(No Model.)

T. C. WALES, Jr.

TRUNK LINE FOR TELEPHONE EXCHANGES.

No. 552,735 Patented Jan. 7, 1896.

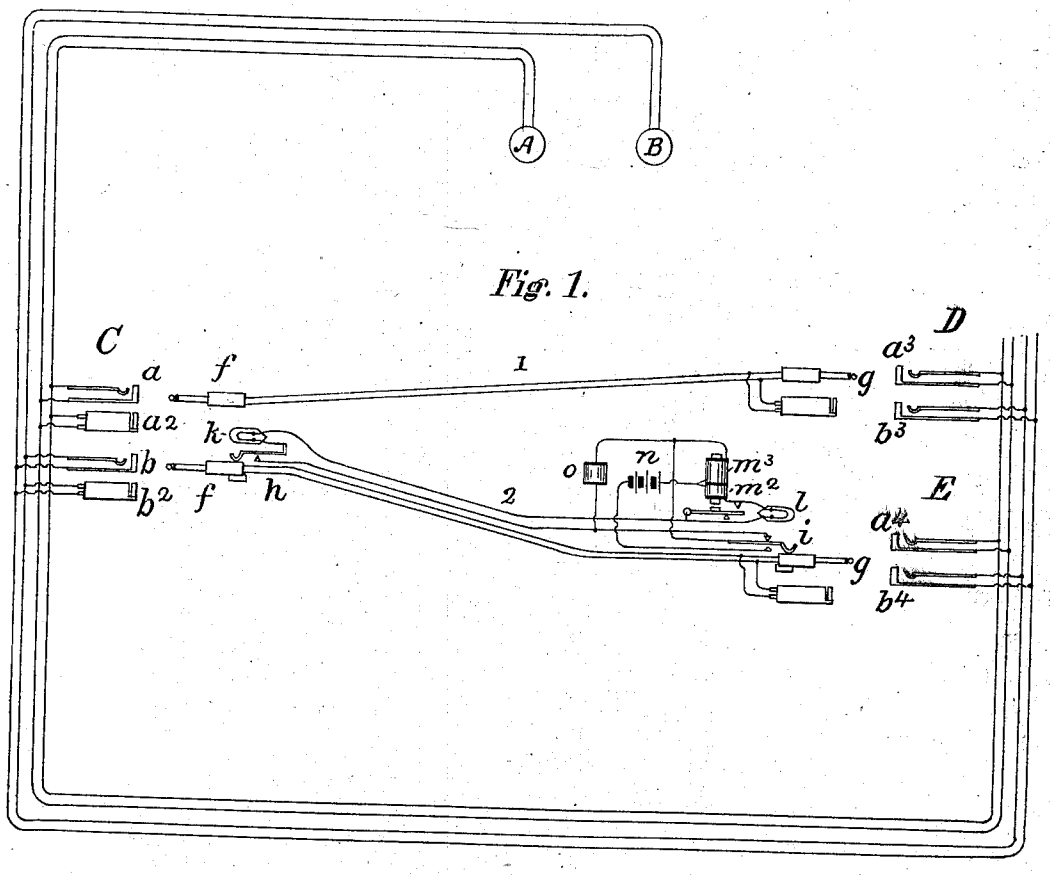

Fig. 1.

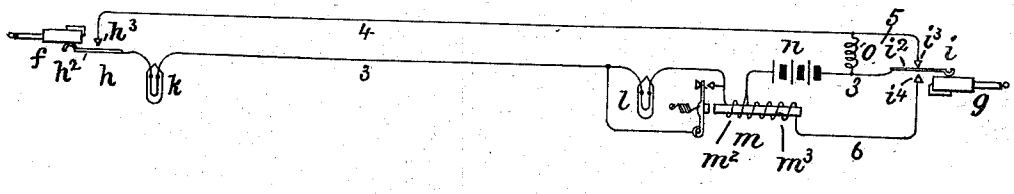

Fig. 2.

Attest.

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TRUNK-LINE FOR TELEPHONE-EXCHANGES.

SPECIFICATION forming part of Letters Patent No. 552,735, dated January 7, 1896.

Application filed August 24, 1895. Serial No. 560,427. (No model.)

To all whom it may concern:

Be it known that I, THOMAS C. WALES, Jr., residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Trunk-Lines for Telephone-Exchanges, of which the following is a specification.

My invention concerns signaling mechanism for trunk-lines of telephone-exchanges. It is a new and simplified organization of parts adapted to the operation of electric lamps as signals.

The invention is applicable particularly to those switching systems in which calls received at an annunciator-board, where all line-annunciators are placed, are distributed by means of trunk-lines to different operators at switchboards.

The signaling apparatus for the trunk-lines is designed to indicate to the operator at the switchboard a connection made to the trunk-line, and to indicate to the switchman at the annunciator-board the disconnection of a trunk-line from a subscriber's line at the switchboard. This signaling system involves the following appliances: two signaling-instruments, as incandescent lamps, responding to different exciting-currents at each terminal station of the trunk-line, the signal at the annunciator-board requiring the greater current for its operation; two plug-seat switches for the terminal plugs of the line, and a relay having a weak and a strong helix.

