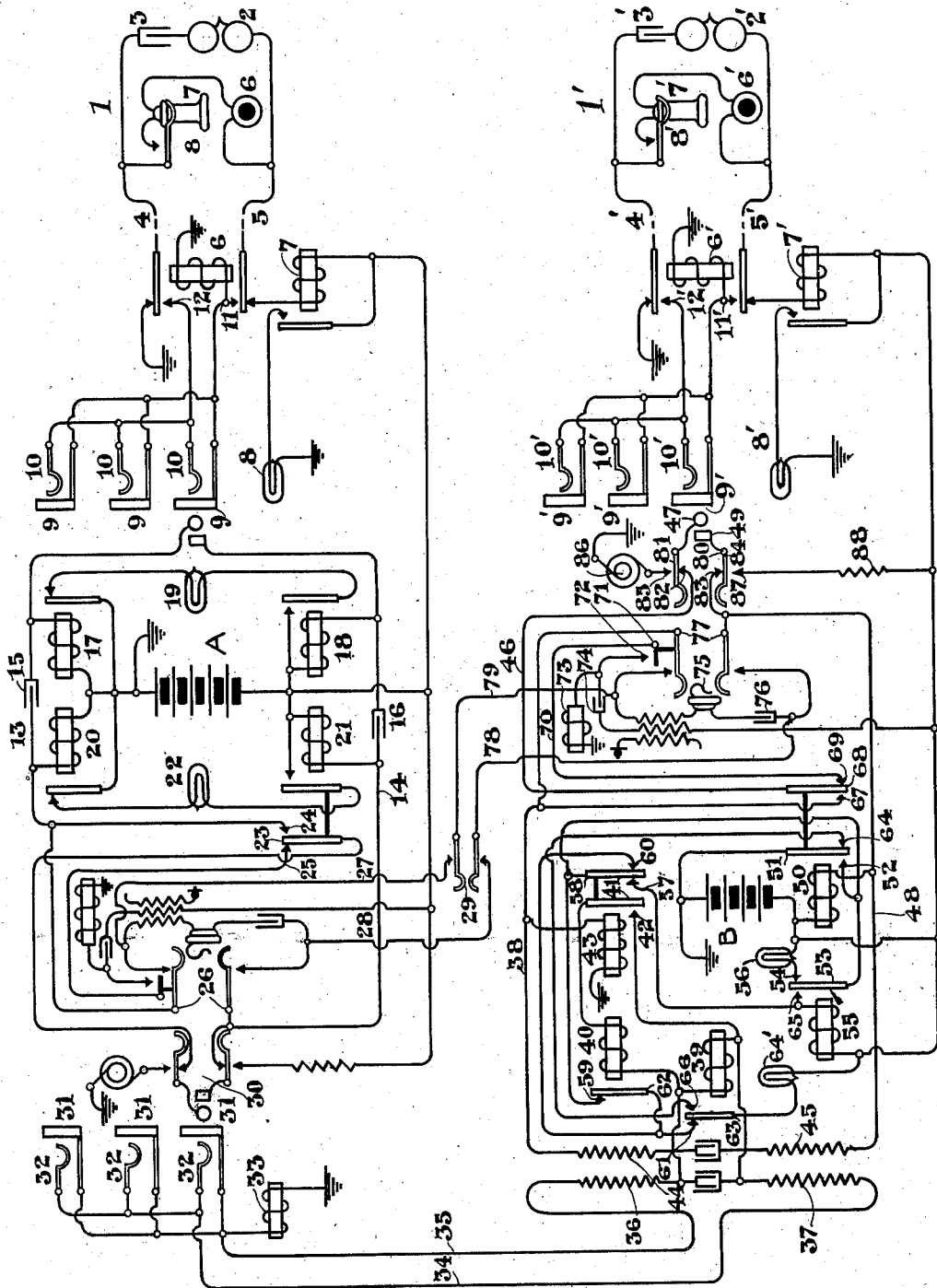


C. S. WINSTON.
TELEPHONE TRUNKING SYSTEM.
APPLICATION FILED DEC. 4, 1907.

1,008,232.

