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SEMI-AUTOMATIC TELEPHONE SYSTEM.

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2 SHEETS—SHEET 1.

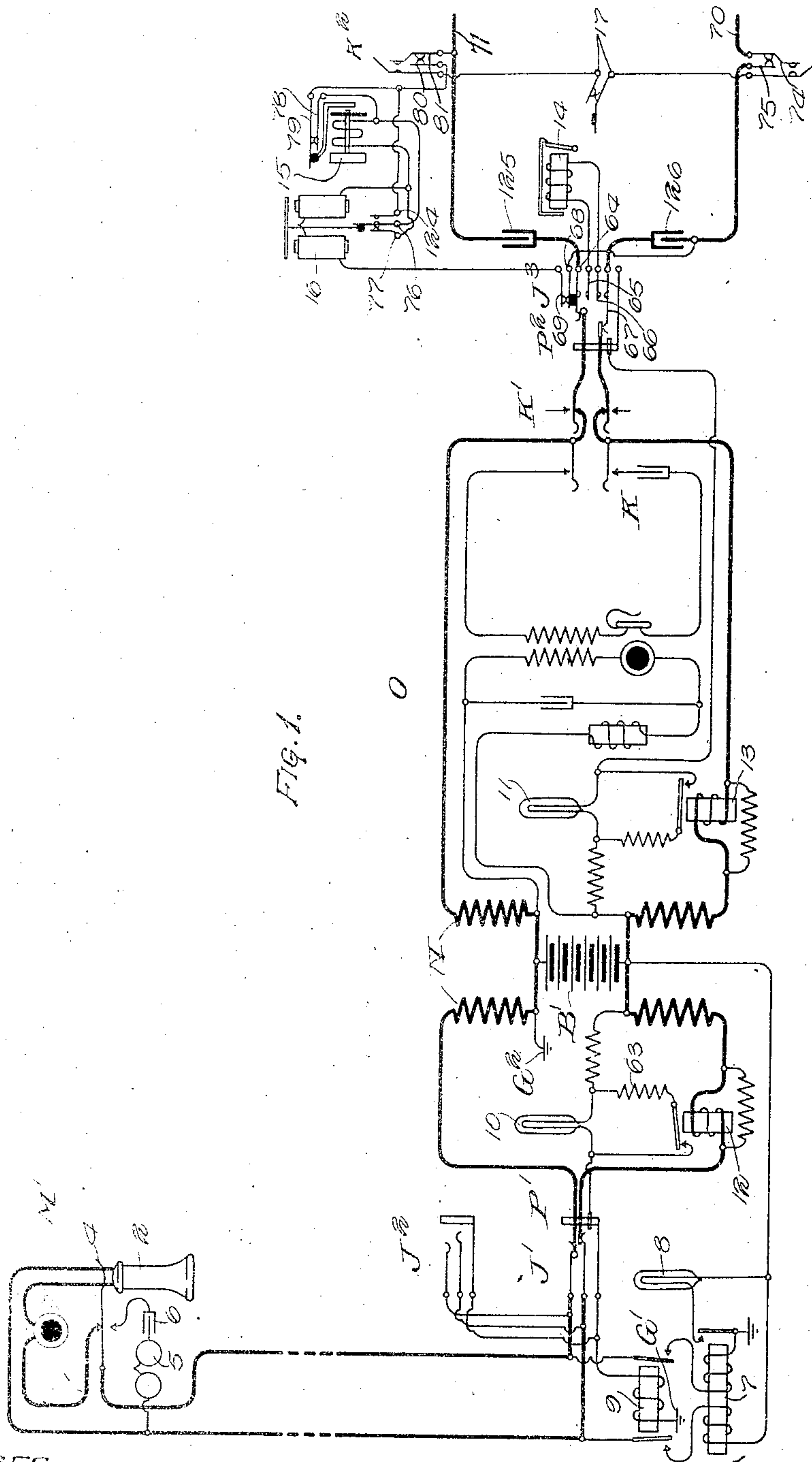


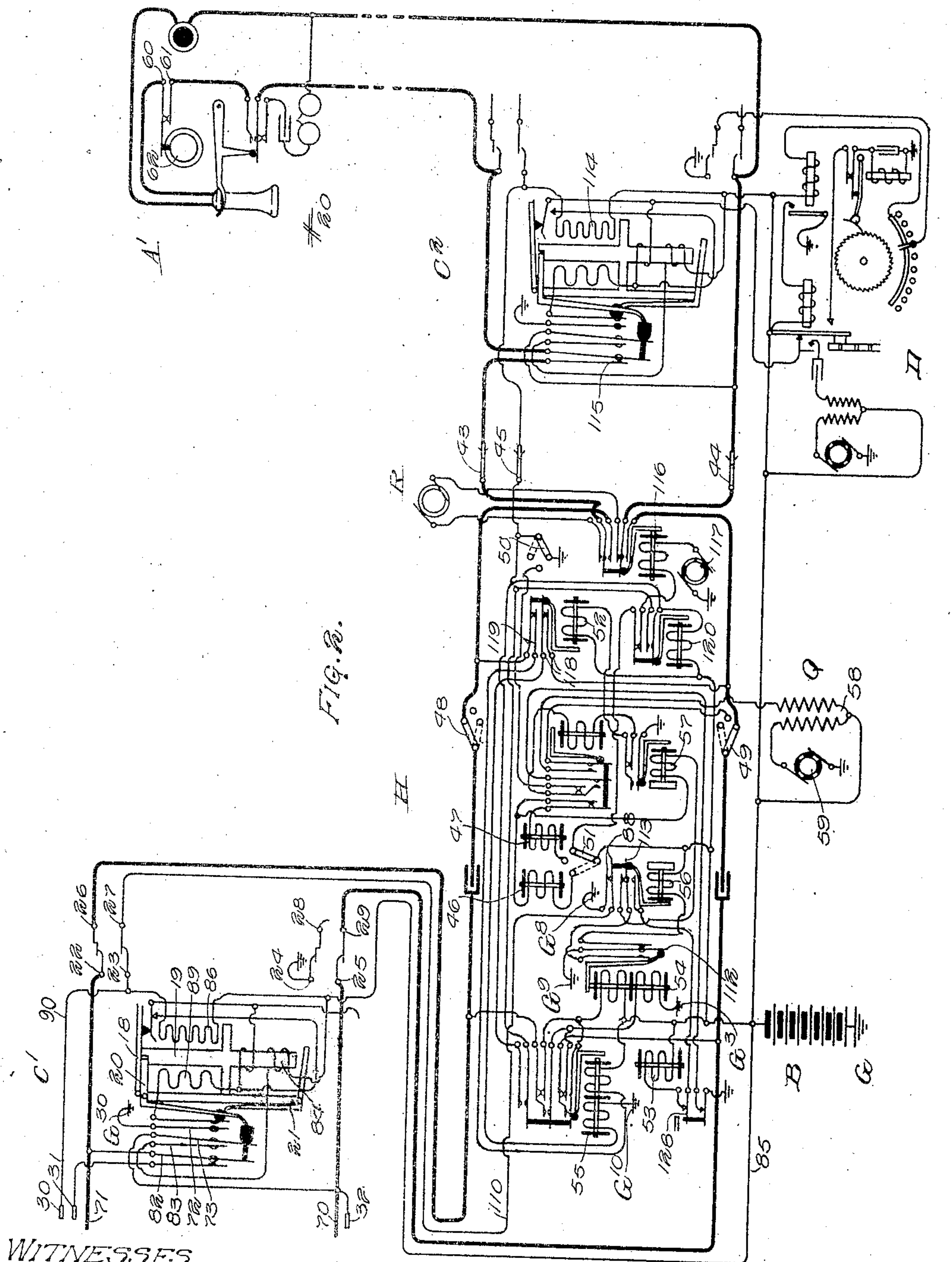
Fig. 1.

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SEMI-AUTOMATIC TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, MICHAEL SCHWARTZ, a citizen of the United States of America, and resident of Los Angeles, Los Angeles county, California, have invented certain new and useful Improvements in Semi-Automatic Telephone Systems, of which the following is a specification.

My invention relates to improvements in semi-automatic telephone systems, and more particularly to a private branch exchange system—that is, a system in which small manual private branch exchanges are employed in connection with automatic or semi-automatic systems.

Ordinarily in such systems the release of the connection from a calling subscriber of a private branch exchange to the main exchange is controlled by the operator at the private branch exchange. Since in smaller exchanges the operator generally has other duties to perform than attend to the switchboard, she does not always promptly respond to the disconnect signals, and consequently the line of the called subscriber may be tied up for a considerable time after the subscribers have signaled for a disconnection.

Connector switches which may be released by the called subscriber have heretofore been devised, but they are open to certain objections. Accordingly the object of my invention is to provide means whereby the ordinary form of connector switch which is released by the calling subscriber can be employed in these private branch exchange systems, and when so used are released by the called subscriber hanging up his receiver—that is, when these connector switches are employed for establishing a connection between two lines, in which connection no private branch exchange is involved, then the connector is released in the ordinary way by the calling subscriber hanging up his receiver. When, however, a call is made through a private branch exchange, then it is not necessary to wait for the exchange operator to release the connection, but the connection is released immediately upon the called subscriber hanging up his receiver.

