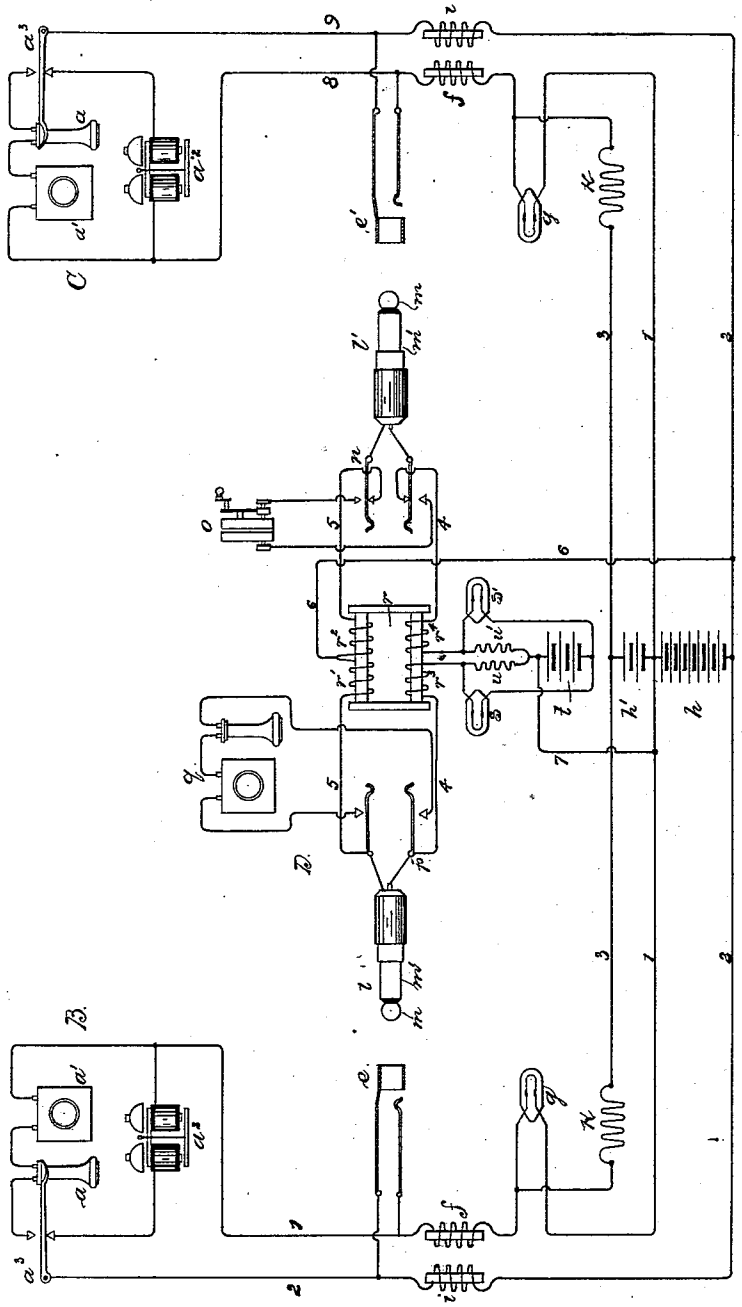
(No Model.)

C. E. SCRIBNER.

APPARATUS FOR TELEPHONE SWITCHBOARDS.

No. 563,073. Patented June 30, 1896.



Witnesses
DeWitt C. Tanner.
George L. Bragg.

Inventor,
Charles E. Scribner,
By Barton & Brown
Attorneys.

UNITED STATES PATENT OFFICE.

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

APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 563,073, dated June 30, 1896.

Application filed June 12, 1895. Serial No. 552,525. (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. 384,) 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.

My invention relates to the automatic operation of signals of telephone-lines terminating in a telephone-switchboard. Its object is, in general, to provide for the switchboard-operator a simple and efficient system of signals adapted to indicate continuously the condition of each telephone-line, or of the different members of a pair of connected lines.