Patented Nov. 7, 1911



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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, CHARLES S. WINSTON, 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 used in furthering a conversation between two separate exchanges or between two different sections of the same exchange. Prior trunking systems of this character were sometimes rendered useless for a time by the called subscriber desiring another connection, or desiring to communicate with the operator after the conversation had terminated. In order to do this the called subscriber often moves his receiver hook up and down thinking that this will attract the attention of the operator. The subscriber then places his receiver to his ear and awaits the response of the operator. With systems used prior to my invention such action on the part of the called subscriber prevented the display of the disconnect signal of the trunk without displaying any other signal whereby the operator at the central office neither had notice that the conversation had terminated nor that the called subscriber was attempting to obtain a second connection.

The object of my present invention is to so arrange the circuits and apparatus of the trunk circuit that the disconnect signal will be received by the trunk operator no matter what the condition of the called subscriber's telephone may be, provided, however, that the called subscriber has moved his receiver hook at least once to give the disconnect signal to the A operator.

Other features of my invention are contained in the circuits and apparatus for producing this result, and such other improvements as will be brought out in the following description and claims.

My invention is illustrated in the accompanying drawing which shows the subscribers' stations 1 and 1' and the cord and trunk

circuits for connecting these subscribers' stations for conversation when the call is initiated at the subscriber's station 1. This station is equipped with the usual annunciator 2 and condenser 3 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 the normal contacts of the cut-off relay 6, and the coil of line relay 7 with the live pole of battery A, while the line conductor 4 is connected through normal contacts of the cut-off relay 6 with earth. The line relay 7 controls normally open contacts in the circuit of the line lamp 8 adapted to complete the circuit of that signal in a manner well known in the art. The sleeve and tip contacts 9 and 10 of the answering and multiple jacks are connected respectively with the inside normally open contacts 11 and 12 of the cut-off relay 6, the contact 11 being also connected through the coil of that relay with earth.

The line here shown as the called subscriber's line is preferably equipped with apparatus similar to that of the calling telephone line, the corresponding apparatus of the called line being designated by like numerals with the suffix " ' ".

The cord circuit of the A exchange may be of any desired character, but is here shown as a two-conductor circuit of a type well known in the art. This circuit has the tip and sleeve strands 13 and 14 respectively, intercepted by condensers 15 and 16. The tip and sleeve supervisory relays 17 and 18 are connected in a bridge between the answering ends of the talking strands, this bridge including the main battery A. The sleeve relay 18 controls normally open contacts in the circuit of supervisory signal 19, while the tip relay 17 controls normally closed contacts in the circuit of this signal. The calling end of the cord circuit is similarly provided with the tip and sleeve relays 20 and 21 connected in a bridge between the talking conductors, this bridge including the main battery A. Likewise, the sleeve relay 21

controls normally open contacts in the circuit of the calling supervisory lamp 22, and the tip relay 20 controls normally closed contacts in the circuit of that signal. The sleeve relay 21 also has the normally open contacts 23 and 24 maintaining a break in the tip talking conductor and has the closed contacts 23 and 25 which connect the testing apparatus with the tip conductor when the operator's listening key 26 is actuated. The secondary of the operator's induction coil, the operator's receiver and a condenser are connected in a bridge between the talking strands by the actuation of the listening key 26 and are permanently connected through conductors 27 and 28 to the normally open contacts of the operator's order wire key 29. The cord circuit is also provided with the usual ringing key 30 which is actuated when the cord is used in completing the connection between two subscribers both local to the A exchange. This key is, however, not used when the cord is used in connection with the trunk circuit.

The trunk circuit has its outgoing end located at the A exchange and its incoming end located at the B exchange. The outgoing end of the trunk circuit is provided with the multiple jacks having sleeve contacts 31 and tip contacts 32, these jacks appearing before each of the operators at the A exchange. The impedance coil 33 is permanently connected between the sleeve contacts of the jacks and earth. The line wires 34 and 35 extend between the contacts 32 and 31 of the multiple jacks at the A exchange and the outside terminals of the windings 36 and 37 of the repeating coil at the B exchange. The inside terminals of these windings are connected together by a condenser, the high resistance relay 39 being connected with its coil in parallel with the condenser. Also connected in parallel with this condenser and the high resistance relay 39 is the shunt circuit containing the coil of relay 40 and the normally open contacts 41 and 42 of relay 43. The windings 44 and 45 of the repeating coil have their inner terminals connected by a condenser, the outer terminal of winding 44 being connected through conductors 38 and 46, with the tip contact 47 of the calling plug, and the outer terminal of the winding 45 being connected through conductor 48 with the sleeve contact 49 of the calling plug.

