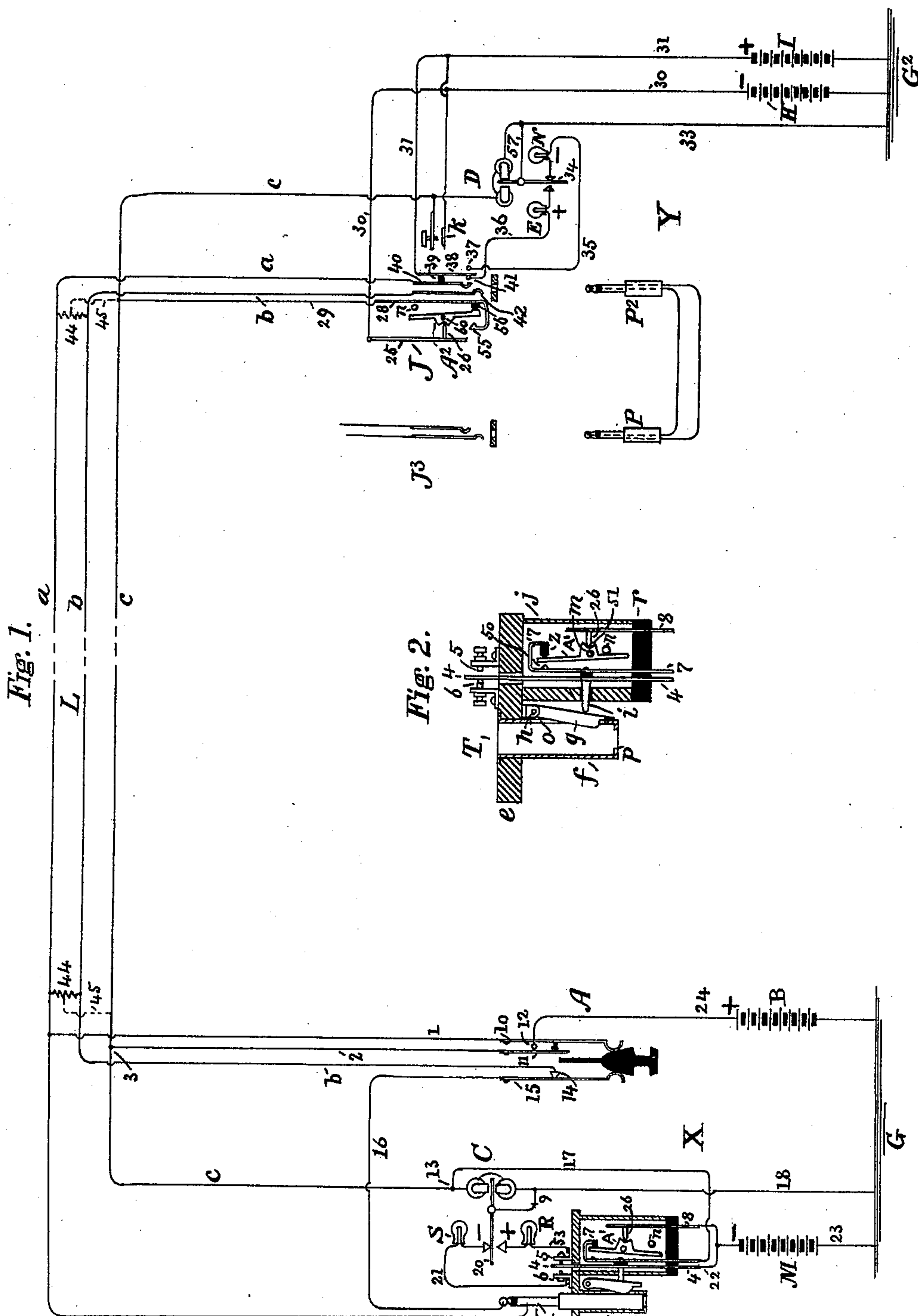


(No Model.)

J. J. O'CONNELL.  
TELEPHONE TRUNK CIRCUIT.

No. 587,226.

