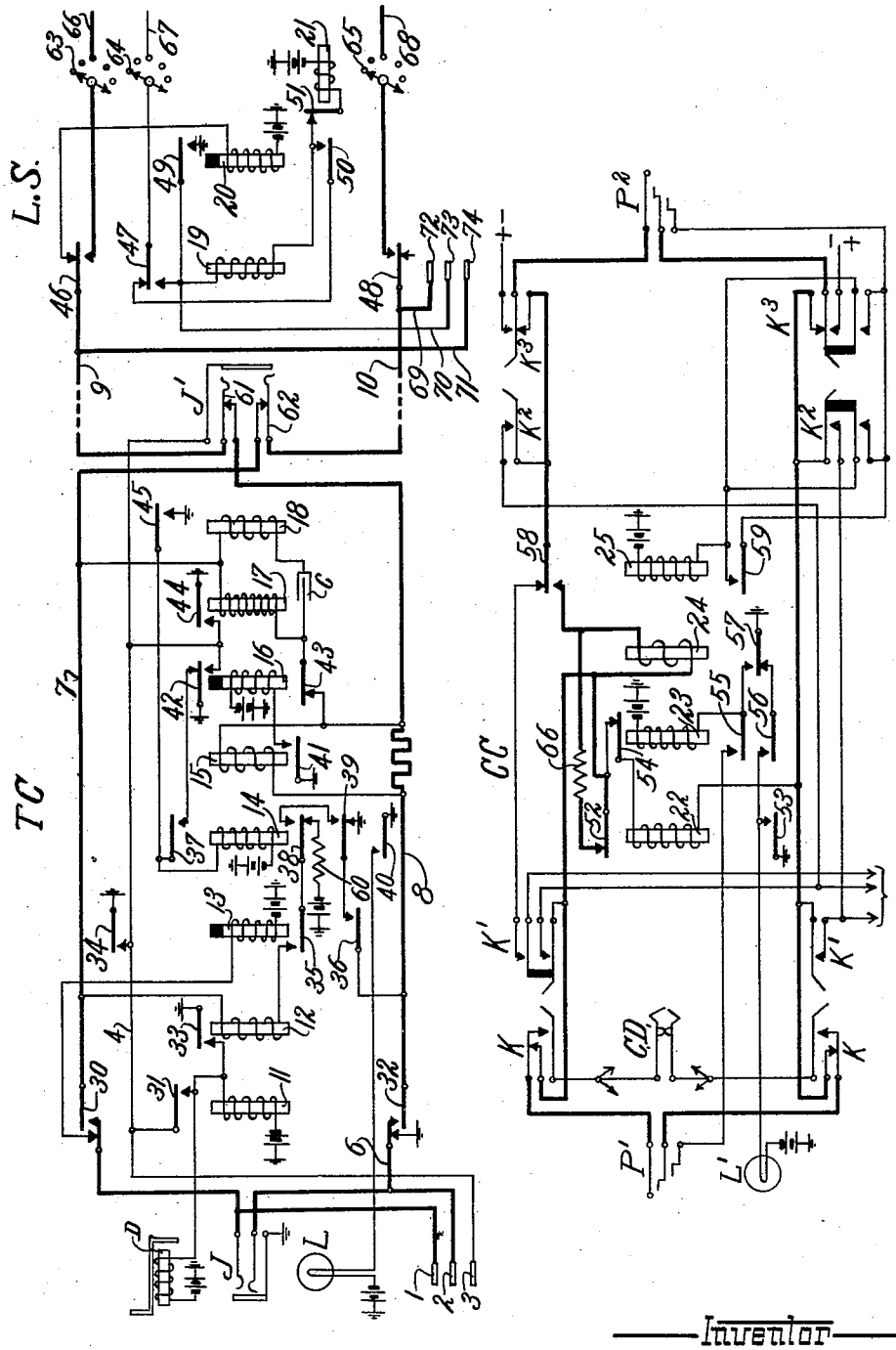
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AUTOMATIC TELEPHONE SYSTEM

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AUTOMATIC TELEPHONE SYSTEM

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The present invention relates to telephone systems in general, but is concerned more particularly with automatic telephone systems in which both main exchange and branch exchanges are employed; and the broad general object, briefly stated, may be said to consist of the provision of new and improved circuit arrangements for a two-way trunk circuit connecting branch and main exchanges.

