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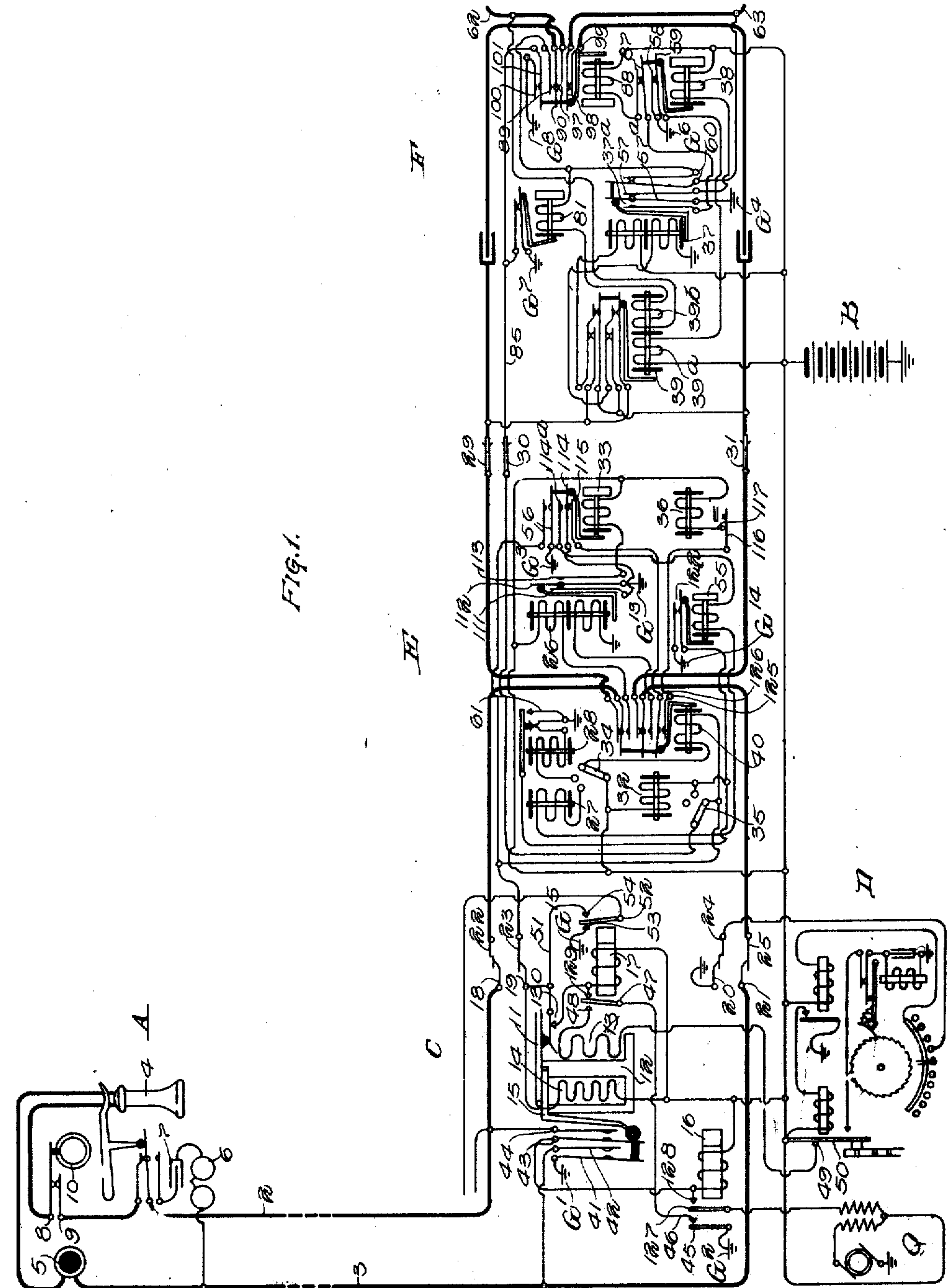
AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED NOV. 28, 1913.

Patented Dec. 19, 1916.

2 SHEETS—SHEET 1.

1,209,293.



