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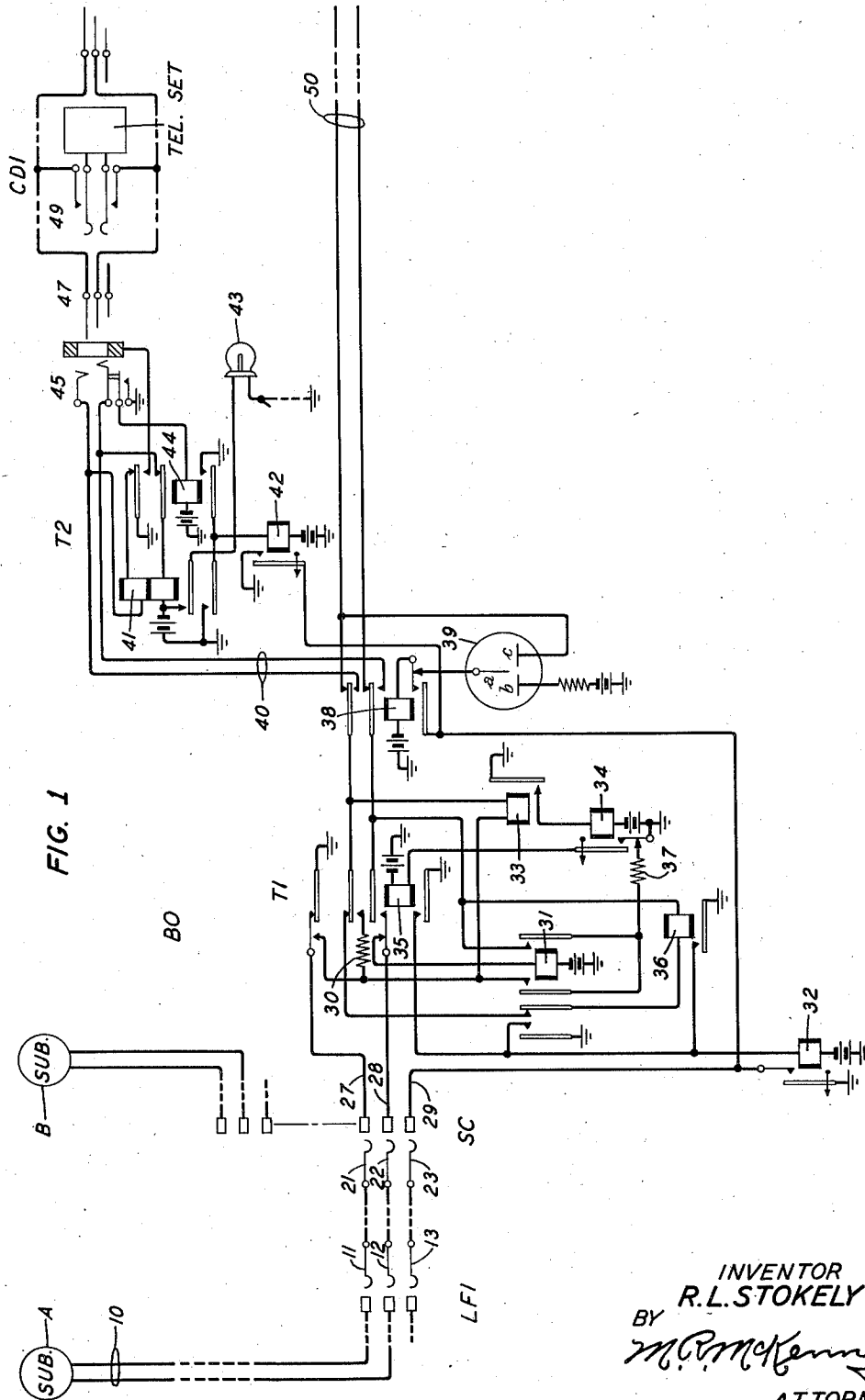
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2,041,096