Patented July 27, 1897.



Attest,  
Notary Public  
H. R. Edelen,

*Inventor,*  
*Joseph J. O'Connell,*  
*By J. J. O'Connell,*  
*his attorney*

# UNITED STATES PATENT OFFICE.

JOSEPH J. O'CONNELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

## TELEPHONE TRUNK-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 587,226, dated July 27, 1897.

Application filed February 11, 1897. Serial No. 622,970. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH J. O'CONNELL, residing at Chicago, in the county of Cook and State of Illinois, have invented certain Improvements in Telephone Trunk-Circuits, of which the following is a specification.

The present invention relates to trunk-circuits employed in telephone central offices or exchanges, and is arranged so that the operators at both ends are enabled to display call and disconnecting signals at the key-board of the other.

I have illustrated the invention in connection with a trunk and signaling circuit extending between a branch telephone-exchange and a main exchange, but it is applicable to any trunk-circuit and is essentially as follows: At the branch operator's table the trunk-circuit terminates in a plug, which when not in use is located in a plug-seat containing a switch, and its withdrawal therefrom or replacement therein acts to open or close at one point two local circuits at the home end, in one of which is a call-signaling device and in the other a similar disconnecting-signal, while a polar relay, operated mainly from the other end of the trunk, by its armature opens and closes the said local circuits at a second point. There are means, shown as two batteries with opposite poles to line, for sending currents of diverse direction through the circuit and a call-key at the operator's board.

At the main or distributing switchboard the trunk-line terminates in a plug-socket, by means of which and an answering-plug two local circuits, one having a call-signal and the other a disconnecting-signal, are closed at one point, while a polar relay operated from the branch operator's keyboard controls the local circuits each at another point. Means for sending call or signaling currents of both directions are at this switchboard also, and are shown as comprising two call-batteries with opposite poles to line and a call-key. Normally the local signal-circuits at both ends of the trunk-conductors are closed at one point and open at another point.

At both stations or switchboards glow-lamps are preferably employed as signal-receiving appliances.

The operation of sending signals from each end is much the same. The branch operator in calling the distributing or main switch-board operator presses a key which sends, say, a plus current to the trunk-signal line operating the polarized relay at the main station to close a local circuit and display the call lamp-signal. At the same time the home relay operates to close the call-signal circuit and open the disconnecting-signal circuit at the points it controls, but the signal in the former circuit is not manifested, because the trunk-plug has been withdrawn from its seat and inserted in the switch socket or jack of the calling-substation, and by such withdrawal has opened at another point the circuit of the said signal.

When the operator at the main station inserts the answering-plug into the trunk-jack, the call-signal local circuit is opened and the lamp extinguished. At the same time the home disconnecting-signal circuit is closed in the jack. Upon ascertaining the call the second or associate plug is inserted in the jack of the called substation.

Upon the termination of conversation either operator may first disconnect—say that the branch operator removes the trunk-plug and replaces it in its seat. The switch of such plug-seat is thereby actuated and a momentary minus current flows over the signal-wire, a portion of which operates the home-relay, opening the call lamp-circuit at the point controlled thereby and closing the disconnecting lamp-circuit. The remainder of the current operates the relay at the main station, which at the points it controls opens the call lamp-circuit and closes the disconnecting lamp-signal circuit lighting the same. The operator there then takes down the plugs, opening the disconnecting-signal circuit in the jack and thus extinguishing the lamp and at the same time closing the call-signal circuit.

If the operator at the main station was to give the disconnecting-signal, the plugs would be taken down, thereby opening the home disconnecting-signal circuit and closing the call-signal circuit in the trunk-jack and sending a momentary minus current to the branch office and operating the relay there to close



the disconnecting-signal circuit and light the lamp, which circuit will again be opened when the trunk-plug is replaced in its seat.

The operator at the main station can call the branch station by closing a key and sending a plus current, which will cause the relay-armature at the said branch station to close the call-signal circuit and light the lamp.