Prior to my invention annunciators or visible signals have been included in telephone-lines, together with sources of signaling-current, the telephone-lines being provided with switches at their substations adapted to open and close the line-circuit, and thus to display or render inert the signaling instruments at the central station when the telephone is in use or is idle. When such lines were connected together by means of loop-conductors in the switchboard, it has been further customary to place in connection with severed portions of the link conductors other visible signals associated with the terminal plugs of the plug-circuit, designed to enable the operator to supervise the connection during its continuance by indicating the condition of the telephonic appliances at both stations of the united-circuits.

In a prior application, filed April 16, 1895, Serial No. 545,855, I have disclosed a mode of using small incandescent lamps as such visible signals in telephone circuits.

My present invention aims to employ such signal-lamps, placed in direct connection with the telephone-line, for indicating the various signals required; and to this end it comprises means for exciting a line-signal permanently associated with the line, when the telephone is removed from the switch-hook for extinguishing this signal-lamp when connection is made with the line and substituting for it a supervisory signal-lamp associated with the connecting-plug, and for causing the illumination of the latter signal-lamp when the telephone is replaced upon its switch-hook at the substation.

Each telephone-line is controlled at its substation by a switch operated automatically in the use of the telephone, which is arranged to close the line-circuit while the telephone is in use, but to interrupt this connection, or to close it through a path of very high resistance, when the telephone is idle. At the central station I lead from one conductor of the line-circuit a ground branch through an impedance-coil and the line-signal lamp, including a signaling-battery which may be common to different lines of the exchange. When the switch at the substation is operated in the use of the telephone, the line-signal is illuminated and indicates the call or "initial" signal to the attendant.

Each terminal plug is provided with a closed circuit through one helix of an induction-coil, the other helix of the same coil being included in the circuit of the other terminal plug of the pair, and from the central point of each helix a conductor is led through a supervisory lamp-signal to the free pole of the same signaling-battery. These helices are constructed of such low resistance that when a plug is inserted into a spring-jack the line-signal lamp, being shunted by the induction-coil helix of low resistance, is extinguished. In a shunt about the supervisory signal is connected a resistance-coil, together with a battery or other source of current of such polarity and strength that the current from the common signaling-battery, in the closed line-circuit, is diverted from the signal-lamp, or, in other words, the battery in circuit about the supervisory signal coöperates with the main signaling-battery to produce a condition of no difference of potential between the terminals of the lamp. Under this condition, when the circuit at the substation is again interrupted, this balanced relation is destroyed and current is created through the supervisory signal to cause its illumination. The operation of this system of signaling is then as follows: When the telephone at the substation

is removed from its switch-hook, to transmit an initial or "call" signal, the line-lamp is illuminated. When the operator makes connection with the line, this lamp is extinguished. When the telephone is returned to its idle position, the supervisory signal is illuminated. Since both members of the pair of plugs used in uniting two lines are provided with such supervisory signals, these signals constantly indicate to the attendant the condition of the substation apparatus at both stations. The operator may be instructed to remove the connection only when both supervisory signals have become lighted.

For the purpose of rendering the lamp-signals as sensitive as possible to current in the line-circuit, I prefer to employ a device described in a pending application filed April 16, 1895, Serial No. 545,856, which consists in a shunt-circuit including a source of current about the signal-lamp, the current in this circuit being so adjusted with relation to the lamp as to be barely insufficient to illuminate the lamp. A very slight addition to this current, by an independent current created in the complete signaling-circuit, is sufficient to cause the full illumination of the lamp, and thus to display the signal.

My invention is adapted for use in exchange systems in which the substation-transmitters are supplied with current from a common source located at the central station. I have illustrated it in connection with such a system in the accompanying drawing.