TELEPHONE SYSTEM

Filed Dec. 28, 1934

2 Sheets-Sheet 1



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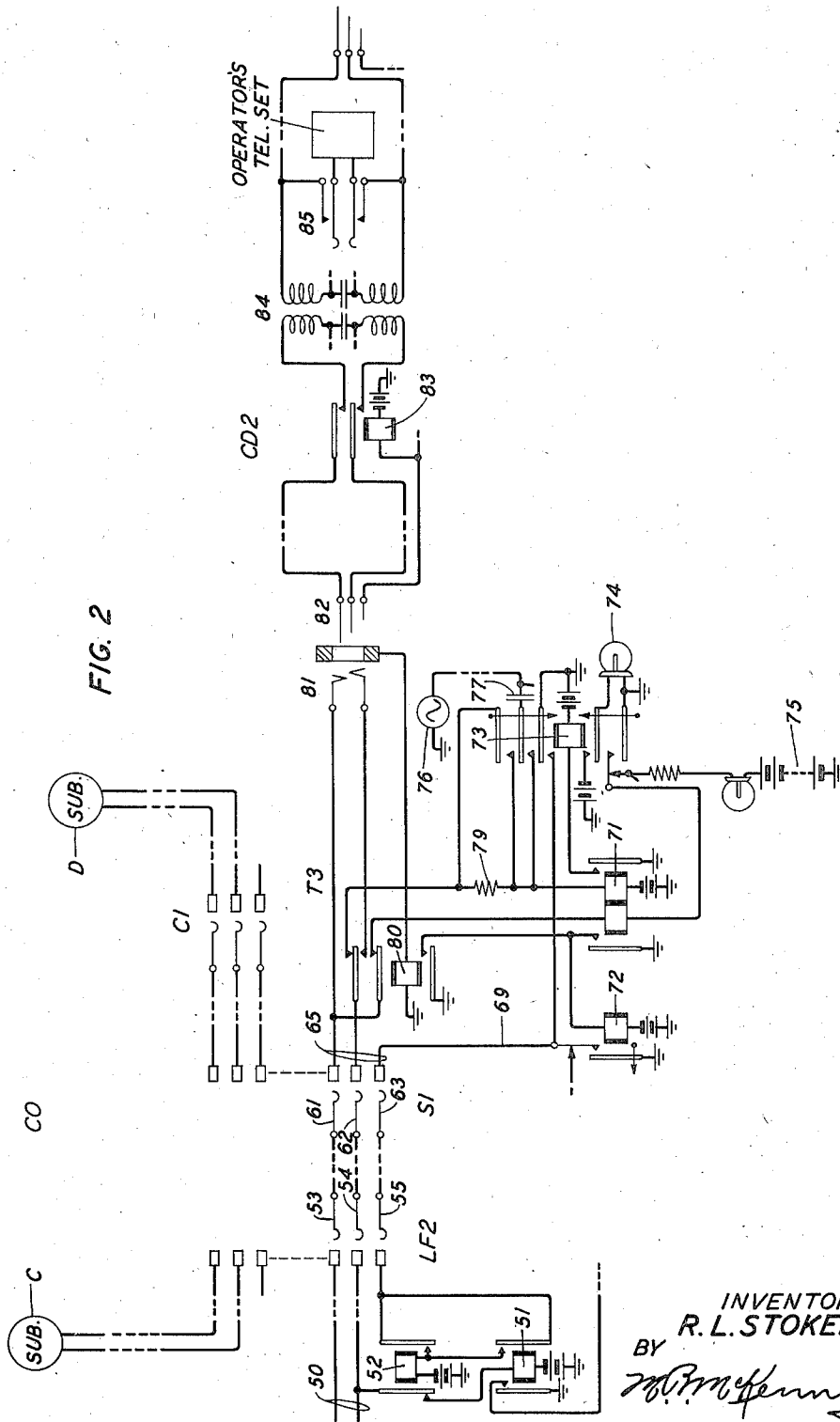
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UNITED STATES PATENT OFFICE

2,041,096

TELEPHONE SYSTEM

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6 Claims. (Cl. 179-27)

This invention relates to telephone systems and particularly to automatic systems which include branch offices.

The object of this invention is to increase the efficiency of trunks employed in completing toll connections and to provide an improved arrangement for diverting toll calls originated in a branch exchange to a local operator.