It has been the general practice heretofore to have a polarized relay bridged across the trunk circuit at the branch exchange for the purpose of instantly busying the trunk circuit at the branch exchange when a connector at the main exchange seizes the trunk circuit. The polarized relay is normally held energized over the trunk circuit from battery through the line relay of the lineswitch at the main exchange and from ground through a resting contact of the switching relay of said lineswitch. When a connector at the main exchange seizes the trunk, said connector causes the cut-off relay of the lineswitch to disconnect the battery and ground connection from the trunk. At the same time the back bridge relay of the connector is connected up to supply current to the trunk, but in the reverse direction, thereby causing the deenergization of the polarized relay at the branch exchange on account of the reversal of current flow over the trunk from the back bridge relay. The polarized relay, therefore, instantly deenergizes as soon as a trunk is seized at the main exchange and instantly busies the trunk at the branch exchange end. The normally energized polarized relay has been objected to on account of its continuous consumption of current and on account of its operation which is dependent on reversals of current. It has been found to be inconvenient in general practice to arrange the various types of switches which have access to such trunks to reverse the current flow so that the polarized relay will function.

In order to overcome the above objections, one of the features of the invention is the elimination of the normally energized high resistance polarized relay and the substitution of other means for instantly guarding the trunk circuit from seizure as soon as the trunk circuit is taken into use at the main exchange. In order to accomplish the above, one of the conductors of the trunk is connected to battery through the line relay of lineswitch at the main exchange and the other conductor is connected to an open contact on said lineswitch. A high resistance relay is substituted for the polarized relay, the circuit of which, however, is normally open; and said relay is, therefore, not energized until a connector seizes the trunk. This high resistance relay instantly energizes as soon as the trunk is seized, and instantly guards the trunk by applying a guarding potential to the trunk at the branch exchange.

Since one of the conductors of the trunk extends through the line relay of the lineswitch to battery and the other conductor of the trunk terminates in the lineswitch in a normally open contact which is free of ground, some means must be provided for initiating the operation of the lineswitch when a call is extended from the branch to the main exchange. Accordingly, another feature of the invention is the provision of means for connecting a ground to one of the conductors to close a circuit for operating the line relay to cause the operation of the lineswitch in the main exchange, said ground being maintained on the conductor until the lineswitch seizes a trunk leading to an idle selector at the main exchange.

Other objects and features of this invention are concerned mainly with circuit details which will be explained fully hereinafter with reference to the accompanying drawing, which shows by means of the usual circuit diagrams the essential features of the invention.

In the upper half of the drawing there is illustrated a trunk line comprising conductors 9 and 10, which extends between a private automatic branch exchange and a main automatic exchange. At the main exchange end, this trunk line has two branches. One of these branches, for use in extending outgoing calls, or calls from the branch exchange to the main exchange, terminates in a lineswitch

LS, which is of the usual rotary type. The other branch, which is used for extending calls from the main exchange to the branch exchange, terminates in a set of bank contacts 72, 73 and 74, and in other multiply connected sets which, like the set indicated, are accessible to connectors of the main exchange. At the branch exchange end, the trunk line terminates in a jack J, which is used mostly for answering main to branch exchange calls, although under certain circumstances it may be used by the operator at whose position it appears for the purpose of extending special calls from the branch exchange to the main exchange. The trunk line also terminates at the branch exchange in a set of bank contacts 1, 2, 3, which, with other multiply connected sets of contacts, are accessible to selector switches in the branch exchange. Associated with the trunk line at the branch exchange there is also provided a trunk circuit, labeled TC in the drawing, and which consists of a number of relays and proper connecting circuits, which will be fully described hereinafter. The reference character J' indicates a night jack, which is used for the purpose of connecting the trunk circuit to some particular line in the private automatic exchange in order to give night service when the operator leaves her position.

In the lower half of the drawing there is illustrated a cord circuit indicated by the reference letters CC. This cord circuit is one of a number of similar cord circuits which are located at the attendant operator's position at the branch exchange, and is used for the purpose of connecting the branch exchange lines with the trunk circuit illustrated, all as will be pointed out in detail hereinafter.

The drawings having been described, it will now be assumed that a subscriber in the private automatic branch exchange desires to converse with a subscriber in the automatic main exchange. It will be assumed further that when the calling subscriber at the private automatic branch exchange removes his receiver and dials the main exchange digit in the number of the desired subscriber, a well know Strowger vertical and rotary selector switch seizes the first idle trunk extending to the main exchange.

