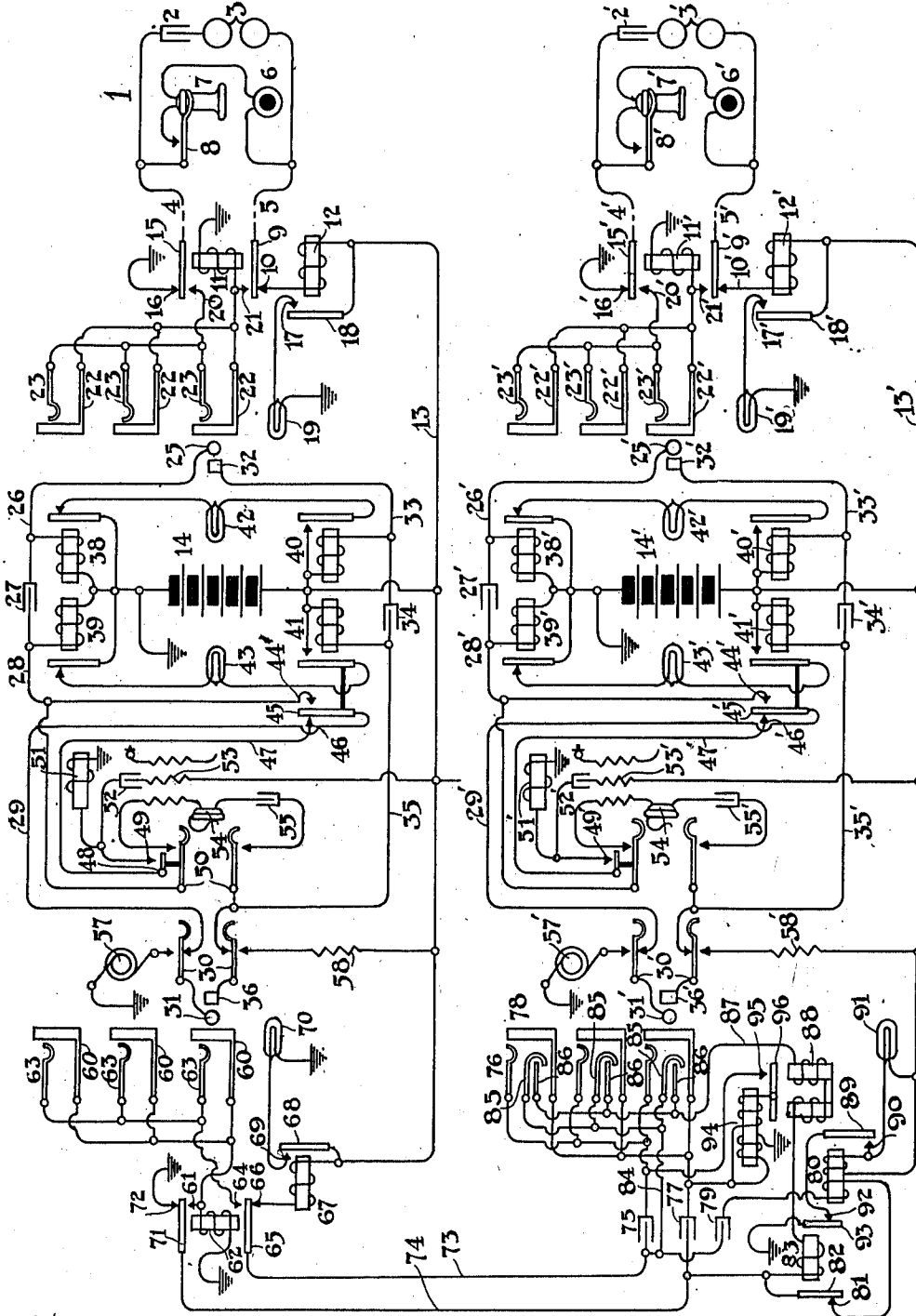


F. M. DAVIS.
TELEPHONE TRUNKING SYSTEM.
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1,026,850.

Patented May 21, 1912.



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TELEPHONE TRUNKING SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRED M. DAVIS, a citizen of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Trunking Systems, of which the following is a specification.

