridge also including the impedance-coil h and the winding e' of the line-relay f. The "bridge" referred to is made up of extensions of the telephone-line conductors leading from the terminal pieces d d' of the spring-jack. The bridge relation will be perceived more readily if the system be considered at a time when the telephone-line is extended by connection of the operator's plug-circuit therewith at the terminal spring-jack. The line, it will be seen, extends from the substation to the spring-jack, and thence through the operator's plug-circuit, and the bridge is permanently connected across the line at or near the spring-jack thereof, said bridge including the impedance-coil h, the battery g, and the winding e' of the line-relay.

The usual calling-key p is furnished for the operator, by which she may disconnect the plug m' from its mate and connect its terminals with the poles of generator q of signaling-current. A listening-key r, controlling the connection of the operator's telephone set s with the plug-circuit 6 7, is provided also.

The contact-sleeve n^2 of plug m constitutes

the terminal of a conductor 9, which includes a signal-lamp t, which is associated with plug m and which is designed to indicate to the attendant the condition of the line with which the plug is connected. The similar contact-piece of plug m' is the terminal of another conductor 10, including a signal-lamp t', associated with plug m'.

While I have for convenience of illustration indicated two batteries in the drawing, (marked g and i,) it will be understood that in practice these may be one and the same battery.

I will now trace the operation of establishing connection between two telephone-lines, assuming that subscriber at station A demands connection with substation B. Upon the removal of the telephone a from its switch-hook a^3 the line conductors 1 and 2 are connected together through the telephone and transmitter, thus completing the circuit from battery g through helices e' and e of the relay and line conductor 1, returning by line conductor 2 and through impedance-coil h to the battery. The relay is excited and closes the local circuit 3 4, whereby the current is permitted to flow from battery i through lamp l, contact-points e^3 e^4 of the relay, and resistance-coil k. The signal-lamp l is thus illuminated and attracts the attention of the operator, who inserts the plug m into the spring-jack b to receive the subscriber's order. It will be noted that the current heretofore existing in the line-circuit was insufficient to properly excite the substation-transmitter, since it was compelled to traverse the high-resistance helix e' of the relay and the impedance-coil h. By the insertion of the plug m into the spring-jack a low-resistance path through the repeating-coil helices o and o^2 is created from battery g to the line conductors 1 and 2. It will be observed also that the helix o is placed in shunt about the line-coil e' of the relay, whereby the latter helix is largely deprived of current through it, but that the increased current in the line-circuit traverses the other helix, e, of the relay, thus maintaining the excitement of this instrument. The current is of course divided between the line-helix e and the non-inductive resistance-coil e^2, the greater portion, however, traversing the magnet-coil. By the insertion of the plug the branch 9 5, containing the supervisory lamp t, is closed and brought into shunt or parallel relation to the portion of the local circuit 3 4 containing the line-lamp l, the resistance-coil k being included in the undivided portion of this circuit. The resistance of this coil should be so adjusted that the current through it when divided in this manner between the two signal lamps is insufficient to cause the illumination of either lamp. Hence by the insertion by the connecting-plug in the spring-jack the line-signal lamp l is extinguished, while the clearing-out signal-lamp remains unlighted. The operator now by depressing the plunger of her listening-key r brings her telephone set s into connection with the plug-circuit 6 7 and receives the oral order of the subscriber at station A for the required connection. She then inserts plug m' into spring-jack b' of line to station B, at the same time depressing the plunger of the calling-key p to ring the bell a^2 at that substation. When the plug is inserted into the spring-jack b', local circuit connections similar to those just traced are made through the line-signal lamps l' and t'; but since the relay of that line is not excited the conductor 3 is interrupted, so that the line-signal l' remains dark, while the supervisory signal t' is lighted, the entire current in the local circuit being diverted through it. At the same time the common source of current-supply g is connected with the line-circuit 11 12 to station B in readiness to excite the substation-transmitter. When the subscriber at the signaled station removes his telephone from its switch-hook, the current created through the line-circuit magnetizes the relay-magnet and the latter closes the conductor 3, thus extinguishing the signal t'. The subscribers are now in position to communicate with each other. Current from battery g flows out through each line-circuit. Variations of the resistance of the transmitter at one substation produce undulations in the current through the same line, which are repeated through the inductive action of repeating-coil helices o o' and o^2 o^3 into the other line-circuit. The telephonic circuit to station A is completed in the plug-circuit through conductor 7, coil o, wire 8, including battery g, coil o^2, and conductor 6. The fluctuations in magnetism of the core of the repeating-coil thus produced create in a similar circuit embracing the other portions of conductors 6 and 7 and the windings o' o^3 of the repeating-coil variations of current similar to those set up in the line to station A. This process is well understood in the art. Thus telephonic transmission is effected between the different stations. The propagation of variations in the current in the line-circuits is practically unobstructed by the presence of the magnet-coils e in the circuit, since the variations are propagated through the non-inductive shunts about the magnet-coils. The replacement of either telephone upon its switch-hook renders the corresponding relay inert, whereby the branch, including the line-lamp, is broken and the entire current in the local circuit diverted through the supervisory signal-lamp, thus effecting its illumination. The operator is thus constantly informed by the signals t and t' of the position of the apparatus at the different substations. When both signals become illuminated, this indicates that both telephones have been replaced on their switch-hooks, and the connection between the lines is removed.