Assuming that the trunk line shown is the first idle trunk line accessible to the selector switch, the wipers of the selector switch will then stop on the selector bank contacts 1, 2, and 3. The switching relay of the selector switch will then energize and connect the line wipers of the selector to the bank contacts 1 and 2 in the well known manner. A circuit is now closed for energizing relay 13 as follows: from ground through the normally closed contacts controlled by armature 32, conductor 6, selector bank contact 2, wiper of the selector switch, the calling subscriber's loop, wiper of the selector switch, selector bank contact 1, conductor 5, through the normally closed contacts controlled by armature 30, winding of relay 13 to battery. Relay 13 energizes over the above traced circuit and at armature 34 places ground on the release trunk conductor 4 so as to furnish a holding ground to the selector and other switches operated by the calling subscriber in extending the call to the trunk circuit. At armature 36, relay 13, closes a circuit for energizing series relay 15 and line relay 20 of the lineswitch LS as follows: from ground by way of resting contact of armature 39 and said armature, working contact of armature 36 and said armature, conductor 8, series relay 15, normally closed contact controlled by spring 61 and said spring, conductor 9, armature 46 and its resting contact, line relay 20 of the lineswitch LS to battery. Relay 13, at armature 35 closes a circuit for energizing relay 17 as follows: from ground by way of the resting contact of armature 39 and said armature, working contact of armature 36 and said armature, line conductor 8, relay 15, resting contacts of armature 43 and said armature, winding of relay 17, conductor 7, winding of relay 12, working contacts of armature 35 and said armature, armature 38 and its resting contact, resistance 60 to battery. The relay 17 energizes over the above traced circuit and at armature 44 grounds the release trunk conductor 4. The operation of the relay 17 at this time, however, is incidental as it performs no useful function. Relay 12 is not energized over the above traced circuit on account of the high resistance of relay 17.

Relay 15, upon energizing, closes at armature 41 and its resting contact a circuit for energizing relay 16. Relay 16 upon energizing, grounds the release trunk conductor 4 at armature 42 and its working contact and at armature 43 and its resting contact opens the circuit of the high resistance relay 17 and the ringing relay 18.

When the line relay 20 of the lineswitch LS, energizes over the above traced circuit, said relay places ground on the private normal conductor 70 at armature 49 and its working contact, thereby making the trunk line busy to connectors in the main exchange. In addition to placing ground on private normal conductor 70, armature 49 and its working contact closes a circuit for switching relay 19 in series with the stepping magnet 21. At armature 50 and its working contact, relay 20 connects test wiper 64 to the above circuit at a point midway between the said switching relay and the stepping magnet. The operation now depends upon whether the trunk line with which the line switch wipers are associated is busy or idle. If the trunk line is busy there is a ground potential upon the test contact with which the test wiper 64 is in engagement; the switching relay is short-circuited, and the stepping mag-

net 21, which interrupts its own circuit is operated in the manner of a buzzer to advance the switch wipers in search of an idle trunk.

When an idle trunk is reached, which trunk, it will be assumed, is the one comprising conductors 66—68 extending to an idle first selector, switching relay 19, being no longer short circuited on account of the fact that there is no ground potential on the bank contact now encountered by the test wiper 64, energizes in series with the stepping magnet 21. The stepping magnet, however, does not energize at this time on account of the relatively high resistance of the switching relay 19. Upon energizing, switching relay 19 disconnects test wiper 64 from the junction of its own winding and that of the stepping magnet 21 and connects it instead to the grounded private normal conductors 70, thereby making the seized trunk busy immediately; and at armatures 46 and 48 disconnects the upper line conductor from the winding of the line relay 20 and extends both line conductors by way of wipers 63 and 65 to trunk conductors 66 and 68, respectively, of the seized trunk. Responsive to this operation, the line relay of the seized selector switch (not shown), and the relay 12 of the trunk circuit TC energize in series as follows: from ground through the lower winding of the line relay of the seized selector switch to conductor 68, wiper 65, working contact of armature 48 and said armature, trunk conductor 10, spring 62 and its resting contact, conductor 7, relay 12, working contact of armature 35 and said armature, armature 38 and its resting contact, resistance 60, to battery. A circuit is also closed for the upper winding of the line relay of the selector as follows: from ground by way of resting contact of armature 39 and said armature, working contact of armature 36 and said armature, conductor 8, relay 15, resting contact of spring 61 and said spring, conductor 9, armature 46 and its working contact, wiper 63, conductor 66, upper winding of the line relay of the selector to battery. Responsive to the energization of the line relay of the selector, the release relay is energized in the well known manner and places ground on the release trunk conductor 67, thereby establishing the usual holding circuit for the line switch LS before the slow acting line relay 20 has had time to fall back.