In the drawing two substations are represented connected by line conductors with the apparatus of a telephone-switchboard at a central station. The appliances at the substations are of the usual character. They comprise a receiving-telephone a, a transmitting-telephone a', a signal-bell a^2, and an automatically-operated switch a^3, acting to switch the telephone and the bell alternately into connection with the line. The bell a^2 should have a high resistance, compared to that of the telephone—as five thousand ohms—for the purpose of practically interrupting the line-circuit when the telephone branch is interrupted. Two substations thus equipped, B and C, are shown in the drawing. Station B is connected by line conductors 1 and 2 with apparatus in a switchboard at the central station D, the different line conductors terminating in the corresponding contact-pieces of a spring-jack e in the switchboard. The line conductor 1 is continued through an inductive resistance or impedance coil f, and through the line-signal lamp g to one pole of a battery or other source of current h, which is common to the different lines of the exchange. The other line conductor 2 is continued through a similar impedance-coil i to the other pole of the same battery h. The impedance-coils f and i should be of about one hundred ohms resistance each. A conductor 3, including a resistance-coil k, is connected in shunt of the signal-lamp g, and includes in its circuit a battery or other source of current h', which also is common to the different lines. The strength of battery h' and the resistance of coil k are so adjusted that sufficient current flows through lamp g to raise it almost to the point of illumination.

The usual pairs of connecting-plugs l and l' are provided for the operator to enable her to establish connection between different spring-jacks for the purpose of looping lines into circuit with each other. The like contact-pieces of these loop-plugs are connected together, the tips m being united through a conductor 4, and the sleeves or tubes through another conductor 5. The switch-springs and the normal resting-contacts of a calling-key n are included in these conductors, the key being adapted, when operated, to disconnect the plug l' from its mate and to close its terminals to the poles of a generator o, suitable for operating the substation-bells a^2. A listening-key p also has its springs connected with the conductors 4 and 5, its office being to bridge the operator's telephone-set q across the plug-circuit 4 5 when the key is depressed.

The conductor 5 includes in series two helices r' and r^2 of a transformer or induction-coil r. From the point of junction of these two helices a conductor 6 is led to that pole of the battery h which is connected with line conductors 2. The conductor 4 of the plug-circuit likewise includes in series two helices r^3 r^4 of the same induction-coil. These helices are united through two signal-lamps s and s'. These lamps are associated, respectively, with the terminal plugs l and l' of the plug-circuit, and should for convenience be placed close together in the switchboard.

The point of junction of lamps s and s' is connected with a battery t, whose other terminal is connected through a conductor 7 with that pole of battery h in which the line conductors 1 terminate. A shunt-circuit is provided about each of the lamps s and s', as about the line-lamps. This shunt consists in a resistance-coil, connected from one terminal of the lamp to the conductor 7, the resistance-coils about lamps s and s' being designated u and u', respectively. The lamp s is thus in a closed circuit formed by the resistance-coil u and battery t. The lamp s' is in a similar circuit with the battery t and its coil u'. The direction and strength of battery t in each of these circuits should be so adjusted with relation to the resistance-coil that while the plug-circuit is open or disconnected a sufficient current will traverse each of the lamps s and s' to fully illuminate them; but its strength should also be so adjusted with relation to battery h that when the conductors 4 and 5 of the plug-circuit are connected with the conductors 1 and 2 of the line-circuit, the latter being connected together through a low-resistance path at the substation, sufficient current from battery t will be diverted from its path through lamp-signals

s and s' to leave these unilluminated. This adjustment will be referred to later in connection with the operation of the complete system.

It may be sufficient here to state that good results may be obtained with a battery h of forty volts electromotive force, and a battery t of six volts, the resistance of coils u and u' being approximately fifteen ohms, and that of the substation-telephone being about one hundred ohms. Like poles of batteries h and t should be connected with conductor 7. The helices of induction-coil r should be of moderately-low resistance—for example, of about twenty-five ohms each.

