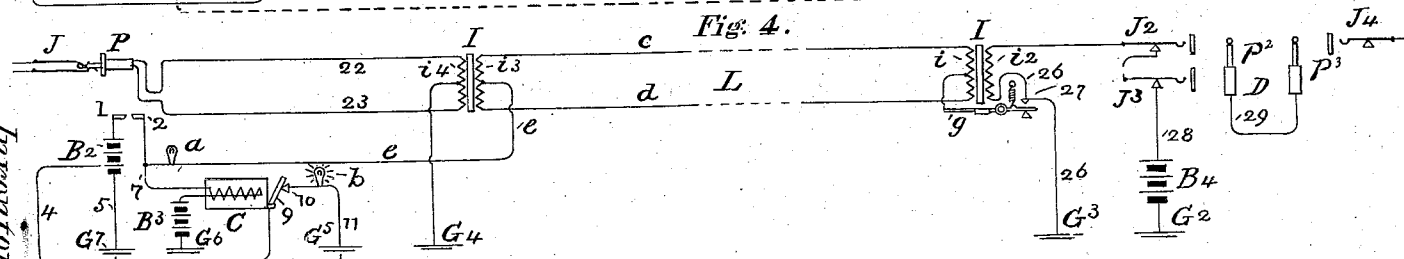
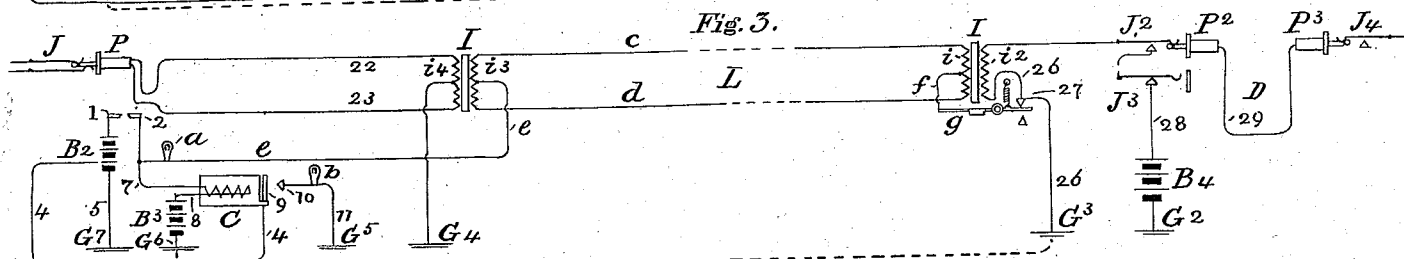
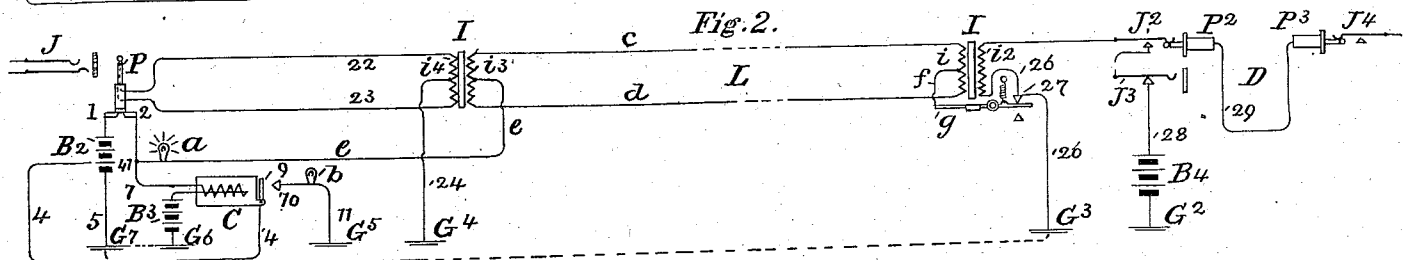
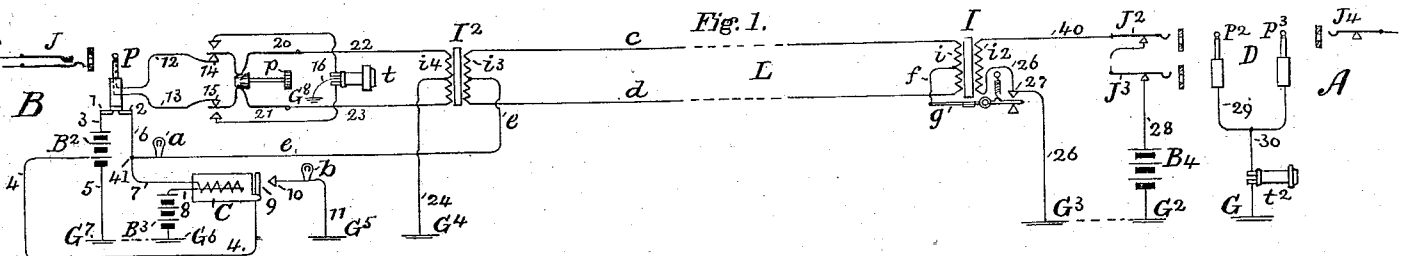