My invention will be more clearly understood by reference to the accompanying drawings, in which I have illustrated my invention in connection with a semi-auto-

matic telephone system of a particular type. I have there indicated a private branch exchange consisting of a cord circuit of a well-known type, with a trunk line extending to a main automatic exchange, in which automatic exchange I have indicated an automatic connector switch in which the trunk line terminates. This connector switch is adapted to make connection directly with the called subscriber's line. As ordinarily constructed, this connector switch has access to but one hundred subscribers, and it will, of course, be understood that where larger exchanges are employed the ordinary method of interposing first and second selectors between the connector switch and the trunk line extending to the private branch exchange will be employed. The manner in which these switches are interposed in the trunk line and their operation are well understood in the art, and as they form no part of my present invention, it is not thought necessary to illustrate the same.

Figures 1 and 2 represent a complete connection between a calling manual telephone M' and a called automatic telephone A' in said system.

The telephone M' (Fig. 1) is an ordinary manual telephone comprising a receiver 2, transmitter 3, switch-hook 4, ringer 5 and condenser 6. At the central office the line of the telephone M' is equipped with the usual line relay 7, line lamp 8, cut-off relay 9, answering jack J' and the calling or multiple jack J². The cord circuit O is a well-known type of cord circuit comprising the usual answering and calling plugs P' and P² inductively connected together through the medium of an impedance coil N. The cord is also equipped with the usual answering and calling supervisory lamps 10 and 11 and the answering and calling supervisory relays 12 and 13. At K there is shown the usual listening key and at K' a ringing key is shown. The trunk line connecting the manual switchboard with the automatic exchange extends from the jack J³ (Fig. 1) to the connector H (Fig. 2). The drop 14 is normally bridged across the trunk at the jack J³ for use when a call is extended from the main to the branch exchange. At the manual switchboard the trunk is also provided with a slow acting neutral relay 15 and a polarized

relay 16. An automatic call-sending device 17 is also provided, through the medium of which the operator may control the switches at the automatic exchange in order to establish the desired connection. This calling device may be of any desired type, such, for example, as that shown in British patent to S. G. S. Dicker No. 29,654 of 1910, and is herein represented simply by a pair of impulse springs 17.

The switch C' (Fig. 2) is of the general type of subscribers' individual switch shown in British patent to R. W. James No. 26,301 of 1906, more closely resembling, however, the particular type shown in British patent to T. G. Martin No. 1,419 of 1910. This switch is controlled in the usual manner by a master switch (not shown) which would be similar to the master switch D which controls the line switch C² of the called line, which line switch is similar to the switch C'.

The connector H (Fig. 2) is of the general type of connector switch disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, the circuits, however, being modified in a manner similar to that shown in said British patent to T. G. Martin No. 1,419 of 1910, so as to adapt the switch for operation in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. The connector is provided with a shaft (not shown) carrying the wipers 43, 44 and 45 and is controlled by the vertical magnet 46 and the rotary magnet 47. The usual side switch comprising the wipers 48, 49, 50 and 51 is controlled by the private magnet 52 in a well-known manner. The magnet 53 is the usual release magnet. The line relay 54 is connected with the line through the reversing springs of a so-called back-bridge relay 55 through the windings of which the called telephone is provided with talking current. The relays 56 and 57 are slow acting relays. At R there is shown a ringing current generator for supplying ringing current for signaling the called subscriber. At Q there is shown a busy signaling current generator comprising an induction coil 58 and interrupter 59.

The automatic telephone A' is similar to the manual telephone M' (Fig. 1), with the addition of an automatic call-sending device, which may be of the type shown in British Patent No. 29,654 of 1910, previously referred to, and is represented diagrammatically by a pair of impulse springs 60 and 61 and an impulse wheel 62.

For the purpose of supplying current for operating the central office apparatus and for talking purposes, there is shown in the drawings a plurality of batteries having

one terminal grounded. There need be in practice, however, only one such battery, or preferably one battery for each exchange.