This invention is a control means for a trunk outgoing from a private branch exchange to an automatic central office, which trunk is used in completing calls originated by dial subscribers in the branch exchange and arranged to transfer a call to the attendant in case the connection is extended in the central office to a trunk employed in completing toll calls. The control means comprises a three-element gas-filled tube having its control element connected to one of the conductors of the trunk and its anode element connected to the winding of a transfer relay. On calls other than toll calls, the potential impressed upon the control element of the tube is insufficient to cause its operation but on toll calls the tube responds to a momentary connection of a high potential to effect the transfer of the call to the attendant.

A feature of the invention is a toll trunk and associated control apparatus so arranged that a high potential battery is normally connected to one of the conductors of the trunk to indicate that it is a toll trunk, the high potential battery being disconnected immediately after seizure of the trunk.

One system arranged in accordance with this invention is represented schematically in the drawing which forms a part of this specification. The invention is not, however, limited in its application to this particular system but may be applied to all automatic and semi-automatic systems in which the service to which some of the subscribers are entitled is restricted in some manner, such for instance as being restricted to local service.

Referring to the drawings:—

Fig. 1 represents a private branch exchange BO and

Fig. 2 represents a central office CO.

In Fig. 1, A and B represent stations in the private branch exchange, LF1 represents a line-finder switch, SC represents a selector-connector switch, T1 represents apparatus associated with an outgoing trunk 50 which connects the branch office BO with the central office CO, T2 represents apparatus associated with a local trunk 40 leading to an attendant's position, and CD1 represents a cord at the attendant's position.

In Fig. 2, C and D represent stations in the main office, LF2 represents a line-finder switch, S1 represents a selector switch, C1 represents a connector switch, T3 represents apparatus associated with a trunk 65 leading to a toll operator's position, and CD2 represents a cord at the toll operator's position.

Each of the stations A, B, C and D is of the type usually employed in automatic telephone systems and includes a dial or other impulse sender for use in securing connections with other stations in the system.

The line-finder switches LF1 and LF2, the selector-connector switch SC, the selector switch S1, and the connector switch C1 are all of the well-known Strowger type. For a complete description of the structure of a Strowger type switch and the operation of a system employing such switches reference may be had to Chapter III of the second edition of "Automatic Telephony", by Smith and Campbell, published in 1921. For a description of the operation of a Strowger type switch when used as a line finder, reference may be had to Patent No. 1,799,654 granted to R. L. Stokely April 7, 1931. For a description of the operation of a Strowger type switch when used as a selector-connector in a branch exchange reference may be had to Patent No. 1,675,886 granted to A. E. Hague July 3, 1928.

The out-going trunk apparatus T1 associated with trunk 50 comprises a line relay 31, release relay 32, supervisory relay 33, auxiliary supervisory relay 34, cut-through relay 35, holding relay 36, transfer relay 38, and the three-element cold-cathode tube 39. The control element of tube 39 is permanently connected to the tip conductor of trunk 50, the tube being adapted to be operatively responsive only to the connection of a high positive potential to this conductor which condition results if the connection is extended to a toll operator's position. The break-down of the tube 39 causes the operation of transfer relay 38 thereby transferring the connection from trunk 50 to trunk 40 leading to the attendant's position.

The apparatus T2 associated with the trunk 40 leading to the attendant's position comprises a line relay 41, release relay 42, lamp 43, cut-off relay 44 and answering jack 45.

The trunk apparatus T3, associated with the trunk 65 which terminates at a toll operator's position, comprises a line relay 71, release relay 72, auxiliary line relay 73, lamp 74, cut-off relay 80 and answering jack 81. To serve notice that the trunk T3 is a toll trunk, the tip conductor is normally connected to a high positive potential

source 75, which potential is effective, in case the call is from a branch office station, to cause the transfer of the call to an intercepting operator's position.