WITNESSES

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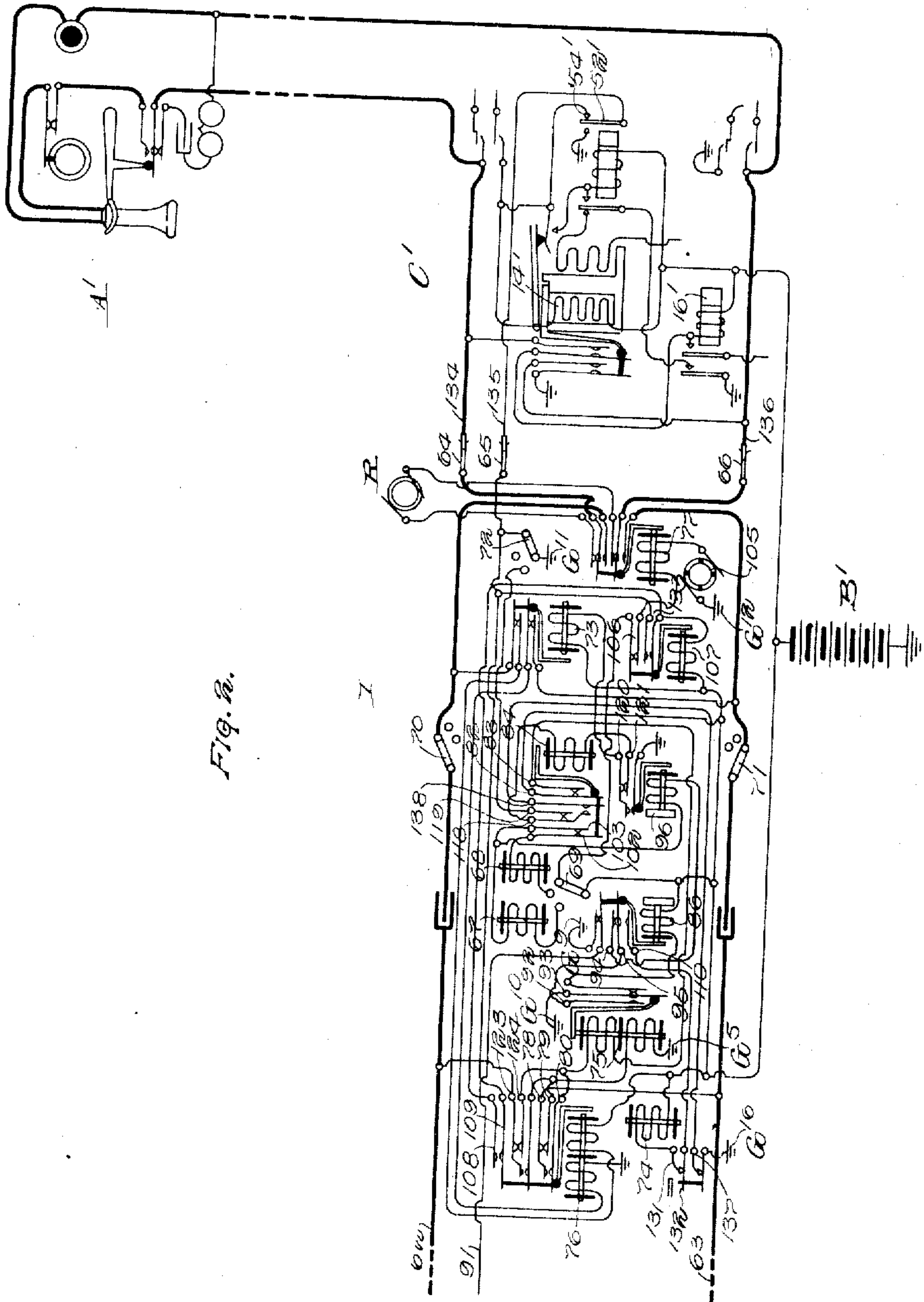


Fig. 2.

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AUTOMATIC TELEPHONE SYSTEM.

1,209,293.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, HARRY E. HERSHEY and GEORGE A. YANOSCHOWSKI, both citizens of the United States of America, and residents of Whitewater, Butler county, Kansas, and Chicago, Cook county, Illinois, respectively, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

Our invention relates to improvements in automatic telephone systems, and particularly to means for releasing the switches of such a system.

Among the novel features of our invention is the provision of a repeater through which any release which is initiated beyond this repeater—that is, on the connector side—can be transmitted back to the apparatus on the subscriber's side of the repeater.

A further novel feature is the means for opening the line circuit beyond the repeater when the connector strikes a busy line, whereby the switches are released over the talking circuit instead of over a trunk-release conductor, as is usually the case.

These and other novel features and objects of our invention will be more readily understood by reference to the accompanying drawings, in which we have illustrated an embodiment of our invention.

Figures 1 and 2 represent a complete connection between a calling substation A and a called substation A' in a telephone system embodying the principles of our invention.

The system herein described is of a well-known automatic type, known as a two-wire system, and is equipped with individual or line switches C divided into groups, each group controlled by a master switch, such as the master switch D, and also with group selectors E, repeaters F and connectors I, but it will be readily understood by those versed in the art that additional so-called selectors may be inserted in the system, thereby increasing the capacity of the exchange without departing from the principles of our invention. The selector switches may be of a type similar to the selector switch shown at E. The subscriber's station is connected with the central office through the conductors 2 and 3, which terminate in a line switch C, said switch being in a group

governed by a master switch D. By means of the line switch C the line is extended to the selector E, which in turn extends the connection to the repeater F. The repeater F repeats the impulses to the connector I, which latter completes the connection to the called subscriber's telephone A'.

The substation A shown herein may be of any suitable or approved type and comprises the usual receiver 4, transmitter 5, ringer 6 and condenser 7. Being an automatic substation it is also provided with an impulse transmitter or calling device which is represented herein by a pair of impulse springs 8 and 9 and an impulse wheel 10, which latter is controlled through the medium of a finger hole dial (not shown) in such a manner that the impulse springs 8 and 9 may be momentarily separated a number of times corresponding to each digit of the number to be called.

The line switch C, which is associated with the line of the substation A, is of the general type of line switch shown in British patent to R. W. James No. 26,301 of 1906, and shown more particularly in British patent to T. G. Martin No. 1419 of 1910, the circuits being slightly modified to operate in a system embodying the principles of our invention. This line switch comprises, among other details, a plunger (not shown) attached to the end of a so-called plunger arm 11 which is controlled by the magnet 12. The magnet 12 comprises two windings, namely, the pull-in winding 13 and the hold-in or cut-off winding 14. The winding 13 operates both the plunger arm 11 and the cut-off armature 15, while the winding 14 is strong enough to operate only the armature 15 and to hold the plunger arm 11 in an operated position after it has been once operated by the pull-in winding 13. The circuit of the pull-in winding 13 is controlled by the line relay 16 and the relay 17, both of which we preferably make slow acting, *i. e.*, they are slow to deenergize after their energizing circuits have been broken. When the plunger arm 11 is operated, the plunger is forced into a bank of contact springs, forcing the springs 18, 19, 20 and 21 into engagement with the springs 22, 23, 24 and 25, respectively. Although only one set of springs (18—25) is shown, each line switch is pro-

vided with a plurality of such sets, each set forming the terminal of a trunk line leading to a selector switch E. Each trunk line is connected in multiple to the corresponding springs of all the switches of the group which is controlled by the master switch D. The switch C is controlled through the medium of the line relay 16, as will be herein-after more fully explained.