It will be noticed that the disconnecting-signal at each end of the trunk is operated by a momentary or short-duration current. This effect is produced by similar peculiar and novel devices located at the branch station in the plug-seat switch and at the main station in the trunk-jack, which are automatically operated by the insertion and withdrawal of the trunk-plug in or from its seat and of the answering-plug in or from the trunk-jack, all of which will be described in detail hereinafter.

In the drawings which illustrate the invention, Figure 1 is a diagram of a trunk and signaling line between branch and main telephone-stations, and Fig. 2 is a section of a plug-seat switch employed therein.

L is the trunk talking-circuit, consisting of conductors *a b*, the former terminating at the sleeve of plug K at the branch station X and at spring 40 of jack J at the main station Y. The latter conductor *b* connects with spring 42 of jack J, and, by means of contact 14 and spring 15 of key A and wire 16, to tip of plug K.

*c* is an associated signaling-wire for the said trunk-circuit and connects to ground G, through controlling-signals S and R and their local circuits 21 and 53, polarized relay C, and wire 18 at one end, and by polarized relay D, which controls the signals E and N and their local circuits 35 and 36, and wire 33 to ground G<sup>2</sup> at the other end.

T is a plug-seat switch consisting of a table *e*, of insulating material, with a hole in one end in which is inserted a tube *f* with a flange *p* at its bottom and having a slot *o* cut in one side thereof, into which projects the lower end of lever *g*, pivoted at *h*.

*j* is a dust-proof casing secured to the under side of the table *e*, the bottom *r* being non-conducting and holding the springs 4, 7, and 8. The former spring extends through a slot in the table *e*, between the contacts 5 and 6, and is provided with a pin *i*, which rests against the lever *g*. The springs 4 and 7 are separated by insulation and move as one, the top of the latter spring being recurved and provided with a contact 50 and insulating-tip *z*.

A' is a lever pivoted at *m*, its upper end playing between the tip *z* and the contact 50, and its lower end rests against the pin *n*. The spring 8 is provided with a pin 26, which rests in a slot 51 on the side of the lever A'.

The contact 6 is connected by wire 21 to lamp S, which is arranged to constitute a disconnecting signal and minus contact of relay C, and contact 5 by wire 53 to the call-signal lamp R and plus contact. The armature 20 is

connected by wire 9 with wire 18. The trunk signal-wire *c* is connected with spring 7 by wire 17, and spring 4 is connected with spring 8 by wire 22 and with battery M and ground G by wire 23.

Battery B is connected from ground G by wire 24 to contact-stop 12 in key A, (whose spring 10 connects by wire 1 with conductor *a*,) and by spring 11, which moves with spring 10, and wire 2 with signal-wire *c*.

The spring 28 in jack J at Y is recurved and provided with a contact 55 on its tip and an insulating-striker 56, against which the lower end of the lever A<sup>2</sup> presses. The lever A<sup>2</sup> is pivoted at 60 and has a notch opposite its pivot in which the pin 26 on the spring 25 presses. The spring 25 is connected by wire 30 to the battery H and ground G<sup>2</sup>. The spring 38 is separated from spring 40 by insulation 39, and both move together, the former being connected by wire 31 with battery I and ground. A pair of looping-plugs P and P<sup>2</sup> are shown, and substation-circuits are represented by the line-jacks J<sup>2</sup> and J<sup>3</sup> at the ends, respectively, of the trunk-circuit.

The signal-wire *c* between the stations X and Y may be omitted and the trunk-conductors *a* and *b* used as one conductor by putting suitable resistance-coils 44 between them and connecting the ends of wire *c* to the center thereof by wires 45, as shown in dotted lines and as well understood by those skilled in the art.