5 Upon origination of a call at station A in the branch exchange, the line-finder switch LF1 (or a similar switch) is operated to find and connect the calling line to a selector-connector switch such as SC which has access both to
10 branch office lines and to trunks leading to the central office. If the number of lines in the branch office were large enough both selector switches and connector switches would be provided, instead of selector-connector switches,
15 for use in completing calls between stations in the branch office; and in this case, the trunks to the main office would be connected to terminals in the banks of the selector switches. The selector-connector SC is operated in response to dial impulses created by the dialing
20 of the first digit of the number of the called station to select a corresponding group of terminals, and, if the called station is in the branch office, is thereupon operated in response to dial impulses
25 created by the dialing of the second digit of the number of the called station to select the set of terminals to which the called station is connected. If the called station is in or beyond the main office, the selector-connector is operated in
30 response to dial impulses created by the dialing of the first digit of the number of the called station to select a group of terminals connected to trunks leading to the main office and to seize an idle trunk in this group.
35 Assuming the calling line 10 to have been extended through brushes 11 and 12 of line-finder switch LF1 and brushes 21 and 22 of selector-connector switch SC to conductors 27 and 28 of trunk apparatus T1, the line relay 31 operates.
40 Relay 31 closes a circuit for operating release relay 32; and relay 32 connects ground to sleeve conductor 29 to hold the selector-connector and line-finder switches and to hold the cut-off relay (not shown) of line 10 all in well-known manner.
45 The operation of relay 31 disconnects the winding of holding relay 36 from the upper conductor of trunk 50, and connects ground at the back contact of relay 34, through resistance 37, the inner left front contact of relay 31, winding of
50 supervisory relay 33 and uppermost back contact of relay 38 to the upper conductor of trunk 50. Since the line relay 51, associated with trunk 50 in the main office, is connected only to the lower conductor of trunk 50, this connection of ground
55 to the upper conductor of trunk 50 is without effect. Relay 31 also closes a circuit from ground at the back contact of relay 34, through resistance 37, the right front contact of relay 31, inner upper back contact of relay 38, over the lower conductor of trunk 50 to the main office, through the
60 back contact of cut-off relay 52 and the winding of line relay 51 to battery. Relay 51 is thereby operated to cause an idle line-finder, which is assumed to be finder LF2, to hunt for and seize
65 the terminals to which the conductors of trunk 50 are connected, in well-known manner. The cut-off relay 52 is operated when the line is found and the conductors of trunk 50 are connected in usual manner to the windings of the line relay (not shown) of the first selector switch S1. A
70 circuit is thereupon completed from battery through one winding of the line relay of selector S1 through brush 54 and terminal of line-finder LF2, over the lower conductor of trunk 50, inner
75 upper back contact of relay 38, right front con-

tact and inner left front contact of relay 31, winding of relay 33, uppermost back contact of relay 38, upper conductor of trunk 50, terminal and brush 53 of line-finder LF2, and through
5 another winding of the line relay of selector S1 to ground. Resistance 37 is high enough so that relay 33 is sufficiently energized to cause its operation. Relay 33 closes a circuit for operating the slow-to-release relay 34 thereby disconnecting the conductors of trunk T from ground at
10 the back contact of relay 34. The operation of the line relay of the selector S1 in the circuit over trunk 50 causes the connection of a holding ground potential to the sleeve conductor of the line-finder LF2 in usual manner to hold the line-finder in operated position and to hold the cut-off relay 52.
15

The aforementioned operation of relay 34 also closes a circuit for operating relay 35. Relay 35 disconnects the line relay 31 and extends the connection from line 10, over conductors 27 and 28,
20 through the uppermost and inner upper front contacts of relay 35, and through the upper back contacts of relay 38 over the conductors of trunk 50, through brushes 53 and 54 of line finder LF2
25 to the windings of the line relay (not shown) of selector switch S1. The operation of relay 35 causes the release of relay 31 but holds relay 32. Resistance 30 is connected in parallel with the winding of relay 33 and in series with conductor 27 but relay 33 remains operated. Dial tone is transmitted from selector S1 to the calling station in usual manner and in response to the impulses
30 created by the dialing of the next digit the selector S1 is operated to select a corresponding group of terminals and to select and seize an idle set of terminals in this group. Since relay 34 is slow in releasing, the response of relay 33 to dial impulses does not cause the release of the connection. If the call is for a subscriber's station D in the main office, the call is completed in
40 response to the dialing of the remaining digits of the called subscriber's number by the operation of intermediate selectors, if any, and a connector switch C1. Relay 38 of trunk apparatus T1 remains normal since no potential high enough to break down tube 39 is connected to the tip conductor of trunk 50 on such a call.
45