My invention relates to telephone trunking systems of the character adapted to be used between two common battery exchanges. It has been customary in the past to equip trunk circuits of this character with signaling apparatus such that the trunks could only be used in one direction, or if used in both directions such that the supervision would be different when used in one direction from that when the trunk was used in the other direction.

It is the object of my invention to provide a trunk circuit which shall terminate in multiple jacks at each end and which shall be provided with a lamp signal at each end, the two signals being adapted to indicate when a connection has been established at the other end of the trunk.

My invention is illustrated in the accompanying drawing in which all apparatus is shown in its normal or unactuated condition and in which two connecting circuits are shown in position to be united by a trunk circuit. The upper and lower connecting circuits and the telephone lines illustrated in connection therewith are duplicates and the apparatus of said circuits will be designated by like figures, the figures for the lower circuit being provided with the suffix " ' ".

Substation 1 is equipped with the usual condenser 2 and annunciator 3 connected in a permanent bridge between line conductors 4 and 5 and with the transmitter 6 and receiver 7 in a bridge maintained normally open by contacts of the switch hook 8. At the central office, line conductor 5 is connected through contacts 9 and 10 of cut-off relay 11 and the coil of line relay 12, and conductor 13 with the live pole of battery 14, and line conductor 4 connects with earth through contacts 15 and 16 of cut-off relay 11. Line relay 12 controls the normally open contacts 17 and 18 in the circuit of the line lamp 19. Cut-off relay 11 also has the normally open inside contacts 20 and 21, the

contact 21 being connected through the coil of relay 11 with earth, and also with the sleeve contacts 22 of the multiple jacks. The contact 20 is connected with the tip contacts 23 of the multiple jacks. The cord circuit to connect with this line is of the well known two conductor type, the tip strand extending from the tip 25 of the answering plug through conductor 26, condenser 27, conductors 28 and 29, contacts of the ringing key 30 to the tip 31 of the calling plug. The sleeve strand extends from the sleeve contact 32 of the answering plug through conductor 33, condenser 34, conductor 35, and sleeve contacts of the ringing key 30 to the sleeve contact 36 of the calling plug. This cord circuit is provided with four supervisory relays, the tip answering and calling relays 38 and 39 being connected in a bridge between the answering and calling ends of the tip conductor, and the ground pole of battery 14, and the answering and calling sleeve supervisory relays 40 and 41 being connected between the answering and calling ends of the sleeve conductor and the live pole of battery 14. The answering relays 38 and 40 control the local circuit of the answering supervisory signal 42, and the calling supervisory relays 39 and 41 control the local circuit of the calling supervisory signal 43.

The sleeve calling supervisory relay 41 has additional contacts 44, 45 and 46, contacts 44 and 45 being normally open and maintaining a separation between the portions 28 and 29 of the tip talking strand of the cord circuit. Contacts 45 and 46 are normally closed, contact 46 being connected through conductor 47 and the normally open auxiliary contacts 48 and 49 of the operator's listening key 50 through the impedance coil 51 to earth and through the condenser 52 and the tertiary winding of the operator's induction coil 53 with the live pole of battery 14.

The operation of the operator's listening key 50 is adapted to place the operator's head receiver 54 and condenser 55 in a bridge between the talking strands of the cord circuit. The operator's ringing key 30 is adapted when actuated to connect the ringing generator 57 with the tip of the calling plug and is adapted to connect the sleeve of the calling plug with the live pole

of battery 14 through the non-inductive resistance 58.

The trunk circuit extending between the two switchboards is provided at one exchange with two conductor multiple jacks, the sleeve contacts 60 of these jacks being connected with the inside contact 61 of cut-off relay 62 and also through the coil of that relay with earth. The tip contacts 63 of the jacks are connected with the other normally open inside contact 64 of cut-off relay 62. The spring 65 of said cut-off relay is adapted when actuated to connect with the contact 64, but in its normal condition connects through contacts 66 and the coil of the line relay 67 with the live pole of battery 14, this line relay 67 controlling normally open contacts 68 and 69 in the circuit of the trunk line lamp 70. Spring contact 71 of cut-off relay 62 is adapted when actuated to connect with the normally open inside contact 61, but normally connects through contact 72 with earth.

