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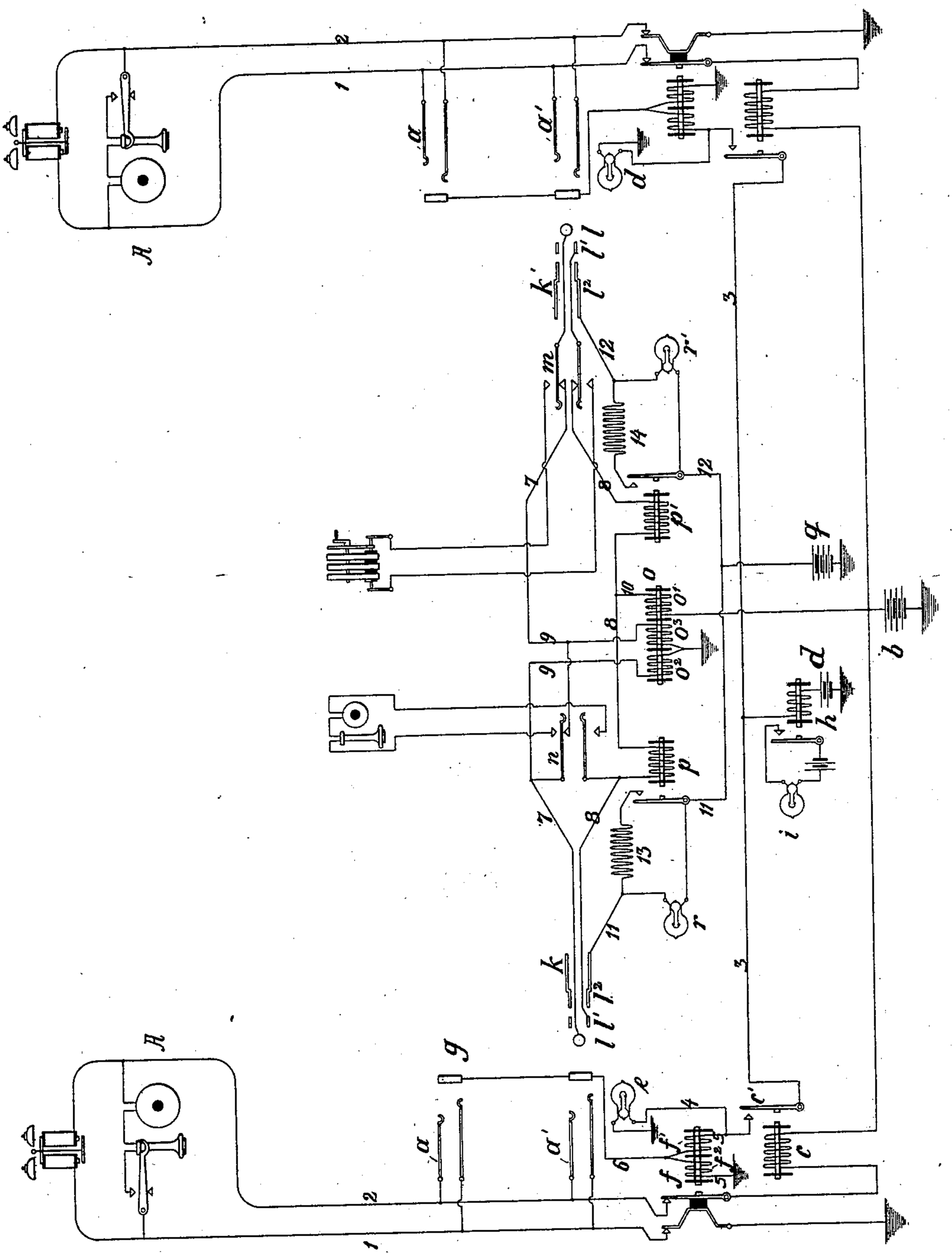
C. E. SCRIBNER.

APPARATUS FOR TELEPHONE SWITCHBOARDS.

(Application filed Jan. 9, 1897.)

(No Model.)



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APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 667,461, dated February 5, 1901.

Application filed January 9, 1897. Serial No. 618,530. (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 Apparatus for Telephone-Switchboards, (Case No. 439,) 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 the mechanism associated with telephone-lines in a switchboard for signaling to the attendant and indicating the use or disuse of the appliances at the stations. It concerns the use of incandescent lamps as secondary signals controlled by suitable devices directly responsive to signaling-currents in the lines.