In order to trace the operation of this system, assume that subscriber at station B requires a connection with station C. The subscriber at the former station, by removing his receiving-telephone a from his switch-hook, permits the latter to connect the line conductors through the low-resistance telephone-set. The battery h now finds circuit through the line conductors 1 and 2 and this low-resistance branch at the substation. This current is of course divided in the switchboard between conductors 1 and 3, the greater part, however, traversing conductor 1 and the lamp-signal g. A sufficient current is thus caused to flow through this signal-lamp, in addition to that normally flowing from battery h', to illuminate the lamp and thus to indicate to the attendant the subscriber's initial signal. The operator then inserts plug l into spring-jack e, and, by operating her listening-key p, brings her telephone-set q into connection with the plug-circuit, and learns the order from the subscriber for the connection desired. By the insertion of this plug into spring-jack e, the helices r' and r^3 of induction-coil r are brought into shunt of the impedance-coil i, and the impedance-coil f and line-lamp g, respectively, so that the current produced by battery h through signal-lamp g is diverted from that path through the path of low resistance formed by conductor 7, lamp s, a coil u, and battery t, in parallel, helix r^3 and conductor 4, returning through conductor 5, helix r', and wire 6. The signal-lamp g is thus extinguished or returned to its normal inert condition.

It will be noted that during the idleness of the plug-circuit the battery t creates in the circuit formed by resistance-coil u, lamp s, and its leads a current which fully illuminates the supervisory signal s. When the plug is inserted in the spring-jack e, however, a portion of the current from battery t is diverted through the line-circuit; or, in other words, batteries h and t coöperate to produce a condition of no difference of potential between the terminals of the signal s, practically the entire current created by the two batteries finding circuit through the resistance-coil u to the conductor 4 and thence to the telephone-line. The current from battery h finds circuit through conductor 7, from whose point of junction with the other circuits it has two paths, namely, one through battery t and each of the lamps s and s' to the portions 4 4 of the conductor of the plug-circuit and thence to the corresponding lines, and the other through resistance-coils u and u' to the same portions of the conductor of the plug-circuit. Considering the circuit to the calling-line, for instance, the current has a path through a circuit of two branches, one including coil u and the other including lamp s and battery t. In the latter circuit the opposing electromotive force of battery t is so adjusted with relation to the resistance of coil u and the current which is passing through it from battery h that the current tending to flow from battery h through the lamp s is exactly opposed; while as to the current which battery t tends to set up in the short closed circuit including coil u, lamp s, and battery t, that is opposed by the difference of potential between the terminals of coil u, which is set up by the battery h. To be accurate, the electromotive force of battery t, the resistance of coil u, the resistance of the external circuit through the line, and the electromotive force of battery h are so adjusted with relation to each other that no difference of potential exists between the terminals of the lamp. The supervisory signal s is thus extinguished, and remains dark as long as this condition of balance is maintained by the continuity of the line-circuit at the substation.

Having learned the order, the operator establishes connection with the lines 8 9 to station C by inserting plug l' into spring-jack e' of that line. She rings the substation-bell a^2 at station C by operating the calling-key n in the usual way.

When the plug l' is inserted into the spring-jack e', no current is created by battery h through the plug l', since the line-circuit at station C is as yet interrupted, or is at least closed only through the bell a^2 of very high resistance. Hence supervisory signal s' is lighted. This condition remains until the subscriber at station C, responding to the signal of his bell, removes his telephone from its switch-hook and permits the latter to close the line-circuit through the telephone. When this is done, current finds circuit from battery h, through conductor 7 and resistance-coil u, thence through conductor 4, plug l', to the line-circuit, returning through the corresponding conductors of the other side of the circuit. This current is in the proper direction and of the proper strength to bring about the condition of no difference of potential between the terminals of signal s', so that the latter also becomes dark. When both supervisory signals are thus obscured, it may be assumed that the subscribers are in conversation. If either telephone be replaced upon its switch-hook, the current in that line-circuit is interrupted and the corresponding supervisory signal is illuminated. When both signals become lighted, it may be assumed that

conversation has terminated and the connection between the lines may be removed.