A general description of the apparatus having been given, it will now be explained how connection may be extended from the manual telephone M' to the automatic telephone A', and how said connection may be released by the hanging up of the receiver at the called telephone. Since the automatic switching apparatus disclosed herein is in general well known in the art, and is described in the publications herein referred to, its operation will be explained in a more or less general manner. Upon the removal of the receiver from the switch hook at the substation M' preparatory to making a call, the talking conductors are closed, whereby the line relay 7 is energized to close the circuit of the line lamp 8 to signal the operator. The operator responds by inserting the plug P' into the jack J', operates the key K to connect her talking set with the line and inquires the number of the line desired. Upon the insertion of the plug P' into the jack J', a circuit is closed from ground G' through the cut-off relay 9, thence through the plug and jack and the lamp 10 to battery B'. The relay 9, upon energizing, disconnects the line relay 7 from the line, after which the calling telephone is provided with talking current over a circuit extending from ground G² through one winding of the repeating coil N in the cord, thence over the heavy conductors to and through the substation M' and back over the other side of the line, through the relay 12 and the second winding of the repeating coil to the non-grounded terminal of battery B'. The relay 12, upon energizing, closes a shunt around the lamp 10 through the resistance 63, thereby shunting enough current away from said lamp to prevent it from glowing. After learning that a subscriber of the automatic exchange is desired, the operator restores the key K to its normal position and inserts the plug P² into the jack J² of the trunk leading to the automatic exchange. Upon the insertion of the plug into the jack, the springs 64 and 67 are separated from the springs 65 and 66 to disconnect the drop 14 from the trunk, while at the same time the springs 68 and 69 are forced into contact to close a bridge across the trunk conductors 70 and 71 through the relay 16. Upon the closure of this bridge, an energizing circuit is closed extending from ground G³⁰ (Fig. 2), through the springs 72 and 73, trunk conductor 70, key springs 74 and 75, springs 68 and 69, relay 16, springs 77, 76, 78, 79, 80 and 81, conductor 71, springs 82 and 83 at the switch C' and the line relay winding 84 to the battery lead 85. The current flowing through the relay 16 (Fig. 1) at this time is in the

proper direction to maintain the contact of springs 76 and 77 closed, while the relay 15 is short-circuited by the circuit passing through the springs 76 and 77. The relay winding 84 (Fig. 2), upon energizing, attracts the armature 21 to close the circuit of the operating winding 89, which attracts the plunger arm 18 to extend the connection through the bank springs to the connector H and the cut-off armature 20 to disconnect the line relay from the line. Before the armature 21 drops back to open the circuit of the operating winding 89 after the line winding 84 is disconnected from the line, the holding winding 86 is energized in the following manner to hold the switch in its operated position. When the connection is extended to the connector H through the springs 22 and 26 and 25 and 29 by the operation of the switch C', the line relay 54 is energized by reason of the closed bridge across the trunk through the relay 16 (Fig. 1). The relay 54, upon energizing, closes the circuit of the relay 56, which, by forcing the springs 88 into contact, completes a circuit extending from ground G⁸ through said springs and through the line switch bank springs 27 and 23 and the winding 86 to the battery B. The energization of this winding serves to hold the plunger arm and cut-off armature in their operated positions after the winding 89 is deenergized. A guarding potential is also extended from ground G⁸ at the connector through the springs 88, 27 and 23 and over the conductor 90 to the connector private bank contacts 30 in the bank of each connector which has access to the trunk line. Upon the closure of the springs 24 and 28 of the switch C', the master switch operates in a well-known manner to move the plungers of the idle switches of the group to a position opposite the terminal of an idle trunk line. The operator now operates the key K² (Fig. 1) to open the bridge across the trunk through the relay 16 and substitute therefor a bridge through the springs 17 of her calling device. She now operates said calling device for the respective digits of the number of the called substation, which will be assumed to be 20. Upon the operation of the calling device for the first digit 2, the impulse springs 17 (Fig. 1) are separated twice momentarily, each time breaking the circuit of the line relay 54 of the connector H. The relay 56 of the connector being slow acting does not deenergize during the momentary interruptions of its circuit by the relay 54, and consequently each time the said line relay deenergizes in response to said impulses, an impulse is transmitted over the circuit extending from ground G⁹ through the spring 112 and its back contact, spring 113, and its front contact, relay 57, vertical magnet 46 and the side switch wiper 51 to the bat-

tery lead 85. The magnet 46 operates in response to the two impulses received over this circuit to raise the switch shaft two steps, while the slow acting relay 57 is energized to close the circuit of the private magnet 52 and to maintain it closed continuously until after the last impulse for the digit is transmitted. After the last impulse is transmitted, the relay 57 deenergizes and opens the circuit of the private magnet 52, which, upon deenergizing, permits the side switch to pass from first to second position in a well-known manner. The movement of the side switch wiper 51 from first to second position transfers the battery connection from the vertical magnet 46 to the rotary magnet 47. The operator now operates the calling device for the last digit O, whereby a series of ten impulses is transmitted through the rotary magnet 47 in series with the relay 57, whereby the shaft wipers are rotated onto the contacts of the desired line. The relay 57 operates in response to the impulses for this digit to again close the circuit of the private magnet 52. When the relay 57 deenergizes after the last impulse for the last digit is transmitted, the private magnet 52 deenergizes also, if the called line is idle, and permits the side switch to advance from second to third position, whereby, through the medium of the side switch wipers 48 and 49, the connection is completed through the shaft wipers 43 and 44 to the called line. The side switch wiper 50, upon passing to third position, provides a guarding potential for the connector private bank contacts of the called line and energizes the cut-off winding 114 of the switch C² to disconnect said switch from the line and close the contact 115 in the talking circuit. The side switch wiper 51 of the connector, upon passing to third position, closes the circuit of the ringing relay 116 through the interrupter 117. The relay 116 thereupon begins to operate to intermittently connect the ringing current generator R with the called line to ring the called subscriber.