One object is to guard against the interruption of service by the breaking of the signal-lamp of a line by indicating the interruption of the circuit through the lamp to an operator making connection with the line.

A further object of the device is to provide means for setting a general signal before any operator to indicate a call from any of the subscribers under her care or to serve as a night-signal.

In signaling systems of the type mentioned the line-signal is commonly placed in a local-battery circuit controlled by a relay responsive to currents in the subscriber's line, such current in the line being determined by a switch at the station, the position of which is changed during the use of the telephone there. The operator is furnished with the usual connecting-plugs for uniting lines and with other signals, termed "supervisory" signals, associated with the connecting-plugs and controlled by other relays in the plug-circuit similarly responsive to currents in the lines. In some instances an electromagnetic switch, termed a "cut-off relay," is arranged to break the normal connections of the line with the line-relay which controls the line-signal, this cut-off relay being excited through current applied in the act of making connection with the line. The present invention is designed for use in connection with such a system of signals. Its several features may be generally described as follows: A shunt is placed about the line signal-lamp, and a relay which may be common to a considerable group of lines is placed in a local circuit of the lamps, sufficiently sensitive to respond to current through any of the shunts, and is arranged to control any suitable general or alarm signal. The circuit of the supervisory lamp is completed during connection with a line through a circuit made up in part of the line-lamp of the line, so that in the event of interruption of the circuit through the line-lamp the normal operation of the supervisory signal is disturbed and the unusual appearance calls the operator's attention to the condition of the line-lamp.

In the specific form of the invention which I am about to illustrate the cut-off relay is provided with differentially-wound helices, which are serially connected and constitute the shunt about the line-lamp. The point of junction of these helices is united with a contact-piece in the spring-jack or terminal socket of the line, with which a suitable contact of the connecting-plug registers, the contact portion of the plug being the terminal of a conductor, including the supervisory signal, together with a source of current. A relay in the plug-circuit controls the supervisory signal by closing about the supervisory lamp a shunt having a resistance nearly equal to that of the lamp when the relay is excited. The electromagnet controlling the night-signal is a magnet of very low resistance interposed in the circuit of several line-lamps and constructed to close a local circuit, including a general signal-lamp or any suitable alarm. The subscriber's act of calling causes the line-relay of the corresponding line to close the local circuit through the line-lamp. If this lamp be not broken, the line-lamp and the general signal-lamp controlled by the relay in the local circuit with the line lamp will light simultaneously. If, however, the circuit through the line-lamp be interrupted, the general lamp alone will light, which will call the attention of the operator to the defective condition of the line-lamp. Also if an operator should make connection with a line called for the supervisory signal corresponding to the plug used

in making the connection should become illuminated under normal circumstances, there being no current through the relay controlling the supervisory signal, and the local circuit of the signal being complete and of normal resistance through the line-lamp. In this case the interruption of the circuit through the latter lamp would be signified by the dimming of the supervisory signal at a time when it should be bright. The connection of the differential windings of the cut-off relay with the special contact-pieces in the spring-jack, which are customarily adapted for testing in multiple switchboards, has the incidental advantage of causing the initial act of the subscriber in removing his telephone from its switch in order to procure a connection to alter the electrical condition of the test-rings, and thus to make the line-test busy.

The attached drawing is a diagram of the circuits of this invention. It represents two stations connected by telephone-lines with switching and signaling mechanism in the switchboard. The apparatus at the station may be of any well-known form adapted for the automatic operation of signals, the essential condition being that a change in the electrical state of the line be produced during the use of the telephone. A suitable arrangement consists in a condenser in circuit with the bell at the station which will permit the circulation in the line of the alternating currents employed to operate the bell, but will constitute a break as to continuous currents. Then the removal of the station-telephone from its switch for use will complete the line-circuit as to battery-currents and permit the operation of a signal in the switchboard.

The line conductors 1 and 2 are led to the spring-jacks a and a' in the switchboard and are extended the one to earth and the other to the free pole of a grounded source b of current, the magnet c of the signal-controlling relay being interposed in the latter conductor 2. The lever c' of the relay forms the terminal of a conductor 3, extending to the free pole of the grounded battery d. The contact-anvil of the relay forms the terminal of another wire 4, extending to earth and including the line-lamp e, which is placed near the spring-jack a' of the line in one of the sections of switchboard.