If in response to the dialing of the second digit, the switch S1 selects a trunk 65 leading to a toll operator's position, the lower conductor of trunk 50 is connected through brushes 54 and 62 of switches LF2 and S1, the uppermost back contact of relay 80, resistance 79 and the right winding of relay 71 to battery; and the upper conductor of trunk 50 is connected through brushes 53 and
55 61 of switches LF2 and S1, the inner back contact of relay 80, left winding of relay 71, and through the back contact of relay 73 to booster-battery 75. Relay 71 is thereby operated and relay 33 held operated by the current over trunk 50. Relay 71 closes a circuit for operating relay 73 and relay 73 connects ground potential to the left winding of relay 71 in place of the booster battery 75. During the short interval of time
65 that booster battery potential remains connected to the upper conductor of trunk 50 after seizure of trunk 65, a current is started across the gap between elements b and c of tube 39 of trunk apparatus T1. The ionization of the gas in tube 39 by this current reduces the resistance between elements a and c so as to cause the operation of relay 38 by a current through its winding, across elements a and c, over the upper conductor of trunk 50 to the booster-battery in trunk appara-
70 75

tus T3. Relay 38 operates and locks through its lower front contact to holding ground potential at the front contact of relay 32. The disconnection of the booster battery potential by the operation of relay 73 causes the deenergization of tube 39. The aforementioned operation of relay 71 also closes a circuit for operating the slow-to-release relay 72 which connects holding ground potential to conductor 69 to hold the line finder and selector switches LF2 and S1 and to hold the cut-off relay 52. The aforementioned operation of relay 73 also closes a circuit for lighting the answering lamp 74. Due to the operation of relay 38 of apparatus T1, the bridge across the conductors of trunk 50 is opened and relay 71 releases. The release of relay 71 causes the release of relays 72 and 73 and the lamp 74 is thereby immediately extinguished to prevent the answer of the call by a toll operator. The release of relay 72 disconnects the holding ground potential from conductor 69 thereby releasing the cut-off relay 52 and causing the return of switches LF2 and S1 to normal in usual manner.

The aforementioned operation of relay 38 extends the connection from the calling line over trunk 40 to trunk apparatus T2 at an intercepting operator's position, the line relay 41 being operated by current through its windings in series with the line 10. Relay 41 closes a circuit for lighting the answering lamp 43 and a circuit for operating the slow-to-release relay 42.

When the intercepting operator answers the call by inserting the plug 47 of a cord CD1 in the answering jack 45, relay 44 operates cutting off line relay 41 and closing a holding circuit for relay 42. The release of relay 41 extinguishes lamp 43. Since relay 42 connects holding ground potential to conductor 29, the connection is now held under the joint control of the operator and subscriber. The operation of key 49 completes a talking connection between the calling station and the operator's telephone set.

When the plug 47 is withdrawn from jack 45, relays 44 and 42 release; and, when the receiver 45 is replaced at station A, relays 33, 34, 35, and 32 release. With both of relays 32 and 42 released, the holding ground potential is disconnected from conductor 29, the switches LF1 and SC being restored to normal in usual manner.

If the trunk 65 is selected by switch S1 on a call originated at a subscriber's station C in the main office, the temporary connection of booster battery 75 through the left winding of relay 71 to the calling line is without effect. The operation of relay 71 in series with the calling line, causes the operation of relays 72 and 73. Relay 72 connects holding ground potential to conductor 69 and relay 73 lights the answering lamp 74. Relay 73 also short-circuits resistance 79 and connects the ringing generator 76 through condenser 77 to one of the conductors of trunk 65 to transmit a ringing tone to the calling station.