After completing the call the operator restores the key K² (Fig. 1) to its normal position, thereby disconnecting the calling device from the trunk line and again bridging the relay 16 across the trunk, whereupon the relay 16 again receives current, which, however, is still of the proper direction to maintain the springs 77 and 76 closed.

When the called subscriber responds to the call by removing his receiver, the called substation is provided with talking current over the circuit extending from ground G¹⁰ at the connector through the back-bridge relay 55, contact of springs 118 of the private magnet 52, thence over the heavy conductors to and through the substation A' and back over the other side of the line,

through the private magnet springs 119 and the other winding of the relay 55 to the battery lead 85. The relay 55, upon energizing, closes the circuit of the ringing cut-off relay 120, which causes the circuit of the ringing relay 116 to be broken. A further result of the energization of the relay 55 is the transposition of the connections of the windings of the line relay 54 with regard to the line conductors, whereby the direction of the current in the calling line is reversed. By this transposition the current in the polarized relay 16 (Fig. 1) is reversed, whereby said relay is operated to shift the spring 76 out of engagement with the spring 77 and into engagement with the spring 124. This shifting of the spring 76 removes the short-circuit from the relay 15 and includes said relay in the bridge across the conductors 71 and 70 in series with the relay 16, which bridge may now be traced from the conductor 71, through the springs 81, 80, 124 and 76, relays 15 and 16 and the springs 69, 68, 75 and 74 to the conductor 70. This bridge is also independent of the springs 78 and 79, which are now separated by the energization of the relay 15. This is the condition of the apparatus during conversation—that is, the relays 16 and 15 are both bridged across the trunk conductors 70 and 71 and the springs 78 and 79 of the relay 15 are opened. The condensers 125 and 126 prevent the passage of direct current from the trunk to the cord and vice versa.

Upon the termination of the conversation, the automatic part of the connection is immediately released by the hanging up of the receiver at the called substation. This is accomplished as follows: When the receiver is restored to the switchhook at the substation A', the circuit of the connector back-bridge relay 55 is broken, which relay restores the current flowing back from the connector switch to the operator's trunk circuit to its normal direction. The polarized relay 16 (Fig. 1) thereupon reverses the position of its armature, whereby the bridge across the trunk is opened by the separation of the springs 76 and 124, owing to the fact that the springs 78 and 79 of the relay 15 are for the time being separated. The relay 15 being slow acting maintains the bridge across the trunk open at these springs for an appreciable length of time before it finally deenergizes and permits the springs 78 and 79 to come into contact. The relay 15 is rendered doubly slow acting on account of its winding being short-circuited at the springs 76 and 77. The opening of the bridge across the trunk conductors 71 and 70 by the relay 16, as above described, breaks the energizing circuit of the connector line relay 54 (Fig. 2), which consequently deenergizes and the relay 15 maintains said circuit open long enough to permit the slow acting relay 56

of the connector to deenergize. The relay 56, upon deenergizing, destroys the holding circuit of the winding 86 of the switch C' and closes the circuit of its own release magnet 53. This latter circuit extends from ground G^o through the spring 112 and its back contact, spring 113 and its back contact, shaft-controlled contact 128 and the magnet 53 to the battery lead 85. The magnet 53, upon energizing, immediately restores the connector switch to its normal position and its own circuit is interrupted at the contact 128 when the shaft reaches its lowest position. The switch C' restores to normal position upon the deenergization of its holding winding 86. This switch will again be operated, however, when the relay 15 (Fig. 1) finally deenergizes to again complete the bridge across the trunk conductors 71 and 70, if in the meantime the operator has not removed the plug P² from the jack J². When the plug is withdrawn from the jack, the bridge across the conductors 71 and 70 is permanently broken at the springs 68 and 69, and the switch C' finally restores to its normal position.

When the calling subscriber hangs up his receiver, the relay 12 deenergizes and removes the shunt around the lamp 10, whereby said lamp glows to give the operator a disconnect signal, whereupon the plugs P' and P² are removed from the jacks. If the plug P² is removed from the jack J² before the called subscriber hangs up his receiver, the breaking of the bridge across the trunk at the springs 68 and 69 will cause the line relay of the connector to deenergize and release the automatic switches in the same manner as when the trunk is opened by the relays 16 and 15.