In the operation of the invention, assuming that a call has been made by substation represented by jack J<sup>2</sup>, the branch operator raises the plug K and inserts it in the jack J<sup>2</sup> and receives the call in the usual manner and then presses in the key A. The removal of the plug permits the springs 4 and 7 to move to the left until the former strikes the contact 6 and closes the disconnecting-signal local circuit 21 at that point, the insulated tip *z* moving the top of the lever A' to the left until its lower end strikes the pin *n*. As the said top of the lever is forced over the pin 26 holds it in such position, where, however, it is not in contact with the point 50 on the spring 7. The key A is then pushed in, breaking connection between contact 14 and spring 15 and bringing spring 11 into contact with stop 12, whereby a part of the plus current from battery B is caused to flow over the branch conductor 2 and signal-wire *c* through relay D at station or switchboard Y and wire 33 to ground G<sup>2</sup>. This causes the armature 34 to close the local circuit of the signal E by way of ground G<sup>2</sup>, wire 31, battery I, spring 38 of jack J, wires 36, 57, and 33, signal E, and relay-armature to ground, and the said call lamp-signal E is lighted, manifesting the signal. A portion of the plus current divides at point 3 and flows over wires *c* and 18, through relay C to ground G, causing the armature 20 to close the call-signal local circuit 53 at that point of said circuit which it controls; but the signal is not ex-



hibited, because the same circuit has previously been opened at 5 by the movement of the spring 4 consequent on the withdrawal of the plug K from its seat. The main operator inserts answering-plug  $P^2$  into jack J and, ascertaining the call, inserts the other plug P into the called-for jack  $J^3$ . The insertion of the plug  $P^2$  into jack J forces spring 38 away from contact 41 into contact with pin 37, opening the call-signal circuit and extinguishing lamp E and closing the disconnecting-signal circuit at that point. At the same time the spring 28 forces the upper end of lever  $A^2$  into contact with pin  $n$ , the lower end approaching contact 55, but not touching the same. The pin 26 on spring 25 holds the lever  $A^2$  in its new position.

A disconnecting-signal can be given from either end. For instance, the branch operator removes the plug K from jack  $J^2$  and inserts it in the plug-seat, where it operates the plug-seat switch by forcing the lever  $g$  and pin  $i$  to the right, which causes the contact 50 on the spring 7 to strike the lever  $A'$  and force it over into position shown at X, where it is held by the spring 8. While the spring 7 is momentarily in contact with the lever  $A'$ , minus current flows from battery M by spring 8, lever  $A'$ , spring 7, wires 17 and  $c$ , relay D, and wire 33 to ground  $G^2$ , which causes the relay-armature to go to the right and close the disconnecting-signal circuit and light the lamp N at Y. The main-switchboard operator thereupon withdraws the plug  $P^2$ , which causes the spring 38 to open the disconnecting-signal circuit and close the call-circuit in the jack J. At the same time the spring 28 draws the lever  $A^2$  into position shown at Y, and a momentary minus current is sent from battery H over the signal-wire, but will not operate the armature of relay C.

If the disconnecting-signal is sent from the main station Y by the withdrawal of plug  $P^2$  from jack J the momentary minus current just referred to will operate the relay C and cause its armature to close the disconnecting-signal circuit and light the lamp S, as will be readily seen, and when the plug K is inserted in its seat the local circuit of the disconnecting-signal is broken at 6, and the momentary minus current which flows through the relay C from battery M will not operate its armature, that being already in the position to which by the influence of such current it would be attracted.

A call-signal can be sent from the main station Y when the plug K is in its seat at the branch station X by pressing key  $k$ , thus sending a plus current from battery I through the relay C, which causes its armature to close the call-signal circuit and light the lamp R.

Much annoyance has been experienced in plug-seat switches because of the collection of dust between the contacts of the springs, and to avoid this I inclose the springs in the device described herein in the casing  $j$ . It is evident that the lever  $g$  may be dispensed

with and the pin  $i$  extend through the opening  $o$  into the socket, but the construction shown is preferable.

I claim—

1. In a telephone system, the combination of a trunk-circuit between two switchboards, an associated signal-circuit, and two local circuits containing call and disconnecting signals respectively, at each end of said trunk and signal circuits; with a polar relay in the signaling-circuit at each end thereof, and switch connections in the trunk-circuit at each end thereof, the said relay and switch connections at each point controlling jointly the said two local circuits at such point; whereby the display of either signal at either switchboard is determined in part by the condition of the switch connections, and in part by the operation of the polar relay at the said switchboard, such operation being responsive to signaling-currents transmitted from the other switchboard.