10 The master switch D is of the same general type as that disclosed in British patent to R. W. James No. 26,301 of 1906, above referred to, being of the particular type, however, disclosed in the above-mentioned British Patent No. 1419 of 1910. The function of the master switch, as is well known, is to maintain the plungers of all the idle line switches in position to engage the terminals of an idle trunk line.

20 The selector E is of the general type of selector switches disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, the circuits being modified, however, as shown in British Patent No. 1419 of 1910, above referred to, in order to operate in a two-wire system. It comprises, among other details, the line relay 26, vertical and rotary magnets 27 and 28 for operating the switch shaft and shaft wipers 29, 30 and 31, private magnet 32, the release relay 33, the side switch wipers 34 and 35 and the release magnet 36. The private magnet 32 is controlled by the rotary magnet 28 electrically through the medium of the contact point 61, instead of mechanically as shown in the selector patent above referred to. The switch shaft (not shown), which has a vertical and a rotary movement, and the line and private wipers 29, 30 and 31 are the direct means of connection between this switch and the repeater F.

The repeater F has a line relay 37, a slow relay 38 and a battery-reversing relay 39. The line relay 37 is normally bridged across the trunk extending to the repeater from the selector E and is arranged so that when its armature operates in accordance with the impulses from the subscriber's station A, it opens and closes the bridge across the trunk extending to the connector I a corresponding number of times. The function of this repeater switch is to receive the impulses transmitted from the subscriber's station and repeat them to the switches farther on. Furthermore, it supplies battery current to the calling line and maintains a holding circuit for the line switch C and selector E without requiring a third conductor to be included in the trunk line extending to the switches beyond, and in this way the necessity for having a third conductor between offices is eliminated.

The connector switch I is of the same general type of connector switch disclosed in 65 United States Letters Patent No. 815,176,

granted March 13, 1906, to Keith, Erickson and Erickson, the circuits, however, being modified to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. The circuits are otherwise slightly modified to operate in a system embodying the principles of our invention. The connector is provided with a shaft (not shown) carrying the wipers 64, 65 and 66. The usual side switch comprising the wipers 69, 70, 71 and 72 is controlled by the private magnet 73 in the usual well-known manner. The magnet 74 is the usual release magnet. The operations of the switch are controlled through the medium of the double-wound line relay 75. The called subscriber receives talking current through the so-called back-bridge relay 76. The ringing relay 77 is the means through which ringing current is applied to the called line. For the purpose of supplying battery current for operating the apparatus and for talking purposes, there are shown batteries B and B', one terminal of each being grounded.

Busy signaling current for the calling line is provided by the busy signaling machine Q (Fig. 1), which is shown associated with the line switch C. This busy signaling machine comprises an induction coil or transformer, the primary winding of which is included in a local circuit with a battery and an interrupter. Through the medium of this interrupter an interrupted current is supplied to the primary winding, which induces an alternating current in the secondary winding, whereby, when said winding is connected with the subscriber's line a buzzing sound is heard in the receiver.

A general description of the apparatus having been given, it will now be explained how a connection is established between the substation A and a called substation A'. It will also be explained how, if the called substation is busy, all of the apparatus is automatically released and returned to normal position, whereby the trunks are kept from being made busy, while the calling subscriber is given the busy signal through the medium of his individual line switch C. It will be assumed that the number of the called substation is 222. Upon the removal of the receiver from the switch-hook at the substation A preparatory to making a call, an energizing circuit is closed through the line relay 16 of the line switch C. This circuit extends from ground G' through the springs 41 and 42, conductor 3, through the substation A, conductor 2, springs 44 and 43 and the line relay 16 to battery B. The line relay 16, upon energizing, operates to close the circuit of the pull-in winding 13. This circuit extends from ground G² through the springs 45 and 46, springs 47 and 48, pull-in winding 13 and the springs 49 and 50 to battery B. The

pull-in winding 13 operates to cause the armature 15 to force the springs 41 and 43 out of engagement with the springs 42 and 44, respectively, and also operates to force the plunger on the plunger arm 11 into the bank of contacts 18 to 25, inclusive. The disengagement of the springs 41 and 43 from the springs 42 and 44 opens the circuit of the line relay 16. The line relay 16 being slow acting does not fall back immediately, however, but holds the plunger arm in an operated position until a holding ground is supplied to the holding winding 14 from the selector E. The engagement of the springs 18 and 21 with the springs 22 and 25, respectively, extends the subscriber's line to the line relay 26 of the selector E. When the connection is thus extended to the selector E, the calling substation receives current through the line relay 26 of the selector E. The line relay 26, upon energizing, closes the circuit of the slow acting relay 33 over a circuit as follows: from ground G^{13} through the springs 112 and 113, through the relay 33 to battery. The relay 33, upon energizing, closes a circuit for the holding winding 14 and the slow acting relay 17 of the line switch C. This circuit is from ground G^3 through the springs 56, springs 23 and 19 and through the holding winding 14 to battery B, and also from the spring 19, through the springs 130 and the relay 17 to battery B. The winding 14, upon energizing, holds the armature 15 and the plunger arm 11 in their operated positions after the circuit of the pull-in winding is broken by the opening of the springs 47 and 48. The relay 17, upon energizing, closes a circuit from ground G^{15} through the springs 53 and 52 to the connector private bank contact which guards the substation A against being seized by a connector. The calling subscriber now operates his calling device for the first digit 2, which momentarily separates the substation impulse springs 8 and 9 twice. Each time these springs are separated the selector line relay 26 deenergizes. Since the relay 33 is slow to deenergize, its armature does not have time to fall back during the momentary interruptions of its circuit by the relay 26. Therefore, each time the relay 26 deenergizes, a circuit is closed through the relay 55 and the vertical magnet 27 as follows: from ground G^{13} through the springs 112 and 111, springs 114 and 114^a, relay 55, vertical magnet 27 and the side switch wiper 34 (in first position) to battery B. The two impulses received by the vertical magnet 27 cause it to raise the shaft wipers 29, 30 and 31 two steps to a position opposite the second level of bank contacts. The slow acting relay 55, which is included in the operating circuit of the vertical magnet 27, closes a circuit through the private magnet 32 and keeps it closed until after the last impulse