The springs 65 and 71 of cut-off relay 62 are connected respectively with the trunk line conductors 73 and 74, conductor 73 connecting at the other exchange through condenser 75 with the tip contacts 76 of the multiple jacks and conductor 74 connecting through condenser 77 with the sleeve contacts 78 of the multiple jacks. The trunk conductor 73 also connects through condenser 79, the operating coil of relay 80 and contacts 81 and 82 of relay 83 with the trunk conductor 74. Line conductor 73 also is connected through the conductor 84 with the open multiple contacts 85 of the multiple jacks, the other open contact 86 being connected through conductor 87, coil of polarized relay 88 and the coil of relay 83 with the other trunk conductor 74. Relay 80 has a locking winding by which its contacts 89 and 90 are adapted to be maintained closed, these contacts being adapted to complete the circuit of the trunk signal 91. Contact 89 of relay 80 is connected with earth through contacts 92 and 93 of relay 83. The impedance coil 94 has two windings, one of which is bridged between the multiple contacts 76 and 78 of the jacks, this bridge containing the contacts 95 and 96 of the polarized relay 88, and the other of which is connected between the sleeves of the jack and earth.

In the operation of my system a call will first be traced as arising at substation 1. The subscriber at that station removes his receiver 7 from the switch hook 8 and thereby completes a circuit from the live pole of battery 14 through conductor 13, line relay 12, contacts 10 and 9 of cut-off relay 11, line conductor 5, transmitter 6, receiver 7, switch hook 8, line conductor 4, and contacts 15 and 16 of cut-off relay 11 to ground. The current in this path actuates line relay

12 closing its contacts 17 and 18 and completing the circuit of the line lamp 19, which lamp is displayed to indicate to the operator that a connection is desired. The operator seeing the display of this signal, inserts her answering plug into the answering jack thus designated, and thereby completes a circuit from the live pole of battery 14 through the coil of supervisory relay 40, conductor 33, contacts 32 and 22 of the plug and jack and the coil of cut-off relay 11 to ground. The current in this path actuates relays 40 and 11. The actuation of relay 11 interrupts the circuit of the line relay 12 and effaces the line lamp, and also connects the contacts of the jack directly with the lamps of the telephone line. Upon the actuation of relay 11 therefore, a further circuit is completed from the live pole of battery 14 through the coil of supervisory relay 40, conductor 33, contacts 32 and 22 of the plug and jack, contacts 21 and 9 of cut-off relay 11, line conductor 5, transmitter 6, receiver 7, switch hook 8, line conductor 4, contacts 15 and 20 of cut-off relay 11, contacts 23 and 25 of the jack and plug, conductor 26 and the coil of supervisory relay 38 to the ground pole of battery 14. The current in this latter path not only maintains the actuation of relay 40 but also actuates relay 38, thus leaving the circuit of the supervisory signal 42 in an un-energized condition. The operator now inquires the desired number and finding it to be that of a subscriber at the other exchange, inserts her calling plug into the jack of the trunk line extending to the other exchange, the operator first having tested the jack to find whether or not the trunk line was busy. Upon the insertion of the plug a circuit is completed from the live pole of battery 14 through the coil of supervisory relay 41, conductor 35, sleeve contacts of the ringing key 30, sleeve contacts 36 and 60 of the plug and jack, and the coil of cut-off relay 62 to ground. The current in this path actuates the relays 62 and 41. The actuation of relay 41 closes the circuit of the supervisory signal 43 and displays that signal and also closes the normal interruption between the conductors 28 and 29 at its contacts 45 and 44. The actuation of cut-off relay 62 connects the limbs 73 and 74 respectively with the tip and sleeve contacts of the jack. The operator now throws her ringing key and sends alternating ringing current from the generator 57 through the tip contacts 31 and 63 of the plug and jack, contacts 64 and 65 of cut-off relay 62, line conductor 73, condenser 79, the operating coil of relay 80, contacts 81 and 82 of relay 83, trunk conductor 74, contacts 71 and 61 of cut-off relay 62, sleeve contacts 60 and 36 of the jack and plug and the non-inductive resistance 58 through the battery 14 back to the

ground pole of the generator 57. The current in this path actuates the relay 80 which closes a locking circuit for itself, this circuit including the locking coil of relay 80 in one branch and the trunk signal 90 in another branch.