As has been mentioned before, the trunk leading from the automatic exchange to the manual switchboard may be used as well for extending calls to the manual switchboard as from it. For example, it is evident that any subscriber of the automatic system may operate the switches of said system to obtain connection with the connector bank terminals 30, 31 and 32 in the same manner in which connection was obtained with the terminals of the line A' by the connector H, and that the ringing current passing over the trunk will operate the drop 14 (Fig. 1) to signal the operator. Through the medium of the cord O, the operator may then complete connection to the trunk and any one of the called manual subscribers desired.

It will thus be seen that I have devised a very efficient and simple arrangement for use in private branch exchange systems in which mechanism is provided in the trunk extending from the exchange which enables the release of the automatic switches at the main exchange to be placed under the con-

trol of the called subscriber, which control is independent of any action on the part of the operator at the private branch exchange. Thus it will be seen that the connection will be released either by the operator taking down the connection, or, if she should neglect to take down this connection, the act of the called subscriber hanging up his receiver releases the automatic switches and thus prevents the called subscriber's line from being tied up.

While I have illustrated and described my invention in connection with automatic apparatus of a particular type, it will, of course, be understood that my invention is not limited to such use, but that it is adapted for use in connection with other forms of automatic apparatus.

What I claim as my invention is:—

1. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, a trunk for extending a connection to said switch, inductive means separating the calling side of the trunk from the called line, and means in the calling side of said trunk controlled by the called subscriber for releasing said switch.

2. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, means including a trunk for extending a connection to said switch, inductive means separating the calling side of the trunk from the called line, a bridge across the calling side of said trunk, and means controlled by the called subscriber for controlling said bridge to release said switch.

3. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, means including a trunk for extending a connection to said switch, inductive means separating the calling side of the trunk from the called line, a bridge across the calling side of said trunk, and means controlled by the called subscriber hanging up his receiver for controlling said bridge to release said switch.

4. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, means including a trunk for extending a connection to said switch, means controlled by the called subscriber for reversing the current in said trunk, and means in said trunk responsive to said reversal of current for controlling the release of said switch.

5. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, means including a trunk line for extending a connection to said switch, inductive means separating the calling side of the trunk from the called line, a bridge across the calling

side of said trunk, means controlled by the called subscriber for opening said bridge, and means controlled by the opening of said bridge to release said switch.

6. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, means including a trunk line for extending a connection to said switch, a bridge across said trunk, means controlled by the called subscriber for reversing the flow of current in said trunk, means controlled by said reversal of current for opening said bridge, and means controlled by the opening of said bridge to release said switch.

7. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, means including a trunk line for extending a connection to said switch, a bridge across said trunk, a back-bridge relay in said connector, means controlled by the called subscriber hanging up his receiver for deenergizing said back-bridge relay, means controlled by the deenergization of said relay for opening said bridge, and means controlled by the opening of said bridge to release said switch.

8. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, means including a trunk line for extending a connection to said switch, a bridge across said trunk, a back-bridge relay in said connector, means controlled by the called subscriber hanging up his receiver for deenergizing said back-bridge relay, means controlled by the deenergization of said relay for reversing the current in said trunk, means controlled by said reversal of current for opening said bridge, and means controlled by the opening of said bridge to release said switch.

9. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with one of said lines, means including a trunk line for extending a connection to said switch, inductive means separating the calling side of the trunk from the called line, a bridge across the calling side of said trunk, means controlled by the called subscriber for temporarily opening said bridge, and means controlled by the opening of said bridge to release said switch.

10. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with one of said lines, means including a trunk line for extending a connection to said switch, a bridge across said trunk, means controlled by the called subscriber for reversing the current in said trunk, means controlled by said reversal of current for temporarily opening said bridge, and means controlled

by the opening of said bridge for releasing said switch.

11. In a telephone system, a plurality of subscribers' lines, means including a connector switch for establishing connection with one of said lines, means including a trunk line for extending a connection to said switch, a bridge including a polarized relay across said trunk, a slow acting relay adapted to be included in said bridge, means controlled by the called subscriber for controlling said relays to momentarily open said bridge, and means controlled by the opening of said bridge to release said switch.

12. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, means including a trunk line for extending a connection from said cord to said switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, inductive means separating the calling side of the trunk from the called line, and means in the calling side of said trunk controlled by the called subscriber for releasing said switch.

13. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, means including a trunk line for extending a connection from said cord to said switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, inductive means separating the calling side of the trunk from the called line, a bridge across the calling side of said trunk, and means controlled by the called subscriber for controlling said bridge to release said switch.

14. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, means including a trunk line for extending a connection from said cord to said switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, means controlled by the called subscriber for reversing the current in said trunk, and means in said trunk responsive to said reversal of current for controlling the release of said switch.

15. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, means including a trunk line for extending a connection from said cord to said switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, inductive means separating the calling side of the trunk from the called line, a bridge across the calling side of said trunk, means controlled by the called subscriber for open-

ing said bridge, and means controlled by the opening of said bridge to release said switch.

16. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, means including a trunk line for extending a connection from said cord to said switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, means controlled by the called subscriber for reversing the flow of current in said trunk, means controlled by said reversal of current for opening said bridge, and means controlled by the opening of said bridge for releasing said switch.

17. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, means including a trunk line for extending a connection from said cord to said switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, inductive means separating the calling side of the trunk from the called line, a bridge across the calling side of said trunk, means controlled by the called subscriber for temporarily opening said bridge, and means controlled by the opening of said bridge to release said switch.

18. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, means including a trunk line for extending a connection from said cord to said switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, means controlled by the called subscriber for reversing the current in said trunk, means controlled by said reversal of current for temporarily opening said bridge, and means controlled by the opening of said bridge for releasing said switch.

19. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch for connecting said trunk with said first switch, and means in said trunk controlled by the called subscriber for releasing said first switch.

20. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, and means controlled by the called subscriber for controlling said bridge to release said first switch.

21. In a telephone system, a plurality of

subscribers' lines, an automatic switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, and means controlled by the called subscriber hanging up his receiver for controlling said bridge to release said first switch.

22. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, means controlled by the called subscriber for reversing the current in said trunk, and means in said trunk responsive to said reversal of current for controlling the release of said first switch.

23. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, means controlled by the called subscriber for opening said bridge, and means controlled by the opening of said bridge to release said first switch.

24. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, means controlled by the called subscriber for reversing the flow of current in said trunk, means controlled by said reversal of current for opening said bridge, and means controlled by the opening of said bridge to release said first switch.

25. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, a back-bridge relay in said connector, means controlled by the called subscriber hanging up his receiver for energizing said back-bridge relay, means controlled by the energization of said relay for opening said bridge, and means controlled by the opening of said bridge to release said first switch.

26. In a telephone system, a plurality of subscribers' lines, a connector switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, a back-bridge re-

lay in said connector, means controlled by the called subscriber hanging up his receiver for energizing said back-bridge relay, means controlled by the energization of said relay for reversing the current in said trunk, means controlled by said reversal of current for opening said bridge, and means controlled by the opening of said bridge to release said first switch.

27. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, means controlled by the called subscriber for temporarily opening said bridge, and means controlled by the opening of said bridge to release said first switch.

28. In a telephone system, a plurality of subscribers' lines, an automatic connector switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge across said trunk, means controlled by the called subscriber for temporarily opening said bridge, means controlled by the called subscriber for reversing the current in said trunk, means controlled by said reversal of current for temporarily opening said bridge, and means controlled by the opening of said bridge for releasing said first switch.

29. In a telephone system, a plurality of subscribers' lines, means including a connector switch for establishing connection with one of said lines, a trunk, a non-numerical automatic switch, means including said trunk and switch for extending connection to said first switch, a bridge including a polarized relay across said trunk, a slow acting relay adapted to be included in said bridge, means controlled by the called subscriber for controlling said relays to momentarily open said bridge, and means controlled by the opening of said bridge to release said first switch.

30. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, a trunk line, a non-numerical switch, means including said trunk line and non-numerical switch for extending connection from said cord to said first switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, and means in said trunk controlled by the called subscriber for releasing said first switch.

31. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, a trunk line, a non-

- numerical switch, means including said trunk line and non-numerical switch for extending connection from said cord to said first switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, a bridge across said trunk, and means controlled by the called subscriber for controlling said bridge to release said first switch.
32. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, a trunk line, a non-numerical switch, means including said trunk line and non-numerical switch for extending connection from said cord to said first switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, means controlled by the called subscriber for reversing the current in said trunk, and means in said trunk responsive to said reversal of current for controlling the release of said first switch.
33. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, a trunk line, a non-numerical switch, means including said trunk line and non-numerical switch for extending connection from said cord to said first switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, a bridge across said trunk, means controlled by the called subscriber for opening said bridge, and means controlled by the opening of said bridge to release said first switch.
34. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, a trunk line, a non-numerical switch, means including said trunk line and non-numerical switch for extending connection from said cord to said first switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, means controlled by the called subscriber for reversing the flow of current in said trunk, means controlled by said reversal of current for opening said bridge, and means controlled by the opening of said bridge for releasing said first switch.
35. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, a trunk line, a non-numerical switch, means including said trunk line and non-numerical switch for extending connection from said cord to said first switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, a bridge across said trunk, means controlled by the
- called subscriber for temporarily opening said bridge, and means controlled by the opening of said bridge to release said first switch.
36. In a telephone system, a plurality of subscribers' lines, a cord circuit adapted to be connected with one of said lines, an automatic connector switch, a trunk line, a non-numerical switch, means including said trunk line and non-numerical switch for extending connection from said cord to said first switch, means in said trunk for controlling the operation of said switch to complete a connection to a called line, means controlled by the called subscriber for reversing the current in said trunk, means controlled by said reversal of current for temporarily opening said bridge, and means controlled by the opening of said bridge for releasing said first switch.
37. In a telephone system, a calling and a called line, means including a trunk line and an automatic switch having vertical and rotary motion controllable over the two sides of said trunk line in series for connecting said lines, and means associated with said trunk line and controllable from the called line for releasing said connection.
38. In a telephone system, a calling and a called line, means including a trunk line and a plurality of automatic switches controllable over the two sides of said trunk line in series for connecting said lines, a bridge across said trunk line to prevent said switches from releasing, and means controlled over the called line for opening said bridge.
39. In a telephone system, two exchanges, a trunk line connecting said exchanges, a calling line in one exchange, a called line in the other exchange, an automatic switch having vertical and rotary motion and having access to said called line, means including said trunk line and said switch for connecting said lines, and means controlled over the connected called line for releasing said connection.
40. In a telephone system, two exchanges, a trunk line connecting said exchanges, a calling line in the first exchange, a called line in the second exchange, an automatic switch for completing connections to the called line having vertical and rotary motion, means including said trunk line and said switch for connecting said lines, and means in the first exchange controlled over the called line for releasing said switch.
41. In a telephone system, a manual exchange, an automatic exchange, a trunk line connecting said exchanges, a calling line in the manual exchange, a called line in the automatic exchange, means including said trunk line and an automatic switch in the automatic exchange for connecting said lines, and means in the manual exchange

controlled over the called line for releasing said switch.

42. In a telephone system, a manual exchange, an automatic exchange, a trunk line connecting said exchanges, a calling line in the manual exchange, a called line in the automatic exchange, means including a cord circuit, said trunk line and an automatic switch for connecting said lines, a bridge across said trunk line to prevent the release of said switch, means controlled by the operator for opening said bridge, and means controlled by the called subscriber for opening said bridge.

43. In a telephone system, a manual exchange, an automatic exchange, a trunk line connecting said exchanges, a calling line in the manual exchange, a called line in the automatic exchange, means including a cord circuit, said trunk line and an automatic switch for connecting said lines, and mechanism associated with said trunk line whereby either the operator at the manual exchange or the called subscriber in the automatic exchange is enabled to restore the said called line to normal condition by releasing the connection.

44. In a telephone system, a calling and a called line, means including a trunk line and an automatic switch having vertical and rotary motion controllable over the two sides of said trunk line in series for connecting said lines, and a relay associated with said trunk line and controllable from the called line for releasing said connection.

45. In a telephone system, a calling and a called line, means including a trunk line and a plurality of automatic switches controllable over the two sides of said trunk line in series for connecting said lines, a bridge across said trunk line to prevent said switches from releasing, and a relay controlled over the called line for opening said bridge.

46. In a telephone system, two exchanges, a trunk line connecting said exchanges, a

calling line in one exchange, a called line in the other exchange, an automatic switch having vertical and rotary motion and having access to said called line, means including said trunk line and said switch for connecting said lines, and a relay controlled over the connected called line for releasing said connection.

47. In a telephone system, two exchanges, a trunk line connecting said exchanges, a calling line in the first exchange, a called line in the second exchange, an automatic switch for completing connections to the called line having vertical and rotary motion, means including said trunk line and said switch for connecting said lines, and a relay in the first exchange controlled over the connected called line for releasing said switch.

48. In a telephone system, a manual exchange, an automatic exchange, a trunk line connecting said exchanges, a calling line in the manual exchange, a called line in the automatic exchange, means including said trunk line and an automatic switch in the automatic exchange for connecting said lines, and a relay in the manual exchange controlled over the called line for releasing said switch.

49. In a telephone system, a plurality of subscribers' lines, an automatic switch for establishing connection with one of said lines, a trunk line including a pair of talking conductors for extending a connection to said switch, inductive means separating the calling side of said trunk line from the called line, a bridge across said talking conductors on the calling side of said trunk line, and means controlled by the called subscriber for controlling said bridge to release said switch.

Signed by me at Chicago, Cook county, Illinois, this 3rd day of November, 1913.

MICHAEL SCHWARTZ.

Witnesses:

HARRY E. HERSHEY,
RAY STOKELY.