is delivered for the digit. The said circuit extends from ground G^{14} through the springs 122 and the private magnet 32 to battery B. When the relay 55 does deenergize, it breaks the circuit of the private magnet 32, which in turn deenergizes and permits the side switch to pass to second position. In second position the side switch wiper 34 completes a circuit through the rotary magnet 28. The side switch remains in second position and causes the rotary magnet to operate in a manner similar to that of a buzzer to rotate the shaft wipers step by step over the bank contacts of the second level until the wipers reach the contacts of an idle trunk line, whereupon the side switch passes to third position. Should the first trunk of the level be busy, its private contact would be grounded, forming a circuit from the grounded private bank contact through the private wiper 30, side switch wiper 35 (in second position) and the private magnet 32 to battery B, thus holding the private magnet energized and keeping the side switch in second position. At the first idle trunk the circuit through the private magnet will be broken and allow the side switch to pass to third position. The moment the side switch wiper 34 passes from second to third position, besides breaking the circuit of the rotary magnet, it closes the circuit of the line-switching relay 40. This circuit extends from ground G^3 through the springs 56 and the side switch wiper 34 (in third position) to battery B. The relay 40, upon energizing, disconnects the line relay 26 from the line and extends the line connection through the line wipers 29 and 31 to the repeater F, whereupon its line relay 37 becomes energized in the same manner in which the relay 26 was energized when the connection was first extended to the selector E.

Upon the line relay 37 energizing, a circuit is closed from ground G^4 through the contact of springs 57^a and 57 and the slow relay 38 to battery. The relay 38, upon energizing, presses the springs 58 and 59 into contact, thereby setting up a circuit through the winding 39^a of the relay 39, which does not yet energize this relay. The relay 37, upon energizing, also presses together the springs 60, thereby closing a bridge across the outgoing trunk line, which closes a circuit for the line relay 75 of the connector I, said circuit being traced from ground G^5 through the lower winding of the line relay 75, through the springs 78 and 79 on the back-bridge relay 76 to the trunk conductor 63, through the springs 60 of the line relay 37 in the repeater F, through the coil 81, through the winding 39^b of the relay 39 to the trunk conductor 62, through the springs 123 and 124 on the relay 76, through the upper winding of the line relay 75 of the connector I and through the springs 82

and 83 of the busy relay 84 to battery B'. The current thus caused to flow through the winding 39^b of the relay 39 is opposed at this time by current flowing through the winding 39^a over the circuit extending from ground G⁶ through the springs 58 and 59 of the relay 38 and the winding 39^a to battery B. As a result the relay 39 does not operate. The current flowing through the trunk causes the relay 81 to pull up and place ground G⁷ on the released trunk 85 to supply a holding circuit for the line-switching relay 40 of the selector E, the holding winding 14 and the relay 17 of the line switch C, the original holding circuit of which is broken when the relay 33 deenergizes and allows the springs 56 to separate. The energization of the line relay 75 of the connector causes the circuit of the slow acting relay 86 to be closed. The central office apparatus is now in a condition for the transmission of the second series of impulses, whereupon the dial is operated in the usual manner, opening the circuit of the line relay 37 in the repeater F twice momentarily. The slow relay 38 maintains its armature in an operated position during the transmission of the impulses. Each time an impulse is sent—that is, each time the line relay 37 drops back while the slow acting relay 38 is retaining its armature in an attracted position—a circuit is completed from ground G⁴ through the springs 57^a and 37^a of the relay 37 and the springs 87 of the relay 38 and through the relay 88 to battery B. The result is that the first time the circuit is broken for the second digit, the relay 88 closes a direct bridge across the trunk, and since the relay 88 is slow acting, the bridge is maintained closed at the contacts 89 and 90 during the subsequent impulses. The relay 88, upon pulling up, also places a ground from ground G⁸ upon the release trunk 85 to take the place of ground G⁷, which will be disconnected when the relay 81 deenergizes, due to said relay being short-circuited by the pulling up of the relay 88. Each time the armature of the line relay 37 drops back in unison with the breaking of the circuit at the calling subscriber's telephone, it opens this bridge, thus repeating the impulses to the connector I. The connector line relay, as hereinbefore stated, upon energizing, closes the circuit of the release relay 86, which in turn places ground from G⁹ upon the release trunk 91, which, in case a selector similar to the selector E was used between the repeater F and the connector I, would hold up the line-switching relay of said selector. The relay 86 of the connector being slow acting does not deenergize during the momentary interruptions of its circuit by the line relay 75, and consequently each time the latter deenergizes, an impulse is transmitted through the

