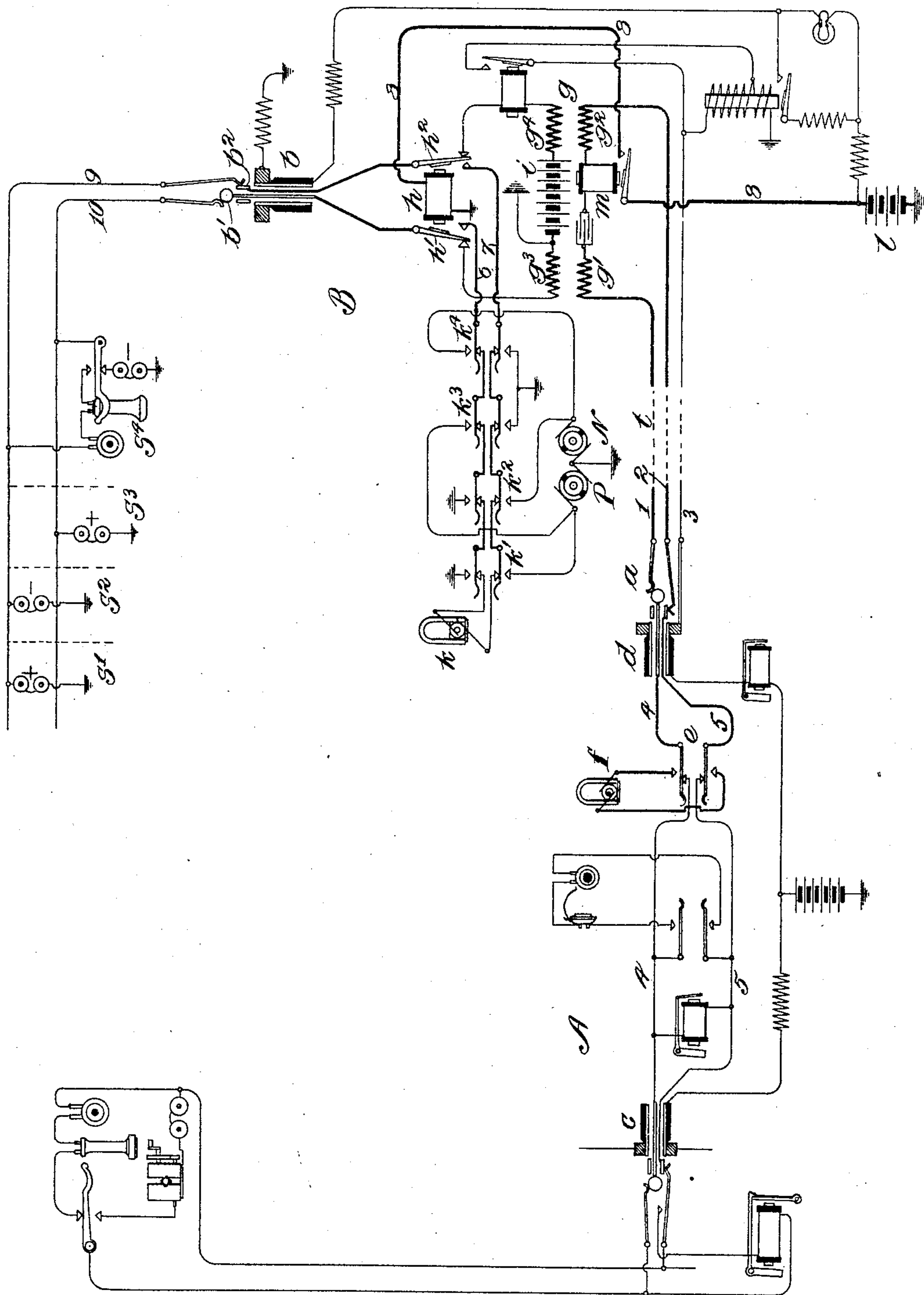


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W. O. PENNELL.  
 APPARATUS FOR TELEPHONE TRUNK LINES.  
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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR TELEPHONE TRUNK-LINES.