When relay 12 energizes over the above traced circuit, said relay, at armature 33 and its working contact closes a circuit for operating the visual signal D to indicate to the operator at the private branch exchange that the trunk line is in use. Relay 12, at armature 33 and its working contact, also closes a circuit for energizing relay 11. Relay 11, upon energizing, closes a locking circuit for itself at armature 31 and its working contact. By the operation of armatures 30 and 32, relay 11 opens the circuit of slow to release relay 13 and switches the subscriber's loop to the seized selector switch in the main exchange. The line relay of the seized selector switch in the main exchange and the series relay 15 are held energized over the calling subscriber's loop. A short interval after the energization of relay 11, slow to-release-relay 13 deenergizes and opens the circuit of relay 12. Relay 12 deenergizes and opens the original energizing circuit for relay 11 which however is maintained energized over its armature 31.

The trunk circuit TC, the line switch LS and the seized selector, are now in condition to extend the connection. The calling subscriber now manipulates his calling device in accordance with the remainder of the directory telephone number of the desired subscriber in the main exchange, with the result that the desired connection is completed and the desired subscriber's bell is rung by the connector switch in the usual manner. Relay 15 responds to the dial but the slow acting relay 16 is maintained in operated position and keeps the release trunk conductor 4 grounded. When the called subscriber responds, the ringing current is cut off by the connector in the usual manner and the talking circuit is completed, whereupon the two subscribers may converse with each other in the usual manner.

When the conversation is completed, the two subscribers replace their receivers.

When the receiver of the calling subscriber at the branch exchange is replaced, the circuit of relay 15 of the trunk circuit TC and the line relay of the connector in the main exchange is opened, whereupon said relays deenergize. Relay 15, upon deenergizing, at armature 41 opens the circuit of slow to release relay 16 which thereupon deenergizes after an interval and removes ground from the release trunk conductor 4. The removal of ground from the release conductor 4 permits the switches operated by the calling subscriber in the private automatic branch exchange to release in the usual manner. The removal of ground from the release trunk conductor also restores the visual signal to norman and opens the circuit of relay 11 whereupon said relay deenergizes. Relay 11 upon deenergizing, places the trunk circuit TC in condition to extend another call.

The connector switch in the main exchange is preferably of the well known release by last party type in which the connector in this case releases when the called subscriber hangs up the receiver. The preceding switches, however, including line switch LS, are released in the usual manner by the removal of ground from the conductor 67.

Having described the operation of the trunk circuit TC in connection with a call

from the private automatic branch exchange to the main exchange, an explanation will now be given of a call from the main exchange to a subscriber in the private automatic branch exchange. It will now be assumed that the subscriber at the main automatic exchange desires to converse with a subscriber in the private automatic branch exchange and that he accordingly removes his receiver and dials the number of the branch exchange as listed in the telephone directory.

It will be further assumed that a connector switch in the main exchange seizes the trunk terminals 72, 73, and 74, responsive to calling the digits of the telephone number of the private branch exchange. The connector switch, upon seizing the bank contacts 72, 73, and 74 of the trunk line, places ground on test terminal 73, whereupon a circuit is closed for energizing switching relay 19 of the line switch LS. When this occurs, the switching relay 19 energizes through bank contact 73, conductor 70, winding of relay 19, interrupter springs 51, of the operating magnet 21, and winding of magnet 21 to battery. The operating magnet 21 of the lineswitch LS is not operated over the above circuit on account of the high resistance of the switching relay 19. Relay 19, upon energizing, disconnects conductor 9 from line relay 20. Relay 19, however, does not operate far enough to connect up the wipers of the lineswitch, owing to the usual interlocking device (not shown) between the armature proper of relay 19 and that of line relay 20. A further result of the connector switch seizing the bank contacts 72—74 results in the energization of high resistance relay 17 of the trunk circuit TC. The circuit for energizing relay 17 may be traced as follows: from ground superimposed on the ringing circuit over the connector switch wipers to bank terminal 74, conductor 71, conductor 9, spring 61 and its resting contact, resting contact of armature 43 and said armature, winding of high resistance relay 17, conductor 7, resting contact of spring 62 and said spring, conductor 10, conductor 69, bank terminal 72, wiper of the connector switch, to winding of the ring-cut-off relay of the connector switch and battery. Relay 17 is energized either during the ringing period of the connector switch, or during the silent period. Relay 17, upon energizing, at armature 44 and its working contact connects ground to the release trunk conductor 4, thereby making the trunk busy to the selector switches of the private branch exchange which have access thereto. Relay 17 is of such high resistance that the ring cut off relay of the connector will not operate. When ringing current is applied to the trunk circuit at the connector switch, the relay 18 energizes over the circuit previously traced for relay 17.