The continuity of the line conductors 1 and 2 is controlled by the switch-contacts of the cut-off relay f, which is arranged to break the connection of the line-wires with the ground and with the relay c, respectively, when the relay f is excited. This relay is wound with two helices f' and f^2, which are connected in series in a conductor 5, being arranged differentially as to currents circulating in that conductor. Conductor 5 is united with wire 4 in such a way as to bring it into shunt about the line-lamp e. The point of junction of the windings f' and f^2 is united by a wire 6 with test-rings g in the spring-jacks a and a'.

A portion of the conductor 3 may be common to all the members of the group of lines assigned to the care of one operator. This common conductor includes the magnet of a relay h, whose switch-contacts control a local circuit including a lamp or other alarm or signal i, which may be placed before the operator.

The usual plugs k and k' are furnished in the switchboard for the use of the operator in uniting lines. Each plug has three contact-pieces l, l', and l^2, which make connection with the two line-springs and with the thimble g of a spring-jack into which the plug is inserted. The contact-pieces l and l' of the two plugs of a pair are united by conductors 7 and 8, respectively, which constitute the plug-circuit. This plug-circuit is equipped with the usual calling-key m for connecting a source of calling-current with the plug k', and listening-key n for connecting an operator's telephone with the plug-circuit. The side 8 of the plug-circuit is connected to the free pole of the grounded battery b by a conductor 10, which includes the winding o' of an impedance-coil. The other side 7 of the plug-circuit is also connected to ground by conductors 9 9, which include the windings o^2 o^3 of the impedance-coil o. The earth thus forms a conductor uniting conductors 10 9 9, whereby a permanently-closed bridge of the plug-circuit, including the battery b, is formed by the wires 9 and 10, which thus lead, in effect, to the terminals of said battery. The windings of the impedance-coil o are interposed in these wires, one adjacent to each of the conductors of the plug-circuit, to prevent the shunting of telephonic current through the bridge. Two relays p and p' are interposed in conductor 8 of the plug-circuit, one at each side of the point of junction therewith of the bridge-wire 9 10, so that one of the relays is in the path of current to each of the stations united through the agency of the plug-circuit. The contact-pieces l^2 of the plugs constitute the terminals of wires 11 and 12, respectively, which lead to the free pole of a battery q. Wire 11 includes a supervisory signal r, which is associated in the switchboard with the plug k, while wire 12 includes a signal-lamp r', similarly associated with plug k'. The illumination of these lamps is controlled by relays p and p', respectively, which close shunts 13 and 14 about the lamps when the relays are excited.

The successful operation of this invention depends to some extent on the proper proportioning of the resistances and electromotive forces in the different parts to each other. The sources b, d, and q of current may have electromotive forces of twenty, four, and eight volts, respectively. The lamps e may be four-volt lamps of approximately twenty ohms resistance. The windings f' and f^2 of the cut-off relay f may be of forty and forty-five ohms, respectively. The supervisory