The coil of relay 43 is connected between the tip strand 38 and the ground pole of battery B. Sleeve relay 50 has its coil connected between the live pole of battery B and the sleeve conductor 48 of the trunk circuit. This latter relay controls the normally open contacts 51 and 52, the contact 51 being connected with the ground pole of battery B, contact 52 being connected through closed contacts 53 and 54 of lock-

ing relay 55 and the ringing signal 56 with the live pole of battery B. Contact 52 also is connected with contacts 58 and 59 of relays 43 and 40. Contact 58 of relay 43 normally connects through contact 60 of that relay with the contact 61 of high resistance relay 39, and is adapted to connect through contact 57 of relay 43 with the contact 65 of relay 55. Contact 59 of relay 40 normally connects through contact 62 of that relay with the same contact 61 of high resistance relay 39. The contact 61 of this latter relay is normally connected through contact 63 and the disconnect signal 64' with the live pole of battery B. Contact 51 of relay 50 is normally connected with contact 64 of that relay and thence with the normally open contact 66 of high resistance relay 39.

The portions of the tip conductors 38 and 46 are normally separated by contacts 67 and 68 of relay 50, contact 68 being normally connected through contact 69 and conductor 70 with the auxiliary contact 71 of the operator's listening key, this contact being adapted to connect with the point 72 by the actuation of that key. Contact 72 connects with earth through the winding of impedance coil 73, and with battery through the condenser 74 and the tertiary winding of the operator's induction coil. The secondary of the induction coil, the operator's head receiver 75 and the condenser 76 are adapted to be placed in a bridge between the talking conductors by the actuation of the operator's listening key 77. The order wire conductors 78 and 79 are connected in the circuit with the operator's head receiver and the secondary of the induction coil so that the receiver is at all times permanently connected with the order wire. The operator's ringing key 80 has the tip series contacts 81 and 82 and the sleeve series contacts 83 and 84, contact 81 being adapted to connect through contact 85 with the ringing current generator 86, the contact 84 being adapted to connect with contact 87 and thence through the non-inductive resistance 88 with the live pole of battery A.

In the operation of this system the call is initiated at the subscriber's station 1 by the subscriber removing his receiver 7 from the switch hook 8 and thereby completing the circuit of the line relay 7 and displaying the line lamp 8. The operator observing the display of the line lamp 8 inserts her answering plug into the jack designated and completes the circuit from the live pole of battery A through the sleeve relay 18, sleeve contacts of the plug and jack, and the coil of the cut-off relay 6 to ground, actuating that relay and moving its springs into connection with contacts 11 and 12, whereby the circuit is completed over the line conductor 5, through the transmitter 6, receiver 7, switch hook 8, line conductor 4, contact 12

of cut-off relay 6, tip contacts of the jack and plug and the coil of supervisory relay 17 to ground. The actuation of relay 6 cuts off the line relay 7 and effaces the line lamp 5.