vertical magnet 67. This circuit extends from ground G¹⁰ through the springs 93 and 92, through the springs 94 and 95, relay 96, vertical magnet 67 and the side switch wiper 69 (in first position) to battery B'. The vertical magnet 67 receives two impulses over this circuit and operates to raise the switch wipers 64, 65 and 66 to a position opposite the second level of bank contacts. The relay 96, which was included in series with the vertical magnet, remains energized during the entire time that impulses are being transmitted through it and operates to close the circuit of the private magnet 73. After the last impulse is delivered, the relay 96 opens the circuit of the private magnet 73, which, upon deenergizing, permits the side switch to pass to second position. The movement of the side switch wiper 69 from first to second position transfers the battery connection from the vertical magnet 67 to the rotary magnet 68. When the series of impulses have been transmitted and the relay 88 of the repeater F falls back, it is so adjusted that its springs 90 and 98 make contact with the springs 97 and 99, respectively, before the springs 100 and 101 break contact, in this way insuring that the relay 81 will be pulled up and have placed ground G⁷ upon the release trunk 85 before the relay 88 cuts ground G⁸ off said trunk 85. The calling subscriber now operates his calling device for the last digit 2, in response to which the connector line relay operates to transmit two impulses through the rotary magnet 68, whereby the shaft wipers are rotated onto the contacts of the desired line. This circuit extends from ground G¹⁰ through the springs 93 and 92, springs 94 and 95, relay 96, springs 103 and 102, rotary magnet 68 and the side switch wiper 69 (in second position) to battery B'. The relay 96 operates in response to the impulses for this digit in the same manner as for the previous digit to cause the private magnet 73 to advance the side switch to third position.

The called subscriber is equipped with an additional line switch C', similar in all respects to the line switch C. By the engagement of the side switch wipers 70 and 71 with their third-position contact points, the line connection is completed with the called line. Upon the engagement of the wiper 72 with its third-position contact point, a circuit is completed through the cut-off winding of the line switch C', the said circuit extending from ground G¹¹ through the side switch wiper 72, private wiper 65, bank contact 135 of the called line switch, springs 52' and 54' and through the cut-off winding 14' to battery B'. The cut-off winding 14', upon energizing, operates to disconnect the line relay 16' from the called substation A'. The connection of ground G¹¹ with the con-

connector private bank contact of the called line prevents the called line from being seized by some other connector switch. By the engagement of the side switch wiper 69 with its third-position contact point, the circuit of the ringer relay 77 is closed. This circuit extends from ground G^{12} through the interrupter 105, relay 77, springs 106 and the side switch wiper 69 to battery B' . The ringing relay disconnects the calling line from the called line and bridges the ringing current generator R across the called line to signal the called subscriber. The ringing relay is energized only intermittently through the medium of the interrupter 105. Upon the response of the called subscriber his line is provided with talking current through the windings of the back-bridge relay 76, which relay, upon energizing, closes the circuit through the ringer cut-off relay 107. The said circuit extends from ground G^{11} through the side switch wiper 72 (in third position), springs 108 and 109 and the relay 107 to battery B' . The relay 107, upon energizing, interrupts the circuit of the ringing relay 77 at the springs 106 and closes a locking circuit for itself through the springs 133, independent of the springs 108 and 109. The energization of the relay 76 also reverses the direction of the current flowing in the trunk conductors 62 and 63. This reversal of current causes the winding 39^b of the relay 39 in the repeater F to assist the winding 39^a, the combined force of the two being sufficient to operate the relay 39, the operation of the relay 39 reversing the direction of current fed out by the repeater F to the calling substation A .

After the conversation is completed the connection is released by the hanging up of the receiver at the calling substation in the following manner: When the receiver at the substation A is restored to the switch-hook, the separation of the switch-hook springs destroys the energizing circuit of the repeater line relay 37. The relay 37, upon deenergizing, opens the circuit of the connector line relay 75 and relay 81, thus causing the deenergization of the relay 81, which, when falling back, removes ground G^7 from the release trunk 85, thus opening the holding circuit for the line-switching relay 40 of the selector E and the holding winding 14 and coil 17 of the line switch C . The line-switching relay 40, upon deenergizing, closes the release circuit from ground G^{13} through the springs 112 and 111, through the springs 114 and 115, through the springs 126 and 125, through the off-normal springs 116 and 117 and through the release magnet 36 to battery B . The energization of the release magnet 36 causes the shaft wipers and side switch wipers to return to normal position, its own circuit being opened when the shaft has reached normal by means of the off-

normal springs 116 and 117. The holding winding 14 of the line switch C , upon deenergizing, allows the plunger arm 11 to return to normal position. The line relay 75 of the connector, upon deenergizing, opens the circuit of the relay 86, which, upon deenergizing, completes a circuit extending from ground G^{10} through the springs 93 and 92, springs 95 and 110, off-normal springs 132 and 131 and through the release magnet 74 to battery B' . The energization of the release magnet 74 causes the line wipers and the side switch wipers to return to normal, its own circuit being opened at the off-normal springs 132 and 131 when the shaft reaches normal.