It will be obvious that the arrangement of circuits and sources of current which constitutes my invention is not limited to use with lamp-signals, since any of several well-known forms of visible signals might be substituted for the signal-lamps described. It is also possible to adapt the same circuit arrangement to systems involving other modes of supplying current to the substation-transmitter without the exercise of invention.

I claim as new—

1. The combination with a signaling-circuit divided at one point into two parallel branches of fixed resistance, of means for varying the resistance of the signaling-circuit, a source of signaling-current in the undivided portion of the signaling-circuit, a signal-indicating instrument requiring for its operation a definite predetermined current in one of the branches, a separate source of current in one of the parallel branches, the polarities of the source of signaling-current and of the said other source being oppositely directed in the portion of the circuit including the signaling instrument, the electromotive force of said last-mentioned source being sufficient to prevent current from actuating the signal when the signaling-circuit is closed; whereby the closing of the signaling-circuit renders the signal inert, and the opening of the signaling-circuit causes its display, substantially as described.

2. The combination with a telephone-line provided with a switch adapted to interrupt the circuit and a source of current in the line, a portion of the line being divided into two parallel branches, of a signal-lamp in one of the branches, a resistance-coil in the other branch, and a source of current in one of the branches, the polarity of said last-mentioned source of current being adapted to oppose the passage of the signaling-current through the lamp and its electromotive force being sufficient to prevent the illumination of the lamp by current in the signaling-circuit, substantially as described.

3. The combination with a telephone-line, of a branch thereof including a signal-lamp and a source of current, a spring-jack connected with the line, a plug-circuit for making connection with the spring-jack, and a conductor of low resistance connected with the plug adapted to form a bridge of the line-circuit including the said source of signaling-current, when connection is made with the line, whereby the signal-lamp is shunted.

4. The combination with a telephone-line, of a spring-jack constituting a terminal thereof, a signal-lamp together with a source of signaling-current in a permanently-closed bridge of the line-circuit, a connecting-plug and its plug-circuit, and a conductor of low resistance including a signal-lamp connected with the plug adapted to be brought into a bridge of the line-circuit when the plug is inserted into the spring-jack, substantially as described.

5. The combination with a telephone-line, of a switch for interrupting the line at the substation, a spring-jack constituting a terminal of the line in a switchboard, a signal-lamp, a low-resistance branch of the line-circuit including a source of signaling-current temporarily associated with the circuit, a supervisory signal-lamp in said low-resistance branch, a shunt-circuit including a resistance-coil about the lamp, and a source of current in the closed circuit formed by the shunt and the conductor including the lamp, the source of current being so adjusted with relation to the source of signaling-current as to produce a condition of no difference of potential between the terminals of the supervisory signal when the line-circuit is closed, substantially as described.

6. The combination with a telephone-line, of a switch at the substation for interrupting the line, a spring-jack for the line in a switchboard, an impedance-coil, a signal-lamp, and a source of signaling-current in a permanently-closed bridge of the line-circuit, a pair of loop-connecting plugs for uniting lines, the different contact-pieces of each plug being united through a helix or helices of the same induction-coil and through a source of signaling-current, a supervisory lamp-signal in the conductor uniting the contact-pieces of each plug, a shunt including a resistance-coil about each supervisory signal-lamp, and a source of current in each shunt adapted to divert the current of said source of signaling-current from the corresponding supervisory signal when the line-circuit is closed, substantially as described.

7. The combination with a telephone-line having a switch for interrupting the line-circuit, a spring-jack for making connection with the line, of a plug in the spring-jack in continuation of the line, a source of signaling-current in circuit with the plug, the circuit of the plug being divided at one point into two parallel branches, a signal-lamp in one of the branches, and a source of current in one of the branches, the said last-mentioned source of current being of such strength and polarity as to prevent the illumination of the signal-lamp by current from the signaling-battery, substantially as described.

In witness whereof I hereunto subscribe my name this 29th day of April, A. D. 1895.

CHARLES E. SCRIBNER.

Witnesses:

ELLA EDLER,

DUNCAN E. WILLETT.