(No Model.)

W. H. HENNESSEY,  
TELEPHONE TRUNK CIRCUIT.

No. 558,686.

Patented Apr. 21, 1896.



Attest.  
J. P. Collier.

Inventor,  
William H. Hennessey,  
by  
Marshall H. Hennessey,  
his attorney.

# UNITED STATES PATENT OFFICE.

WILLIAM H. HENNESSEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

## TELEPHONE TRUNK-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 558,686, dated April 21, 1896.

Application filed February 7, 1896. Serial No. 578,312. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM H. HENNESSEY, residing at Chicago, in the county of Cook and State of Illinois, have invented certain  
5 Improvements in Telephone Trunk-Circuits, of which the following is a specification.

This invention relates to telephone trunk-circuits arranged to extend between two switchboards at widely-separated central offices. The trunk is used as an instruction  
10 and as a signaling circuit between the switch-board-operators and also as a conversation-circuit between connected substations. It may be employed with grounded and metallic  
15 substation-circuits, and when so used I associate the calling end with the grounded circuit and the called end with the metallic circuit. In such an arrangement the trunk-circuit consists of three sections, a central  
20 and two end sections, divided by repeating-coils, one of which operates as a relay, with means for connection with substation-circuits at each end, the calling-end section constituting a circuit having an earth or independent  
25 return through the repeating-coil winding, the multiple switchboard spring-jack switches in series, and a battery, and the called-end section terminating in a connection-plug normally resting on a plug-seat switch of the signaling-circuit. The signaling-circuit consists  
30 of the central section, with single-wire circuits connecting to the center of its repeating-coil windings, the circuit at the calling end connecting with the armature of the repeating-coil relay, which armature is normally  
35 attracted to the said relay and away from its grounding contact, keeping the signaling-circuit open at that end, the single-wire circuit at the called end branching to a plurality of  
40 grounds, to include an "attention" signal, the plug-seat switch and a battery of relatively high electromotive force, a high-resistance relay and a battery of low electromotive force, and a "disconnect" signal adapted to  
45 be operated by the said relay-armature, which is normally held attracted to its core by the said high-voltage battery. A branch extends from between the cells of the high-voltage battery to the armature of the relay and serves  
50 as a path for current from a portion of the

said battery. The second winding of the repeating-coil at the called end of the trunk is connected through the operators' calling and listening apparatus to the tip and sleeve of the connecting-plug, and the said winding has a  
55 branch from its center to ground.

When the first operator at the calling end of the trunk wishes to connect a substation-circuit with the trunk, as preliminary thereto one of a pair of connecting-plugs is inserted  
60 in a jack-switch associated therewith, which opens the end-section circuit and the repeating-coil relay-armature falls upon its back contact, thereby closing the signaling-circuit through the ground at the calling end and  
65 lighting the attention incandescent-lamp signal at the second operator's table at the called end of the trunk.

The second operator is informed by the first operator of the substation wanted, and then  
70 lifts the connecting-plug of the trunk from its seat and inserts it in the jack of the said substation-circuit. The act of removing the plug from its seat opens the signaling-circuit and the attention signal is restored to its normal condition. Upon the termination of the  
75 conversation the first operator withdraws the plug from the trunk-jack, whereupon the repeating-coil relay is demagnetized and the signaling-circuit is opened, thereby permitting the armature of the relay to fall upon its  
80 back contact and cause the disconnect incandescent-lamp signal at the second operator's table to glow. When the second operator withdraws the plug from the substation-line  
85 jack and returns it to its seat, the signaling-circuit is closed thereby and the disconnect signal is extinguished and the circuits are restored to their normal condition, all of which  
90 I will now proceed to describe in detail.