Relay 18, upon energizing, closes a circuit at armature 45 and its working contact for energizing relay 14. Relay 14, upon energizing, closes a locking circuit for itself at armature 37 and its working contact to ground at armature 42. At armature 40 and its working contact, relay 14, closes a circuit for lighting the lamp L which indicates to the operator at the private branch exchange that a subscriber at the main exchange desires connection with a subscriber in the private branch exchange. Relay 14, also at armatures 39 and 38, closes a point in a bridge across the trunk circuit, which circuit includes the relays 12 and 15, for energizing the ring cut-off relay to cut off the ring.

When the operator perceives the lighted condition of the lamp L, she inserts the answering plug of an idle cord circuit, for example the plug P′ of the cord circuit CC, into the jack J. Responsive to the plugging in of the plug P′ into the jack J, a circuit is closed for energizing relay 13 in series with the relay 22 of the cord circuit CC. Relays 13 and 22 energize over the following circuit: from ground at the normally closed springs controlled by armature 32, conductor 6, ring spring of jack J, ring terminal of plug P′, normally closed springs controlled by the key K, winding of relay 22, resting contact of armature 54 and said armature, normally closed springs controlled by key K, tip terminal of the plug P′, tip terminal of the jack J, conductor 5, normally closed springs controlled by armature 30, and winding of relay 13 to battery. Relay 13, upon energizing, at armature 34 and its working contact connects ground to the release trunk conductor 4, and at armatures 35 and 36 completes a bridge across the trunk circuit TC, which bridge includes the windings of relays 12 and 15, thereby energizing the ring cut-off relay in the connector to cut-off ringing current. As soon as the ring cut-off relay of the connector is energized, a circuit is closed for energizing the back bridge relay of the connector and relays 12 and 15 of the trunk circuit as follows: from ground by way of lower winding of back bridge relay of the connector, connector switch wiper, bank contact 74, conductor 71, conductor 9, spring 61 and its resting contact, winding of relay 15, conductor 8, armature 36 and its working contact, armature 39 and its working contact, working contact of armature 38 and said armature, armature 35 and its working contact, winding of relay 12, conductor 7, resting contact of spring 62 and said spring, conductor 10, conductor 69, connector bank contact 72, wiper of connector switch, and through the upper winding of the back bridge relay to battery. The relays 12, 15, and the back bridge relay of the connector energize in series over the above circuit. Relay 15, upon energizing, closes at armature 41 and its working contact a circuit for energizing relay 16. Relay 16, upon energizing, at

armature 42 opens the locking circuit of relay 14 and at its working contact grounds the release trunk conductor 4; and at armature 43 opens the circuit of the high resistance relay 17, which deenergizes. The locking circuit of relay 14 being opened at armature 42, said relay deenergizes and opens the bridge across the trunk at armatures 38 and 39; and at armature 40 disconnects ground from the lamp signal L thereby extinguishing the same. When relay 12 energizes over the above traced circuit, said relay closes a circuit at armature 33 and its working contact for energizing relay 11, and in addition closes a circuit for operating the visual signal D. Relay 11, upon energizing, completes a locking circuit for itself at armature 31 and its resting contact to the grounded release trunk conductor 4. At armatures 30 and 32, relay 11, bridges the relay 22 across the talking conductors of the trunk circuit TC and therefore, relay 22 is maintained energized in series with the back bridge relay of the connector switch at the main exchange. At armature 30, relay 11, opens the circuit of relay 13 whereupon said relay deenergizes and opens a further point in the bridge across the trunk circuit.

Relay 22 of the cord circuit CC, upon energizing, closes a circuit for lighting the supervisory lamp L′ at armature 53 and its working contact, and at armature 52 removes the resistance 66 from in shunt of the relay 24.

The operator now throws her key K′ into listening position, thereby connecting her head set to the strands of the cord circuit. The operator now converses with the calling subscriber and ascertains from him the number of the desired substation. Upon learning that the calling subscriber desires to converse with one of the subscribers at the private branch exchange, the operator tests for the busy or idle condition of the desired line by tapping the tip of the plug P2 against the sleeve of the jack which is assigned to the line of the called subscriber. If the desired line is busy, there is a ground potential upon the sleeve of the jack and a circuit is closed through the tip of the plug P2, ringing key K3, armature 58 and its resting contact, springs controlled by key K1, through the tertiary winding of the operator's induction coil to battery. Accordingly the operator hears a click in her receiver each time she taps the sleeve of the jack. In this case, the operator informs the calling subscriber that the desired line is busy. The calling subscriber replaces his receiver with the result that the established connection is broken.