2. In a telephone system, a trunk-circuit between two switchboards, provided at one end with a switch-plug terminal, and at the other with a switch-socket or spring-jack terminal, an associated signal-circuit, a plug-seat for said plug-terminal, two local circuits at each switchboard, and independent call and disconnecting signals also at each switchboard included in the said local circuits respectively; combined with a polar relay in the signal-circuit at each end thereof, and circuit-controlling devices in the said switch-socket and plug-seat actuated in each case by the insertion and withdrawal of the switch-plug, the said relay and circuit controlling devices at each point being adapted and arranged to conjointly control the said two local circuits at such point; and means at each switchboard for transmitting currents of both direction or polarity over the signal-circuit for the operation of the polar relay at the other, substantially as described.

3. A trunking system comprising a trunk-circuit between two telephone-switchboards, terminating at both switchboards in suitable plug and spring-jack connecting devices; an associated signal-circuit; two local signaling-circuits at each switchboard, containing a call-signal and a disconnecting-signal respectively; a polar relay at each switchboard included in the main signaling-circuit, and controlling at one point the continuity of the two local circuits at such switchboard; and switches associated with said plug and spring-jack devices at the two ends of the trunk-circuit controlling at a second point the continuity of the said local circuits, the said switches being so arranged that they shall close at such point the call-signal local circuit when the trunk connections are not employed, leaving the disconnecting-signal local circuit open, and shall close the latter local circuit, and open the former when the said trunk connections are in use substantially as specified herein.



4. In a telephone system the combination with a trunk-circuit extending between two switchboards, an associated signal-circuit, two local circuits at each end of said trunk and signal circuits, and independent call and disconnecting signals also at each end contained in the said two local circuits respectively, of a polar relay in the signaling-circuit at each end thereof, and switch connections in the trunk-circuit at each end thereof, the said relay and switch connections at each point controlling jointly the said two local circuits at such point, and means for sending currents of both directions over the signaling-circuit from either end thereof to the other; whereby the display of the signals at either station is made dependent partly upon the operation of its polar relay by a current sent from the other station, and partly on the condition of its own trunk-switch connections, substantially as described.

5. A telephonic conversation and signaling circuit provided at both ends with two lamp-signals in independent local circuits, a polarized relay adapted to alternately open one and close the other of said local circuits and vice versa, at one point, according to the direction of a signaling-current in the main signaling-circuit, two batteries with opposite poles to line, and means for uniting the said line to either battery; the said main circuit being also provided at one end only with a switch-plug terminal, and a plug-seat switch, and at the other end only with a spring-jack or switch-socket terminal; the said plug-seat switch at one end, and spring-jack at the other being both adapted when associated with switch-plugs to alternately open one and close the other of their respective local circuits, and vice versa, at a second point,

whereby call-signals and disconnecting-signals may be displayed at either end of the main circuit, by the action of the polarized relay when the appropriate local circuit is already closed in the spring-jack or the plug-seat, as described herein.

6. A plug-seat switch, consisting of a seat for a plug, a casing inclosing two mechanically connected but insulated contact-springs, one of which plays between two contact-points and is provided with an extension into the plug-socket, a lever-connector adapted to be actuated by the movement of the other contact-spring to reverse its position, said spring being adapted to make electrical contact with the lever, substantially as described.

7. In a trunking system between two exchanges a combined talking and signaling circuit provided at each exchange with a signaling battery and key, a polarized relay, a battery and two lamp-signals in independent local circuits, and means for connecting with a substation-circuit consisting at the first exchange, of a plug and a seat-switch therefor; and at the second exchange of a spring-jack and connecting cord and plugs; whereby when the said plug is restored to the seat-switch or the looping-plug is withdrawn from the said spring-jack a momentary current is caused to flow over the circuit and light a disconnecting lamp-signal at the other end.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 4th day of February, 1897.

JOSEPH J. O'CONNELL.

Witnesses:

ARTHUR D. WHEELER,  
WILLIAM MATHIESEN.