It having been explained how one subscriber establishes a connection and releases the same, it will now be explained how a connection is prevented from being made with a busy line, how the calling subscriber's line switch is released and how the calling subscriber receives a busy signal through his own individual switch. If the called number is busy there will be a guarding potential upon the connector private bank contact, just as explained in connection with the line switch C . The connector private wiper 65, upon engaging this guarding contact, and before the side switch wipers have passed to third position, completes an energizing circuit through the relay 84. This circuit extends from ground at the private bank contact through the private wiper 65, side switch wiper 72 (in second position), springs 119 and 118, relay 84, springs 121 and 120 and the private magnet 73 to battery B' . The relay 84, upon energizing, opens the circuit of the connector line relay 75 at the springs 82 and 83 of the relay 84. This opening of the circuit of the line relay 75 of the connector I causes the relay 81 at the repeater F to deenergize, the said relay 81 being slightly slow acting, although not as much so as the relay 86 of the connector I . The deenergization of the relay 81 removes ground from the released trunk 85, as previously explained. The winding 14 of the line switch C , upon deenergizing, allows the armature 15 to fall back and the springs 41 and 43 to make contact with the springs 42 and 44, respectively. The plunger 11 is withdrawn from the bank of contacts (18--25), thus opening the circuit of the line relay 37 of the repeater. The springs 41 and 43 making contact with the springs 42 and 44, respectively, closes a circuit through the line relay 16 of the line switch C . The line relay 16, upon energizing, completes a holding circuit for the relay 17. The relay 17 did not deenergize when the ground was removed from the release trunk on account of it being slow acting. The said circuit extends from ground G^2 through the springs 45 and 46, springs 47 and 129 and

the relay 17 to battery B. The relay 17 remains energized over the above circuit and retains the circuit of the pull-in winding 13 open at the springs 47 and 48. The line switch C is thus prevented from tripping and the cut-off armature 15 is prevented from operating. The energization of the relay 16 closes a path for busy signaling current to the calling subscriber's line as follows: from the busy machine Q through the springs 127 and 128, springs 43 and 44, conductor 2, through the substation A, conductor 3, springs 41 and 42 to ground G' and from ground G' back to the busy machine Q. The subscriber, upon receiving the busy signal, replaces his receiver upon the receiver hook. The replacing of the receiver upon the receiver hook allows the switch-hook springs to separate, which action opens the circuit of the line relay 16, thus allowing the line switch C to return to normal. The relay 84, upon energizing, forms a locking circuit for itself from ground G¹⁶ through the springs 137, through the springs 138 and 118, relay 84, through the springs 120 and 121 and the relay 73 to main battery B'. The opening of the circuit of the line relay 75 by the relay 84 causes the slow relay 86 to deenergize, whereupon the release magnet 74 is energized and the connector releases, as previously explained. The removal of ground G⁷ from the release trunk 85 also causes the deenergization of the switching relay 40 of the selector E, whereupon the release magnet 36 becomes energized and the selector releases, as previously explained.

It will thus be seen that we have devised a very efficient means for giving a calling subscriber a busy signal when a called substation located in a distant exchange is in use, without unnecessarily retaining the switches and trunk lines in use, thus causing a great saving in the number of switches and trunks required in a telephone exchange. It will also readily be seen that should a trunk line be open for any reason, any person attempting to call over that particular trunk will be released and given the busy signal.

While we have illustrated our invention in connection with one particular type of automatic system, it will, of course, be understood that it is capable of use with many other forms of systems, and is equally as well adapted for use in connection with semi-automatic systems—that is, systems in which a manual link circuit is employed in combination with automatic means for establishing a connection between the subscribers' lines.

What we claim as our invention is:—

1. In a telephone system, a series of switches for establishing connection between

a calling and a called telephone line, a repeater, and means in said repeater for transmitting back to the switches on the calling side of said repeater a release which is initiated on the called side of said repeater.

2. In a telephone system, a repeater, a connector, and means for opening the line circuit beyond said repeater when the connector strikes a busy line.

3. In a telephone system, a connector, a pair of conductors extending to said connector, a bridge across said conductors, and means for opening said bridge at a point between said conductors when said connector lands on a busy line.

4. In a telephone system, a connector, a pair of conductors extending to said connector, a bridge across said conductors, means for opening said bridge at a point between said conductors when said connector lands on a busy line, and means controlled by the opening of said bridge for releasing said connector.

5. In a telephone system, a connector, a front bridge in said connector, means for opening said bridge when said connector lands on a busy line, and means controlled by the opening of said bridge for releasing said connector and any other switches involved in extending the connection to said connector.

6. In a telephone system, a calling line, a called line, a link for connecting the two, said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the calling line with the first section of said link, a relay connected with the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay, another relay associated with the third section of said link, said relay controlling said first relay, a busy test circuit for the called line, means for applying a busy potential thereto, the said second relay responsive to said busy potential to control said first relay to release said switch whereby the connection is broken.

7. In a telephone system, a calling line, a called line, a link for connecting the two, said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the calling line with the first section of said link, a relay across the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay, another relay associated with the third section of said link, said relay controlling said first relay, a busy test circuit for the called line, means for applying a busy potential thereto, the said second relay responsive to said busy

potential to control said first relay to release said first switch whereby the connection is broken.

8. In a telephone system, a calling line, a called line, a link for connecting the two, said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the calling line with the first section of said link, a relay connected with the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay, another relay associated with the third section of said link, said relay controlling said first relay, a busy test circuit for the called line, means for applying a busy potential thereto, the said second relay responsive to said busy potential to control said first relay to release said first switch whereby the connection is broken, a source of signaling current, said source controlled by said release means when the connection is broken for applying said signaling current to the calling line to give the calling subscriber a signal.

9. In a telephone system, a calling line, a called line, a link for connecting the two, said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the calling line with the first section of said link, a relay across the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay, another relay associated with the third section of said link, said relay controlling said first relay, a busy test circuit for the called line, means for applying a busy potential thereto, the said second relay responsive to said busy potential to control said first relay to release said first switch whereby the connection is broken, a source of signaling current, said source controlled by said release means when the connection is broken for applying said signaling current to the calling line to give the calling subscriber a signal.