The several figures in the drawings are diagrams embodying the invention and illustrate the condition of the circuits at the several stages of operation.

Figure 1 shows the circuits in their normal  
95 or unused condition. Fig. 2 shows the insertion of a cord-connecting plug by the calling or first operator and the glowing of the attention signal-lamp at the called or second operator. Fig. 3 shows the trunk-connecting plug  
100

as having been inserted by the second operator, and Fig. 4 the withdrawal of the cord-connecting plug by the first operator.

A and B represent, respectively, two central stations connected by a trunk-circuit. At A, J<sup>1</sup> indicates the terminal of a substation grounded circuit, and D a pair of cords and plugs, the operator's telephone being represented at t<sup>2</sup>.

The trunk-circuit consists of the main loop L, composed of the conductors *c* and *d*, including at each end a winding *i*<sup>1</sup> of a repeating-coil, the opposite winding of each coil being associated with circuits and apparatus as follows: From the center of winding *i* of coil I a wire *f* extends to an armature *g* opposite the core of the said coil, which acts as a relay. The winding *i*<sup>2</sup> of the coil connects on one side by wire 26 (which includes the back contact 27 of the armature) to ground G<sup>3</sup>, and on the other sides by wire 40 to the jacks J<sup>2</sup> J<sup>3</sup> (in series) upon the multiple switchboard-sections, by wire 28 and battery B<sup>4</sup> to ground G<sup>2</sup>. The armature *g* is normally held to its front contact by the battery B<sup>4</sup>, energizing the core of coil I. At the other end of the trunk a wire *e*, including the lamp-signal *a*, extends from the center of the winding *i*<sup>3</sup> of the repeating-coil I<sup>2</sup> to a point 41, where it divides, one part extending by wire 6 to a plate 2, which forms a part of the seat normally bridged by the metal butt of the plug P, the other part extending by wire 7 through the high-resistance relay C (of one thousand ohms resistance) and by wire 8 and battery B<sup>3</sup> to ground G<sup>6</sup>. A wire extends from ground G<sup>7</sup>, battery B<sup>2</sup>, and wire 3 to a second plate of the plug-seat. A wire 4 divides the battery B<sup>2</sup> and connects with the armature 9 of the relay C.

The battery B<sup>2</sup> has a pressure of forty volts and the battery B<sup>3</sup> of six volts, and consequently when the plug P rests upon the plates 1 and 2 a circuit is completed from battery B<sup>2</sup>, wire 5, from ground G<sup>7</sup> to ground G<sup>6</sup>, through battery B<sup>3</sup> and relay C, wires 7 and 6, plate 2, plug-butt, plate 1, and wire 3 to battery, causing the armature 9 to be attracted to the relay and away from its back contact 10, which is connected by wire 11 through the lamp-signal *b* to ground G<sup>5</sup>. The battery B<sup>3</sup> is poled opposite to and is of less resistance than battery B<sup>2</sup> and is overcome thereby. The second winding of the repeating-coil I<sup>2</sup> has a branch 24 from its center to ground G<sup>4</sup>, and its ends are connected by the conductors 22 23 with the respective springs 20 and 21, contacts 14 and 15, wires 12 and 13 to the tip and sleeve, respectively, of the plug P.

*p* is a key by means of which the operator can place the telephone *t* into the trunk-circuit, as will be readily seen.

In the operation of the trunk-circuit suppose the first operator at A wishes to connect the substation-terminal J<sup>4</sup> with the jack J<sup>2</sup>, which represents the trunk upon that section, the plug P<sup>3</sup> is inserted in the jack J<sup>4</sup> and the