It is apparent that my invention may be applied with advantage to systems which may differ in many respects from the one shown in the drawing, and various modifications may be made by those skilled in the art without departing from the spirit of my invention.

I claim and desire to secure by Letters Patent—

1. The combination with a telephone-line, of an electromagnet having two coils, one of said coils being included serially in the line-circuit and the other in a closed bridge of the line-circuit together with a source of signaling-current, and a signal-indicator controlled by said electromagnet, substantially as described.

2. The combination with a telephone-line, of a signal-controlling electromagnet having two magnetizing-coils, one of said coils being included serially in the line-circuit and the other in a high-resistance bridge of the line-circuit containing a source of signaling-current, means for making connection with the line, a bridge-conductor of low resistance containing a source of current adapted to be closed across the line when such connection is made, and a switch for closing or interrupting the line-circuit at the substation to operate the signals, substantially as described.

3. The combination with a telephone-line, of a switch for closing the line-circuit at the substation, spring-jacks constituting normally open terminals of the line, a signal-controlling electromagnet having two magnet-coils, one coil included in the line-circuit between the substation and the spring-jacks, and the other coil in a high-resistance bridge of the line-circuit with a source of signaling-current, a plug-circuit for making connection with the line, and a bridge of low resistance across the plug-circuit including said source of current, substantially as described.

4. The combination with a telephone-line and spring-jacks constituting normally open terminals of the line, of a winding of a signal-controlling electromagnet in the line-circuit between the spring-jacks and the substation, a closed bridge of the line-circuit connected with the line intermediate of the spring-jacks and the magnet-coil, and another winding of the magnet in said closed bridge, as described.

5. The combination with a telephone-line and a switch at the substation for closing the line-circuit, of an electromagnet controlling both a line-signal permanently associated with the line and a supervisory signal temporarily associated with the line, said electromagnet having its magnet-coil interposed in the line-circuit, a bridge of the line-circuit connected with the line intermediate of the electromagnet and the spring-jacks, and a source of current in the bridge, as described.

6. The combination with a telephone-line, of spring-jacks constituting normally open terminals of the line, a relay having two magnet-coils, one of said coils being included in the line-circuit between the substation and the spring-jacks, a closed bridge of the line-circuit including a source of signaling-current, the other of said coils being included in said bridge, a subsidiary line-signal included in a local circuit controlled by a relay, and a supervisory signal adapted to be temporarily associated with the line-circuit in a local circuit also controlled by the relay, a plug-circuit for making connection with the line, the terminals of the one connecting-plug being united through helices of different induction-coils with the poles of said source of signaling-current, the different members of a pair of plugs being connected with the same repeating-coils, substantially as described.

In witness whereof I hereunto subscribe my name this 1st day of December, A. D. 1899.

FRANK R. McBERTY.

Witnesses:

GEORGE P. BARTON,

J. W. SKINKLE.