10. In a telephone system, a calling line and a called line, a link for establishing a talking circuit between the two lines, talking conductors in each side of said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the talking conductors of the calling line with the talking conductors of the first section of the link, a relay across the talking conductors of the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay over a circuit excluding the talking conductors, another relay associated with the third section of the said link, said relay con-

trolling said first relay over a circuit including the talking conductors, automatic progressively movable switching means for the link for finding the called line, a busy test circuit for the called line, means for applying a busy potential thereto, said second relay responsive to said busy potential over a circuit excluding the talking conductors to release said first switch whereby the connection is broken.

11. In a telephone system, a calling line and a called line, a link for establishing a talking circuit between the two lines, talking conductors in each side of said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the talking conductors of the calling line with the talking conductors of the first section of the link, a relay across the talking conductors of the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay over a circuit excluding the talking conductors, another relay associated with the third section of the said link, said relay controlling said first relay over a circuit including the two sides of the talking conductors in series, automatic progressively movable switching means for the link for finding the called line, a busy test circuit for the called line, means for applying a busy potential thereto, said second relay responsive to said busy potential over a circuit excluding the talking conductors to release said first switch whereby the connection is broken.

12. In a telephone system, a calling line and a called line, a link for establishing a talking circuit between the two lines, talking conductors in each side of said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the talking conductors of the calling line with the talking conductors of the first section of the link, a relay across the talking conductors of the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay over a circuit excluding the talking conductors, another relay associated with the third section of the said link, said relay controlling said first relay over a circuit including the talking conductors, automatic progressively movable switching means for the link for finding the called line, a busy test circuit for the called line, means for applying a busy potential thereto, said second relay responsive to said busy potential over a circuit excluding the talking conductors to release said first switch whereby the connection is broken, a source of signaling current, said source controlled by said release means when the connection is broken for applying

said signaling current to the calling line to give the calling subscriber a signal.

13. In a telephone system, a calling line and a called line, a link for establishing a talking circuit between the two lines, talking conductors in each side of said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the talking conductors of the calling line with the talking conductors of the first section of the link, a relay across the talking conductors of the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay over a circuit excluding the talking conductors, another relay associated with the third section of the said link, said relay controlling said first relay over a circuit including the two sides of the talking conductors in series, automatic progressively movable switching means for the link for finding the called line, a busy test circuit for the called line means for applying a busy potential thereto, said second relay responsive to said busy potential over a circuit excluding the talking conductors to release said first switch whereby the connection is broken, a source of signaling current, said source controlled by said release means when the connection is broken for applying said signaling current to the calling line to give the calling subscriber a signal.

14. In a telephone system, a calling line, a called line, a link for connecting the two, said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the calling line with the first section of said link, a relay connected with the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay, another relay associated with the third section of said link, said relay controlling said first relay, a busy test circuit for the called line, means for applying a busy potential thereto, the said second relay responsive to said busy potential to control said first relay to release said switch whereby the connection is broken, a source of signaling current, a relay for the calling line for applying said signaling current to said line, the circuit of said third relay controlled by said switch to close the same when the connection is released.

15. In a telephone system, a calling line, a called line, a link for connecting the two, said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the calling line with the first section of said link, a relay across the second section of said link, release means for restoring said switch to normal to release said connection, said re-

lease means controlled by said relay, another relay associated with the third section of said link, said relay controlling said first relay, a busy test circuit for the called line, means for applying a busy potential thereto, the said second relay responsive to said busy potential to control said first relay to release said switch whereby the connection is broken, a source of signaling current, a relay for the calling line for applying said signaling current to said line, the circuit of said third relay controlled by said switch to close the same when the connection is released.

16. In a telephone system, a calling line and a called line, a link for establishing a talking circuit between the two lines, talking conductors in each side of said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the talking conductors of the calling line with the talking conductors of the first section of the link, a relay across the talking conductors of the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay over a circuit excluding the talking conductors, another relay associated with the third section of the said link, said relay controlling said first relay over a circuit including the talking conductors, automatic progressively movable switching means for the link for finding the called line, a busy test circuit for the called line, means for applying a busy potential thereto, said second relay responsive to said busy potential over a circuit excluding the talking conductors to release said first switch whereby the connection is broken, a source of signaling current, a relay for the calling line for applying said signaling current to said line, the circuit of said third relay controlled by said first switch to close the same when the connection is released.

17. In a telephone system, a calling line and a called line, a link for establishing a talking circuit between the two lines, talking conductors in each side of said link divided into three inductively connected sections, an automatic progressively movable trunking switch for connecting the talking conductors of the calling line with the talking conductors of the first section of the link, a relay across the talking conductors of the second section of said link, release means for restoring said switch to normal to release said connection, said release means controlled by said relay over a circuit excluding the talking conductors, another relay associated with the third section of the said link, said relay controlling said first relay over a circuit including the two sides of the talking conductors in series, automatic progressively movable switching means for the link for

finding the called line, a busy test circuit for the called line, means for applying a busy potential thereto, said second relay responsive to said busy potential over a circuit excluding the talking conductors to release said first switch whereby the connection is broken, a source of signaling current, a relay for the calling line for applying said signaling current to said line, the circuit of said third relay controlled by said first switch to close the same when the connection is released.

18. In a telephone system, a series of switches for establishing connection between a calling and a called telephone line, a repeater, means in said repeater for transmitting back to the switches on the calling side of said repeater a release which follows as a result of an impulse by the calling subscriber for advancing a switch on the called side of the repeater.