The operator at the second exchange seeing the signal 91 displayed, inserts her answering plug into the jack designated by the display of the signal 91. In so doing the auxiliary contacts 85 and 86 of the trunk jack are closed and a circuit is completed from the live pole of battery 14 through the coil of supervisory relay 41, conductor 35, sleeve contacts of ringing key 30, sleeve contacts 36 and 60 of the plug and jack, contacts 61 and 71 of cut-off relay 62, line conductor 74, the coils of relay 83 and 88, conductor 87, auxiliary contacts 86 and 85 of the jack, conductor 84, trunk conductor 73, contacts 65 and 64 of cut-off relay 62, tip contacts 63 and 31 of the jack and plug, tip contacts of the ringing key 30, conductor 29, contacts 45 and 44 of supervisory relay 4, conductor 28 and the coil of supervisory relay 39 to ground pole of battery 14. Current in this path actuates supervisory relay 39 at the first exchange, which interrupts the circuit of supervisory signal 43, and indicates to the first operator that the operator at the other end of the trunk has established her connection with the trunk. Current in the path before described also actuates relay 83 which interrupts the circuit of the operating coil of relay 80 so that that coil is no longer bridged across the talking circuit. The actuation of relay 83 also severs the locking circuit of relay 80 allowing that relay to fall back and efface the trunk signal 91. The current which now passes through the coil of the polarized relay 88 is in the proper direction to maintain the contacts 95 and 96 of that relay in their closed condition, and therefore, upon the insertion of the answering plug of the second circuit, a circuit is completed from the live pole of battery 14 through the coil of supervisory relay 40, conductor 33, contacts 32' and 78 of the plug and jack, the winding of impedance coil 94, contacts 96 and 95 of polarized relay 88, the tip contacts 76 and 25' of the jack and plug, conductor 26' and the coil of cut-off relay 38' to the ground pole of battery 14'. Current in this path actuates both relays 40' and 38', leaving the circuit of supervisory signal 42' in its deenergized condition. The operator now obtains the desired number either from the calling subscriber or from the first operator and inserts her calling plug into the jack of the desired line, having first made the usual test to obtain the idle or busy condition of this line. The insertion of the calling plug into the jack of the desired line completes a circuit from the live pole of battery 14' through

the coil of supervisory relay 41', conductor 35', contacts of the ringing key 30', sleeve contacts 36' and 22' of the plug and jack and the coil of cut-off relay 11' to ground. The current in this path actuates relay 11' and 41', the actuation of relay 11' connecting the line conductors 4' and 5' directly with the contacts 23' and 22' of the jacks. The actuation of relay 41' completes the circuit of supervisory signal 43' and displays that signal. The operator now throws her ringing key 30' and sends ringing current from her generator 57' to the tip contact 31' and 23' of the plug and jack, contacts 20' and 15' of cut-off relay 11', condenser 2', annunciator 3', line conductor 5', contacts 9' and 21' of cut-off relay 11', sleeve contacts 22' and 36' of the jack and plug through the non-inductive resistance 58' and the battery 14 to the ground pole of the generator 57. Current in this path being alternating, passes through the condenser 2' and sounds the annunciator 3' calling the subscriber to his phone. When the called subscriber answers his call a path for a current is completed from the live pole of battery 14' through the coil of supervisory relay 41', conductor 35', sleeve contacts 36' and 22' of the plug and jack, contacts 21' and 9' of cut-off relay 11', line conductor 5', transmitter 6', receiver 7', switch hook 8', line conductor 4', contacts 15' and 20' of the cut-off relay 11', tip contacts 23' and 31' of the jack and plug, conductor 29', contacts 45' and 44' of relay 41', conductor 28', and the coil of supervisory relay 39' to the ground pole of battery 14'. Current in this path actuates relay 39' which severs the circuit of the supervisory signal 43'. Substations 1 and 1' are now connected for conversation and all the signals at the central office are effaced. When the subscribers again replace their receivers upon their switch hooks the circuits of relays 38 and 39' are severed and supervisory signals 42 and 43' are displayed. Upon the display of these signals the operators remove their plugs from the jacks and all of the circuits are severed, thus allowing the apparatus to return to its normal condition.