SPECIFICATION forming part of Letters Patent No. 779,497, dated January 10, 1905.

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*To all whom it may concern:*

Be it known that I, WALTER OTIS PENNELL, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Improvement in Apparatus for Telephone Trunk-Lines, of which the following is a full, clear, concise, and exact description.

My invention relates to trunk-lines for telephone-exchanges, and has for its object to provide improved apparatus and circuits whereby the answering operator who makes use of the trunk-line to extend a connection to a distant switchboard may signal the called station directly instead of having the trunk operator do the signaling.

In long trunk-lines the line conductors usually are not separate and continuous from one terminal of the line to the other; but a bridge or bridges of the trunk-circuit is provided, generally at the receiving end of the line, containing a repeating device and usually a battery. The usual practice is to divide the trunk-line at the receiving-board into two sections united telephonically through the windings of a repeating-coil, one section extending to the answering-switchboard and the other to the terminal plug of the trunk-line which is adapted for connection with subscribers' lines. Where the common-battery system is used, a battery is included in a bridge of the last-mentioned section extending to the plug and the connected subscriber's line for supplying current to the subscriber's microphone-transmitter. By interposing the repeating-coil in the trunk-line the circuit of the battery is made local to this short section of the trunk-line and the connected subscriber's line, although the trunk-line is telephonically complete from one terminal to the other. Ringing cannot be successfully done from the answering-switchboard through the repeating-coil for two reasons: first, because the repeating-coil is constructed with great nicety to respond to high-frequency telephonic currents and will not work properly to transmit low-frequency ringing-currents, and, second,

because the character of pulsating currents, such as are used for signaling on party-lines, is changed by the repeating-coil, the effect being to transform them from pulsating to alternating currents. In telephone-exchange systems heretofore in use, therefore, it has been usual for the trunk operator at the receiving-switchboard to which the call is trunked from the answering or "long-distance" board to signal the called station at the time of putting up the trunk connection upon the order of the long-distance operator. This division of the work of establishing and supervising the connection, however, causes considerable confusion and loss of time. Furthermore, whenever a subscriber has to be signaled a second time or at any time other than when the trunk connection is put up a separate order must be given by the answering operator to the trunk operator, involving a delay as well as increase of labor. With present methods of operating this separate order for ringing is not infrequent, and the delay is directly apparent to the public, since when the connection is about to be established one party is waiting at the telephone while the other is being signaled. A further objection is that the load on the order-circuit from the long-distance office to the trunking-board or "B position," as it is called, is nearly doubled.

To overcome these difficulties, I have devised a system whereby with but little change in the apparatus the supervising operator at the long-distance board may signal the called station directly without the assistance of the trunk operator, unless the called station be on a party-line. If a substation of a party-line is to be signaled, the trunk operator assists the supervising operator to the extent of depressing a key which will determine the special current to be applied, the application of such current still being controlled by the supervising operator.

In accordance with my invention the terminal plug of the trunk-line at the receiving-board or "B position" is equipped with an electrically-controlled calling-key adapted to



apply calling-current to the end of the trunk-line, and so to its connected telephone-line, and means are provided at the distant switchboard—that is, at the long-distance or answering switchboard—whereby the supervising operator at that board may control the actuation of the aforesaid calling-key. To be more specific, the calling-key is controlled by a magnet in the trunk-circuit from the answering-board, and the supervising operator at said board is provided with means for controlling the flow of current through said magnet. Preferably the magnet is responsive to ordinary calling-current, and the supervising operator is provided with an ordinary calling-key in her plug-circuit for applying the calling-current to the trunk-circuit. The supervising operator thus signals the distant substation through the trunk-line the same as though the trunk-line were an ordinary subscriber's line.