19. In a telephone system, a calling and a called telephone line, a repeater, an automatic progressively movable switch for extending a connection from said calling line to said repeater, means including a second progressively movable switch for extending the connection from said repeater to said called line, and means for releasing said switches if the called line is busy when an attempt is made to connect therewith.

20. In a telephone system, a calling telephone line, a switch for said line, a repeater, means for extending a connection from said switch to said repeater, a called line, an automatic progressively movable switch controlled through the medium of said repeater for finding the called line and for completing connection therewith, and means for releasing said switches when an attempt is made to connect with a called line which is busy.

21. In a telephone system, a calling telephone line, a switch for said line, a repeater, means for extending a connection from said switch to said repeater, a called line, an automatic progressively movable switch controlled through the medium of said repeater for finding the called line and for completing connection therewith, means for releasing said switches when an attempt is made to connect with a called line which is busy, and means associated with said first switch for giving the calling telephone a busy signal.

22. In a telephone system, a calling and a called telephone line, means including a repeater and automatic progressively movable switching mechanisms for extending a connection between said lines, means for making the called line busy, and means in one of said mechanisms responsive to the busy condition of the called line for releasing said repeater and switching mechanisms.

23. In a telephone system, a calling and a called substation, lines for connecting said stations with the exchange, a switch individual to said calling substation, a repeater and a plurality of automatic progressively movable switches for extending a connection to the line of the called substation, means for making the called line busy, and means in one of said progressively movable switches responsive to the busy condition of the called line for releasing said switches and said repeater, and means associated with the individual switch for giving the calling substation a busy signal.

24. In a telephone system, a calling telephone line, a switch for said line, a repeater, means for extending a connection from said switch to said repeater, a called line, an automatic progressively movable switch controlled through the medium of said repeater for finding the called line and for completing connection therewith, means for releasing said progressively movable switch, means controlled by said progressively movable switch for releasing said repeater when said progressively movable switch attempts to connect with a busy called line, and means controlled by the release of said repeater for releasing said first switch.

25. In a telephone system, a calling telephone line, a switch for said line, a repeater, means for extending a connection from said switch to said repeater, a called line, an automatic progressively movable switch controlled through the medium of said repeater for finding the called line and for completing connection therewith, means for releasing said progressively movable switch, means controlled by said progressively movable switch for releasing said repeater when said progressively movable switch attempts to connect with a busy called line, means controlled by the release of said repeater for releasing said first switch, and means associated with said first switch for giving the calling telephone a busy signal.

26. In a telephone system, a series of switches for establishing connection between a calling and a called telephone line, a repeater, and a relay in said repeater for transmitting back to the switches on the calling side of said repeater a release which is initiated on the called side of said repeater.

27. In a telephone system, a connector, a pair of conductors extending to said connector, a bridge across said conductors, and a busy test relay for opening said bridge at a point between said conductors when said connector lands on a busy line.

28. In a telephone system, a connector, a pair of conductors extending to said connector, a bridge across said conductors, a busy test relay for opening said bridge at a point between said conductors when said connector lands on a busy line, and means controlled

by the opening of said bridge for releasing said connector.

29. In a telephone system, a connector, a front bridge in said connector, a busy test relay for opening said bridge when said connector lands on a busy line, and means controlled by the opening of said bridge for releasing said connector and any other switches involved in extending the connection to said connector.

30. In a telephone system, a series of switches for establishing connection between a calling and a called telephone line, a repeater, a relay in said repeater for transmitting back to the switches on the calling side of the repeater a release which follows as a result of an impulse by the calling subscriber for advancing a switch on the called side of the repeater.

31. In a telephone system, a calling and a called telephone line, a repeater, an automatic progressively movable switch for extending a connection from said calling line to said repeater, means including a second progressively movable switch for extending the connection from said repeater to said called line, and relay controlled means for releasing said switches if the called line is busy when an attempt is made to connect therewith.

32. In a telephone system, a calling telephone line, a switch for said line, a repeater, means for extending a connection from said switch to said repeater, a called line, an automatic progressively movable switch controlled through the medium of said repeater for finding the called line and for completing connection therewith, and relay controlled means for releasing said switches when an attempt is made to connect with a called line which is busy.

33. In a telephone system, a calling telephone line, a switch for said line, a repeater, means for extending a connection from said switch to said repeater, a called line, an automatic progressively movable switch controlled through the medium of said repeater for finding the called line and for complet-

ing connection therewith, circuits for releasing said switches when an attempt is made to connect with a called line which is busy, and means associated with said first switch for giving the calling telephone a busy signal.

34. In a telephone system, a calling and a called telephone line, means including a repeater and automatic progressively movable switching mechanism for extending a connection between said lines, means for making the called line busy, and a busy test relay in one of said mechanisms responsive to the busy condition of the called line for releasing said repeater and switching mechanisms.

35. In a telephone system, a calling and a called substation, lines for connecting said stations with the exchange, a switch individual to said calling substation, a repeater and a plurality of automatic progressively movable switches for extending a connection to the line of the called substation, means for making the called line busy, and a relay in one of said progressively movable switches responsive to the busy condition of the called line for releasing said switches and said repeater, and means associated with the individual switch for giving the calling substation a busy signal.

36. In a telephone system, means for connecting calling and called lines comprising in serial relation a selector switch, a repeater, and a final connector, a control circuit for said connector including a relay in said repeater, means for opening said control circuit when the said connector attempts to connect with a busy line, and a circuit controlled by said relay for releasing said selector.

Signed by us at Chicago, Illinois, this 13th day of November, 1913.

HARRY E. HERSEY.

GEORGE A. YANOCHOWSKI.

Witnesses:

MARJORIE R. MORGAN,
ALICE OSWALD.