In the operation of my system when the call originates at substation 1' the subscriber in charge of that substation removes his receiver 7' from the switch hook 8' and this completes a circuit from the live pole of battery 14' through conductor 13', coil of line relay 12', contacts 10' and 9' of cut-off relay 11', line conductor 5', transmitter 6', receiver 7', switch hook 8', line conductor 4' and contacts 15' and 16' of cut-off relay 11' to ground. The current flowing in this path energizes the line relay 12' closing its contacts 17' and 18' and displaying the line signal 19'. The operator observing the display of the line lamp inserts her answering

plug into the line designated and thereby completes the circuits of supervisory relays 38' and 40' and of cut-off relay 11', these relays being actuated to perform the same functions as relays 38, 40 and 11. The operator now obtains the desired number and finding it to be that of a subscriber connected with the other exchange, after testing, inserts her calling plug into one of the multiple jacks connected with the other exchange. A circuit is thereby completed from the live pole of battery 14' through the coil of supervisory relay 41', sleeve conductor 35', sleeve contacts of ringing key 30', the sleeve contacts 36' and 78 of the plug and jack and through one of the windings of impedance coil 94 to ground. The current in this path actuates relay 41' closing its contacts and displaying the signal 43' which indicates to the operator that the operator at the other exchange has not yet connected with the other end of the trunk line. Upon the insertion of the plug into the jack contacts 85 and 86 of the jack are closed completing a circuit from the live pole of battery 14 through the coil of trunk line relay 67, contacts 66 and 65 of cut-off relay 62, trunk conductor 73, conductor 84, contacts 85 and 86 of the jack, conductor 87, the windings of polarized relay 88, the coil of relay 83, trunk conductor 73 and the contacts 71 and 72 of cut-off relay 62 to ground. The current in this path energizes the trunk line relay 67 which completes the circuit of the trunk line signal 70, indicating to the operator that a connection is desired over the trunk. The operator seeing the signal 70 displayed inserts the answering plug of her cord circuit into the answering jack of the trunk and thereby completes the circuits of relays 38, 40 and 62, actuating these relays to perform their functions as previously described. Upon the actuation of relay 62 the direction of the current in the trunk line is reversed, the current now flowing from the live pole of battery 14 through the coil of relay 40, sleeve conductor 33, sleeve contacts 32 and 60 of the plug and jack, contacts 61 and 71 of cut-off relay 62, trunk conductor 74, the coil of relay 83, the windings of polarized relay 88, conductor 87, contacts 86 and 85 of the jack, conductor 84, trunk conductor 73, contacts 65 and 64 of cut-off relay 62, contacts 63 and 25 of the jack and plug, tip conductor 26, and the coil of supervisory relay 38 to ground. The current in this path being in the reverse of its former direction actuates the polarized relay 88 and closes its contacts 95 and 96, placing a winding of the impedance coil 94 in a bridge between the tip and sleeve contacts of the jack. This completes a circuit from the live pole of battery 14' through supervisory relay 41', sleeve conductor 35', sleeve contacts of the ringing key 30', sleeve

contacts 36' and 78 of the plug and jack, a winding of impedance coil 94, contacts 96 and 95 of polarized relay 88, tip contacts 76 and 31' of the jack and plug, conductor 29', contacts 45' and 44' of supervisory relay 41', conductor 28' and the coil of supervisory relay 39' to ground. This actuates the relay 39' and effaces the signal 43' indicating to the operator at the originating exchange that the operator at the second exchange has connected with the trunk line in response to the signal. The completing of the connection between the second exchange and the desired subscriber's line is exactly the same as formerly described in connection with a call passing through the system in the other direction. The disconnect is accomplished in exactly the same manner as when the call originated at the other end, the apparatus returning to its normal condition when the answering and calling plugs at each exchange are removed from their respective jacks.

While my invention is herein shown and described with respect to certain details, it is to be understood that I do not wish to be unduly limited thereto, the gist of the invention being concerned not so much with the details of the circuit as with the results accomplished thereby, which results could be brought about by the use of other combinations without in any way departing from the spirit or scope of my invention.

I claim:

1. In a telephone system, the combination with a pair of telephone lines terminating at different switchboards, of connecting circuits at each of the switchboards, a trunk circuit extending between said switchboards and terminating at each end in jacks, a trunk signal at each end of the trunk line, a supervisory signal for each connecting circuit, and means to display the trunk signal at either end of the trunk when a connecting circuit is connected with the other end of the trunk, and means to display the supervisory signal at the latter end of the trunk when the connecting circuit is connected with the trunk at said end and to again efface said signal when the connecting circuit is connected with the trunk at the opposite end, substantially as described.