Assuming, however, that the desired line is idle when called, there is no ground potential on the sleeve of the jack, but rather a battery potential on the sleeve, and accordingly, the operator does not hear any clicks in her receiver. The operator then inserts the plug P2 into the jack of the called line and rings the called party in a well known manner by the operation of key K3. Responsive to the insertion of the plug P2 into the jack of the called line ground is connected to the sleeve of the jack, and where key K3 is operated relay 25 is energized as follows: from ground by way of sleeve of the jack of the called line, springs of the key K3, and winding of the relay 25 to battery. Relay 25 energizes over the above traced circuit and at armature 59 closes a locking circuit for itself; and at armature 58 and its working contact connects the supervisory relay 24 in series with the talking strands of the cord circuit, preparatory to furnishing talking battery to the called station. Relay 25 also opens the above mentioned busy test circuit at armature 58 and its resting contact.

When the called subscriber at the branch exchange removes his receiver, a bridge is placed across the conductors of the line including the receiver, transmitter, and calling device of the called subscriber. Supervisory relay 24 which is connected in series in the upper talking conductor of the cord circuit is consequently connected in multiple with the bridge across the trunk circuit which includes the relay 22. As a result of the direct current bridge being placed across the line the supervisory relay 24 energizes in series with the back bridge relay of the connector switch in the main exchange. Relay 24, upon energizing, closes a circuit at armature 57 for energizing relay 23. Relay 23, upon energizing, at armature 54 and its resting contact opens the circuit of relay 22, at armature 56 and its working contact prepares a circuit for the supervisory lamp L′, and at armature 55 and its working contact closes a locking circuit for maintaining itself energized over the sleeve of the conductor of the cord circuit until the plug P1 is removed from jack J. Relay 22, upon deenergizing, inserts the resistance 66 in multiple with the relay 24 to improve the transmission of the talking circuit. The relay 24, however, is so wound that it is maintained energized when the resistance 66 is in shunt of said relay. At armature 53, relay 22, opens the circuit for the supervisory lamp L′ thereby extinguishing said lamp to notify the operator that the called man has answered. The calling and called subscribers may now converse with each other as desired.

When the conversation is completed, the two subscribers replace their receivers.

It will be assumed that the calling subscriber in the main exchange is the first to replace his receiver. The line relay of the connector switch in the main exchange deenergizes and prepares the circuit for releasing the connection. The connector however, does not release because the back bridge relay is maintained energized by the called sub-

scriber. The switches used by the calling subscriber in the main exchange with the exception of the connector switch, release in the well known manner. The connector switch however, maintains ground on the release trunk conductor 70, to maintain the switching relay 19 of the lineswitch LS in operated position until the called subscriber hangs up.

When the called subscriber at the branch exchange replaces his receiver the back bridge relay of the connector deenergizes whereby the connector is released in the usual manner. Relay 24 of the cord circuit CC is also deenergized by the replacement of the receiver of the called party. Relay 24, upon deenergizing, closes a circuit for lighting the supervisory lamp L' as follows: from ground by way of armature 57 and its resting contact, armature 56 and its working contact, the supervisory lamp L' and battery. The lighting of the supervisory lamp L' indicates to the operator that the called subscriber has hung up and that the plugs P1 and P2 may be removed from their respective jacks.

The hanging up of the receiver by the called party also causes the deenergization of relay 15 of the trunk circuit TC. The relay 15, upon deenergizing, opens the circuit of the slow to release relay 16 which falls back and removes ground from the release conductor 4, whereupon relay 11 is deenergized in the same manner as previously explained. The trunk circuit is now returned to normal position and it will be noted that calls can be completed over the trunk line even though the cord circuit CC has not been removed from the jack J.

The operator in response to the lighting of the supervisory lamp L' removes the plugs P1 and P2 from the jacks of the trunk circuit and called line respectively. Responsive to the removal of the plug P1 from the jack J, the relay 23 deenergizes thereby opening the circuit to the supervisory lamp at armature 56. Relay 25 deenergizes responsive to the removal of the plug P2 from the jack of the called line.

The operator at the branch exchange with the aid of the cord circuit CC and the calling device CD is able to set up a call to the main automatic exchange by inserting the plug P' into the jack J after which she dials the number of the desired subscriber of the main exchange. The operation of the trunk circuit TC and the line switch LS are the same as previously described for completing a connection from a private branch exchange subscriber to a called main exchange subscriber. In such a call however, the relay 22 is connected in bridge of the trunk circuit instead of the calling subscriber's line. The various operations in the cord circuit are also the same as previously explained.