8. The actuation of relays 17 and 18 do not change the condition of the supervisory signal 19, the circuit of that signal being closed at the contacts of relay 18 and immediately opened at the contacts of relay 17. The operator now inquires the desired number and finding it to be a subscriber of the B exchange presses her order wire key 29 and thus connects her receiver circuit in parallel with the receiver circuit of the trunk operator at the B exchange. The A operator then repeats the desired number to the B operator and the B operator designates the trunk circuit to be used in furthering the connection. The A operator now inserts her calling plug into the jack of the trunk line designated by the B operator and the B operator proceeds to test the jack of the desired line by touching the tip of her calling plug to the sleeve contact of the jack of the desired line. If the line is busy the sleeve contact will be at a potential higher than that of earth and current will flow over the tip 47 of the B operator's calling plug, through contacts 81 and 82 of the ringing key 80, conductor 46, contacts 68 and 69 of the relay 50, conductor 70, contacts 71 and 72 of the now actuated listening key 77 to earth through the impedance coil 73. This causes a slight rise in the potential of the terminal of the impedance coil 73 and one terminal of the condenser 74, thus causing a slight discharge of the condenser which produces a disturbance in the tertiary winding of the operator's induction coil. This disturbance in the tertiary winding of the operator's induction coil produces a similar disturbance in the secondary and in the operator's receiver, notifying the operator of the busy condition of the line. The B operator then inserts her calling plug into a busy back jack, not shown, which by means of an interrupted circuit notifies the calling subscriber that the desired line is busy. Assuming, however, that the desired line is found idle the B operator inserts her calling plug completely into the jack of the desired line. In the meantime, however, it is probable that the A operator will have inserted her calling plug into the jack connected with the outgoing end of the trunk. When this is done a circuit is completed from the live pole of battery A at the A exchange through the coil of supervisory relay 21, sleeve conductor 14, sleeve contacts 60 of the plug and jack and the impedance coil 33 to ground. Current in this path actuates the relay 21 and completes the circuit of the signal 22. The circuit is also completed from the sleeve contact of the jack at the

conductor 35, the winding 36 of the repeating coil, the coil of high resistance relay 39, the winding 37 of the repeating coil, trunk conductor 34, tip contacts of the jack and plug, the now closed contacts 23 and 24 of supervisory relay 21 and the coil of supervisory relay 20 to ground. The current in this path is sufficient to actuate the high resistance relay 39 at the B exchange but owing to the high resistance of this relay is not sufficient to actuate the relay 20 at the A exchange. The actuation of relay 39 closes its contacts 63 and 66 and completes the circuit from the live pole of battery B through the guard and disconnect lamp 64', contacts 63 and 66 of relay 39, and contacts 64 and 51 of relay 50 to ground. This displays the guard signal 64' and indicates to the B operator that the A operator has connected her cord with the proper outgoing trunk line. As soon as the B operator has completed her connection with the jack of the desired line a circuit is completed from the live pole of battery B through the coil of relay 50, sleeve conductor 48, contacts 83 and 84 of the ringing key 80, the sleeve contacts of the plug and jack and the coil of cut-off relay 6' to ground. Current in this path actuates cut-off relay 6' moving its contacts to their abnormal position, and also actuates relay 50, completing the circuit between its contacts 51 and 52, thus lighting the ringing signal 56 and severing the circuit between its contacts 51 and 64, thus interrupting the circuit of the guard and disconnect lamp 64'. The operator now throws her ringing key in the usual manner and sounds the annunciator at the desired substation. When the desired subscriber answers his call a circuit is completed from the live pole of battery B through the coil of relay 50, sleeve conductor 48, contacts 83 and 80 of the ringing key, the sleeve contacts of the plug and jack, line conductor 5', transmitter 6', receiver 7', switch hook 8', line conductor 4', contacts of the cut-off relay 6', tip contacts of the jack and plug, contacts 81 and 82 of the ringing key, tip conductor 46, contacts 68 and 67 of supervisory relay 50, tip conductor 38 and the coil of supervisory relay 43 to ground. Current in this path actuates the supervisory relay 43. The actuation of this relay completes the connection between contacts 58 and 57 of relay 43, and thus completes a circuit through the coil of locking relay 55, contacts 57 and 58 of relay 43, and contacts 52 and 51 of relay 50 to ground. Current in this path actuates the relay 55 and opens the circuit of the ringing lamp 56, at the same time closing a locking circuit for itself through its normally open contacts 53 and 65. The actuation of relay 43 also closes contacts 41 and 42 completing a shunt about the high resistance relay 39, this shunt including the coil of relay 40. When this

shunt is completed sufficient current is permitted to flow in the line conductors 34 and 35 of the trunk to actuate relay 40 and to actuate relay 20 at the A exchange and thereby to efface the supervisory signal 22 and to indicate to the A operator that the desired subscriber has answered his call. The completion of the shunt about the coil of relay 39 deprives that relay of sufficient current to actuate it, and its contact 63 therefore falls back and severs its circuit with contact 66. The actuation of relay 40 opens its contacts 62 and 59 which will be seen to be connected in parallel with contacts 58 and 60 of relay 43.