To provide for cases where the called station is on a party-line, I have provided means whereby the trunk operator may, upon the order of the supervising operator, manipulate apparatus at the time of putting up the connection which will determine in advance the special kind of calling-current to be used. The supervising operator still does the ringing herself by means of her usual ringing-key. The trunk operator merely adjusts the apparatus so that a particular kind of ringing-current may be available.

My invention is illustrated in the accompanying drawing, which is a diagram showing an ordinary telephone-line extending from a substation to the central office answering or long-distance switchboard and there connected through the supervising-operator's plug-circuit with a trunk-line. The receiving end of the trunk-line in turn is shown connected with a subscriber's telephone-line having four substations.

The switchboard A is the answering-board or long-distance board, and the switchboard B is the receiving or trunking board. The attendant at the board A is usually called the "A operator," and the attendant at the board B is called the "B operator." The trunk-line  $t$  extends in three limbs 1 2 3 from a spring-jack  $a$  at the answering-switchboard to a terminal plug  $b$  at the receiving-board. The A operator is provided with apparatus for connecting lines together, such apparatus consisting of a pair of plugs  $c$   $d$ , united by link conductors 4 5 of the plug-circuit. A calling-key  $e$  is associated with the plug-circuit and is adapted when actuated to connect the poles of alternating-current generator  $f$  with the conductors 4 5 of the plug-circuit leading to the calling-plug  $d$ .

The trunk-line is divided at the B board by a repeating-coil  $g$ . The windings  $g'$   $g''$  of said repeating-coil are connected in the circuit of the trunk-line leading to the A board, and the

windings  $g^3$   $g^4$  are connected with the circuit leading to the trunk-plug  $b$ . The circuit of the trunk-line from the windings  $g^3$   $g^4$  of the repeating-coil to the trunk-plug is by way of the armatures  $h'$   $h''$  of the relay or electrically-controlled calling-key  $h$ . The armatures  $h'$   $h''$  are connected with the contact-pieces  $b'$   $b''$ , respectively, of the trunk-plug, and the back contacts of said armatures are connected with the windings  $g^3$   $g^4$  of the repeating-coil. The battery  $i$  may be connected in a bridge of this circuit between the windings  $g^3$   $g^4$  of the repeating-coil, as usual. The front contacts of the relay  $h$ , against which the armatures  $h'$   $h''$  are drawn when the relay is excited, form the terminals of a bridge-circuit, including the generator  $k$  of alternating current. The relay  $h$  thus is adapted when energized to sever the trunk-line and connect the terminals thereof leading to the trunk-plug with the bridge-circuit, which includes the calling-generator  $k$ . Four party-line ringing-keys  $k'$   $k''$   $k^3$   $k^4$  are connected in the circuit between the generator  $k$  and the relay  $h$ . Each of said party-line ringing-keys is adapted when depressed to open the circuit and connect one of the severed ends thereof leading to the calling-plug with a source of special calling-current of a peculiar and distinctive character. Thus the key  $k'$  connects the conductor 7, leading to the front contact of armature  $h''$ , with the grounded source P of positive pulsating current, and key  $k''$  connects the same conductor 7 with another source N of negative pulsating current, while keys  $k^3$  and  $k^4$  connect the other conductor, 6, leading to the front contact of armature  $h'$ , with the sources of current P and N, respectively. The armatures of relay  $h$ , together with the apparatus associated therewith, constitute a calling-key, whereby alternating ringing-current may be connected in a bridge of the telephone-line to which the plug  $b$  may be connected or whereby positive or negative pulsating current may be applied to either of said conductors.