2. In a telephone system, the combination with a pair of telephone lines, of a pair of cord circuits, one adapted to be connected with each of said lines, a trunk circuit terminating at each end in jacks and adapted to connect said cord circuits for conversation, trunk signals, one associated with each end of the trunk, a supervisory signal for each of said cord circuits, means to display the supervisory signal at one end of the trunk and the trunk signal at the other end of the trunk when the cord circuit at the first end is connected with the trunk,

and means to efface both said signals when a cord circuit is connected with the other end of the trunk, substantially as described.

3. In a telephone system, the combination
5 with a pair of cord circuits, of a trunk circuit terminating in jacks and adapted to connect said cord circuits for conversation, trunk signals at each end of said trunk
10 adapted to be displayed when the cord circuit is connected with the opposite end of the trunk and again effaced when a cord circuit is connected with each end of the trunk, a supervisory signal for each cord
15 circuit, means to display one of said signals when only its associated cord circuit is connected with the trunk and to efface said signal when both cord circuits are connected with the trunk, substantially as described.

20 4. In a telephone system, the combination with a pair of cord circuits, of a trunk circuit adapted to connect said cord circuits for conversation, trunk signals at each end of said trunk adapted to be displayed when
25 the cord circuit is connected with the opposite end of the trunk and again effaced when a cord circuit is connected with each end of the trunk, a supervisory signal for each cord circuit, means to display one of said signals
30 when only its associated cord circuit is connected with the trunk and to efface said signal when both cord circuits are connected with the trunk, substantially as described.

35 5. In a telephone system, the combination with a trunk line, of a relay and condenser normally in series with the trunk at one end thereof, a cord circuit adapted to be connected with the other end of the trunk, a
40 source of alternating current, means to send alternating current over the trunk line and through said relay and condenser when the cord is connected with the trunk at the latter end, whereby said relay is actuated, a
45 signal displayed by the actuation of said relay, and means for disconnecting said relay and condenser from said trunk, substantially as described.

6. In a telephone system, the combination
50 with a trunk circuit, of a line relay and a source of direct current normally in series therewith at the first end of the trunk, and a line relay and condenser normally in series therewith at the second end of the trunk,
55 a cut-off relay at each end of the trunk, that at the first end of the trunk being adapted when actuated to interrupt the circuit of the line relay at that end, and a cut-off relay at the second end of the trunk
60 being adapted to interrupt the circuit of the

line relay at the second end, cord circuits to connect with each end of the trunk, and means to actuate the cut-off relays at each end when the cords are connected with the trunk at each end, substantially as described. 65

7. In a telephone system, the combination with a trunk line, of a pair of cord circuits, one adapted to be connected with each end of the trunk, a supervisory signal for each of said cord circuits, the supervisory signal
70 at one end of said trunk being adapted to be displayed when the cord at that end is connected with the trunk, and the cord at the other end is disconnected therefrom, and adapted to be effaced when the cord at the
75 latter end is connected with the trunk, substantially as described.

8. In a telephone system, the combination with a trunk circuit, of similar cord circuits adapted to be connected with the opposite
80 ends of said trunk, a pair of supervisory relays associated with each of said cord circuits, a supervisory signal for each of said cord circuits controlled by the joint action of said relays, means to complete the circuit
85 of one of said relays when the cord is connected with the trunk and no connection is established with the other end of the trunk, whereby the supervisory signal is displayed, and means to complete the circuit of the
90 other of said supervisory relays when a connection is established with the trunk at the other end, whereby said supervisory signal is again effaced, said trunk being adapted to control said signals in the same manner when
95 used in either direction, substantially as described.

9. In a telephone system, the combination with a trunk line, of a source of current having its positive pole normally connected
100 with a limb at one end of the trunk line, and a polarized relay at the other end of the trunk line adapted to receive current from said source but adapted to remain in its normal condition during the flow of current in one direction, and means to reverse
105 the direction of current flow from said source over the trunk line when a connection is established with the trunk at one end, whereby said polarized relay is actuated, and a signal controlled by the actuation of said polarized relay, substantially as described. 110

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two
115 witnesses.

FRED M. DAVIS.

Witnesses:

CLIFFORD C. BRADBURY,
MARJORIE E. GRIER.