In the operation of a trunk circuit it is not desirable that the B operator should receive any signals whatever after the conversation has commenced until the conversation has been entirely terminated and the connection between the A cord circuit and the outgoing end of the trunk has been severed. For this reason when the called subscriber hangs up his receiver at the termination of the conversation no signal is received by the B operator and the only disconnect signal is given to the A operator. The disconnect signal is received by the A operator in the following manner: When the called subscriber replaces his receiver he severs the circuit of supervisory relay 43 at the B exchange. This relay falling back to its normal condition opens its contacts 41 and 42 and thereby interrupts the shunt circuit about the coil of the high resistance relay 39. The current through this high resistance relay is not sufficient to maintain the actuation of supervisory relay 20 in the A exchange and that relay falls back, closing its contacts in the circuit of the supervisory signal 22 and displaying that signal indicating to the A operator that the conversation has been terminated. The separation of contacts 57 and 58 does not, however, release the locking relay 55 because of its contacts 53 and 65, and therefore the signal 56 is not displayed. When the A operator receives a disconnect signal by the display of the lamp 22 she removes her calling plug from the outgoing end of the trunk and thereby severs the circuit through the coil of the high resistance relay 39. The contacts of that relay therefore resume their normal condition and a circuit is completed from the live pole of battery B through the disconnect signal 64', contacts 63 and 61 of relay 39, contacts 62 and 59 and contacts 60 and 58 in parallel, and contacts 52 and 51 of relay 50 to ground. This displays the disconnect signal 64' indicating to the trunk operator that the A operator has removed her connection from the outgoing end of the trunk. If it should now happen that the called subscriber should de-

sire to communicate with the operator he will again remove his receiver from the hook and the circuit of supervisory relay 43 will again be completed over the path as before described. This relay pulling up severs its contacts 58 and 60 and if it were not for the parallel contacts 59 and 62 the disconnect signal 64' would be immediately effaced and the trunk operator would have no indication that the conversation had terminated and would likewise have no indication that the called subscriber wished another connection. However, by the addition of relay 40 having the contacts 59 and 62 in parallel with the contacts 58 and 60 of relay 43 it is impossible for the circuit of the disconnect signal 64' to be interrupted by the actions of the called subscriber. The operator therefore removes her calling plug from the jack of the called line and if the called subscriber desires a second call the call will appear before the proper answering operator by the display of the line lamp associated with the line desiring the connection. When the B operator removes her calling plug from its connection with the called line she severs the circuit of relay 50 allowing that relay to fall back and open its contacts 51 and 52 in the circuit of the locking relay 55 such that the circuit of the relay 55 is severed and that relay falls back. At the same time, severing the contacts 51 and 52 of relay 50, severs the circuit of the disconnect signal 64' and allows all apparatus to assume its normal or unactuated condition.

It is to be understood that while I have shown and described my invention with respect to a form of trunking circuit well known in the art, it may be applied to many other forms of trunk circuits and that, therefore, I do not wish to be limited to the specific details here shown, many minor as well as major modifications being possible without in any way departing from the spirit or scope of my invention.

I claim:

1. In a telephone system, the combination with a trunk circuit, of a cord circuit adapted to connect with one end thereof, a telephone line with which the other end is adapted to connect, a signal for the trunk, a high resistance relay bridged across said trunk, a circuit closed when said cord is connected with said trunk and before said trunk connected with said line to operate said relay to display said signal, a low resistance relay, a third relay energized during a conversational connection and adapted to place said low resistance relay in shunt of said high resistance relay to restore said high resistance relay to efface said signal during a conversational connection, a circuit for again displaying said signal when the cord

is disconnected from the trunk at the termination of a conversation, said circuits being independent of the subscriber in charge of said line, substantially as described.