From the foregoing description, it can be readily seen that I have provided a novel and improved trunk circuit which makes both ends of the trunk line busy at the time it is seized from either end and which eliminates the commonly used, normally energized polarized relay which heretofore has been bridged across the trunk circuit. In addition I have provided a novel circuit for connecting and holding ground on the negative line of the trunk line until the lineswitch LS seizes an idle selector, whereupon said ground is removed. No auxiliary relays are required at the main exchange and no circuit changes with the exception that the positive line conductor is left open at the lineswitch.

What is claimed is:

1. In a telephone system, a main exchange and a branch exchange, a two conductor trunk connecting the main with the branch exchange, said trunk terminating in multiple switch banks at the branch exchange and in a non-numerical hunting switch at the main exchange, means for seizing said trunk at said switch banks, means in said trunk responsive to said seizure for connecting ground to only one of the conductors of said trunk, and means in said switch controlled responsive to said ground connection for causing said switch to hunt for an idle trunk.

2. In a telephone system, a main automatic exchange and a private automatic branch exchange, a trunk line connecting the main with the branch exchange, said trunk line terminating in switch banks at the branch exchange and terminating in a switch at the main exchange, means for seizing said trunk at said switch banks, means in said trunk operative responsive to said seizure for connecting ground to only one of the conductors of said trunk to close a circuit to cause said switch to hunt for and seize an idle trunk in the main exchange, and means in said trunk operative responsive to the seizure of an idle trunk for removing the ground from said conductor and for connecting the two conductors of the calling line to the two conductors of the selected trunk.

3. In a telephone system, a main exchange and a branch exchange, a two conductor trunk connecting the main with the branch exchange, said trunk terminating in multiple switch banks at the branch exchange and in an automatic switch at the main exchange, means for seizing said trunk at said switch banks, means in said trunk operative responsive to said seizure for connecting negative battery to one of the conductors of said trunk and for connecting ground to the other talking conductor of said trunk, and means responsive to the connection of ground to said other conductor for causing said switch to hunt and seize an idle trunk in the main exchange.

4. In a telephone system, a main exchange and a branch exchange, a two conductor trunk

connecting the main with the branch exchange, said trunk terminating in multiple switch banks at the branch exchange and in an automatic switch at the main exchange, means controlled from a calling line for seizing said trunk at said switch banks, means in said trunk operative responsive to said seizure for connecting negative battery to one of the conductors of said trunk and for connecting ground to the other conductor of said trunk, means responsive to the connection of ground to said other conductor for causing said switch to hunt and seize an idle trunk in the main exchange, and means in said trunk operated responsive to the such last seizure by current flow from said negative battery connection for removing the negative battery and the ground from the conductors of said trunk and for connecting the line of the calling subscriber with the conductors of said trunk.

5. In a telephone system, a two way trunk line, an electromagnetic relay at one end of said trunk line having a winding normally bridged across the talking conductors of said trunk line, means effective when the trunk line is taken into use at the other end for connecting a source of current in bridge of said trunk line to energize said relay, a test terminal for said trunk line, and contacts on said relay for connecting ground to said test terminal to make said trunk line test busy.

6. In a telephone system, a two way trunk line connecting a main automatic exchange with an automatic branch exchange, a high resistance relay normally bridged across the talking conductors of said trunk, means in said main exchange for seizing said trunk and for making said trunk busy at the main exchange end, means for energizing said relay responsive to said seizure, a test terminal for said trunk, contacts on said relay operated for connecting ground to said terminal to make said trunk test busy at the branch exchange end, an operator's position including a cord circuit, means operative responsive to the connection of said cord circuit with said trunk for deenergizing said relay, and means for maintaining said trunk busy at the branch exchange end.

7. In a telephone system, a two way trunk line connecting a main automatic exchange with an automatic branch exchange, a high resistance relay normally bridged across the talking conductors of said trunk, means in said main exchange for seizing said trunk and for making said trunk busy at the main exchange end, means for energizing said relay responsive to said seizure, a test terminal for said trunk, contacts on said relay operated for connecting ground to said terminal to make said trunk test busy at the branch exchange end, an operator's position including a cord circuit, means operative responsive to the connection of said cord circuit with said trunk for deenergizing said relay, and means for removing the busy condition from said trunk even though said cord circuit remains connected with said trunk.