plug P<sup>2</sup> in the jack J<sup>2</sup>, as shown in Fig. 2. The plug P<sup>2</sup> raises the jack-spring J<sup>2</sup> from its back contact and opens the circuit from the battery B<sup>4</sup>, the repeating-coil relay I becomes demagnetized and the armature-spring brings the armature against the back contact 27, and a circuit is formed from battery B<sup>2</sup> at B, wire 5, ground G<sup>7</sup>, to ground G<sup>3</sup>, wire 26, contact 27, armature *g*, wire *f*, through the winding *i* of repeating-coil I, over both conductors *c* and *d* through the winding *i*<sup>3</sup> of repeating-coil I<sup>2</sup>, wire *e*, lamp-signal *a*, wire 6, plate 2, plug-butt, plate 1, and wire 3 to battery, and the lamp-signal *a* is caused to glow. The battery B<sup>2</sup> also continues to send sufficient current through the relay C to keep the armature 9 from falling. When the second operator at B has noticed the signal and learned the substation wanted, the trunk-plug P is raised from its seat and inserted in the terminal-jack J of the said substation-circuit, as represented in Fig. 3. The effect of removing the plug P from and breaking the bridge between the plates 1 and 2 is to open the circuit of the battery B<sup>2</sup>, and the instant this occurs a circuit is established from the battery B<sup>3</sup>, ground G<sup>6</sup> to ground G<sup>3</sup>, wire 26, contact 27, armature *g*, wire *f*, through the winding *i* of repeating-coil I, over both conductors *c* and *d*, through the winding *i*<sup>3</sup>, wires *e* and 7, relay C, and wire 8 to battery. The lamp-signal *a* will not glow on account of the one thousand ohm resistance-relay C and the low voltage of the battery B<sup>3</sup>, yet there is sufficient current to hold the armature 9 away from its back contact 10. At the termination of the conversation the first operator at A withdraws the plugs P<sup>2</sup> and P<sup>3</sup> from the jacks J<sup>2</sup> and J<sup>4</sup>, as shown in Fig. 4. The effect of withdrawing the plug P<sup>2</sup> from the jack J<sup>2</sup> is to allow the line-spring thereof to make contact with its anvil and close the circuit through the battery B<sup>4</sup> and the repeating-coil relay I, and separate the armature *g* from its back contact 27, and open the circuit through battery B<sup>3</sup>, allowing the armature to fall upon its back contact 10. At the same time a circuit is closed from battery B<sup>2</sup>, wire 5, ground G<sup>7</sup> to ground G<sup>5</sup>, wire 11, disconnect lamp-signal *b*, contact 10, armature 9, wire 4 to battery, and the current therefrom causes the lamp *b* to glow, and to notify the second operator to disconnect the plug P from the jacks J, which being done restores the circuits to their normal condition.

Having now fully described my invention, I claim—

1. A combined conversation and signaling trunk-circuit, the former consisting of inductively-connected sections with means at each end section for connection with substation-circuits and also for controlling the signaling-circuit; the signaling-circuit having two lamp-signals at the called end adapted to be successively lighted from the calling end and to be extinguished from the called end, which circuit consists of the two conductors of the

central section of the conversation-circuit combined with circuits at each end thereof, the circuit at the calling end being normally held open by the relay there, and the circuit at the called end closed through a lamp-signal the plug-seat switch and a source of current, and also through a relay adapted to close a circuit through the second lamp-signal and the said source of current.

2. A combined conversation and signaling trunk-circuit, the former consisting of three inductively-connected sections with means at each end section for connection with substation-circuits and also for controlling the signaling-circuit, which means comprise, at the calling end, spring-jack switches and a relay inductive device, and at the called end a connecting-plug and its seat-switch; the signaling-circuit having two lamp-signals at the called end adapted to be successively lighted from the calling end and to be extinguished from the called end, and which signaling-circuit consists of the two conductors of the central section combined with circuits at each end thereof, the circuit at the calling end being normally held open by the relay inductive device, and the circuit at the called end closed through one lamp-signal the plug-seat switch and a source of current, and also through a relay adapted to close a circuit through the second lamp-signal and the said source of current.

3. A combined conversation and signaling trunk-circuit, the former circuit consisting of three inductively-connected sections with means at each end section for connection with substation-circuits, and with means for controlling the signaling-circuit, which means consist, at the calling end, of spring-jack switches and an inductive relay device, and at the called end, of a connecting-plug and a switch-seat bridged thereby; the signaling-circuit, having two lamp-signals at the called end adapted to be successively lighted from the calling end and to be extinguished from the called end, and which signaling-circuit consists of the two conductors of the central section of the conversation-circuit combined with circuits at each end thereof, the circuit at the calling end being normally held open by the inductive relay device, and the circuit at the called end closed through the attention lamp-signal, the plug-seat switch and a relatively high voltage source of current, in one branch, and through a high-resistance relay in another branch adapted to close a circuit through the disconnect lamp-signal and the said source of current.