A local circuit for the relay  $h$ , including a battery  $l$ , is provided at the trunking-board, said local circuit being controlled by a relay  $m$ , which is connected between the windings  $g'$   $g''$  of the repeating-coil. The relay  $m$ , in other words, is included in the circuit 1 2 of the trunk-line extending to the distant switchboard A. Said relay  $m$  is responsive to alternating calling-current, and when the supervising operator at board A after inserting her calling-plug in the trunk-line spring-jack depresses her calling-key  $e$  the relay  $m$  will thus be energized. The relay  $m$  in drawing up its armature closes the local circuit 8 through the relay  $h$ , which in turn applies calling-current to the trunk-plug  $b$ . The trunk-line plug is shown inserted in the spring-jack of the ordinary four-party telephone-line. The bells at the substation of the line are connected to ground and are polarized to re-



spond only to pulsating current flowing in a predetermined direction. The bells at stations  $S^1 S^2$  are connected in grounded branches from the limb 9 of the subscriber's telephone-line, and the bells at stations  $S^3 S^4$  are connected in grounded branches from the limb 10 thereof. The bells at stations  $S^1 S^2$  respond to positive and negative pulsating currents, respectively, sent out from limb 9 of the line, while the bells at stations  $S^3 S^4$  respond to positive and negative currents, respectively, sent out from the other limb, 10. The usual signaling apparatus may be associated with the trunk-line for indicating at each board the condition of the trunk-line at the other board, and the A operator is provided with a supervisory signal indicating the condition of the called line. It is understood, of course, that the central-office operators at each board are provided with the usual telephone apparatus for communicating with subscribers and that the usual order-circuit extends between the two boards, whereby the operator at the A board may communicate with the B operator. These features are well known in the art and form no part of this invention.

The operation of the system of my invention is as follows: The long-distance operator at the A board desiring to have a connection made with a called subscriber's line terminating at the B board will plug into a jack of the trunk-line and give her order for the line wanted to the B operator. The B operator will test the line in the usual manner, which need not here be described, and will put up the required connection. If the called station be on a party-line, she will also depress that one of the special party-line ringing-keys  $k^1 k^2 k^3 k^4$  which is adapted to apply the proper current for operating the call-bell of the station wanted. Then the A operator will ring the bell at the called station directly by depressing her ordinary ringing-key  $e$  in her cord-circuit. Calling-current flowing from the limbs 1 2 of the trunk-line will traverse the winding of relay  $m$ , whereby said relay will be excited and will close the local circuit 8, which includes the relay  $h$ . The relay  $h$  being excited will thus connect with the plug-terminal of the trunk-line the poles of the calling-generator. The particular kind of current which will be applied to the called line will depend upon which one of the four party-line calling-keys has been depressed by the B operator. If none of the party-line keys have been depressed, ordinary alternating current from generator  $k$  will be applied. After the B operator has put up the connection and if the line wanted is a party-line after she has depressed the particular party-line ringing-key required the long-distance operator at the A board may ring the called station as long or as frequently as desired. The supervision of the connection will remain with the long-distance operator. The disconnection-

signal of the called party will be conveyed back to the A board over a signaling-circuit, which is shown in the drawing, but which need not be described.

I claim as my invention—

1. The combination with two telephone-switchboards at each of which telephone-lines are centered, of a trunk-line uniting said switchboards and adapted for connection with a telephone-line at each board, of an electrically-controlled ringing-key at one of the boards for applying current to the telephone-line with which the trunk-line is connected at that board, and means controlled at the distant board for actuating said ringing-key.

2. The combination with two telephone-switchboards and telephone-lines centered at each board, of a trunk-line extending between the boards, the trunk-line being divided at one of the boards by a repeating-coil, of a source of calling-current at the board where the trunk-line is divided and a calling-key for applying the calling-current to the end of the trunk-line at that board to signal the substation of a connected subscriber's line, a magnet in the trunk-circuit leading to the distant board, controlling said calling-key, said magnet being responsive to the flow of calling-current in said trunk-circuit, a source of calling-current at the distant board and means for applying the same to the trunk-circuit, whereby the substation of a subscriber's line connected with the trunk-line at one board may be signaled from the distant board, substantially as set forth.