8. In a telephone system, a trunk line terminating in one end in switch banks and in the other end in a manual jack at an operator's position, means for seizing said trunk line at said switch banks and for automatically applying ringing current thereto, means in said trunk line at the other end operated responsive to the application of said ringing current for signalling the operator at said position and for preparing a bridge circuit across the conductors of said trunk line, means in said trunk line operated responsive to the operator plugging into said jack for completing said bridge circuit to cut off the application of said ringing current, and means responsive to the operation of said last means for causing said last means to operate again and open said bridge circuit.

9. In a telephone system, a trunk line terminating in one end in switch banks and in the other end in a manual jack at an operator's position, means for seizing said trunk line at said switch banks and for automatically applying ringing current thereto, a relay in said trunk line at the other end energized responsive to the application of said ringing current for signalling the operator at said position and for preparing a bridge circuit across the conductors of said trunk line, a second relay in said trunk line energized responsive to the operator plugging into said jack for completing said bridge circuit to cut off said ringing current, and a third relay in said trunk line energized responsive to the energization of said second relay for opening the energizing circuit of said second relay to cause said second relay to deenergize and open said bridge circuit.

10. In a telephone system, a trunk line terminating in one end in switch banks and in the other end in a manual jack at an operator's position, means for seizing said trunk line at said switch banks and for automatically applying ringing current thereto, a relay in said trunk line at the other end energized responsive to the application of said ringing current for signalling the operator at said position and for preparing a bridge circuit across the conductors of said trunk line, and means comprising a plurality of relays in said trunk line operated responsive to the operator plugging into said jack for only momentarily completing said bridge circuit to cut off said ringing current.

11. In a telephone system, a main exchange and a branch exchange, a two-way two conductor trunk connecting the main with the branch exchange, said trunk line terminating in multiple switch banks and a manual jack at the branch exchange and in a non-numerical hunting switch and connector

bank contacts at the main exchange, means for seizing said trunk line by way of said manual jack, said switch banks, or said connector bank contacts to extend a connection over said trunk line, means in said trunk line responsive to the seizure of said trunk line by way of said switch banks or said manual jack for connecting ground to only one of the conductors of said trunk line, and means in said switch responsive to said ground connection for causing said switch to hunt for an idle trunk in the main exchange.

12. In a telephone system, a trunk line having two normally disconnected sections and terminating in one end in switch banks and in the other end in an automatic switch, a relay bridged across one of said sections operated responsive to the seizure of said trunk line by way of said switch banks, means controlled by said relay for causing the operation of said switch to extend a connection. a second relay in said trunk line energized over a circuit including only one conductor of said trunk line when said switch has completed its operation, means controlled by said second relay for connecting to two sections of the trunk line together, and a third relay in series with another conductor of said trunk line for maintaining the connection.

13. In a telephone system, a two conductor trunk line having two normally disconnected sections and terminating in one end in switch banks and in the other end in an automatic non-numerical hunting switch, a relay in said trunk line normally bridged across one of said sections and energized responsive to the seizure of said trunk line by way of said switch banks, means controlled by said relay for connecting ground to only one conductor of said trunk line to cause the operation of said switch to extend a connection, a second relay in said trunk line energized over a circuit controlled by said first relay and including the other conductor of said trunk line after said switch has completed its operation, and means controlled by said second relay for connecting the two sections together and for deenergizing said first relay.

14. In a telephone system, a two conductor trunk line having two normally disconnected sections and terminating in one end in switch banks and in the other end in an automatic non-numerical hunting switch, a relay in said trunk line normally bridged across one of said sections and energized responsive to the seizure of said trunk line by way of said switch banks, means controlled by said relay for connecting ground to only one conductor of said trunk line to cause the operation of said switch to extend a connection, a second relay in said trunk line energized over a circuit controlled by said first relay and including the other conductor of said trunk line after said switch has completed its operation, means controlled by said second relay for connecting the two sections together and for deenergizing said first relay, means responsive to the deenergization of said first relay for deenergizing said second relay, and a third relay in said trunk line in series with said one conductor for maintaining the connection.

15. In a telephone system, a two way trunk, automatic switches having access to said trunk at both ends, a busy test circuit at one end of the trunk for marking the same busy to the switches at that end, a relay having contacts in said test circuit for connecting a potential thereto, a circuit for said relay including only one conductor of the trunk, and means for closing said last circuit responsive to the seizure of the trunk by a switch at the other end of the trunk.

In witness whereof, I hereunto subscribe my name this 7th day of September, A. D., 1926.

CLARENCE E. LOMAX.