4. A combined conversation and signaling trunk-circuit, the former circuit consisting of inductively-connected sections with means at each end section for connection with substation-circuits and also for controlling the signaling-circuit, which means consist, at the calling end, of spring-jack switches and a relay inductive device, and at the called end, of a connecting-plug and its seat-switch; the

signaling-circuit consisting of the two conductors of the central section of the conversation-circuit combined with circuits at each end thereof, the circuit at the calling end being normally held open by the inductive relay device, and the circuit at the called end closed through an attention lamp-signal the plug-seat switch and a relatively high voltage source of current in one branch, and through a high-resistance relay in another branch and a relatively low voltage source of current adapted to close a circuit to include a disconnect lamp-signal, whereby upon the insertion of a plug in a spring-jack switch the attention lamp-signal will be lighted, and upon the removal of the trunk-plug from its seat-switch the signal will be extinguished.

5. A combined conversation and signaling trunk-circuit, the former circuit consisting of inductively-connected sections with means at each end section for connection with substation-circuits and also for controlling the signaling-circuit, which means consist, at the calling end, of spring-jack switches and a relay inductive device, and at the called end, of a connecting-plug and its seat-switch; the signaling-circuit consisting of the two conductors of the central section of the conversation-circuit combined with circuits at each end thereof, the circuit at the calling end being normally held open by the inductive relay device, and the circuit at the called end closed through an attention lamp-signal the plug-seat switch and a relatively high voltage source of current in one branch, and in another branch through a high-resistance relay and a relatively low voltage source of current, adapted to close a circuit to include a disconnect lamp-signal whereby upon the insertion of a plug in a spring-jack switch the attention lamp-signal will be lighted, and upon the removal of the trunk-plug from its seat-switch the signal will be extinguished; and upon the removal of the plug from the spring-jack switch the disconnect lamp-signal will be lighted, and upon the replacement of the trunk-plug upon its seat-switch, the disconnect signal will be extinguished.

6. A trunk-circuit, extending between two telephone-switchboards, divided into three sections by repeating-coils, and constituting conversation and signaling circuits, the conversation-circuit being provided with a connecting-plug at its called end, which is adapted to open and close the signaling-circuit at the said end, the calling end section being normally closed through a repeating-coil winding, spring-jack switches in series upon the multiple switchboard, a battery and the earth, the repeating-coil at the calling end being adapted to operate as a relay to automatically close and open the signaling-circuit at the calling end; the signaling-circuit at the called end being closed to ground by a branch from a repeating-coil winding of the central trunk-section through an attention lamp-signal and separate branches, one of which leads through

a plug-seat switch and a battery, and the other through a high-resistance relay and battery, the back contact of said relay being grounded through a disconnect lamp-signal.

5 7. In a telephone system, a metallic talking-circuit extending between two stations; an inductive extension-circuit therefor, at one of the said stations, normally containing a battery, and provided with a plug-socket  
10 switch, the said battery being connected with the extension-circuit when the plug is not in its socket, but disconnected when the plug is inserted; a grounded signaling-circuit formed of the two conductors of the said talking-circuit in parallel, and extending between the  
15 said two stations; an induction-coil relay interposed between the talking-circuit and its extension and having one of its windings in the said talking-circuit, the other in said  
20 extension-circuit, and its armature and back contact-stop in the said signaling-circuit; and signal-receiving devices at the other station, in the said signaling-circuit controlled by the said relay; whereby the insertion and the with-  
25 drawal of a switch-plug at one station is made to operate signals at another.

8. The combination of the two conductors of a trunk-line extending between two telephone-stations, and forming in series the direct and return wires of a talking-circuit, and  
30 in parallel the single-line conductor of an independent grounded signaling-circuit; and

an extension for the said talking-circuit at one of the said stations, normally closed through a battery and circuit-controlling or switch  
35 connections; with an induction-coil relay having one of its helices in the said talking-circuit, and the other in the said extension; an armature for said relay and circuit-controlling contacts actuated thereby, connected in the  
40 said independent signaling-circuit at the said station, the movement of the said armature being dependent upon the makes and breaks of the extension battery-circuit produced by the operation of the switch connections there-  
45 of; and two independent visual signals associated with the said signaling-circuit at the other station, one responsive to the action of the relay-armature in closing the signaling-circuit when the extension battery-circuit is  
50 opened, and the other to the action of the said armature, in subsequently opening the said signaling-circuit, when the extension of said battery is again closed, substantially as specified.

55 In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 28th day of January, 1896.

WILLIAM H. HENNESSEY.

Witnesses:

A. A. THOMAS,  
A. B. RAYMOND.