lamps r r' may be similar to the lamps e, in which case the resistance of shunts 13 and 14 may be sixteen ohms. In the normal operation of this system the removal of the subscriber's telephone from its switch at a station permits the battery b to create current in the line, which operates the line-relay c, and thus effects the illumination of the line-lamp e. The closing of the switch-contacts of relay c creates current in the circuit controlled by them, which excites the magnet h, and thus determines the operation of the alarm i. A portion of the current in the local circuit finds a path through conductor 5, including the windings f' f^2 of the cut-off relay; but since these windings are reversely connected in the circuit the magnet of the relay remains neutral. In response to the call indicated by the display of signal e the operator inserts plug k into the spring-jack a' of the calling-line. In this act the battery q becomes connected through wire 11 with wire 6, from which it has a path through winding f^2 to earth directly and through winding f' and a portion of wire 4, including the line-lamp e, to earth. The currents in the two windings now coöperate to magnetize the core of the relay, whereby the switch-contacts of the cut-off relay are separated and the connections of the line-wires 1 and 2 with earth and with the relay c are broken. The relay c becomes inert, permitting its switch-contacts to break the connection between wires 3 and 4, whereby the current from battery d through lamp e is broken and the magnet h is rendered inert. The portion of current which flows from battery q through lamp e is insufficient to illuminate this lamp, since it has in series with it the magnet f' of the cut-off relay, and both it and the winding f' are shunted by the winding f^2 of the same relay. The subscriber's telephone having been removed from its switch at the substation when the operator inserted plug k into spring-jack a', the relay p becomes excited by current flowing from battery b through the windings of the impedance-coil, and thence to the subscriber's station and closes the shunt 13 about the supervisory signal r. Hence this signal remains dark. Having received the subscriber's order for the connection required, the operator tests the line called for by applying the tip of plug k' to the test-ring g of the line. If the line be free for use—that is, if all the appliances associated with it be in their normal conditions, as represented in the drawing—no source of current is connected with the test-rings and no electrical change is produced in the application of the plug to the test-ring. If, however, the subscriber's telephone were removed from its switch for use, the corresponding line-relay c would have become closed and would have connected battery d through wire 3, a portion of wire 4, a portion of wire 5, including winding f', and wire 6 with the test-rings, and the application of the plug to the test-ring would result in a current through these wires and through a portion of conductor 7 and winding o^3 of the impedance-coil to earth, whereby a distinctive test-signal would be produced inductively in the operator's telephone, or, similarly, in case an operator at a distant switchboard had established connection with the line by means of a plug having connections similar to those of plug k' a circuit would exist from battery q through the wire 12 to the test-rings of the line to be tested, whereby a similar test-signal would be produced in the telephone of the operator testing. Having ascertained the idle condition of the line called for, the operator thrusts plug k' into the spring-jack of the line and rings the bell at the station by means of the calling-key m. The insertion of the plug in the spring-jack completes a circuit through wires 12 and 6 to the cut-off relay, whereby that relay of the line called for becomes excited and severs the connection of the line conductors with the line-relay. Hence the latter relay remains inert and the line-lamp associated with it does not become lighted at the response of the called subscriber. The relay p', however, remains inert until the telephone at the called station is removed from its switch, whereupon it closes the shunt 14 about the previously-lighted signal-lamp r' and extinguishes that lamp.

Having thus considered the normal operation of the system, the function of the devices of the present invention in indicating the broken condition of the line-lamps may now be traced. Suppose that the lamp e of the line were broken or that any defect existed in the circuit through it. The removal of the station-telephone for use would effect the operation of the alarm or pilot signal i before the operator, but would fail to illuminate lamp e. The operator observing the display of the general signal i would ascertain the identity of the calling-line and would replace the broken signal-lamp of that line. Assume, on the other hand, that an operator should attempt to make connection with a line whose lamp was broken. In this case the operator would at once insert plug k' into a spring-jack of the line and would call the subscriber in the usual way. Now, however, the relay p' would be inert, the subscriber not yet having answered, and hence the supervisory lamp r' would be in circuit. The current through it would be less than normal, however, since the branch through winding f' and lamp e' to ground would be interrupted in the broken lamp, the complete branch of the circuit being that only through winding f^2 of the cut-off relay. Hence the supervisory lamp instead of being illuminated to its full candle-power would be dimly lighted, and its dimness would be a signal to the operator that the circuit through the line-lamp of the line with which connection had been made was defective and would enable her to locate and replace the defective lamp.

Many other systems of circuits involving incandescent lamps as signals in telephone-switchboards have been provided. To most of these this invention may be applied with suitable modifications, which will be obvious to those familiar with telephonic appliances.

I desire to secure by Letters Patent—

1. The combination with a local circuit and a switch controlling the circuit, of a lamp in the circuit and a shunt about the lamp, a spring-jack of the telephone-line and a plug therefor, a supervisory signal associated with the plug, and circuit connections closed in registering contacts of the plug and spring-jack, adapted to bring the said supervisory signal into circuit with the shunted lamp, whereby the response of the supervisory signal is made independent of the condition of the lamp, as described.

2. The combination with a telephone-line, a line-relay responsive to currents in the line, a local circuit for the relay, and a lamp signal in the local circuit appearing in the telephone-switchboard, of a shunt about the lamp and an alarm signal device in the circuit responsive to current through the shunt, as described.

3. The combination with a group of telephone-lines, each provided with a relay responsive to current in its line, with a local circuit controlled by the relay, and with a signal-lamp in the local circuit, of a shunt about each signal-lamp, a conductor common to all said local circuits, a low-resistance electromagnet in the said common conductor and a signal controlled by the said magnet, as described.