The signaling-circuit includes a source of current, a resistance-coil, the lamp-signal at the annunciator-board, and the lamp-signal and the weaker relay-winding at the switchboard, the continuity of the circuit being controlled by the plug-seat switch at the annunciator-board. The lever of the plug-seat switch at the switchboard oscillates between a normal and an alternate contact-anvil as the plug is withdrawn from or replaced in the plug seat or socket. Its circuit connections are such that the lever and normal contact close a short circuit about the resistance-coil, and the lever and alternate contact-point complete a local circuit of the battery through the stronger relay-winding. The relay is adapted when excited to close a shunt about the lamp at the switchboard.

The removal of the terminal plug of the trunk-line at the annunciator-board from its seat permits the plug-seat switch to close the signaling-circuit, and thus effects the excitement of the signal at the switchboard, the other signal remaining unaffected on account of the greater current required for its display. The removal from its seat of the plug at the latter board, in response to the signal, causes the relay to close its contacts and thus renders the displayed signal inert. Finally, the replacement of the plug in its socket at the switchboard causes the switch to short-circuit the resistance-coil in the circuit, and permits sufficient current to flow to display the less sensitive signal at the annunciator-board.

The invention is illustrated in the accompanying drawings, of which Figure 1 shows it associated with a trunk-line in a switching system such as has been mentioned, and Fig. 2 represents in simplified form the circuits of the signaling system.

In the switching system alluded to the lines from the different sub-stations A and B extend to corresponding connection-sockets a and b and to signal-annunciators a^2 and b^2 in an annunciator-board C, and also to spring-jacks, which are designated a^3 and a^4 and b^3 and b^4, in sections D and E of the multiple switchboard. Trunk-lines 1 and 2, each terminating in connecting-plugs f and g, extend from the annunciator-board C to the different sections of the multiple switchboard.

An incoming call from either of the sub-stations is received at the annunciator-board C by a switchman stationed there. The switchman inserts a plug f of a trunk-line extending to one of the sections D or E into the connection-socket of the signaling-line, after which the operator having charge of the same trunk-line makes connection between the latter and the required subscriber's line upon the multiple section at which she is stationed. For the purpose of facilitating the work of the switchman and the operator it is desired that the use of plug f for making connection at the annunciator-board shall automatically set a signal at the other end of the trunk-line, and that after the completion of the required connection the return of plug g to its normal position, after the receipt of a

signal for disconnection at the switchboard, shall indicate to the switchman at annunciator-board C that the connection is no longer required and that plug f may be removed.

The circuits and mechanism of my invention by which these requirements are accomplished are best displayed in Fig. 2. The socket in which plug f normally rests is provided with a plug-seat switch h whose lever h^2 is adapted to close upon an anvil h^3 when the plug is removed. The socket of the other plug g is provided with a similar switch i, whose lever i^2 oscillates between a normal contact-anvil i^3 and an alternate anvil i^4. At the annunciator-board C is placed a lamp-signal k, associated with the plug f, and at the section of the switchboard, associated with the plug g, is placed another lamp-signal l. The lamp l is constructed to require less current for its illumination than the lamp k, so that although the two lamps may be traversed by the same current only lamp k shall be lighted. At the switchboard is placed also a relay m having two helices m^2 and m^3. The former of these helices is insufficiently excited when traversed by the normal current of the system to draw up the armature of the relay, but has sufficient strength to hold the armature when the latter has been placed in contact with the core. Coil m^3 has sufficient turns to cause the attraction of the armature when it is traversed by the normal current.

The signaling-circuit may be considered as made up of conductors 3 and 4. Conductor 3 unites the levers h^2 and i^2 of the two plug-seat switches h and i, and includes the lamp k, the lamp l, the weaker helix m^2 of relay m, and a battery n. Conductor 4 extends from anvil h^3 to the conductor 3 at the switchboard, being connected with the latter conductor through a resistance-coil o. The lever i^2 and contact-anvil i^3 of switch i act to close a short circuit 5 about coil o. Contact-anvil i^4 constitutes the terminal of the conductor 6, which includes coil m^3 of the relay, and this contact-anvil and the lever i^2 co-operate to close a local circuit of battery n. The contact-points of the relay m control a local short circuit about lamp l.

The circuit when not in use is open between the spring h^2 and its anvil h^3, the short circuit about lamp l and the local circuit through helix m^3 of the coil being also interrupted. When plug f is removed from its socket the signal-circuit is closed and lamp l, stationed at the switchboard, is illuminated; but the current through the circuit is insufficient to light the lamp k. The current in coil m^2 of the relay is also insufficient to draw up the armature of the relay to close the local circuit. When plug g is removed from its socket the switch-lever i^2 closes the local circuit through coil m^3, which causes the attraction of the relay-armature and thus brings about the short-circuiting of the lamp l. At the same time the short circuit 5 about resistance-coil o is interrupted, throwing into the circuit a resistance equivalent to that of lamp l and thus preventing an increase of the current which would illuminate lamp k. When, finally, plug g is replaced in its socket, the resistance-coil o is again short-circuited, whereupon the current in the circuit, now of low resistance, becomes sufficient to illuminate lamp k. Relay m does not release its armature, however, since the coil m^2 has sufficient magnetizing effect to keep the armature in contact with the magnet.