3. The combination with two telephone-switchboards and telephone-lines centered at each board, of a trunk-line extending between the boards, the trunk-line being divided by a repeating-coil at one of the boards, of a source of calling-current at the board where the trunk-line is divided, a calling-key for applying the calling-current to the end of the trunk-line at that board, to signal the substation of a connected subscriber's line, a magnet in the circuit of the trunk-line leading to the distant board, controlling the said calling-key, a source of current, and means at the distant board for controlling the flow of current through the circuit of the trunk-line which includes said magnet, substantially as described.

4. The combination with two telephone-switchboards and telephone-lines centered at each board, of a trunk-line extending between the switchboards, and means at one of the boards for connecting the line with a subscriber's telephone-line, of an electrically-controlled calling-key associated with the trunk-line at the last-mentioned board adapted to apply calling-current to signal a substation of the connected subscriber's line, party-line keys adapted to determine the special character of the calling-current to be applied, and means controllable from the distant board for actuating said calling-key, whereby the sub-



stations of the telephone-line may be signaled from the distant board, substantially as described.

5 The combination with two switchboards and telephone-lines centered at each board, of a trunk-line uniting the boards and adapted to be connected with a subscriber's line at one of said boards, an electrically-controlled calling-key and means for specializing the calling-  
10 current to be applied by said calling-key, whereby party-line substations may be selectively signaled, a source of calling-current at the distant board and means for applying the calling-current to the trunk-line, and apparatus  
15 responsive to the flow of calling-current in the trunk-line for actuating said electrically-controlled calling-key, whereby the operation of said key is determined by the application of calling-current to the trunk-line, substantially  
20 as set forth.

6. The combination with an answering-switchboard and a trunking-switchboard and an operator's plug-circuit for connecting telephone-lines together at the answering-board,  
25 of a calling-key in the plug-circuit adapted to connect a source of calling-current therewith, a telephone trunk-line extending from the answering-board to a trunking-board and adapted for connection with a subscriber's line at  
30 said trunking-board, a source of calling-current and an electrically-controlled calling-key at the trunking-board adapted to connect the same with the terminal of the trunk-line to signal a connected subscriber's line, a relay  
35 in the trunk-line circuit from the answering-board responsive to the flow of calling-current in the trunk-line, a magnet for operating the calling-key, and a circuit including said magnet and a source of current, said circuit being  
40 controlled by said relay, substantially as described.

7. The combination with an answering-switchboard and a trunking-switchboard with

a trunk-line uniting them, said trunk-line terminating in a connecting-plug at the trunk- 45 ing-board, of a source of calling-current at the trunking-board, an electrically-controlled calling-key associated with the plug for applying said source of current to the plug to signal the telephone-line with which such plug 50 may be connected, and means controlled from the answering-switchboard for actuating said calling-key, substantially as set forth.

8. The combination with an answering-switchboard A, a trunk-switchboard B, and 55 a through telephone-circuit extending from the A board to the B board, and thence by a subscriber's line to a substation, of a loop-circuit at the B board including a source of current, said loop-circuit being normally dis- 60 connected from the trunk-line, an electrically-controlled switch at the B board controlling the connection of said loop-circuit with the trunk-line, and means controlled from the A board for severing the trunk-line circuit and 65 connecting the loop therewith, substantially as set forth.

9. The combination with an answering-switchboard A, of a trunking-switchboard B, and a trunk-line between said switchboards, 70 a subscriber's line united with the trunk-line at the B switchboard, forming a through telephone-circuit from the A board to the subscriber's station, a loop-circuit including a source of current at the B board, an electric- 75 ally-controlled switch adapted to sever the trunk-line and to connect said loop-circuit with the terminals thereof leading to the substation, and means controlled at the A board for actuating said switch. 80

In witness whereof I hereunto subscribe my name this 6th day of August, A. D. 1900.

WALTER OTIS PENNELL.

Witnesses:

GEORGE ROOT SCOTT,  
CHAS. A. FROST, Jr.