4. The combination with a telephone-line, of a signaling-circuit associated therewith including a source of current and divided at one point into parallel branches, a signal-lamp in one of the branches, the other branch including a resistance, and means for controlling current in the circuit to light the signal, of a second or supervisory signal-lamp and a local circuit therefor including a source of current, said local circuit being constituted in part by the parallel branches of the first-mentioned signaling-circuit and being completed in establishing connection with the telephone-line, the said supervisory signal-lamp being adapted to be lighted by a current flowing in its local circuit when both of the parallel branches are completed, as set forth.

5. The combination with a telephone-line and a lamp-signal therefor in a switchboard, of a spring-jack and plug for making connection with the line, a signal-indicating instrument associated with the plug, and local-circuit connections including the line-lamp adapted to bring the said lamp into series with the said signal-indicating instrument when connection is made with the line, whereby an interruption of the circuit in the lamp may be detected in making connection with the line, as described.

6. The combination with a telephone-line and a lamp signal therefor in a switchboard, a spring-jack for the line and a plug for making connection therewith, of a supervisory lamp associated with the plug, a local circuit for the line and a source of current included therein, said local circuit being divided into parallel branches, one of which includes the signal-lamp, a resistance-coil in the other branch, and registering switch-contacts of the plug and spring-jack adapted to bring the said supervisory lamp serially into the local circuit, as described.

7. The combination with a telephone-line, a switch at the station thereof determining the flow of current in the line and a relay responsive to such current, a cut-off relay for the line-relay, spring-jacks connected with the line and plugs for use therewith, of a local-battery circuit closed in registering contact-pieces in the spring-jack and plug including the magnet of the cut-off relay, a local circuit controlled by the line-relay, and a secondary signal therein, said local signal-circuit being connected with the circuit through the cut-off relay, the circuit connections of the windings of the relay with the said local circuits being adapted to leave the relay inert as to current circulating in the signal-circuit, as described.

8. The combination with a telephone-line, a line-relay responsive to current in the line and a cut-off relay, of a local circuit controlled by the line-relay and a secondary line-signal included therein, two serially-connected differential windings of the cut-off relay in a shunt of the line-signal, a spring-jack for the line and a plug therefor, and a local-battery circuit closed in registering contacts of the spring-jack and plug including the said windings of the cut-off relay in suitable direction to cause the excitement thereof by current in the circuit, as described.

9. The combination with a telephone-line, a switch determining the flow of current in the line during the use of the telephone, a line-relay and a source of current in the line at a central office, a cut-off relay adapted to break the line-circuit in the switchboard when excited, spring-jacks for the line and connecting-plugs and plug-circuits therefor, of a line signal-lamp and a local circuit controlled by the line-relay including said lamp, serially-connected differential windings of the cut-off relay in shunt about said lamp, a circuit closed in registering contacts of the spring-jack and plug including the windings of said cut-off relay in multiple, a supervisory signal in the portion of said local circuit terminating in the plug, and means for controlling the display of the supervisory signal, substantially as described.

10. The combination with a telephone-line extending from a substation to a central office, of a line-relay in the circuit of the line at the central office, a source of current and means at the substation for determining the flow of current in the line, a local signal-cir-

cuit controlled by said line-relay, a source of current and a line signal-lamp included in said local circuit, an alarm signal device responsive to the flow of current in said local circuit, and a shunt about the line-lamp, whereby the response of the alarm signal device is made independent of the condition of the lamp, substantially as set forth.

11. The combination with a telephone-line extending from a substation to a central office, of a relay in the line-circuit at the central office, a source of current and means at the substation for determining the flow of current in the line, a local circuit including a source of current and an alarm device in series and having two parallel branches, one of said branches including a line signal-lamp, and the other branch including resistance, a spring-jack for the line, a connecting-plug adapted for insertion in said spring-jack to establish connection with the line, and a local circuit including a source of current and a supervisory signal, said local circuit being closed in registering contacts of the plug and spring-jack when connection is made with the line, a part of said local circuit being made up of the two parallel branches of the first-mentioned local circuit, as set forth.

In witness whereof I hereunto subscribe my name this 18th day of November, A. D. 1896.

CHARLES E. SCRIBNER.

Witnesses:

ELLA EDLER,

DUNCAN E. WILLETT.