In the operation of the switching system a signaling-circuit like that described is applied to each trunk-line. When the switchman at board C, having received a signal from the subscriber, raises the plug f to insert it into the corresponding spring-jack, the lamp l at the multiple switchboard becomes lighted and calls the attention of the operator. This operator is supposed to be provided with the usual telephones and signaling apparatus, and with keys for connecting the telephone or the generator of a signaling-current with any trunk-line. She receives the order from the subscriber in the usual way, and established the required connection by inserting plug g into the spring-jack of the required line. When she raises the plug from its socket the displayed lamp l becomes extinguished. At the termination of the conversation either or both of the subscribers transmits the usual signal for disconnection and operates the clearing-out drop at the switchboard. Upon the receipt of this signal the operator removes the plug from the spring-jack and replaces it in its socket, whereby the lamp k is lighted. This is the signal to the switchman that the connection has been removed at the switchboard, and he accordingly withdraws plug f from the socket of the call-initiating line and returns it to its normal resting-place, whereby lamp k also is extinguished.

Obviously this signaling apparatus for trunk-lines might be applied in connection with other systems of switching, or might be applied to trunk-lines terminating in spring-jacks instead of in terminal plugs in a way which is well understood by those skilled in the art.

It is obvious that the lamps referred to herein may be replaced by relays designed to operate by different strengths of current, the local circuits of said relays including some form of signaling apparatus, together with a source of current to operate the same.

A signaling system such as that shown in Patent No. 494,385 to Pickernell and Dunbar has been used heretofore and works well for short signaling-circuits whose two ends are both in the same office. In such a system, however, under certain conditions, the signaling-circuit includes in series both the low and high resistance windings of the relay, and while the weakening effect of the latter is not so noticeable in a short signaling-circuit, if such an arrangement were em-

ployed upon a long signaling-circuit, say extending between two distant central offices, the enfeeblement of the current consequent upon the introduction serially into the circuit of the high resistance of the larger relay-winding together with that of the long circuit makes the addition of considerably more battery-power necessary.

By placing the high-resistance winding of the relay in an independent derived circuit of the same battery as is in circuit with the low-resistance relay-winding, as described in this specification, a strong magnetizing force is uniformly exerted on the relay-core without regard to the length of the signaling-circuit proper, in which the high-resistance winding is never included. Thus the signaling-circuit may be elongated considerably without proportionately increasing the battery or adding to the electromotive force of the current employed, so that the said main signaling-circuit is capable of being used upon the plan described either between the sections of a local switchboard or between the switchboards of widely-separated central offices.

My system is in other respects differentiated from that of Pickernell and Dunbar, to which, however, it is not necessary here to make specific reference.

I claim as new and desire to secure by Letters Patent—

1. The combination with a switching system comprising an annunciator-board containing a signal annunciator and a connection socket for each line, a multiple switchboard of several sections, each having a socket for each line, and trunk lines extending between the annunciator board and each section of the multiple board, of means in connection with each trunk line for causing the display of a signal at the switchboard when connection is made with the trunk line at the annunciator board, and for causing the display of a signal at the annunciator board when the terminal of the trunk at the switchboard is returned to its idle position, the connection at the annunciator board still existing; said means consisting in a circuit including the signaling instrument at the annunciator board, controlled in the concurrent operation of switches at both ends of the trunk line, and a circuit including the signaling instrument at the switchboard, controlled by a switch at the annunciator board, as described.

2. The combination of a signaling circuit extending between two stations and provided at one with a normally open and at the other with a normally closed automatic circuit controlling switch; a low resistance signal at the open switch station, and a high resistance signal, and a source of current, at the other or closed switch station, included serially in one of the conductors of the said circuit; a relay also located at the latter station and having independent low and high resistance windings, the former being connected in the said signal circuit conductor; a resistance at the latter station uniting the two conductors of the said signaling circuit alternatively and parallel to their connection through the normally closed switch; an independent derived circuit including the high resistance winding of the said relay and the source of current, extending from a point of the signaling circuit conductor between the low resistance relay winding and the said source of current to the second switch and normally open therein, but adapted to be closed when the said switch is operated to open the signaling circuit; and a normally open shunt round the high resistance signal controlled by the said relay; whereby upon the operation of both terminal switches the independent derived circuit containing the high resistance relay winding and source of current is closed; and immediately operates to withdraw the high resistance signal by closing a shunt circuit around it, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 19th day of August, 1895.

THOMAS C. WALES, JR.

Witnesses:
GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.