2. In a telephone system, the combination with a trunking circuit, of an operator's cord circuit to connect with the outgoing end thereof, a telephone line with which the incoming end may be connected, a signal for the trunk, a high resistance relay bridged across said trunk and adapted to be actuated by current over said trunk, a low resistance relay, a third relay adapted to place said low resistance relay in shunt of said high resistance relay to restore said high resistance relay, a circuit for actuating said signal by the operation of said high resistance relay, a second circuit for actuating said signal including contacts of said high and low resistance relays, both of said circuits being under the control of the cord operator and independent of the subscriber in charge of said telephone line, substantially as described.

3. In a telephone system, the combination with a trunk circuit, of a cord circuit to connect with the outgoing end thereof and a telephone line with which the incoming end may be connected, a high resistance relay bridged across the incoming end of said trunk and adapted to be actuated by current from said cord circuit, a shunt about the coil of said high resistance relay adapted when closed to deprive the high resistance relay of actuating current, a relay having its coil connected in said shunt, a supervisory relay for the trunk circuit under the control of the subscriber in charge of said line, a signal conjointly controlled by said supervisory relay and said high resistance relay and adapted to be displayed when both of said relays are unactuated and the trunk is connected with said line, the relay in said shunt having contacts in parallel with the contacts of said supervisory relay, whereby the re-actuation of the supervisory relay will not prevent the display of said signal when the cord is disconnected from the trunk, substantially as described.

4. In a telephone system, the combination with a trunk circuit, of an operator's cord circuit to connect with the outgoing end thereof, a telephone line with which the incoming end thereof may be connected, a signal for said trunk, means for displaying said signal when the cord is connected with said trunk, means for effacing said signal when the trunk is connected with said telephone line, a high resistance relay bridged across said trunk, a low resistance relay adapted to be placed in shunt of said high resistance relay, a circuit including normally closed contacts of said relays adapted to display

said signal when a conversation is terminated and the cord is disconnected from said trunk, and means for preventing said signal from being effaced if the called subscriber again removes his receiver from its hook, substantially as described.

5. In a telephone system, the combination with a trunk line, of a cord circuit adapted to be connected with the outgoing end thereof, and a telephone line with which the incoming end is connected, a disconnect signal at the incoming end, a relay at the incoming end actuated by current over the telephone line and controlling normally closed contacts in the circuit of said disconnect signal, a trunk relay controlled from the outgoing end of the trunk controlling normally closed contacts in the circuit of said signal, and a relay having a pair of normally closed contacts in parallel with the contacts of said first relay and having its actuation depending upon the connection of the cord with the outgoing end of the trunk, whereby the disconnected signal may be displayed whether the first relay is in its actuated or its unactuated condition, substantially as described.

6. In a telephone system, the combination with a cord circuit and a telephone line, of a trunk circuit to establish a connection between them, a signal therefor, a high resistance relay in a bridge of said trunk and adapted to display said signal when a connection is established with the outgoing end of said trunk when the incoming end thereof is disconnected, means to efface said signal when the incoming end of said trunk is connected and while the connection is still established with the outgoing end of said trunk, a low resistance relay adapted to be placed in shunt of said high resistance relay to restore said high resistance relay, and a circuit including normally closed contacts of both of said relays to again display said signal when the connection is removed from the outgoing end of said trunk whether the line with which the incoming end of the said trunk is connected is open or closed at the substation, substantially as described.

7. In a telephone system, the combination with a trunk line, of a signal associated with the outgoing end and adapted to be effaced during conversation, a trunk relay adapted to complete the circuit of said signal when the cord is disconnected from the trunk, a second relay under the control of the subscriber connected with the incoming end of the trunk and controlling normally closed contacts in the circuit of said signal, and a third relay actuated whenever the cord is connected with the outgoing end of the trunk and the relay under the control of the subscriber is actuated, said relay being deprived of actuating current either when the relay under the control of the subscriber

is unactuated or when the cord is disconnected from the outgoing end of the trunk, said relay controlling normally closed contacts in the circuit of said supervisory signal and in parallel with the contacts of the relay under the control of the subscriber, substantially as described.

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

CHARLES S. WINSTON.

Witnesses:

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