When the toll operator answers the call by inserting the plug 82 of a cord CD2 in jack 81, relay 80 of apparatus T3 operates in series with a relay 83 of the cord. Relay 80 cuts off the line relay 71 and closes a circuit for holding relay 72. Relay 83 completes a connection from the calling line over the conductors of trunk 65, jack 81 and plug 82 to the windings of repeating coil 84. Operation of the key 85 completes a talking connection between the calling subscriber and the toll operator.

Upon removal of plug 82 from jack 81, relay 80 releases and, if the calling subscriber has re-

placed the receiver, relay 71 cannot reoperate. The release of relay 72 disconnects holding ground potential from conductor 69, the line finder and selector switches LF2 and S1 being restored to normal in usual manner.

The arrangement might be modified or incorporated in a system in which the trunk 65 is connected to terminals of intermediate selectors instead of to terminals in the banks of first selectors as shown. In such a case the dialing of more than one digit would be required to select a trunk in the group which includes the trunk 65. The invention may, of course, also be applied to systems in which toll calls are automatically completed. In such a system the trunks employed in extending calls outside of the local zone would be provided with a booster battery connection as is the trunk apparatus T3 by which the completion of the connection would be prevented and a call from a branch office be diverted to an intercepting operator's position.

What is claimed is:

1. In a telephone system comprising a branch exchange and an automatic main exchange and subscribers' lines in each of said exchanges, an attendant's equipment at said branch exchange, a trunk between said branch and main exchanges, another trunk for use in completing a toll call, signal responsive means individual to said first mentioned trunk for transferring a call originating in said branch office from said trunk to said attendant's equipment, and means associated with said other trunk and momentarily operable in response to seizure of said other trunk for transmitting a signal to operate said signal responsive means.

2. In a telephone system comprising a branch exchange and an automatic central exchange and subscribers' lines in each of said exchanges, an attendant's equipment at said branch exchange, a trunk between said exchanges, and means comprising a three-element gas-filled tube associated with said trunk for transferring a call originating in said branch exchange from said trunk to said attendant's equipment.

3. In a telephone system comprising a branch exchange and an automatic central exchange and subscribers' lines in each of said exchanges, an attendant's equipment at said branch exchange, a trunk between said exchanges, another trunk for use in completing a toll call, means comprising a three-element gas-filled tube associated with said first mentioned trunk for transferring a call originating in said branch exchange from said first mentioned trunk to said attendant's equipment, and means associated with, and operable responsive to the seizure of, said other trunk for momentarily connecting to said trunk a potential high enough to cause the operation of said gas-filled tube.

4. In an automatic telephone system, a branch office, a main office, subscribers' lines in each of said offices, a trunk for use in connecting a calling line in said branch office to said main office, a toll operator's position, a trunk extending from said main office to said position, a high potential source of current normally connected to a conductor of said toll trunk, switching means for seizing said toll trunk and connecting a calling line in said main office or said trunk from the branch office to said toll trunk, and means operatively responsive to seizure of the toll trunk for disconnecting said high potential source.

5. In a telephone system comprising a branch

exchange and an automatic main exchange and subscribers' lines in each of said exchanges, an attendant's equipment at said branch exchange, a trunk between said branch and main ex-
5 changes, another trunk for use in completing a toll call, signal responsive means individual to said first-mentioned trunk for transferring a call originating in said branch office from said trunk to said attendant's equipment, and means
10 effective upon seizure of said other trunk for transmitting a signal to operate said signal responsive means.

6. In a telephone system comprising a branch exchange and an automatic central exchange and
15 subscribers' lines in each of said exchanges, a trunk from the branch to the central exchange, subscriber controlled switching means for con-

necting a calling line over said trunk to said central exchange, a trunk outgoing from said central exchange for use in completing calls originating in either of said exchanges, subscriber controlled switching means for use in connecting
5 either a calling line in said central exchange or the first-mentioned trunk to the second-mentioned trunk, an intercepting operator's position, means comprising a switching relay for
10 transferring a calling line in said branch exchange from connection with said first trunk to said intercepting operator's position, and signaling means immediately effective upon intercon-
15 nection of said first and second trunks for operating said switching relay.

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